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managing mobile services

technologies and business practices

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Ulla Koivukoski and Vilho Räisänen
Nokia Networks & TeleManagement Forum, Finland

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Ulla Koivukoski is the head of service management at Nokia Networks and the team leader of Service Framework Team (SFT) at TeleManagement Forum. She has been working in IT since 1984. Ms Koivukoski has been involved in sales, marketing and business management of the SW houses, and worked as a product manager and head of product management of UNIX, PC and communications networks. As an independent consultant she has implemented several Customer Relations Management (CRM) systems in medium-sized and large Finnish companies, to keep customer information updated both for long-term business planning and as a marketing and sales tool. Ms Koivukoski has worked for Nokia since 1995 as a marketing and business manager in network and service management and broadband product units, as well as regional area organisations. She has a BSc in natural science.

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John Wiley & Sons, Ltd., as well as over 20 peer-reviewed articles in international journals in datacommunications and physics. He has also acted as peer reviewer for three IEEE journals in the area of service quality.

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Foreword

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A TELECOM OPERATOR'S AND SERVICE PROVIDER'S VIEW ON SERVICE MANAGEMENT

During the past few years, telecom operators and service providers (hereafter called operators) have faced remarkable challenges caused by the fast changes in the technological, business, market and regulatory environments. These changes have forced the operators to rethink their business models, technology and service platform infrastructures as well as their service offerings.

Due to regulatory issues (network/service provider), cost-sharing (MVNOs, Mobile Virtual Network Operators etc.) and interface openness, traditional telecom business models have changed. Third party service providers or Application Service Brokers (ASBs) are entering the new wireless service market traditionally controlled by telecom operators. This new chain of service production involves several players and has an impact on business models as well as operational issues.

One of the most important changes, from the technological point of view, has been the infiltration of Internet technology, namely Internet Protocol (IP), into almost all sectors of telecommunication. Internet technology, when applied in professional operator-managed telecommunication networks, is the major technical facilitator for

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the convergence of fixed and mobile networks and new innovative multi-channel (access independent) service offerings for different applications and terminals. IP-based communication and applications together with digital content delivery will change the traditional telecom networks to scalable multipurpose Service Networks.

The converging IP-based networks and the emergence of new open application and service platforms will dramatically change the traditional operator and service environment. The possibility to rely on common network and service platform architectures for both fixed and mobile networks offers the operators the possibility to plan and deploy cost-effective, future-proof and multipurpose infrastructure and service offerings for several customer segments. In this open communication environment the importance of the service management will be emphasized. Understanding new requirements for Operations Support Systems/Business Support Systems (OSS/BSS) functions, their relation to the service environment and overall service management process is very important for operator business.

New operator-managed IP-based services will set difficult requirements for service management and will call for close interaction between network management (e.g., resource management) and service management layers and functions. The basic requirement will be the overall security at all levels and end-to-end. The importance of the security will be emphasized along with the convergence of fixed and mobile networks, open interfaces, diversity of terminals, and the possibility to integrate services.

The security issues will be even more challenging to handle due to the complexity of the service environment. Longer service production chains also add the importance of service provisioning and service assurance systems as part of the service management. New intelligent charging and billing methods must also be developed and managed within this multiplayer environment.

New multimedia IP services will also require that network and service platforms support advanced Quality of Service (QoS) handling and application and service specific QoS classes. From a service management point of view there must be versatile end-to-end QoS and Service Level Agreement (SLA) management features, especially in the case of wireless and mobile networks because of the terminal and service mobility and restricted recourses of bandwidth.

The convergence of Telecommunication and Information Technology (IT) towards Information and Communication Technology

(ICT) gives business customers added value for their IT solutions with the integration of communication services like open interfaces to contact centres, billing and payment services, authentication and authorization services, location and presence services. IT and ICT convergence brings OSS and BSS closer together, not only within the operator systems, but also between the operator and the customer systems. This leads to the requirement of getting information about the customer's business processes and mapping them to the operator's OSS/BSS processes. Close interaction with service management and Customer Relationship Management (CRM) is required for efficient service and customer care.

Operators are switching from the technology and service-centric approach to a user-centric paradigm which includes self-provisioning, personalized and user-tailored solutions. The user-centric view should also contain the role of the partners in the service chain. This means that new business models have to be evaluated and place the users and the partners in central position. This will create new business roles and open Application Programming Interfaces (APIs). One good example is the increase of peer-to-peer applications and services where the business models and service management solutions are still in the early phase.

With mobility and in the future ambient intelligence and ubiquitous computing environment, new service delivery methods will be needed for context-aware services. These will include conditioned action in response to context information and their mapping to user profiles to provide an adaptive behaviour of services.

The user-centric approach, and the complexity of the heterogeneous network and service environment, will present a number of operational challenges for the operators in enabling effective and efficient service provisions and offerings. From the user's point of view, the key requirement will be the ability to access the services in a seamless and technology-transparent way, with the ease of use of terminals. Standardized service management tools, functions and processes will help to meet these challenges.

About the Book

This book was written based on the increasing need to obtain topical information about implementing packet-based services in mobile networks. General Packet Radio Service (GPRS) and Wideband Code Division Multiple Access (WCDMA) networks provide good basic tools for provisioning services for mobile users, but the business environment has changed since the inception of the original GPRS mobile network architecture. One of the central themes of this book, the change has been apparent in service value chains. The service provisioning capabilities of mobile networks are evolving to keep up with business requirements, and new technologies such as Wireless Local Area Networks (WLAN) are being incorporated into mobile networks. Evolving and diversifying services bring an extra dimension to the picture.

The above situation has manifold consequences. In a sense, the provisioning of packet-based services moves closer to provisioning of Internet services in general. However, state-of-the-art mobile networks currently provide capabilities surpassing those of the Internet, including service quality support and charging. From the viewpoint of a content service provider, the capabilities of individual networks and terminal types may vary. In an environment where lean operations are required of different business parties, a proper understanding of the business environment is imperative. Indeed, business and technology can no longer be thought of as separate subjects in service provision, but should be dealt with together.

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Conveying the current understanding of the subject is the purpose of this book.

This book will be of use both for business and technical readers. The different chapters generally fall on either side of the business/technical fence, but an attempt has been made to make them all readable for both audiences. Below, we have outlined the organization of the book and described the dependencies between the chapters.

ORGANIZATION

Chapter 1 is an introduction to the topic, describing the overall approach adopted in the book.

Chapter 2 discusses business aspects of service management, including changing operator business environments and value chain structures.

Chapter 3 introduces the first focus topic, providing a summary of a real-life service creation project. It provides the background to the enhanced service management techniques introduced later. This chapter, like Chapters 1 and 2, deals with business aspects of mobile services, but is also useful reading for advanced technical experts and managers.

Chapter 4 discusses service management at a generic level from the viewpoint of processes and technology.

Chapter 5 reviews standardization relevant to service management and operations support systems such as TeleManagement Forum. Also, relevant aspects of other standardization fora such as Third Generation Partnership Project (3GPP), Open Mobile Alliance (OMA), and Internet Engineering Task Force (IETF) are discussed.

Chapter 6 discusses the requirements and characteristics of different kinds of packet-based services. It provides the reader with an understanding of technical issues that relate to different kinds of services. It also summarizes service support capabilities.

Chapter 7 discusses service modelling related issues. Having an adequate model for services is crucial for being able to manage increasingly complex networks with a large number of multi-component services. A framework for service modelling is presented and put into the context of selected industry initiatives and academic research. This chapter should be of interest to business-oriented readers, too, since recent modelling efforts address business and technology as a whole.

Chapter 8 introduces the second focus topic, describing service control functionality for mobile networks. It provides an example of powerful functionalities in the mobile network that service management is able to utilize.

Chapter 9 discusses potential future trends that relate to service management. Both business and technical trends are discussed.

Chapter 10 provides a summary of the topic area of the book.

INTERDEPENDENCIES BETWEEN CHAPTERS

The matrix below presents a rough dependence of the content between different chapters. The horizontal axis shows the chapter, and the vertical axis lists those chapters whose content helps in understanding the discussion. The chapters can also be read independently of each other.

	1	2	3	4	5	6	7	8	9	10
1		X	X	X	X	X	X	X	X	X
2			X						X	X
3				X			X			X
4					X	X	X	X	X	X
5							X	X		X
6							X	X	X	X
7									X	X
8										X
9										X
10										

Figure 0.1 Interdependence between chapters of the book

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Abbreviations

3G	Third Generation (mobile system)
3GPP	Third Generation Partnership Project
3GPP2	Third Generation Partnership Project 2
ABE	Aggregate Business Entity
ACK	(Positive) Acknowledgment
ACM	Association for Computing Machinery
ADSL	Asynchronous Digital Subscriber Line
AIN	Advanced Intelligent Network
AP	Access Point
API	Application Programming Interface
APN	Access Point Name
ARIB	Association of Radio Industries and Business
ARPU	Average Revenue Per User
ASP	Application Service Provider
ATIS	Alliance for Telecommunications Industry Solutions
AuC	Authentication Centre
B2B	Business-to-Business
BPEL4WS	Business Process Execution Language for Web Services
BSS	Business Support Systems
CAC	Connection Admission Control
CAPEX	Capital Expenditure

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CCSA	China Communications Standardization Association
CD	Compact Disc
CDR	Charging Data Record
CGM	Computer Graphics Metafile
CIM	Common Information Model
COPS	Common Open Policy Service
CP	Client Provisioning
CPL	Call Processing Language
CRM	Customer Relationship Management
CSCF	Call State Control Function
DAML-S	DARPA Agent Mark-up Language for Services
DARPA	Defence Advanced Research Projects Agency
DB	Database
DCF	Distributed Coordination Function
DEN	Directory Enabled Networking
DiffServ	Differentiated Services
DM	Device Management
DMTF	Distributed Management Task Force
DOM	Document Object Model
DoS	Denial of Service
DRM	Digital Rights Management
DS	Discovery Service
DSL	Digital Subscriber Line
DSS	Digital Signature Services
DST	Data Services Template
DSN	Dynamic Service Network
e-2-e	End-to-End
ebXML	Electronic Business using eXtensible Mark-up Language
ECMA	European Computer Manufacturers' Association
EDGE	Enhanced Data Rates for Global Evolution
EESSI	European Electronic Signature Standardization Initiative
EMS	Element Management System
eTOM	enhanced Telecom Operations Map™
EU	European Union
ETSI	European Telecommunication Standardization Institution
FM	Frequency Modulation
FP	Framework Program

GAA	Generic Authentication Architecture
GERAN	GSM/EDGE Radio Access Network
GGF	Global Grid Forum
GGSN	GPRS Gateway Support Node
GPRS	General Packet Radio Service
GSM	Groupe Special Mobile
GSMA	GSM Association
GUP	Generic User Profile
HIPAA	Health Insurance Portability and Accountability Act
HLR	Home Location Register
HTTP	HyperText Transfer Protocol
ID-FF	IDentity services, Federation Framework
ID-SIS	IDentity services, Service Instance Specifications
ID-WSF	IDentity services, Web Services Framework
IdP	Identity Provider
IEEE	Institute of Electrical and Electronics Engineers
IETF	Internet Engineering Task Force
IFPI	International Federation of the Phonographic Industry
IMEI	International Mobile Equipment Identity
IM	Instant Messaging
IMS	IP Multimedia Subsystem
IMSI	International Mobile Subscriber Identity
IN	Intelligent Networks
INAP	Intelligent Network Application Protocol
IntServ	Integrated Services
IOP	Interoperability
IP	Internet Protocol
IrDA	Infrared Data Association
IRTF	Internet Research Task Force
IS	Interaction Service
ISDN	Integrated Services Digital Network
ISO	International Organization for Standardization
ISP	Internet Service Provider
ISUP	ISDN User Part
IT	Information Technology
ITU	International Telecommunications Union
J2EE	Java 2 Platform, Enterprise Edition
JAIN	Java Advanced Intelligent Networks
JCP	Java Community Process
KPI	Key Performance Indicator
KQI	Key Quality Indicator

LAN	Local Area Network
LBS	Location-Based Services
LDAP	Lightweight Directory Access Protocol
LEC	Liberty-Enabled Client
LECP	Liberty-Enabled Client or Proxy, old terminology for LUAD
LEP	Liberty-Enabled Proxy
LIF	Location Interoperability Forum
LUAD	Liberty-enabled User Agent or Device
MAC	Medium Access Control
MAP	Message Access Protocol
MBMS	Multimedia Broadcast/ Multicast Service
MGCF	Media Gateway Control Function
MGIF	Mobile Gaming Interoperability Forum
MIB	Management Information Base
MIP	Mobile IP
MIT	Massachusetts Institute for Technology
MNO	Mobile Network Operator
MPLS	Multi-Protocol Label Switching
MWIF	Mobile Wireless Internet Forum
MMS	Multimedia Messaging Service
MMSC	Multimedia Messaging Service Centre
MSC	Mobile Switching Centre
MNO	Mobile Network Operator
MS-ISDN	Mobile Subscriber International ISDN Number
MVNO	Mobile Virtual Network Operator
MWIF	Mobile Wireless Internet Forum
NDS	Network Domain Security
NGOSS	New Generation OSS
OASIS	Organization for the Advancement of Structured Information Standards
OCSP	On-line Certificate Status Protocol
OECD	Organization for Economic Cooperation and Development
OIL	Ontology Inference Layer
OMA	Open Mobile Alliance
OMG	Open Management Group
OPEX	Operational Expenditure
OSA	Open Service Architecture

OSI	Open Systems Interconnection
OSS	Operations Support Systems
OSS/J	OSS Through Java Initiative
OTA	Over-the-Air (configuration)
OWL	Web Ontology Language
PAOS	Reverse HTTP binding for SOAP
PBM	Policy-Based Management
PCF	Point Coordination Function (802.11) or Policy Control Function (3GPP)
P-CSCF	Proxy CSCF
PCMCIA	Personal Computer Memory Card International Association
PDA	Personal Digital Assistant
PDF	Policy Decision Function
PDP	Packet Data Protocol
PKI	Public Key Infrastructure
PLMN	Public Land Mobile Network
POP3	Post Office Protocol 3
POST	HTTP request method
PPP	Point-to-Point Protocol
PSTN	Public Switched Telephone Network
PTT	Push-To-Talk
QoS	Quality of Service *or* Quality of Services
R5, R6	3GPP Release 5/ Release 6
R97/98	GPRS Release 97/98
R99	3GPP Release 99
RAB	Radio Access Bearer
RAN	Radio Access Network
RDF	Resource Description Framework
RFC	Request for Comment
RIAA	Recording Industry Association of America
RPC	Remote Procedure Call
RTCP	Real-Time Control Protocol
RTP	Real-Time Protocol
RTSP	Real-Time Streaming Protocol
SAF	Service Availability Forum
SAML	Security Assertion Mark-up Language
SAP	Service Access Point
SASL	Simple Authentication and Security Layer
SBM	Subnet Bandwidth Manager
SCP	Service Control Point
SCS	Service Capability Server
SD&M	Service Development & Management

SIG	Special Interest Group
SIM	Subscriber Identity Module
SFT	Service Framework Team
SGML	Standard Generalized Mark-up Language
SID	Shared Information Data
SIP	Session Initiation Protocol
SP	Service Provider
SLA	Service Level Agreement
SMIL	Synchronized Multimedia Interaction Language
SMS	Short Message Service
SMSC	SMS Centre
SNMP	Simple Network Management Protocol
SoA	Service oriented Architecture
SOAP	Old meaning: Simple Object Access Protocol. Currently not an abbreviation
SP	Service Provider
SRI	SRI international (former Stanford Research Institute)
SS7	Signalling System Seven
SSL	Secure Socket Layer
SSO	Single Sign-On
SSP	Service Switching Point
STM	Service Template Model
SyncML	Synchronization Mark-Up Language
T2R	Tune-To-Radio
TC	Technical Committee
TCAP	Transaction Capabilities Application Part
TCP	Transmission Control Protocol
THP	Traffic Handling Priority
TLS	Transport Layer Security
TMF	TeleManagement Forum
TNA	Technology-Neutral Architecture
TOG	The Object Group
TOM	Telecom Operations Map
TRX	Transceiver
TSG	Technical Specification Group
TSP	Telecommunication Service Provider
TTA	Telecommunications Technology Association
TTC	Telecommunication Technology Committee
TV	Television
UBL	Universal Business Language

UDDI Universal Description, Discovery, and Integration Protocol
UDP User Datagram Protocol
UE User Equipment
UIM Universal Information Model
UML Unified Modelling Language
UMTS Universal Mobile Telecommunications System
URL Universal Resource Locator
USIM UMTS Subscriber Identity Module
UTRAN UMTS Terrestrial Radio Access Network
VALS Values and Lifestyles
VAS Value-Added Service
VASP Value-Added Service Provider
VoIP Voice over IP
VPN Virtual Private Network
W3C World Wide Web Consortium
WAP Wireless Application Protocol
WBEM Web-Based Enterprise Management
WCDMA Wideband Code Division Multiple Access
WLAN Wireless Local Area Network
WML Wireless Mark-up Language
WPKI Wireless Public Key Infrastructure
WSDL Web Services Description Language
WS-I Web Services Interoperability organization
WSI Web Services Interface
WSMT Wireless Service Measurement Team
WTLS Wireless Transport Layer Security
WTP Wireless Transaction Protocol
XACML eXtensible Access Control Mark-up Language
XHTML eXtensible Hypertext Mark-Up Language
XML eXtensible Mark-up Language

1

Introduction

Ulla Koivukoski

1.1 INTRODUCTION TO MANAGING MOBILE SERVICES

Since 1992, when the first GSM call was made in the commercial network, mobile services have had a tremendous impact on our life. Being constantly accessible is useful for the majority of people in developed countries, and developing countries are taking steps in the same direction. In the same vein, having immediate access to up-to-date information is becoming an essential part of daily life.

The nature of the services that consumers use is expected to change drastically in the future. End users of services require a better match with their lifestyle, and want services to add recognizable value to their lives. Likewise, expectations of quality increase with the maturity and richness of the services. End users won't come back to services that don't provide the expected usage experience. They want access to services independently of location, time and eventually also device. They want to use services according to their roles in the context they are acting in at a given point in time. For operators and service providers, this means a transformation from technology-based service development to end-user driven development in order to continuously indulge their customers.

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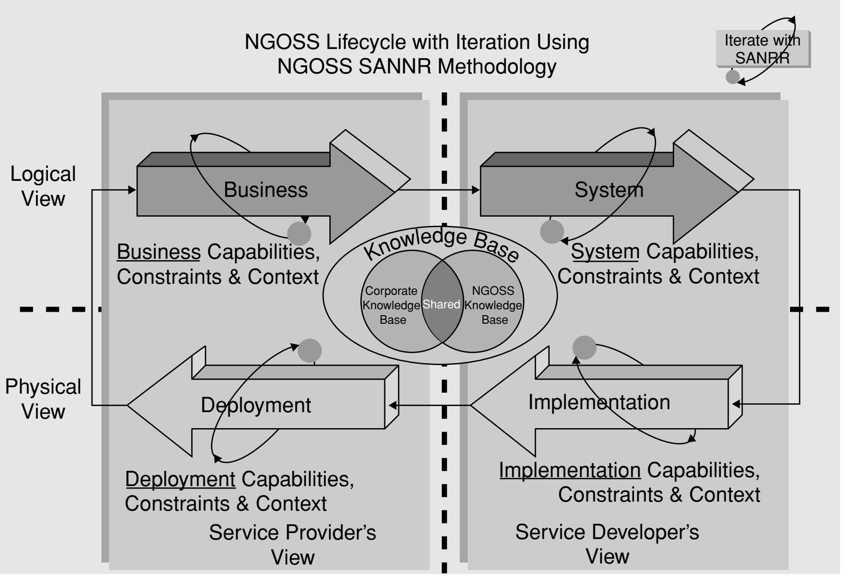

Figure 1.1 The NGOSS lifecycle methodology. From (GB927). Reproduced by permission of TeleManagement Forum

The TeleManagement Forum (TMF) has illustrated the problem that operators, providers and vendors are facing using the high-level process shown in Figure 1.1. The operators need to be able to use business requirements for directing their work, convert the requirements into system solutions and implementations, and deploy them. For most of the actors, all of the above needs to take place while operating in a legacy system environment.

The TeleManagement Forum has analysed the problems relating to the above process mostly from the viewpoint of fixed access networks. In this book, we shall discuss problems and solutions from the viewpoint of wireless networks.

Emerging technologies move service development in new directions, but also present operators and service providers with novel challenges. In this book, we shall mostly pay attention to Internet Protocol (IP)-based services. Recently summarized in an Internet Engineering Task Force (IETF) plenary speech, the basic philosophy of IP is, 'everything over IP, IP over everything'. That is to say, IP acts as a convergence layer for services, and interfaces to multiple lower-layer technologies, including ethernet, wireless LAN, General Packet Radio Service (GPRS) and Wideband Code Division Multiple Access (WCDMA) networks.

IP is a new challenge compared to circuit-switched connections, due to the way the base protocols of the Internet function. This sets new requirements for ways of building services, taking into consideration the capabilities of the new technology on one hand and the growing demand by end-users on the other.

In addition to the base protocols of the Internet, new protocols have been designed on top of IP, an example of which is Session Initiation Protocol (SIP). SIP-based services provide a new way of implementing services currently implemented using Intelligent Networks (IN) technologies, such as call forwarding services. SIP also acts as an enabler of new services such as forwarding incoming connections to a terminal of your choice. Presence information can be used in new collaboration forms such as text chat, group chat, online multiplayer games and Push-To-Talk (PTT). Terminal context information is seen as an emerging building block for advanced services; Location-Based Services (LBS) can already be used for locating the nearest restaurant or a city map.

One approach to put together composite services is the web services framework. Web services would provide user a way of amalgamating with services from other services, defining and storing the service information in a way that enables the publishing of the services as well as security functionality, specifically integrity, confidentiality and authentication. In the first phase of carrier-grade service management, web services may be used for systems integration. The direct use of web services-based technologies by end users is a research topic today.

The emerging technologies and topics discussed above are only a sample of the topic area. From the viewpoint of services and their management, service modelling will be the essential enabler for service management. In Chapter 7, service modelling is discussed in more detail. The service model should contain the essential concepts needed for managing future services, in addition to current ones.

Service models need to be balanced between a model providing element-specific configurations, and being simple and logical enough for service management without getting lost in details. It also needs to make sure that end-to-end design is also possible to implement in the environment of a complex service value chain.

Non-voice services are expected to be the fastest growing segment in mobile services, driven by messaging in the first place. Content browsing and downloading are also predicted to play a notable role in service revenue generation, due to end-users' willingness to pay premium prices for content that provides them with ways of keeping ahead. Business data services such as the Internet, corporate intranet and email access services is still the segment that waits for a clear return on their investments. A Nokia study carried out during June 2004 suggests that business segment will represent 5 per cent of mobile data service revenue in the year 2008. To speed up revenue growth, there is a need to demonstrate more tangible process-based savings than simply saving time and increasing convenience. The continuously growing mobile services market attracts new players to the service provision business all the time, and therefore new business models are being developed.

Service management will have a central role to play in presiding over the demanding aggregate of diverse end-user expectations, complex and feature-rich service execution environment, as well as a variety of business models.

One way of approaching the service management solution in the new business environment is to study different organizational roles in the value chain. The 'business roles' set the requirements for the entire service lifecycle, whereas 'technical roles' take care of design and implementation of a service according to business requirements, 'operational roles' look after the actual service operations and 'managerial roles' are responsible for different management tasks throughout the lifecycle. In this book, we have assumed no single mapping of the service management problem into any particular organizational structure but rather have tried to describe the point of view of different players in the value chain generically. The roles participating in the process and their relationship with service management will be discussed in more detail in Chapter 4.

The term 'service' does not have a single definition. In this book, the definition is:

> A service to be sold within a product is mainly developed by an operator or service provider. The same service may be included in multiple end user products, and packaged differently, for example with different pricing in each case, etc. A service element comprises one or more network or service resources that are combined with other service elements to provide a service.

'Customer' means an entity that buys products and services from an operator or service provider, or receives free offers or services. A customer may be a person or a business. The end user is the actual user of the products or services offered by the enterprise. Within the context of mobile networks, the customer could be a corporation that is paying its employees' bills. The individual employees, in turn, would be the end users of the service.

Furthermore, 'operator' refers to a network operator, which is a company or organization operating and providing telecommunication network connections as a business. These may be provided directly to customers, in which case the operator is also a service provider, or under contract to service providers who in turn provide services to customers.

A 'service provider' is an entity that offers packet-based services to another entity. Note that the term 'service provider' is now being used generically and may include Telecom Service Providers (TSPs), Internet Service Providers (ISPs), Application Service Providers (ASPs) and other organizations which provide services, such as internal IT organizations that need or have Service Level Agreement (SLA) capabilities or requirements.

As service management also has several definitions, this book we have chosen to use the definition from the glossary of the TeleManagement Forum: 'Service management is the set of processes that manages services to meet customers' requirements, whether the customer has explicit knowledge of these services, including any delivery objectives, or not. It has authority to make decisions about the delivery of the entire portfolio of services.'

1.2 THE BUSINESS ENVIRONMENT

The growth in the number of mobile data customers in developed countries suggests that once end-users acquire devices that enable the use of advanced services, service providers will face more and more exacting customers who on one hand are willing to pay for services adding value to their life but on the other hand also demand substantive value for money. This is a business opportunity, but before the opportunity becomes as an actual business, some barriers need to be overcome.

Let us take an example of services based on content and delivered to the end-user over a GPRS network utilizing multimedia push messaging with content provided by a third party. To build the service, special know-how and resources are required to map the business requirements of the service with the capability of the network as well as service control such as charging and subscription management.

At the moment, typically lengthy commercial negotiations on the nature of the service as well as financial expectations and revenue sharing are followed by an implementation that can be also a long-lasting process, ranging from a few weeks to months. Neither a feasible standard for the business model nor for the implementation of the service is in place yet. Therefore, most projects consume both resources and time without adding any value to the end-user, but instead add another price tag to the service. This motivates industry players to work on standards such as Liberty for privacy, authentication and web services management, OSS through Java™ OSS/J™ for open interfaces, TeleManagement Forum projects for business-to-business relationships such as enhanced Telecom Operations Map (eTOM), Shared Information/Data model (SID) and Service Framework Team (SFT) and OASIS, to mention a few. Standardization may be used to build a market, increase interoperability and reduce costs and time to market.

From the point of view of a content provider, the current means of building a service does not exceed the profitability threshold without high-volume use of the service. An example of content that is created once and used multiple times without customization is a ring tone, with required volumes being achieved reasonably easily. In the interactive services area where the usage triggers are pushed to the end user, achieving such volumes is much more difficult. First of all, the challenge lies in how to market the service so that the end-user subscribes to the service and also allows the push messages. Second, the challenge lies in understanding the fascination of the target audience in order to being able to create attractive enough messages to capture the audience and therefore get them to ask for more from the service. In order to appeal to the end-user, the content provider needs to be able to produce information matching the needs of the end-user as well as ensure the expected quality of the service, quickly and efficiently, also fully utilizing the network capabilities provided by the network operators. The challenges mentioned above have motivated the authors of this book to discuss the issues publicly in order to find ways of improving ways to build and manage new services.

From the point of view of both parties, there are several further issues to solve jointly. Depending on the size and the role the players have taken in the value chain, responsibilities in the different phases of the service lifecycle may vary considerably. After the expected revenue share, branding and service marketing issues have been agreed, the parties need to define their actual roles in service execution and management as well as subscription management. They should be able to answer questions such as:

- How is service ownership structured and managed by the involved parties?
- Which charging model is used for the service (content value, traffic, timing, delivery mechanism, etc.)?
- Who takes care of charging and billing?
- Who takes responsibility for the customer relationship and manages the service for the customer, managing possible subscriptions?
- Who manages quality and ensures that the service quality meets the expectations of all parties?
- How is usage reporting implemented, and to whom is usage and customer information reported or accessed?

The role of providers is not clear-cut, and several competing business models will co-exist in the marketplace. The assumption in the coming discussions is that several parties will in most cases provide the service. This calls for new ways of approaching service development processes as well as service management.

1.3 BUSINESS REQUIREMENTS

1.3.1 The end-user perspective

Customers use mobile services for both private and professional use. This sets service providers in a situation where knowledge of their customers, their roles and behaviour becomes an essential asset. An end-user will be an complex entity to manage and please.

Several end-user service studies suggest that the main driver in service consumption is the desire to keep up-to-date on the latest news and other information related to business and their lifestyles. Naturally, there are differences between geographical areas as well as between generations. In Japan, both older and younger people are attracted by content services, but the older generation consumes news services whereas the younger generation is more active in gaming and downloading. [Exploring the Mobile Internet Business from A User Perspective, A Cross-national Study in Hong Kong, Japan and Korea] The Nokia Pulse [internal] study from December 2003 shows that Short Message Service (SMS) is used by 26 per cent of mobile users in the USA while 76 per cent of European mobile users have adopted SMS. The Asia-Pacific region leads in messaging use.

Browsing service providers' web pages also supports this view. The main groups of services for consumers are based around news, sport, music, banking and gaming. Business users are provided with a mobile email service, Internet and intranet access and several choices of data access packages. Global players can also enable the home environment abroad, although with some limitations for the time being. The vision of the future seems to be based around the consumer in the context of their social groups where they interact and share interests through mobile devices, and the home environment.

The usability of services is an issue that will increase in importance with the development of handset capabilities as well as a growth in the number of competing services. To engage end-users, services need to be easy to discover, configure to the device, and use. Considering the steps the end-user needs to take after discovering the service, usability plays an essential role in the success of a service. Once the end-user has configured the service settings to start using the service, the next potential barrier is the usage if the service has not been designed keeping the potential user in mind.

For global service providers, managing the scattered personalities of a single end-user with high expectations is a challenge. It may not be unfair to claim that up to now the popular term 'customer experience' has amounted to management driven by customer complaints. Management of customer experience has, however, been addressed by some standardization teams such as TeleManagement Forum's Wireless Systems Measurement Team (WSMT).

1.3.2 The network operator and service provider perspective

To be able to deliver what end-users are expecting in today's fast-moving environment will require players to position themselves in the value chain within the different business models. The potential

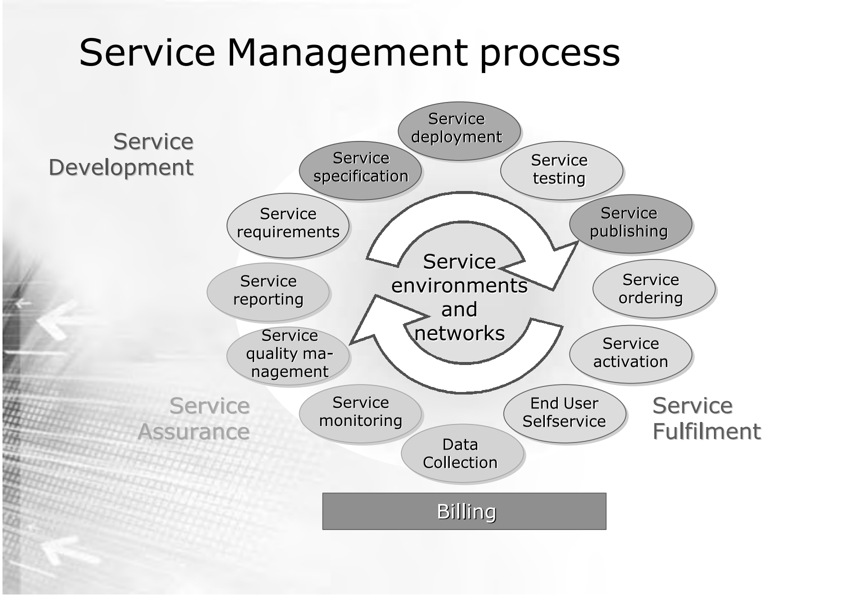

Figure 1.2 Service management process overview. Reproduced by permission of Nokia

models might be an intelligent service provider, an efficient network provider, or something between. Whatever the chosen role, there is a need to establish a proper service development process between the different parties in service build, execution and management. One way of looking at the process is the Service Management Process shown in Figure 1.2, where the process has been approached from the principles of eTOM [GB921] but has been heavily simplified.

The evolution towards multi-provider environment and services will also require more attention to be paid to the management of confidential and coordinated, but still dynamic, information exchange between providers. Key areas to be highlighted are charging, billing and revenue-sharing models, contracts between providers, service quality and Service Level Agreements. Essential factors to solve the communication and interworking issues between the providers involved are a common service model and efficient service data management.

Provided that the predictions of the mobile industry are even partially fulfilled, there will be hundreds of content service providers partnering network operators to create revenue streams for both. Assuming that the end-user studies show the way for service providers to develop services driven by end-user needs, there will be a high number of services for global use as well as fast-changing, short-term services aimed at small target groups. Proposing that the industry transformation will take place as anticipated, the convergence of telecommunication, information technology, consumer electronics and the media industry will provide completely new dimensions for service development.

Network operators and service providers who have already established their position and customer base in the market face the challenge of ensuring maximum outcome from their existing investments, keeping operational expenses down and, at the same time, transforming competencies to manage the new environment without ruining their current revenue streams. Newcomers don't have the baggage of the past to drag with them; instead they have a complex world of technology and business models to enter.

1.4 THE SHIFTING FOCUS OF SERVICE MANAGEMENT

The nature of service is changing and customer demand is increasing, as is competition in service provisioning. Consequently the focal point of service management will shift from traditional network service management to management of the end-user experience. This calls for a slightly different approach to service management as well as its positioning within OSS (operating support systems) and BSS (business support systems).

One of the trends we have identified is that service management and development are shifting from being technology-driven to customer demand- and requirements-driven. This places service develeopement and mangement organizations in a new situation. All the processes as well as the supporting applications related to service management should be flexibly integrated to help service providers better manage the business and technical aspects of the services.

Traditionally, service management covers the development loop depicted in Figure 1.2, where service requirements form the basis of whole service management, and the end-user experience also provides information for service developement and optimization. In real life, however, service management mainly covers the technical aspects of the end-user experience. The approach of current standardization efforts, as well as service management publications, is on the best way of taking into consideration customer requirements in service development and managing customer expectations in service execution.

The aim of the following section is to discuss end-to-end service management starting from customer needs and requirements and their match to service providers' business requirements. This is a topic that is not within the focus area of this book, but discussion about it helps in placing the book in a wider context.

1.5 END-USER DRIVEN SERVICE DEVELOPMENT AND OPTIMIZATION

1.5.1 From customer requirements to service development

As will be discussed in more detail in Chapter 2 on business modelling, services need to meet the constantly increasing demand for a better user experience. One of the key questions is to understand how the user divides the limited resources to indulge himself. (For "itself", i.e., machine users, this question is easier to answer.) One of the factors hindering the consumption of services today is a lack of understanding of the pricing structure and total cost of ownership of a service, perceived by the user from the point of view of price/benefit. To understand the related thresholds, for example from the perspective of price or quality of service, considerable homework is required by the operator before the service launch to understand the preferences of the user.

One way of looking at the challenge is to model customer requirements and their dependences on the service and its features and the building blocks of the service. In the service modelling approach adopted in this book, we have approached the challenge from the point of view of a technical implementation of the service, whereas a more extensive approach is to include user- and market-related factors in the service model, as in Figure 1.3 [PS02], where the service information has been presented as a composition of items. The service requirements and features have been depicted, the attributes describe the items, and rules define the dependences between the items. These are then mapped with market requirements, as illustrated in Figure 1.4 [PS02].

Even if we are not going to discuss this approach in this book, the example areas of improvement in service modelling, development

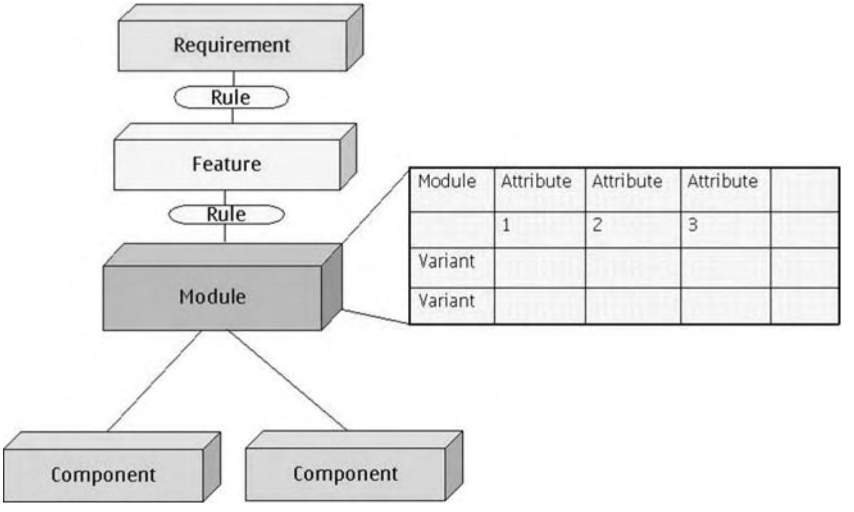

Figure 1.3 Requirements in service model

and management needed to be introduced. To fulfil the needs of a user in a cost-efficient way, there should be a process and methodology in a place to feed the service development and optimization teams with customer requirements to better capture the target audience.

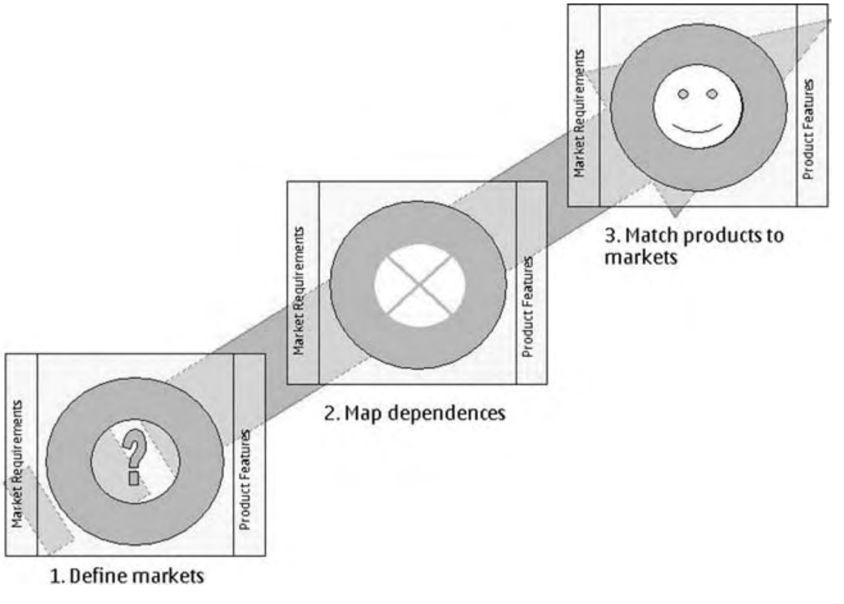

Figure 1.4 Mapping of requirements processes

In order to built a service attracting the user over and over again, the old marketing saying, "know your customer" is relevant in mobile service business too. When building a mobile service, although it may match well with customer needs, the important question is also how to ensure that users choose your mobile service and not any of the competing alternatives of the same service. In addition to knowing the needs of the customer, the cost/benefit weighting is essential for continuous service usage.

1.5.2 From customer experience to service optimization

An essential requirement for service development and optimization is to provide an operator with the capability to assess all the relevant aspects resulting in the optimal usage of operator's assets. One aspect here is representation of inventory, or knowledge of the available resources, in a form which lends itself to analysis of how to best utilize it. There are tools in the market by which operators can measure and report key performance indicators (KPI) of network performance and use them to build service-related key quality indicators (KQI), but mapping them to end-user preferences is a challenging task. For some services such as Voice over IP (VoIP) this is a well-established discipline, but for most of the other services the work has only just begun. Thus, there is a need to find ways to fine-tune service quality according to user needs. Therefore, to manage services profitably, it should be possible to link service development and optimization to understanding of the service user base, consisting of different user segments having specific demands such as appreciation of service quality or pricing.

Figure 1.5 [NT04] summarizes a holistic service planning principle from the user experience point of view in a very simplified way. The basic idea in this example is that the business objectives are used to justify e.g. the quality of service (QoS) design as part of the general business model. In this model, the users were first divided into segments with related requirement. Based on the segment-specific demand, services will be provided for users to consume. The measurement and analysis of usage, customer satisfaction and revenue of the service will be input to calculate the total cost of the service. The calculation can be used for optimization of the service from pricing, QoS and other relevant service development resources points of view.

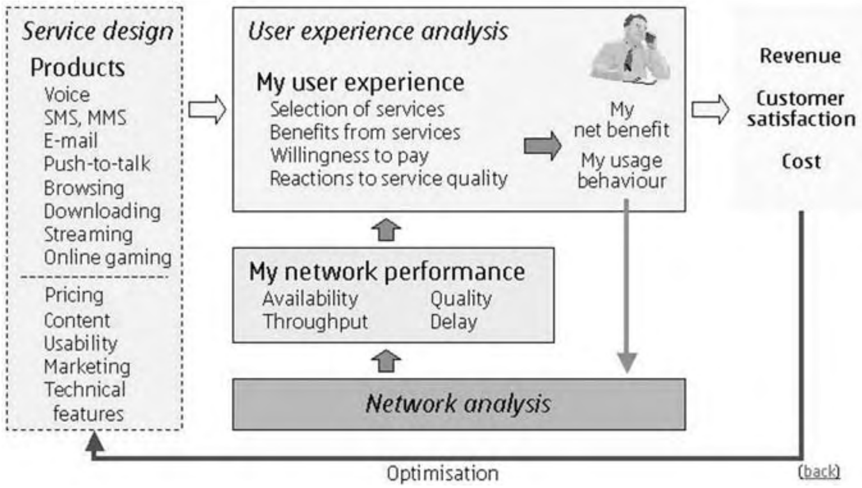

Figure 1.5 Holistic service planning model

Service quality is only one example of the criteria of the complete understanding of service performance from the point of view of business, technical and user experience. There are , however, several other areas, such as pricing, network dimensioning and marketing, to take into account. All of these are closely interrelated and should therefore be included in service development and optimization if targeted to maximize customer satisfaction and operator business benefits.

1.6 RE-SHAPING THE POSITIONING OF BSS AND OSS

Traditionally the Operations Support System (OSS) and Business Support System (BSS) have not been very closely interrelated, as the OSS focus has been on the network, not so much considering the services and users, whereas BSS has been looking at the users and business-related operations. The changing nature of the services described earlier sets requirements for both solution areas to improve service management. Yet there is an additional request to provide external parties with a view over the jointly executed services to speed up the service launch, lower integration costs and share service data according to the business model. The prolonged discussions about mobile and fixed convergence have also shown some signs of realizing this, at the time of writing this book.

Tightly interrelated services and their users and the efficient management of both will require a new approach in building OSS and BSS solutions. The modularity of the functionality provided will be the key to managing the new service business environment. From the currently provided solutions for vertical silos, the transformation to unify the functionality horizontally on a higher level requires major efforts to be made by both the operators and their suppliers.

There are initiatives in service management standardization forums, such as Telemanagement Forum (TMF) and the OSS through Java TM (OSS/J) that address this challenge. New Generation OSS (NGOSS) from TMF defines the framework and OSS/J provides guidance for the implementation of the applications and interfaces.

The major efforts from a standardization point of view are issues such as the service model and interfaces between the different management modules. [NT04] Although the same service data model is not implemented through the infrastructure, there should be a mapping methodology within the elements in the system. The same applies to the interfaces throughout the individual parameters the service consists of.

1.7 WAYS TO CAPTURE MARKET OPPORTUNITY

This chapter described the framework the concepts of this book are set into. Some of the concepts are purely business-oriented, whereas some have more technical flavour to them. Roughly speaking, one could divide the challenges faced by operators into two categories: ones resulting from increased and diverse competition, and one resulting from increasingly complex services.

The increased level of competition means better provided services that end-users find useful enough to spend money on. This calls for advanced market analysis and end-user behaviour monitoring, and mapping this onto adequate characterization of commercial products that can be used for managing technical functionality within operator networks as well business agreements with other business entities.

The increase in the complexity of services, in turn, means more technical functionality to be managed, as well as integration of the functionalities into existing operator networks. This poses challenges for not only the modelling of the services and related configurations, but also for taking business requirements into technical configurations. Important issues here relate to accuracy and the ability to the backtrack individual service configuration process phases to previous ones.

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2

Business Evolution of Mobile Services

Sonja Hilavuo

2.1 INTRODUCTION

There are more than a billion mobile phone owners in the world at the time of writing, and the whole telecommunications industry is geared toward providing new phones with new functionality and design concepts, faster networks, and ever more innovative services to meet customer needs. The value of the industry is enormous, and will become even larger when mobile and fixed Internet technologies converge. The numerous players in the services ecosystem certainly want their share of the overall pie, so after generating value to the market all players need to be sure to also capture their share of it. And this is not simple. Companies must stay alert, as there are constant disruptions coming from technical or business model innovations, and consumer tastes are ever-changing. What makes the mobile services business so interesting is the unusually high potential for innovation in an emerging value web, where business models are under development and current technical and human boundaries can be pushed still further.

This chapter takes a holistic view of the business evolution of mobile services through discussing three key evolutionary paths

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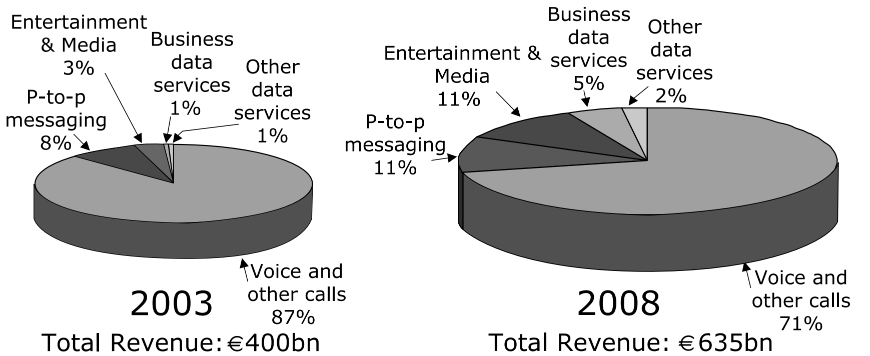
that are highly interconnected; mobile services evolution, services value chain evolution, and services business model evolution.

The chapter is built on a mobile services-centric approach, which ties selected broad mobile industry trends together with the key challenges on revenue generation from the services. Starting with the mobile services evolution, we'll take a brief look at the current status of the services market and service revenues, and then we will drill deeper into business evolution aspects by discussing the current service concepts, how they are being used and charged, and the dimensions of cooperation required to move the services market further. This is followed by a discussion on the mobile services value chain evolution, which has had to be narrowed down to focus on three key player spheres; consumers, mobile operators and the service, content and application providers. We'll be looking at both weak and strong signals within these spheres and tackling topics such as cost-consciousness and convenience of use, commoditization and convergence, coalitions and co-opetition as well as convergence and complexity. The last part of the chapter will address the services business model evolution, and it presents some of the current and emerging approaches for generating revenues from services across the value web. This section will discuss some complementary charging logics as well as revenue-sharing practices in the industry. Finally, the concluding section maps the overall services landscape and ties it together with current ways of running the mobile business. Conclusions also highlight some particular challenges for services management that can be anticipated from emerging industry trends.

2.2 MOBILE SERVICES EVOLUTION

Current mobile users – much more than 1 billion in 2004 – are estimated to double by the year 2008, when, for example, Nokia forecasts that the value of the global mobile services business will be more than 600 billion euros. As indicated in Figure 2.1, voice revenues are a strongly dominating revenue source in the estimates but mobile data services will soon account for nearly one-third of the total pie. This will also be an area of more rapid growth, contrasted with the maturing voice revenue market. The share of data revenues is an important and keenly followed indicator, because the industry is worried about potential revenue decline and companies



Growth in Mobile Services Market between 2003 and 2008: CAGR 10%
of which:
Voice and other calls CAGR 5% and data services CAGR 30%

Source: Nokia June 2004

Figure 2.1 Nokia's forecast of global mobile services revenues. Reproduced by permission of Nokia

wish to see not only the data share of revenues but also who are the players that can gain highest increases in the use of data services such as messaging, intranet access and other value-adding content services.

All this revenue will come either from consumer pockets or from enterprises, which are likely to be increasingly mobilizing their workforces and company processes. The average revenue per user, or ARPU, is one of the key indicators the industry is following, and at the time of writing this figure tends to be between 25–45 euros, with significant differences depending on the market, segment, operator and region. The post-paid users, i.e. people who are getting a monthly bill for their mobile services, usually generate higher bills than the pre-paid market.

The most widely used mobile service is undoubtedly voice calls. Unfortunately its dominant position is so strong that common industry-wide efforts are required to create and, ever more importantly, successfully market, incremental mobile data services to potentially penny-pinching customers. Some successes are, however, evident: more than 1.5 billion short messages (SMS) are being sent globally every day, and this low-cost no-frills service has still a strong growth potential both through increased usage and extended global reach in emerging markets, for example Africa or South America.

SMS revenues alone are a far cry from the industry's overall revenue expectations embedded into various bold visions for "Mobile life". So far, the major achievements of bringing mass-market mobile content to consumers can be spotted around the buzzing ring-tone market, which is a multi-billion euro business and successfully challenging the compact disc (CD) singles market in terms of volume. And more positive noises are constantly being generated by games, multimedia messaging (MMS) and the growing business market for data access to corporate intranets. Increased deployment of web services is anticipated to be a driver for the convergence of the fixed and mobile Internet. This will create a service-oriented architecture that allows mobile devices to participate in a variety of data applications, enhancing the use of mobile devices and the mobile network, driving additional revenues for mobile operators, handset manufacturers and service providers.

Mobile services in general can be classified in several ways. For the purpose of presenting a broad but structured description of current and future service offerings, this chapter will use the following six-step service revenue categorization, which is based on a user perspective and identifies the sources of current and future mobile service revenues as follows:

1. Voice and other calls
2. Person-to-person messaging
3. Content services
4. Transaction services
5. Business data services
6. Advertising.

This Nokia-based service categorization has been chosen for further analysis because it also links directly back to the previous pie chart of the predicted monetary value of each service category. Additionally we'll introduce a simple method – Four Cs – for discussing each category. Concepts, Charging, Cooperation and Challenges. The concept component makes us first look at the typical service concepts within the category and then exploring them further through charging i.e. what are the current tariffing models and charging logics in use. Cooperation refers to the partnerships and connections required for the rest of the value web, and finally challenges are presented in terms of growth and future development of this category. Let's begin with the greatest revenue generator – the voice – and what else can we expect from this category?

2.2.1 Voice and other calls

Concepts: The search of a new mobile service with revenue potential equal to or higher than voice traffic has so far been futile. Therefore, in the near future, voice is likely to maintain its position as the best revenue-generating service, even though heavy minute price competition is driving unit prices down and the increase in user minutes will reach a limit based on the time available to even the most gregarious people.

Video calling is providing an extension to this revenue stream, and these services are widely touted as early differentiators for the first operations launching their third generation (or 3G) mobile networks. It remains to be seen how popular this will be; at least the more conventional fixed video telephony has found its niche in video conferencing, which naturally will be available on mobile as well. For consumers the usage of real-time video sharing is likely to provide value when users can share the nature of their current surroundings with their counterparts e.g. during holidays or even shopping trips.

Push to talk (known as PTT or PoC, depending on the context) is also a concept for connecting people with a walkie-talkie-like push of a button to a number of other people simultaneously. In the USA the service has been particularly popular and it is predicted to appeal to consumers and corporate users alike. Youngsters staying in touch or staff management in larger hotels are just some of the potential users of this service.

Charging: A simple item like a voice minute can be served to consumers in several ways: highlighting the lowest minute price is one approach, or it can be bundled in numerous ways from all-you-can-use or fixed-fee monthly packages to differentiating the call charges based on who you call or when you call. There are also some reward schemes that allow you to gain extra minutes of use for just keeping received calls going, which naturally is not ideal if the call is received from a company. Good uses are often generating mis-uses, and that is one limitation of charging logic innovations in general.

Cooperation: A common view on technology evolution between operators, network and terminal providers and the rest of the value chain is essential. International roaming, national interconnections and alignment of network and terminal capabilities with the consumer service launches – all these still have room for improvement.

Challenges: Consumers want simplicity for tariffing plans, because comparing packages is difficult and time-consuming. Similarly, charging for video calls and push to talk should be simple and perhaps allow for low-cost trial options, like a day charge for push to talk, instead of making people commit to subscription packages before they know what they are going for. Voice-over IP networks are also a challenge, as much of this calling is currently offered free of charge or at extremely low cost, and the likelihood of mobile domains opening up to similar technologies and approaches is quite significant.

2.2.2 Person-to-person messaging

Concepts: Sending text messages was the first real non-voice service adopted by the masses. Low unit cost and ease of use have made it a service with apparent longevity even among more advanced messaging alternatives, and consumers' price consciousness has certainly been one of its competitive advantages. The launch of multimedia messaging has actually created a step-change towards more colourful user experiences, still building on the same kind of messaging behaviour as its simpler predecessor. Sending video clips is also one dimension of messaging, and related extended usages include video-editing, micro movie-making and picture-by-picture storytelling.

Community formation is an ancient human phenomenon, so no wonder that it also has its mobile applications. Instant messaging and chatting as well as mobile email are behaviours familiar from the Internet world and their value propositions are particularly strong in regions where Internet penetration is low. Maintenance of buddy lists to monitor who is available for contacting is an element of this communication culture. Email on mobile is also likely to become increasingly popular among corporate users and consumers alike.

Charging: paying per message is the most common charging method but with MMS there are also some volume-based charging cultures, where the price is dependent on the size of the MMS message. Video clips, instant messaging, mobile chat and email have numerous ways of charging: by message, by subscription, package or by volume are all in use in various countries.

Co-operation: For all messaging services the interconnectivity between users in different operator networks is essential to get the services bandwagon started. It is estimated that at least a 25 per cent active user base is required to kick-start the growth in use of a messaging service, and this phenomenon is commonly referred to as the "network effect". Typically there needs to be a national interconnection among operators, and GPRS and MMS form a good common ground for evolving these interconnections further into international as well as more service-evolutionary dimensions. Standardization helps in connectivity, but unfortunately it cannot be taken for granted that services, particularly email or instant messaging, would work across platforms.

Challenges: As in any service area, there are many challenges. One major one is always to grow the usage. Another, more strategic, challenge is to see whether the instant messaging and chatting cultures flourishing in the fixed Internet can find convergence in the mobile domain, as the business models and charging logic are quite different.

2.2.3 Content services

Concepts: Delivery of various content services over wireless services is seen as one of the major growth areas in the telecommunications industry. For example, news content to be browsed includes several content categories comparable to the Internet or daily press, particularly global and local headlines and celebrity gossip, sports highlights, travel information and weather which, together with games, are available in most operator portals. Music is also seen as an interesting growth area including concepts from interactive radio to streaming music and supporting information from artiss, songs, concerts, etc.

Branded content plays a strong role in the offerings – for Disney and CNN this may be an extension of their branded content to a new channel, and operator brands build their own positioning and loyalty for their customer base or clientele. Mobile games tend to have the same brands and concepts as in the console and PC domains, and adult entertainment is aslo seen as a highly potential revenue generator, as it is one of the services people pay for even on the Internet. However, promotion of adult content is a tricky area, considering that close operator brand attachment is not necessarily seen as advantageous, and gambling is also facing similar challenges.

Research-based predictions of user behaviour suggest that people choose the content delivery mechanism based on their interest in the content itself. In practice, this suggests that streaming would thus be a good way of watching a news report in which the consumer has only a casual interest and which will in any case be repeated in several other media channels all through the day. Alternatively, people may prefer to download the decisive goal of a football game that could then later on be shared with friends or saved as a season's cherished memento. Browsing on mobile also follows the patterns of internet browsing, where user motivation comes from checking information rather than storing it. This tendency in consumer behaviour is highlighted in Figure 2.2.

Location services appear to be an area of unfulfilled promises as the concepts of interactive street maps, city guides for tourists and advice on parking sound very useful but are still to find active users in the mass market. Presence-enabled services introduce a more novel area of growth potential by allowing mobile phone users to update their current presence status i.e. availability, mood or location to their close family and friends with the intent of advising

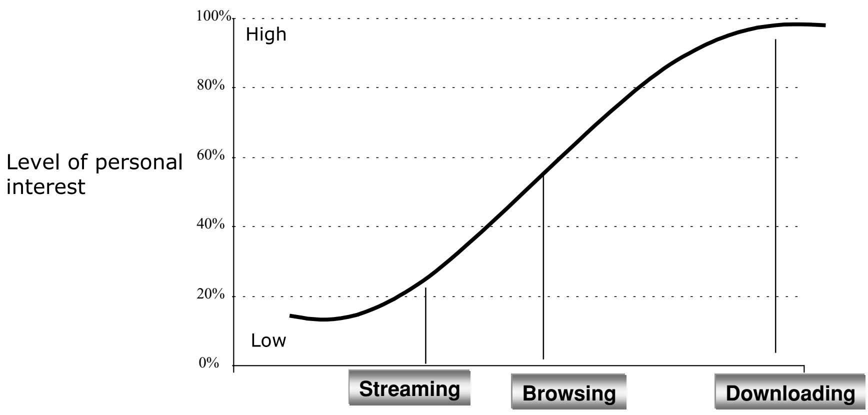


Figure 2.2 How the level of personal interest affects the preferred content delivery mechanism. Reproduced by permission of Nokia

or inviting an appropriate way for making contact. The concept is based on people having these presence-enabled contact cards in their phonebooks, and thus this service has excellent potential use cases in aslo allowing people to choose company- or service-related contact cards from, for example, their favourite football club with the latest match score or a picture-enhanced weather report – all available directly to their phone books.

Ring tones are a good example of a widely used and profitable mobile content service. For years, ring tones, together with logos, have been used across all typical customer segments and demographics. They are simple to use, easy to acquire, personal and fun – thus possessing many of the key requirements for breaking through the chasm of early adopter services towards a real mass market. They haven't seen the end of the innovation either, as the concept has evolved into ringback tones, i.e. the caller tunes that people can select to be played while their callers are waiting for them to pick up the phone. Ring tones may also have extended uses, for example, as a channel for goodwill, like selling ring tones with animal sounds and then giving a share of the revenue to a wildlife organization.

Charging: Content services is a very wide category with lots of services and potential for innovation. We cannot yet imagine all the possible business innovations, but as consumers are in practice purchasing content, some form of content-based charging would seem logical, whether by session or subscription. Alternatively, the amount of browsing via mobile is growing so this could become an important source for revenue and again charging could be based on subscriptions or data volumes.

Cooperation: The value web for producing content services is very wide-ranging from big operators down to the person making a code for a mobile game. The technology required for content services also comes from many sources so industry-wide cooperation is required to foster seamless interaction of devices and services.

Challenges: The content services market is filled with significant challenges but also with great growth potential. Selected key issues include driving usage up through better matching services with real consumer needs and business models. Another future challenge lies in differentiation of the services rather than content availability. Content area provides the acid test for the value web; the better value that is generated here, the easier will it be to solve problems in other mobile service areas too.

2.2.4 Transaction services

Concepts: Broadly speaking, service transactions may include all service payment-related activities, but in this category transaction services mean specifically the payment commission generating services of local and remote payments as well as mobile banking. Local payments typically include the micro size payments made directly over mobile phones for, e.g. refreshments from vending machines or SMS-based payments for parking fees. This usage represents phone payments as a clear alternative to cash payments and the activity takes place in the immediate vicinity of the product or service.

Remote payments refer to online payments for online purchases. For example, this could mean theatre or cinema tickets, books or CDs from an online store or also betting in markets where this is allowed by regulation. Mobile banking, on the other hand, is about online banking activities such as checking your account balance and paying bills over mobile phones.

Charging: Currently, transaction services seem likely to generate only very small commission revenues, whether commission on a soft drink or tickets sold, or a repetitive small monthly fee in connection with other banking charges for having mobile access to a bank account. Potentially some kind of a sales commission as a percentage of the value of goods sold could also come into question, but a fixed fee per transaction is more likely because the value of goods or services sold over mobile will probably remain low.

Cooperation: Security of the payment transaction is a key issue here, and therefore the innovation networks around transaction services are likely to be formed between major stakeholders such as banks and online ticketing service providers as well as terminal manufacturers. It is a question of positioning whether a vending machine manufacturer wants to build mobile charging as a machine-to-machine type of functionality or whether a payment aggregator is offering micro payments to all kinds of devices as a service.

Challenges: Transaction services are still in their infancy and the category includes a lot of uncertainty, as the development of a mobile phone as a payment device has not yet taken off in any major scale. However, society is moving more and more towards virtual interaction between its members, so there is undeniable potential to capture value from the global mega-trends of consumption and shopoholism.

2.2.5 Business data services

Concepts: All the categories discussed so far have represented mobile services driven by mainly consumer value propositions, so it is appropriate to dedicate one service category solely to enterprise data services. In practice, these services include all the Internet, corporate intranet and email access services as well as phone books and web services used for business connectivity. In addition to this horizontal access-based service offering, business data services will increasingly focus on deeper integration into vertical industries with solutions directed to increased process efficiencies for e.g. field force and sales force activities. For example, it will increase a plumber's efficiency to check the repair history of a property via mobile at any place, so that he can anticipate any problem areas. Also the coordination of the work of field engineers becomes easier if the system can track their locations at any time.

Charging: In business data services, revenue generation typically comes either from the usage of the services over mobile or from the development and integration work of enterprise business systems. Like in any business, larger customers can negotiate better contracts and this also applies to horizontal connectivity services. Typically corporate customers also want to see a clear return on their investments when implementing corporate solutions, so particularly in the vertical solutions there is a need to demonstrate more tangible process-based savings than just saving time and increasing convenience.

Cooperation: Access-based business data services centre around enterprise customers and their enterprise service providers, which can be mobile operators or independent service and application providers. To provide value for an enterprise beyond simple access to email or intranet requires a deep understanding of business processes, so the level of cooperation will be based on partnership and projects, and there is potential for value capture for new players from IT and consulting industries.

Challenges: At the time of writing, it is unknown who will become a dominant player in this field; all parties agree that the revenue potential from corporate solutions is significant. It will be difficult to provide too many standard solutions in the vertical industry area, and there is a lot of development and integration work required, so one challenge is to form either winning partnerships or develop a lot of new competencies in-house. As a new area there are also some challenges relating to overall profitability and cost-efficiency, but time usually takes care of these in the long run.

2.2.6 Advertising

Concept: Mobile advertising is probably one of the most controversial service categories, as it is filled with so many opportunities of providing value, but it is equally plagued by threats of misuse and spamming. This category includes both mobile advertising and the marketing of products and services in the more traditional sense over wireless, as well as mobile, customer relationship management in terms of maintaining interactivity with customer bases and developing more advanced customer segmentation and data mining opportunities as a result of advanced information gathering.

The current state of mobile advertising varies a lot from country to country, as the results of campaigns have been very promising in markets where the consumer has maintained control over this channel and the rules of opt-in have been strictly enforced. Store visits, campaign responses and product purchases as results of mobile marketing campaigns have often exceeded typical direct marketing results, and with MMS, video clips and colour screens adding to the attractiveness, this area is one of substantial growth.

Typical mobile advertising campaigns may include broadcasting of SMS or MMS messages to consumers to promote goods and services. Marketing can take many forms, from mobile coupons to MMS-embedded barcodes, and other examples include small downloadable applications, wallpapers or ring tones or sponsored content such as games or news. Advertisers often run competitions with mobile response-mechanisms to people in exchange for their personal contact data.

Charging: The positive aspect in mobile marketing is that it can provide a lot of innovation for consumers and it is free of charge for them. From a marketer's point of view, this medium is very direct and offers incomparable interactivity and possibilities for community building around products and services. Some of the competition campaigns may even be self-funding, as the consumer's responses may be charged as a premium SMS, thus covering the costs of SMS bulk prices.

Cooperation: The mobile advertising value chain includes players such as operators, advertising agencies, contact aggregators, third-party advertising service providers and many more. This is an attractive field for partnering but if the ownership of the consumer data becomes very controversial then there are likely to be few intermediate partners between the advertiser and the consumer.

Challenges: Gaining user acceptance and opt-in is one of the great challenges in this area, as there is no lack of interest in utilizing this channel. The opportunity lies in quality, not quantity, as the more mobile advertising is seen as a well-directed value-adding service to consumers the more likely it is to fulfil its promise.

2.3 VALUE CHAIN EVOLUTION

There are several players in the mobile services value chain, which extends from consumers to content rights owners, with numerous other parties taking important roles between them. Some examples of participants in value chains are also discussed in Chapter 7. Instead of trying to design the perfect and all-encompassing value chain, one may be better off viewing the services market as a web of players including service providers, application developers, content owners, content aggregators, infrastructure and terminal providers who are interlinked through multiple business models. In order to understand the future developments of the services business, it is essential to keep an eye on these player positions and anticipate their movements within this web of buyers and sellers. For the purposes of this book, the focus in this overview will be limited to three spheres of value: the customers, the mobile operators and the service, content or application providers. So much effort is put into inducing consumers to use the mobile services that this sphere is a natural starting point.

2.3.1 Customers

Mobile services consumers come in all shapes and forms, their dominant characteristics perhaps being that they mostly use phones for voice calls and text messaging and are only slowly changing their behaviour for to benefit from more advanced services such as reading news, watching TV on mobile or playing multi-player interactive

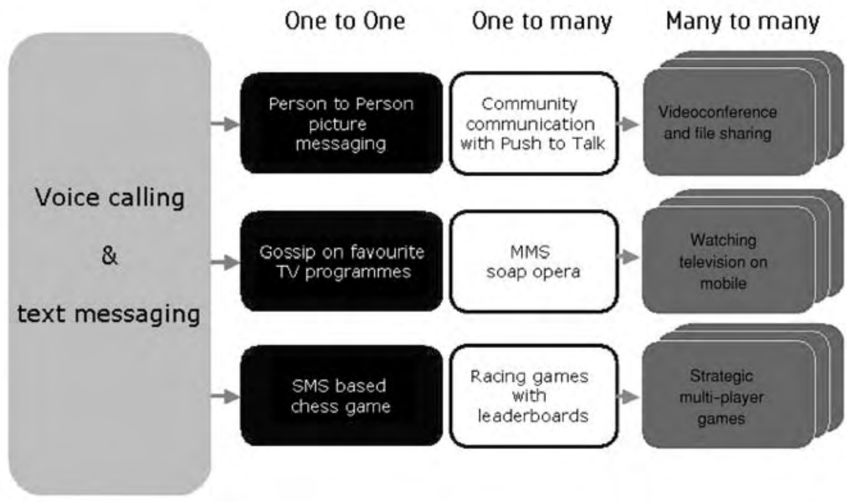


Figure 2.3 Service evolution towards richer experience. Reproduced by permission of Nokia

games. Based on the discussions on mobile services evolution, it is clear that the services aim at meeting consumer needs by providing richer and richer user experiences, some examples being presented in Figure 2.3. But the trick is still to get people to use these services. One can highlight the importance of costs, convenience and communication – the three Cs – in overcoming the barriers of service usage.

One reason for the slow adoption of advanced services lies in the related direct **costs** that come straight out of the consumers' pockets. Customers need to first make an up-front investment into upgrading to a technologically more advanced handset and secondly come the costs of the usage of these services. Phone manufacturers are doing their best to drive phone purchases and speed up replacement cycles by introducing more and more fashionable phone designs, operators are supporting terminal upgrades via handset subsidies, and the cost of the actual usage of the services is coming down. However, cost-consciousness seems to be a universal trait so optimal value proposition must take into consideration the total cost of ownership. This is particularly true in some of the emerging markets in Africa, Asia or Latin America where totally new consumers are still to be found, contrary to the dominantly phone-replacing markets of the Western world. The other main cost-related service adoption obstacle is the consumer's perceived opportunity cost which is very low for acquiring much of the content services through some other channel than mobile. Press, radio, TV or the Internet provide a lot of competitive content, perhaps not directly to the pocket, but mobile services have still a way to go to fully leverage their unique benefits of timeliness, availability, personalization and location-specificity.

Convenience in terms of use and availability of mobile services is a goal in itself, because mobile services must be easy to understand, easy to use and easy to personalize. The desired state is a service that is fully functional and as ready to go out of the purchase box as making voice calls is. Alternatively, the worst-case example is a service that requires retrieval of service settings prior to complex installation of them and then several clicks to get the service started. Currently both examples exist on the market, and most of us have unfortunately experienced at least some problems.

Sometimes advances in technology are still the main driver of service development, and consumer behaviour or consumer needs are taken for granted. This leads into assumptions of consumer behaviour that may ignore the gradual development and progression in steps rather than leaps, when it comes to introducing services to mass market. The gradual evolution of SMS services towards MMS is a good example of how the market is first educated into a certain behavioural pattern and then this behaviour is used as a basis for the upgrade of the service. Similarly, a keen web surfer will find it quite easy to start browsing on his mobile phone, whereas a person who is not a very active Internet user will be slow to discover mobile browsing. Hence, in services development it is important to anticipate behaviours and develop hooks between the new services and some more familiar traditional use cases. When segmenting users and analysing segment sizes, it is important to take behavioural patterns into consideration instead of focusing only on demographics. As discussed before, the enterprise market is also providing substantial growth potential for data services and integrated corporate solutions, and convenience of use combined with increases in cost efficiency will work for this segment too.

Finally, it is important to discuss **communication** as a means of reaching consumers. Much of marketing communication in telecommunications industry has been about branding, positioning the brand and building brand awareness. In very competitive mobile markets brand promotion is naturally an important factor in the battle for consumers' mindshare and thus the potentially related share of their pockets. Multi-channel brand promotion is often supported by aggressive and bundled voice and SMS price-driven promotions, particularly in the printed media. However, there is a growing need for clever marketing tactics for more advanced mobile services than voice calls and messaging. Vodafone Live and iMode are consumer propositions where the brand is positioned with the parallel importance of promoting a service portfolio, and we will see more promotions on a single service level in future. Compared to predominantly online marketing activities – banners, emails, links and search engines in the fixed Internet domain – mobile services tend to require a more traditional approach. Marketing via TV, press, radio, events, brochures and, posters sees to complement the intangible nature of mobile services, and the channel itself provides good opportunities for SMS or MMS broadcasting of marketing messages. Viral marketing through groups, chatrooms and communities is also well suited, particularly for younger users, and free service trials seem to work across various age groups. A free promotional period of service use together with ultimate ease of service discovery is a strong marketing proposition; it was not an accident that most MMS messaging offerings were initially launched free of charge.

2.3.2 Mobile Operators

Mobile operators have a central role in developing service offerings and thus facing the increased need for improved and more efficient services management. Within a decade the voice-centric service products have transformed into services hypermarkets, where offerings range from data access to voice to messaging and to a wide variety of value-adding content services such as news, games and music. And the portfolio keeps developing, so it is a challenging task to manage all the billing, customer care and technology platform integration issues at any point of time as well as managing the constant development and evolution of these aspects. Here we can introduce more Cs into our thinking, as the challenges to operators are coming from the commoditization of their offering, potentially partnering with the right operators and preparing for the convergence of technologies in offering any digital services to market.

Commoditization. Overall operator approaches to mobile services tend to have more similarities than differences, as much of the services and content on offer does not vary much from one operator to another. A competitive edge usually comes from either cost leadership or differentiation, and the commoditization of mobile services sways development towards the cut-throat business of price competition. Agreeing to commoditization or fighting against it – that's the question!

Depending on the speed of the network, the usability of services can differ and network management plays a significant role in the overall quality of service, but one must not forget the importance of customer care, education of the retail network and the overall handling of point-of-sales activities – these are differentiators visible to the consumer. Fostering developer communities may result in improved capabilities of product differentiation, but the propensity to use the same branded content providers creates similar phenomenon as in the retail industry. For example, certain big brands of chocolate bar, fragrance or clothing can be purchased from many department stores and the ways these stores build their own loyal clientele could perhaps be exploited more in the mobile domain. Price differentiation has been widely exercised; no one wants to be perceived as an expensive operator brand, but there is a huge spread between positioning as being good value for money, affordable or low-cost, and all these approaches are widely used. In general the challenges of creating differentiation may also be overcome by focusing on the service platforms and their flexibility. For instance, value-based pricing is a differentiator, but there are depths and efficiencies required that vary from the capabilities of one service platform to another.

Coalitions. The global mobile village is also becoming a battlefield of mobile operator alliances. Vodafone has been on a big acquisition spree, resulting in it becoming perhaps the single most dominating operator brand globally. However, iMode, the Japanese mobile services portfolio concept, has been gaining ground in Europe and other operator consortia or alliances have emerged to counter the power of Vodafone. Freemove Alliance has Europe as its stronghold and the key partners are European giants T-Mobile, TIM, Telefonica and Orange. mmO2 is also driving an European-originating mobile operator alliance with tier 2 challengers like O2, sunrise, Amena, ONE, Pannon, Telenor and Wind, and there is also an Asian approach to the alliance game, namely the Asian Mobility Initiative with CSL, Maxis, MobileOne, Smart, Telstra, DTAC and CTM as the core players. It remains to be seen how and when these alliances will connect and compete globally, but the operating mode within an alliance is likely to facilitate synergies between its members trying to iron out major intra-alliance competition. On one hand, this would mean seamless roaming, services access and tariffing propositions for consumers, and on the other hand it means compound purchasing and customization power for terminal, content and network infrastructure providers. Greater operational efficiency is one underlying goal of alliance-building, and potential brand clashes or co-branding challenges will also be tackled in one way or another.

One of the operators' strategic challenges is also the approach to **convergence**, which is a popular visionary discussion point. The deregulation of many telecommunications markets in the early 1990s drove the emergence of new operating companies to challenge the dominant national telecommunication players, and suddenly many markets had between two and five operators, which totally changed the competitive landscape. Mobile network operators, fixed network operators, mobile and fixed operators together with virtual mobile network operators are now part of the system that gradually must find technically and commercially more direct connections to broadcasters, cable companies, fast Internet access providers and each other in pursuit of a better, seamless user experience. The ability to access the same content on your sofa at home, regardless of using TV or PC or mobile or Personal Digital Assistant (PDA), is the ultimate goal, and this again requires services management subsystems that can deal with interfaces and handovers and take into account various billing models. Technology aside, there are also new challengers aspiring for growth in this area, voice-over IP entering one of the operators' traditional revenue strongholds, and then all the bundled offers based on Asynchronous Digital Subscriber Line (ADSL) raise debate over the most dominant value chain positioning within convergence strategy – wireline or wireless.

2.3.3 Service, content and application providers

For the purposes of this chapter, the discussion around service, content and application providers is bundled together and they are viewed as a collective key interface with which mobile operators work in order to launch services. One reason for this collective perspective is that nowadays there often is just a fine line, if any, to differentiate these players clearly from one another. In other words, the value net is in flux and it has not always been possible for these companies to capture value and run a profitable business within a very specialized and narrow part of the value chain. Instead, they have had to change or expand their initial roles and positioning which originally meant that service providers were just offering services to consumers and application providers were primarily developing applications to operators and service providers, whereas content providers focused on selling content to operators or service providers. Conveniently, the issues arising from these transformations within the value net can be discussed using the final Cs, namely co-opetition and complexity, in regard to understanding the business of service, content and application providers.

Co-opetition generally refers to a new mindset of business that combines competition and co-operation, and this is becoming a common way of working in the new network economy. Instead of viewing application and content providers as sole suppliers in the value chain, both service providers and operators can position themselves as more or less integral partners in their business, while at the same time, for instance, content providers may be selling their content to consumers directly, thus becoming buyers from application providers. Many publishing and media companies, such as Time Warner, present a good example of this practice, as their content is available in several operator portals mainly as branded and sometimes even as non-branded content, but they also run their own direct content sales channel with optimized applications (as CCN is doing) Co-opetition as a mobile industry phenomenon illustrates how the same companies are simultaneously both complementing each other and engaging in competitive activities. These new value networks facilitate the spreading of knowledge and developing industry wisdom on how things could and should be done, as well as cumulating a critical mass of competences and contributors to run service provisioning activities in a multinational environment. The flip side is again in the area of differentiation, as good concepts will be copied fast. Whereas providing value in terms of innovation may be easy, the actual capturing value and creating a unique proposition is getting harder and harder. For all service, application and content providers with multiple partners, customers and suppliers contribute to their success, so mastering co-opetition is truly the play of the day.

Complexity in the mobile services business is not only provided by multiple partnerships among competitors, complementors and suppliers, but there is much more for these often small companies to cope with. Regulatory conditions vary from one country to another, and often international exposure is the lifeline for a small innovative company emerging from a small market. Neither are technology platforms nor standardization providing enough commonalities for seamlessly rolling out services over different connectivity, consumption and software domains and operator and terminal interfaces. Customized integration is usually needed, which is very costly and also leads to longer time to market and thus becomes a barrier for trying out innovations. The much-sought niche market services may be too cumbersome to implement if too much tailoring is required. Developing content services also increasingly needs to address the many challenges of Digital Rights Management (DRM) and it is still unclear who is in the best position to develop that area; content owners, application providers, operators and service providers or terminal vendors? To protect business objectives, some premium content protection mechanisms will need to be in place to prevent viral distribution of content that has only been paid for once. Demand for branded content in general favours content rights owners in terms of position in the value chain, but white label content to be packaged attractively by service providers has its uses too. So far the most successful players in the service, content and application provisioning domain have been the ones that also have other non-mobile revenue sources, as well as those who are offering extended services platforms i.e. from content, applications and hosting, and hence who are able to operate by simple plug and play logic globally within various operators' portal offerings.

Due to the focus of this book, value chain analysis has been scoped to strategic developments within consumer, operator and service provisioning spheres as discussed here, but the other key players in the value web should not be forgotten. Technology and product providers through handsets, network and service infrastructure solutions are enabling the creation of future services, and together with IT and operating system developers they need to sort out issues of compatibility, integration and standardization, among other things. Regional and national regulators will also shape the way the industry develops, whether it comes to locating base stations in communities or allowing bundling of voice, data and DSL offerings to consumers. It is easy to conclude that the value chain is in flux and that the evolution of the business ecosystem is likely to be accelerated by the development of technology and slowed down by the gradual service adoption of consumers – all this will strike a balance one day.

However, the mobile industry is today is an exciting area to be in, as there is so much business development potential, so few saturated market positions and the rules of the game are still being made by the players themselves. As the very last C in this chapter it is therefore appropriate to take a holistic look at the **comparative benchmarking** opportunities with other industries, as there are many similarities that mobile services value net players can identify from consumer and enterprise markets for other goods and services, and the development of the mobile industry will also have an impact on many more traditional business areas. Without going into details, some interesting comparisons and fields for benchmarking can be derived from the following areas:

- Fixed Internet business – portal strategies (e.g. AOL) and content-based charging logics (e.g. adult entertainment);
- Broadband – subscription models for TV channel content offerings (e.g. Sky, HBO);
- Retail – consumer segmentation, customer service, customer relationship management, inventory management;
- Utilities – cost efficiency and profitability on commodity services; and
- Media – advertising, sponsoring, promotions, events.

Let's bear in mind that many of these concepts will converge in the near future anyway and much of the learning relates to and has an impact on business models, the last of the three evolution concepts that we'll be focusing on.

2.4 BUSINESS MODEL EVOLUTION

Business models are a challenging topic. They are perceived to be complex, including lots of numerical analyses, which simply puts people off, and hence many like to leave it to others to sort out the details. Unfortunately the devil often is in the detail, and business models are actually very common-sense matters, so this section will try to demystify some of the key developments in the mobile services area.

First, a business model simply tries to make sure that the business stays in business, and in order to do that it must make more revenues than costs in the process. An increase in revenues typically comes from getting more customers, getting customers to use more products and services and/or the company charging customers more for the goods sold. Decreases in costs are typically derived from driving down operational inefficiencies, reducing resource costs and trying to optimize outsourcing and purchasing of components. Generally, as long as revenues exceed costs, the business is usually profitable, so the principle of a successful business model is simple, but how to make it work is the key question embedded in the development of any company's unique competitive edge. Practically, in order to grow, a company needs to get new customers but it also needs to keep its existing customers happy to maintain its market share. Without service and product differentiation, it will be hard to produce high margins and increase profitability, and some unprofitable efforts will often need to be made just for the sake of image and market visibility. Average revenue per user (ARPU) has for a long time been one of the key indicators for operators, but the usage of other measures is growing and AMPU, or average margin per user, is already indicating the importance of profitability over sheer drive for revenue growth.

In the mobile services business, a positive spin affecting business models is resulting from the overall growth of the mobile market and the collective market education activities that the industry as a whole is doing for its customers. The problem areas have been, on one hand, the commoditization of voice calls and the related price erosion, which is leading to a decrease in revenues. On the other hand, unrealistic expectations around the speed of service adoption and consumers' actual usage of mobile services is not bringing all the growth that has been planned for as a background assumption of the business models. We'll focus here on mobile business models at two levels; first we'll focus on pricing at a *consumer level* because that is the feature of the value proposition that is very visible to customers and thus has a great impact on usage and service revenues. Second, we'll look at revenue sharing between partners on a *business system level*, as this is a very common mechanism of expressing value distribution in the chain that is producing the service.

In consumers' eyes, there seem to be at least two important price points that are used in assessing the relative affordability of a mobile service; a price of a voice minute and a price of a text message. This is actually a favourable comparison for the industry, as neither of these products has very low profit margins. Figure 2.4 illustrates how many text messages one could get for the price of one MMS in

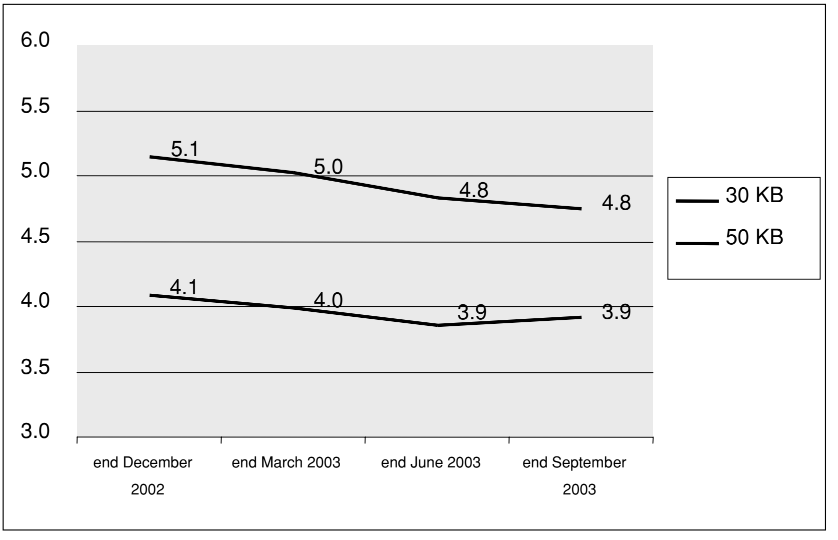
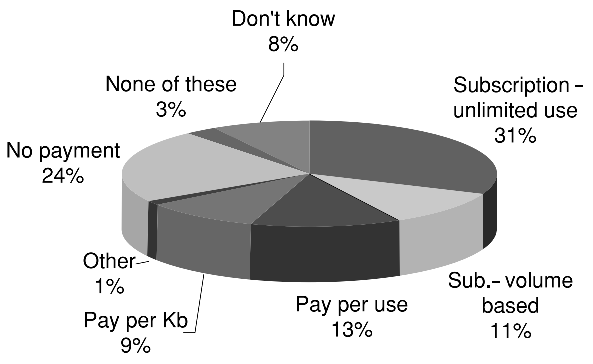


Figure 2.4 Price ratio of MMS versus SMS. Reproduced by permission of Nokia

2002–2003 based on a sample of 120 operators. We can see that the ratio has come down from 5.1 to 4.8 in the 50 kB size category and 4.1 to 3.9 in the 30 kB category, but depending on the market there have been big variations in the ratios, for example 9:1 in China or 3:1 in Australia. The unit price of some of the first multimedia messages in 2002 was above 1.5 euros and by 2004 the European average was around 0.4 euros, so the price of an MMS has come down drastically and one can safely predict that the closer it gets to the SMS price, the more consumers will be using it. Other price benchmarks for a mobile content service are the cost of the content via some other competitive channel. For instance, the price chargeable for a mobile weather service must be reasonable, keeping in mind that weather forecasts are also reachable via the Internet, daily newspapers and television. Hence, the unique selling point (usp) of a mobile weather service relates to the value of the convenience and location accuracy of the service rather than the content itself. Thus, there is a clear need for value-based pricing logics in the mobile industry.

Several pricing models can be used as differentiators and to support value-based pricing. The benefit of a single unit price or transaction-based charging is that it is usually very simple and understandable, and it also keeps the barrier of the service trial reasonably low. Other typical pricing models include subscription charges



Source: Nokia content study 2003.

Figure 2.5 Consumer preferences for payment methods. Reproduced by permission of Nokia

that can entail unlimited usage of services for a certain period, or then there can be fixed prices for certain volumes of usage. It is also possible to charge purely based on volume, which puts the amount of data traffic in the centre of the pricing logic. From an operational point of view it may make sense to charge with this clear cost plus strategy based on network capacity used, but from a consumer point of view it is hard to understand the data traffic amounts required for the services, so this has in general been perceived as a pricing model with difficulties for consumer communication. Figure 2.5 illustrates this fact, as it presents consumer preferences for these different pricing models in a research study carried out by Nokia and NOP in nine different markets across the world. The 24 per cent share of people not wanting to pay for services at all presents loud and clear the challenge for the industry, and these people may be more open towards improved value-based argumentation than overall marketing promotion, because the current value proposition is clearly not striking a chord for this audience. Generally, volume-based pricing is most commonly used for pure GPRS data traffic packages that can be consumed via browsing, emailing, downloading or streaming. Like MMS, the price of GPRS data has come down in 2003–2004, and the new value-based pricing challenges require help for improved service platforms and services management to allow price differentiation of megabytes of data depending on the content, the time of delivery, the delivery mechanism as well as the origin of the data, i.e. the source of the data content coming from partners, the operator's own service portfolio or the Internet in general.

On the consumer perception level there must be a match between the price, the usability and the quality as well as the perceived value of the mobile service in question. This is only achieved by forging a strategic fit between all these aspects when developing the business model. Easy-to-use mobile phones, optimal network design, flexible service platforms and efficient services management all contribute to the usability and quality of the service, and the perceived value of the service is the sum of these enhanced by communication and targeting consumer needs, which typically must be aided by end-user market research. The research will help in producing segments and segment-specific needs, and it is unlikely that in the early phases of mobile services market development one pricing model could fit all. This is why alternative pricing models will continue to co-exist, as described in Figure 2.6. There will be consumers who are more willing to subscribe to service packages to ensure a steady service consumption and clear view over the costs of that service too. This is similar to cable TV usage, and even subscribing to a daily newspaper has similar behavioural foundations. Equally, some services may be better off with transaction pricing that fits casual usage and the trial of new services as well as keeping up the impression of low telecommunication expenses compared to some subscription rates. The increased interactivity of services drives event-based charging,

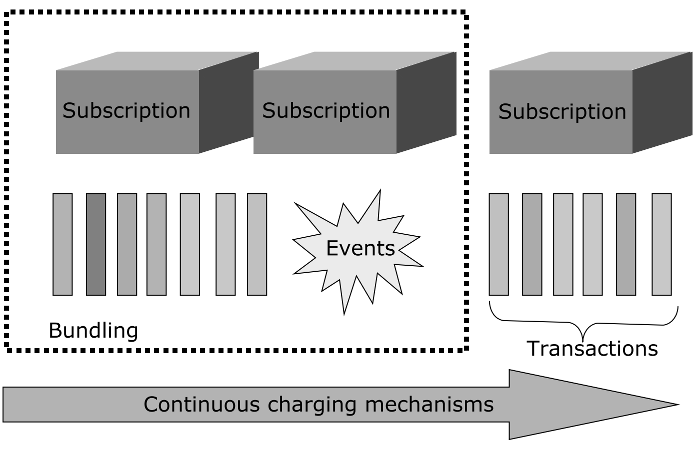


Figure 2.6 Co-existence of alternative pricing methods. Reproduced by permission of Nokia

which can invite customers to join for an Olympic news service or a single interactive games night competition. From a business model point of view, continuous charging generates more long-term revenue than one-off charging, and new pricing model innovation can be developed here. One example of a practical continuous business model can be implemented over interactive games, where downloading the game could even be free of charge but then there would be small traffic charges incurred while playing the game and also tips and hints for advancing in the game will cost extra. This would provide better revenues than just charging a one-off fee for a game download, provided that the game is interesting enough to keep up continuous usage. Increases in bundling will present customers with multiple usage options within a package, that is likely to be customized but still consisting of a number of elements such as video clips as transactions, visual radio as subscription and clubbing interaction as events. The trend may be towards various subscription bundles but there still is a justification for a number of other pricing model alternatives.

With the co-existence concept, we'll now shift our focus from pricing models to the business system level and the revenue-sharing models implemented there. As discussed before, value chains in the mobile industry are complex and hence it is more illustrative to speak about value webs or value nets. The complexity of these services and content producing networks is forcing the industry (and operators in particular) to strive for increased simplicity in business interfaces. In practice this means that since the year 2000 and the aduent of the Japanese iMode business model, many other operators have followed suit and made public their standard revenue-sharing conditions to their content partners. The openness is still not a predominant feature in mobile markets, but at least some of the North European markets have spearheaded the openness and so have big players in other markets. The key driver for open models is the operational efficiency achieved; operators already have hundreds or even thousands of services and content and application partners, and open models do facilitate communication. However, in some cases the open models is still flexible depending on Factors such as brand value, usage volumes or co-marketing agreements with some major partners.

Public revenue-sharing models do vary a lot from market to market and from one operator to another. Hosting and marketing are costly activities and this is reflected in revenue sharing, and so is the exclusivity of content and in some cases the content brand, and

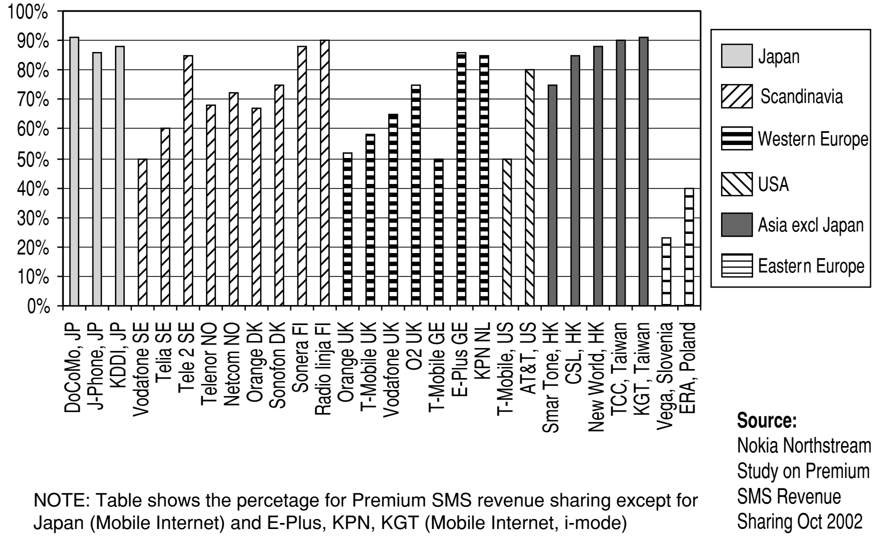


Figure 2.7 Global overview of premium SMS revenue sharing. Reproduced by permission of Nokia

these factors explain some of the differences in the chart. As presented in Figure 2.7, in 2002 content revenue-sharing ranged from 20 per cent up to 91 per cent from a typical premium SMS service like a ring tone. It is worth highlighting here that the figures in the chart go through operator billing to content providers, but this only relates to the content part of the product. All traffic-related revenues, e.g. content-bearing SMS charges, will be borne by the operator alone. This trend has prevailed until 2004 when traffic revenues are still not shared by operators to partners and revenue sharing percentages have not drastically changed from 2002 levels either, even though content is now richer and often transported over GPRS in addition to SMS. As an example from 2004, some big players like Vodafone and iMode in Europe have gone public with revenue-sharing figures of 60 per cent and 85 per cent toward content partners respectively, and this is excluding traffic.

The actual share of revenues is then another story, as traffic can form a significant part of the revenue. The net revenue share left for the content partner, after reducing traffic fees, taxes, royalties and operator billing revenue from the retail price, was in 2004 typically closer to 35–50 per cent than the higher percentages quoted, so all this needs to be calculated by partners when they are building business cases of their own. Due to increasingly data-hungry applications like video streaming, it may make sense to reward partners with better revenue share depending on data traffic generation, so the evolution of revenue-sharing in that respect may change, but the trend is towards more open models.

Service hosting and content licensing are also potential growth areas within business system level logic. Operators tend to look for partners who can host their own content and thus reduce complexity in the operator infrastructure, even though the service platform consequently needs to handle many interfaces as a background process to provide a unified front for consumers. The approach of offering content at the cost of browsing traffic is an indicator of content licensing deals also growing as an alternative to plain revenue-sharing. For a consumer this approach can facilitate the perceived value of some data-bundling value proposition when the package also includes content like news and headlines in addition to plain traffic.

In conclusion, we can again say that the industry is in transition – this time toward simpler, more standardized and easily communicable models. However, this is not to say that the end of the business model innovation has been reached. On the contrary. With converging technologies and market entries from other industries there are more players entering the arena, and the way to gain market share is not necessarily through contingency but rather through disruption. Mobile virtual network operators, media and content conglomerates and parties building approaches on all IP, wireless LAN or mobile multicasting are likely to shake the market, and the vision has no limits but the depth of a consumer's pocket and his available time.

2.5 CONCLUSION

Let's first ask, what do cows and mobile phones have in common? Before giving you the answer, we can conclude that recent years have witnessed many new mobile services blossoming all over the world. MMS users form one of the fastest growing consumer segments, and it has been possible to observe increased utilization of mobility, immediacy, location-relevancy and personalization in numerous content applications. Mobile service evolution is well on its way, supported by clever concepts, multiple charging models and various forms of partnerships within the value chain.

Mobile value chain evolution is a complex matter, it requires forming coalitions, preparing for convergence and fighting against commoditization of mobile offerings. Consumers are cost-conscious and require convenience of use as well as communication about the value added by the new mobile services gradually entering their lives. Co-opetition is seemingly the way forward in this exciting industry. More disruptive innovations are to be expected, not only in the area of services but also in service business models. Revenue sharing may be complemented with content licensing and the co-existence of various pricing models. From a services management point of view all these demands need to be supported in the most very cost-efficient way – and that is a true challenge. Luckily there are some solutions in sight.

For entrepreneurial spirits this is the market to be in, and it also has multiple dimensions for other, more established, industries to build business links with. A healthy cross-contamination of down-to-earth planning practices and operational efficiency from elsewhere will be good for the occasionally over-optimistic spirits in the mobile industry that can overnight turn pessimistic when things do not go quite as planned. The direction of the industry is upwards, even though several players may still exit, more will survive. The 3G hype has taught us a lesson, but one to ignore at your peril!

. . . oh, and the question about cows and mobile phones? They are linked by a common creative business model in India, where the Grameen bank has traditionally loaned money to villagers in remote areas, who have then in turn paid the loan back by selling cows' milk to neighbours in the area. Grameen is now using the same model, thus loaning money to villagers for purchasing mobile phones, and the payback takes place through the phone owners then re-selling the "village phone" call minutes to talkative fellow villagers. Common sense and not bad for the ARPU either!

3

Focus Topic 1 – The Tune2Radio Service

Ulla Koivukoski

3.1 INTRODUCTION

As the purpose of the book is to introduce service management issues from both a business and a technical point of view, this case study introduces a real-life example of the implementation project of an interactive end-user service where a content provider is also involved.

Tune2Radio is a service idea which Nokia introduced with its partners in 2002 in attempt to both develop a workable service business and application model and demonstrate the attractiveness of this type of services to end-users. This case study is also a good example of services that are targeted to a small target segment but that also provide the opportunity of enhancement in accordance with the evolution of the network and terminal capabilities as well as content.

Tune2Radio (T2R) is a personalized, interactive entertainment service delivered in association with a radio station, with an application developer providing the required application and operator to deliver the service to the end-user. The service is designed to be attractive to trend-setting, young users who are early adopters of

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Figure 3.1 The Tune2Radio promotion example created for Nokia by Advertising Agency Contra. Reproduced by permission of Nokia

new mobile services and looking for unique solutions to reflect their lifestyles (Figure 3.1).

By taking a lifestyle view of service delivery, specific customer segments can be identified where focused mobile services such as T2R can be targeted. By laying these service foundations in General Packet Radio Service (GPRS), operators can manage user expectations and create an evolving user experience of mobile data. GPRS provides an additional "push/pull" element above and beyond text messaging to stimulate revenue growth and service adoption by wider audience.

A service such as T2R can be delivered fairly simply today with GPRS and then evolve to include high-value music-related multimedia services to provide, for example, video clips, artists' performances or interviews as new quality service classes are introduced.

The end-user gain of the T2R service is the availability of real-time music-related information and the opportunity to personalize their listening experience. This is achieved by notifications of radio broadcasts as well as event guides at any time, wherever the end-user is.

This case study introduces generic information on the service based on the end-user studies and business case prepared by Nokia, but which is based on the views of several discussions with the operators and a couple of radio stations. The initial service specification as well as the business case was created together with a few operators and radio stations to which Nokia introduced the idea. The service concept and enabling solution were provided by one of the application developers of Forum Nokia.

This chapter depicts T2R service in the way it was developed, and at the end there is a short introduction of the potential evolution of the service seen at the time of writing.

3.2 THE BUSINESS ENVIRONMENT ENCOURAGING SERVICE DEVELOPMENT

At the time the Nokia service development project started, there were differing views of whether end-users would be willing to part with sufficient amount of money to justify the investments in new mobile network infrastructure such as GPSR and third generation (3G) networks. The launch of the data services except text message-based services didn't suggest quick enough Average Revenue Per User (ARPU) growth to carry through the business case.

Entertainment services and content were predicted to play an active role in data services. Research studies carried out on behalf of Nokia highlighted music as one of the most popular entertainment service for end-users. HPI Research Group conducted a study in eleven key markets, focusing on mobile entertainment in particular

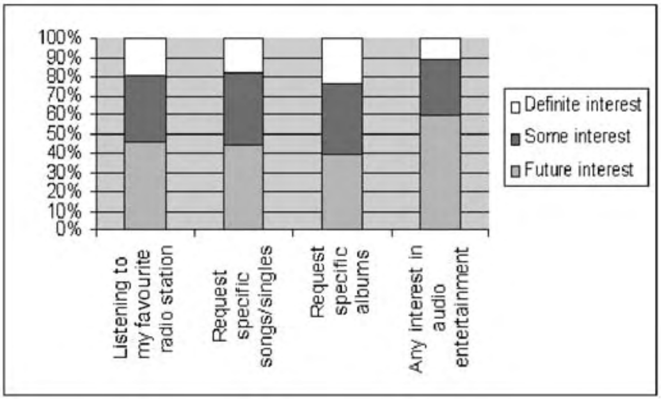

Figure 3.2 Mobile phone users aged 16–45 in eleven countries. Reproduced by permission of Nokia and HPI Research

(Figure 4.2). The study looked at motivations and barriers, content types and formats, as well as the predicted level of demand, usage and willingness to pay.

The results of the study suggested that 90 per cent of respondents would be interested in mobile audio entertainment. The study also found that mobile music entertainment would have a wide audience across the life stages. The interviewees foresaw the usage of mobile music services on various occasions, especially away from home, during commuting and during times when nothing else can be done, on holiday and so on. The interviewees also regarded the mobile phone as a potential tool to deliver music services as they carry their phones wherever they go. A mobile phone equipped with an FM radio and headset provides an obvious channel for delivering music in a convenient and flexible manner that is attractive to end-users.

3.3 BUSINESS MODEL

The T2R value chain (Figure 3.3) consisted of several players such the radio station broadcasting music and other radio programmes and sharing information with the service provider, who provides additional content synchronized with radio programmes. Examples are buying the song currently playing or running contests or general

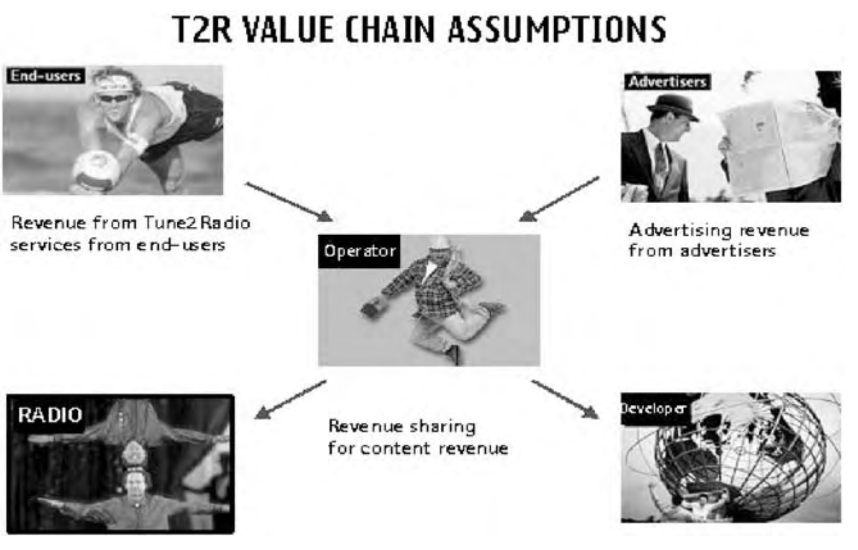

Figure 3.3 T2R value chain structure. Reproduced by permission of T2R

radio station interfacing such as requests, questions and so on. T2R service also opens up an ideal opportunity for an advertiser to either sponsor the service or offer a mobile shopping choice to benefit the end-user. The service provider, application developer or operator can provide service hosting.

This service model provides a clear role and position for each player in the value chain for development and execution responsibilities. A significant benefit for every player is that T2R is a 'sticky' service, which has the potential to help reduce churn from both radio programmes and the mobile operator. The simple act of registering for a service has been shown to be a good way of getting end-users to return to the service.

For a network operator, there is the opportunity to increase its number of sellable services and generate more traffic, accelerated by the on-the-air promotion of the radio station in conjunction with radio programmes. The investment of the network operators was planned to be the infrastructure, customer care and billing capability as well as hosting or aggregating of the service in cases when the service had to be available for the end-users of all of the network operators.

For the radio station, the service was supposed to open a new communication channel to talk to radio listeners as well as provide listeners with the option of talking back, and consequently getting listeners hooked to that particular radio station. There was also a chance for the radio station to build a new means of advertising for their business partners. The investment of the radio station was to ensure that the content is in digital format and available for the application to fetch as well as using airtime for service promotion.

The application developer could demonstrate the effectiveness of their application and therefore ask for part of the revenue. For the end-user, T2R provided a trendy way of staying ahead. The investment of the developer was to modify the application according to the service features as well as the execution environment, including integration with the network operator's infrastructure and customer care and billing and the content management system of the radio station.

When the T2R concept was introduced, business models were still under development and the common understanding of the value of each player in the execution chain was not easy to define in practice.

3.4 VALUE FOR THE END-USER

With GPRS technology, the end-user is always connected to the service without bothering with the sometimes complicated session set-up, as was the case with earlier services. The always-on capability, however, doesn't only provide the end-user with value that could be charged. T2R is a service package that offers real-time music and music and events-related information to end-users who have music as part of their lifestyle. The service was designed to be attractive to trend-setting, young users who are early adopters of new mobile services and looking for unique ways of reflecting their lifestyle.

T2R is a good example of a service targeted at specific end-user segments around different interests such as sport, fashion and (in this case) music. The capability to personalize a service according to personal interests brings more value to the end-user, also stimulating usage of the service.

The basic feature of the T2R service is the "What's playing?" type of service where the end-user can listen to the inbuilt FM radio in the phone and fetch for more information on the song playing such as the song title, artist, album details and possibly an advertisement with the potential to purchase related items.

Another feature of the service is the "What's on?" service where the end-user can look for radio programmes or personalize the listing of radio shows to match his personal taste, and even subscribe to a push reminder of events. The T2R user could sign up to the service on the web or through his mobile phone. The push feature also enables reminders for the end-user when her favourite songs will be played or certain radio programmes will be broadcasted.

3.5 TECHNICAL IMPLEMENTATION

3.5.1 The roles of the players in implementation

Radio station or service provider: The central role in defining the service features and content to be linked to radio activities such as play lists, albums behind the play list, possible information on how to purchase the album, and so on.

Network operator: Provides the service with the network services capability such as connectivity and GPRS push as well as charging and billing.

Application developer: Builds the agreed functionality of the service with integration capabilities with the network operator and radio station's systems.

Service Aggregator: The implementation of the T2R service enables different hosting models, such as services hosted by radio station, service or network operator or third-party service aggregator.

System Integrator: The entire service can be integrated with the network and the content production system of the radio station by either the application developer or system integrator.

3.5.2 Deployment

The selected hosting model determines where the server platform for the T2R application will be installed and operated, as explained in Chapter 2.

Figure 3.4 depicts the tasks required and estimated time spent per task to launch the service for end-users. This example introduces a case where the entire service execution environment should be built. The picture doesn't show the time and resources required to build the actual business case, or the revenue share negotiations and implementation plans.

As T2R depends highly on the content provided by the radio station or service provider, a clear partnership between all the players needs to be established both for technical implementation as well as for business monitoring.

An essential base for implementation is the choice of the hosting model from the options, such as hosting by the network operator, hosting by the application developer or hosting by third-party aggregators.

Based on the hosting model decision, the actual planning for integration will get its structure. Depending on the agreed features of the service, the implementation plan should cover interfaces to the customer's network elements such as Short Message Service Centre (SMSC), Wireless Application Protocol (WAP) gateway and possibly Multimedia Messaging Service Centre (MMSC) and also agree the technical implementation of the content integration with the network.

The critical path for the commercial launch of the service is the integration with billing and therefore the integration work must be carefully planned and conducted. If the service is delivered over the

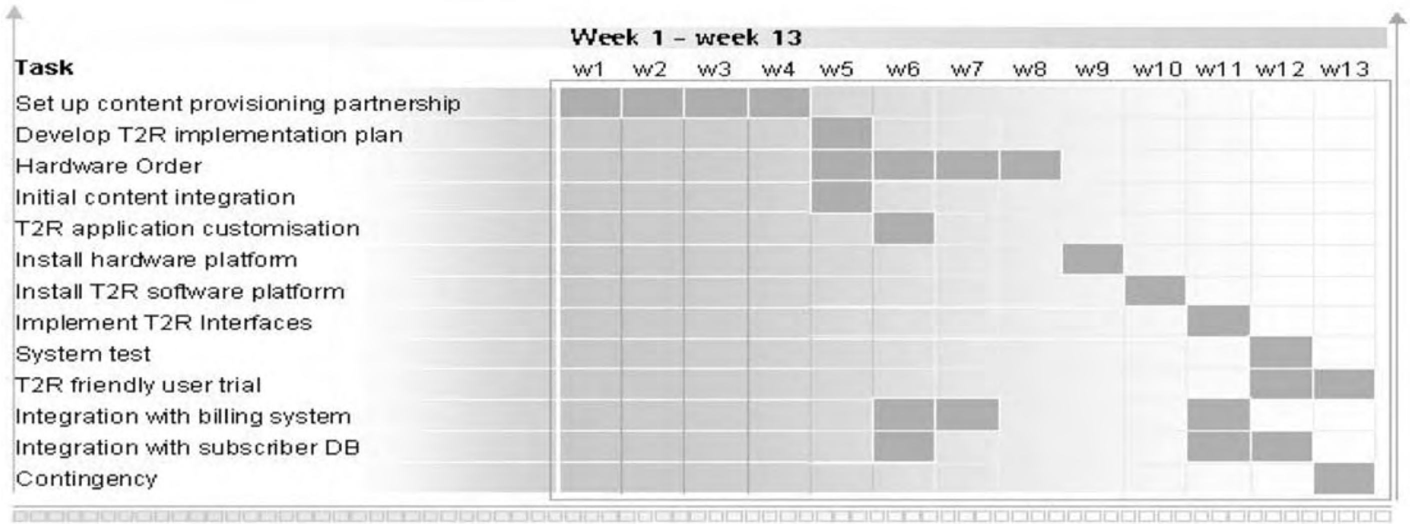

Figure 3.4 T2R deployment. Reproduced by permission of T2R

network of several network operators, the reverse billing capability needs to be in place. The same applies to subscription management to ensure that the service will be activated for subscribers signing up for the service.

For convenient access of the T2R WAP user interface, the terminal management system was recommended as it can provision the service-specific terminal setting over the air when the end-user registers for the service.

3.6 LEARNING

The T2R case was taken as an example as it very much typifies the current challenge in building new services by making use of the latest technology both in devices and network and service enablers as well as emerging business models.

3.6.1 End-user perspective

Consumers are slowly changing the usage behaviour of mobile services from traditional voice and text messaging services to fully benefit the more advanced services. T2R is an excellent service to help consumers understand and accept the service as an association with their favourite radio station and utilization of their new, feature-rich handsets.

As explained in Chapter 2, the three Cs, cost, convenience and communication, shall be analysed to convey the value proposition to the consumer. For the consumer, it is essential to understand the features related to the chargeable service as well as the handset functionality, especially when new handset features are combined with the services, such as the inbuilt radio in the handset and the mobile service with radio content. The man on the street doesn't necessary understand which part of the features he needs to pay for and which are part of the handset functionality. Questions like: "Do I need to pay if I listen to the radio?", tell us the importance of both cost and communication.

T2R is one of the very first services utilizing the capabilities of GPRS network technology and GPRS enabled handsets. The consumer has already learned how to send a text message to the radio station or service provider using a short code. However, to fully benefit from the always-on browsing on the service site, the consumer needs to manage complex tasks, first in signing on for the service and second to get the settings right in his handset. Convenience of use requires that it is easy to register, and automated device settings.

Availability of the required handsets and point of sales where to get more information or advice how to get the service is one of the issues that needs to be solved, to serve the consumer better. Between the T2R project and the writing of the book, there has been no major development in the point of sales development of the service providers. The focus is still mainly on selling the handset and subscription, but not so much on actively promoting the service and guiding the consumer to other services.

3.6.2 Technology perspective

The T2R service was built to provide consumers with several channels to interact with the radio station. Although all the required capabilities were available, the integration of all the essential pieces of technologies to complete the service consumed a considerable amount of development work by all parties.

The service consisted of several network services, such as content browsing and downloading, requiring that the service application has interfaces to all relevant network elements such as SMSC, WAP Gateway and Gateway GPRS Support Node (GGSN) of the operator's network as well as to the external content provider's content server. As there are no standard ways of building the service, all the integration efforts need to be planned and built case by case.

The need to execute the service in a multi-operator environment, where a radio station listener can use the service, whether he is a customer of the hosting operator or not, sets special requirements for the billing system. At the time T2R was introduced, the hosting operator had to establish reverse billing capabilities with other operators. The option of charging content and traffic separately was not present and therefore the technology did not support very well the service case where several parties were involved in sharing revenue.

Current service creation platforms and solutions still lack the ability to scale the service both of the point of view of features and functionality. For example, taking new network services domains such as multimedia messaging (MMS) or visual capabilities requires major development efforts.

T2R and similar services have a high potential of providing the consumer with a personalized set-up of the service. However, the

Figure 3.5 Nokia's 7700 media device with the Visual Radio application. Reproduced by permission of Nokia

current capabilities to combine consumer data with usage data are not good enough to serve both the service development as well as the consumer to get a better match with the likes and dislikes of the consumer.

3.6.3 Business perspective

For a radio station, T2R offers a new channel to interact with listeners and even attract a wider audience. Personalization and mobile advertising give the radio station opportunities for higher advertising revenue in conjunction with increased listener loyalty.

For the service provider and mobile operator, T2R provides a good way of getting their customers used to new services and consequently attain new revenue opportunities from currently untapped markets. T2R also gives a good evolution path for richer service functionality to keep up consumer usage. One example of this evolution is the Visual Radio concept introduced by Nokia (Figure 3.5). Visual Radio is a great opportunity to enhance even current T2R features with visuals, also when on the move.

Mobile marketing, as briefly discussed in Chapter 2, is still a non-utilized business opportunity, partially because of the threat of junk messaging. Both T2R and Visual Radio could provide a channel for mobile advertising based on, for example, consumers' selected permission or as part of the purchasing content of the channel.

4

Service Management

Elena Lialiamou, Mikko Ruhanen
and Pertti Pielismaa

4.1 INTRODUCTION

In this chapter, we shall discuss service management at a general level. Main topics covered include service management frameworks, processes and architectures. We'll handle processes and frameworks mainly from a requirements point of view: what is needed to be able to manage services efficiently. Standardized models are recognized, but actual discussion about them is left for Chapter 5 on standardization. The latter part of this chapter takes the reader through the evolution of service management from GSM to General Packet Radio System (GPRS) and mobile data networks, and onwards to third generation (3G) mobile systems and multimedia. We explain why service management needs to be enhanced through technical and business paradigms. Furthermore, we shall introduce different service management processes in each area, but focus more on the last two.

Service management has been defined in several ways. The Service Framework Team (SFT) of the TeleManagement Forum (TMF) uses the following definition [GB924]: 'Service management is the set of processes that manages services to meet customers'

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requirements whether the customer has explicit knowledge of these services, including any delivery objectives, or not. It has authority to make decisions about the delivery of the entire portfolio of services.'

Different aspects of an individual service can be visible to a customer (individual person, corporate or another service provider), or not. In TMF, the two viewpoints of a service are known as customer-facing and resource-facing services, respectively. To carry out service management, both aspects need to be addressed.

Service management is a central part of a service provider's business processes as it has a major impact on every other area, thus requiring interworking with many other business processes. As the telecom business matures, the complexity of service management increases. The major reasons for that are:

1. End-user requirements make services themselves more complex.
2. New business models make service management more distributed.
3. Competition between service providers increases the need for Operational Expenditure (OPEX) savings.
4. Rapid evolution of technologies make the overall environment more complex and diversified.

End-user driven service creation together with convergence and new technologies will result in a larger number of services needing to be built for smaller target segments, where the renewal of services is faster and the lifecycle of the services is shorter. For service management this also means a quickly changing product portfolio to manage.

OPEX can be reduced at least two ways. Different kind of services can be partly produced by common infrastructure and technology. An example of this is Session Initiation Protocol (SIP) technology, which can be used to amend existing technologies while interfacing to legacy equipment, and thus reduce operative costs through a more unified environment. However, this kind of strategy is not so feasible in the short term due to Capital Expenditures (CAPEX) and immaturity of technologies. Another way is to have Operations Support Systems (OSS) and Business Support Systems (BSS) capable of managing a multi-technology environment.

4.2 SERVICE MANAGEMENT PROCESSES

4.2.1 The service lifecycle

According to the definition, service management covers the whole lifecycle of services. Another issue is how consistent a service management solution a service provider has. Today, many service providers are struggling with more or less separate service management processes for different parts of the service lifecycle, as depicted in Figure 4.1. However, as we will see, evolution is going in the direction where a consistent service management process is a competitive advantage. Otherwise, the complexities cannot be managed well enough.

The lifecycle of a single end-user service is composed of the following phases, each phase representing a highest-level task that can be split into more detailed tasks:

1. **Plan:** Role of the service is defined and high-level requirements and targets are set. External dependencies, e.g. revenue-sharing schemes with other providers, shall be defined at this phase.
2. **Specify:** implementation of the service is defined. A detailed description of the implementation is done. The mechanisms needed in the whole lifecycle of the service shall be defined.

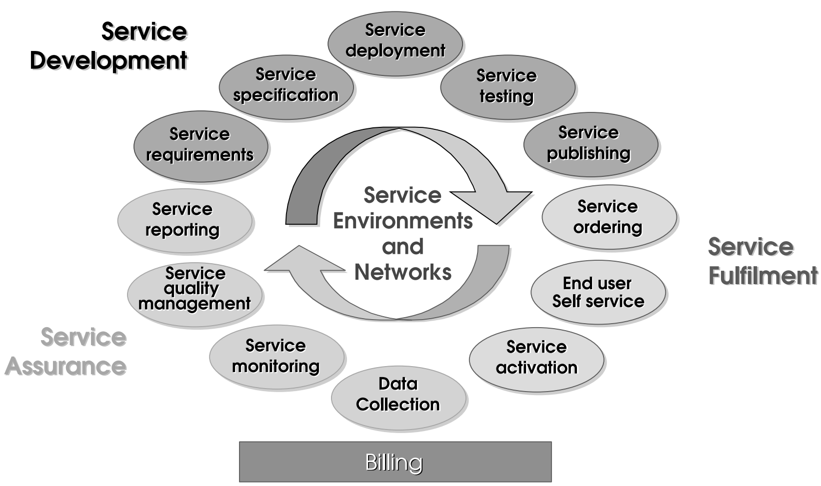

Figure 4.1 Service lifecycle illustration. Reproduced by permission of Nokia

3. **Deploy:** Service is implemented in network and in all related systems, and operator's organization is adapted to the service. These include the partnering service provider's environment as well. From a technical point of view, deployment may mean very different things depending on the service. Sometimes major changes in infrastructure are needed and even the introducing of new technologies. Sometimes configuring of the existing systems is enough.
4. **Test:** This takes place parallel with service deployment, because testing is done in phases, often first in separate testing networks.
5. **Pilot:** Service is often provided for a small group of friendly customers, so that it can be optimized for the mass launch.
6. **Launch:** Service is made available to potential customers. It is now visible, e.g. in the operator's self-service portal. Operator's whole organization is ready for handling the service, particularly billing and customer care.
7. **Order:** Customers discover the new service and subscribe to it through a web portal or operator's customer care. Certain formalities, such as credit check, pre-paid account creation, selected options and acceptance of the conditions, are carried out.
8. **Activate:** The customer is given access to the service, i.e. the new subscription is introduced to the operator network so that the customer is authorized to use the service. Also the user's terminal may need configuring to service-specific settings.
9. **Serve:** This phase includes several major concurrent processes:
   a. **Use:** The end-user uses the service according to the subscription.
   b. **Bill:** Usage generated by the subscription is measured in the network and the subscriber is billed accordingly. Billing may be by post-paid bill, or by pre-paid account withdrawal. The bill, or part of it, may also be directed to a third party, for example, in the case of a sponsored service, or when advertisement is involved.
   c. **Complain:** If customer is dissatisfied with the service, or otherwise needs some guidance, she'll contact operator's customer care, which triggers troubleshooting and corrective actions.

10. **Un-subscribe:** The subscription is terminated, and customer's further access to service is disallowed by network.
11. **Monitor:** Service is monitored by combining various information sources. Continuous actions are needed in order to maintain adequate service availability and quality without excessive use of scarce network resources.
12. **Report:** Performance and usage data are collected from the network and from operator BSS systems. This data is analysed in order to get valuable information for different functions within the operator organization, including network planning, service planning, marketing, etc. The future development of both network infrastructure and service portfolio is based on these reports.
13. **Optimize:** Service is modified according to the data from reporting. Target is to guarantee best possible quality and coverage and highest revenue streams. Optimizing phase can be seen as the implementation of the feedback loop from service reporting to service specifying.
14. **Withdraw:** Also known as retirement – existing subscriptions are cancelled, and the service is removed from portals and Customer Relationship Management (CRM) systems. Service-specific configurations in network and systems are recalled.

In addition to the processes directly related to the service lifecycle, there are also more general operator processes that do not deal with individual services but rather with the service portfolio as a whole. These include areas like service strategy, brand management, partnering, infrastructure development and workforce development, to mention just a few.

4.2.2 Operating roles in service management

In order to understand the service management process, it is not enough to define *what* is done, but also *who* does it, i.e. what are the related operating roles in each phase of the service lifecycle. Defining the operating roles is an essential part of modelling the service management process. Mapping the operating roles to actual tasks defines the job description of the individuals and business functions in the operator's environment. It should be noted that the roles do not map one-to-one to any particular employees within

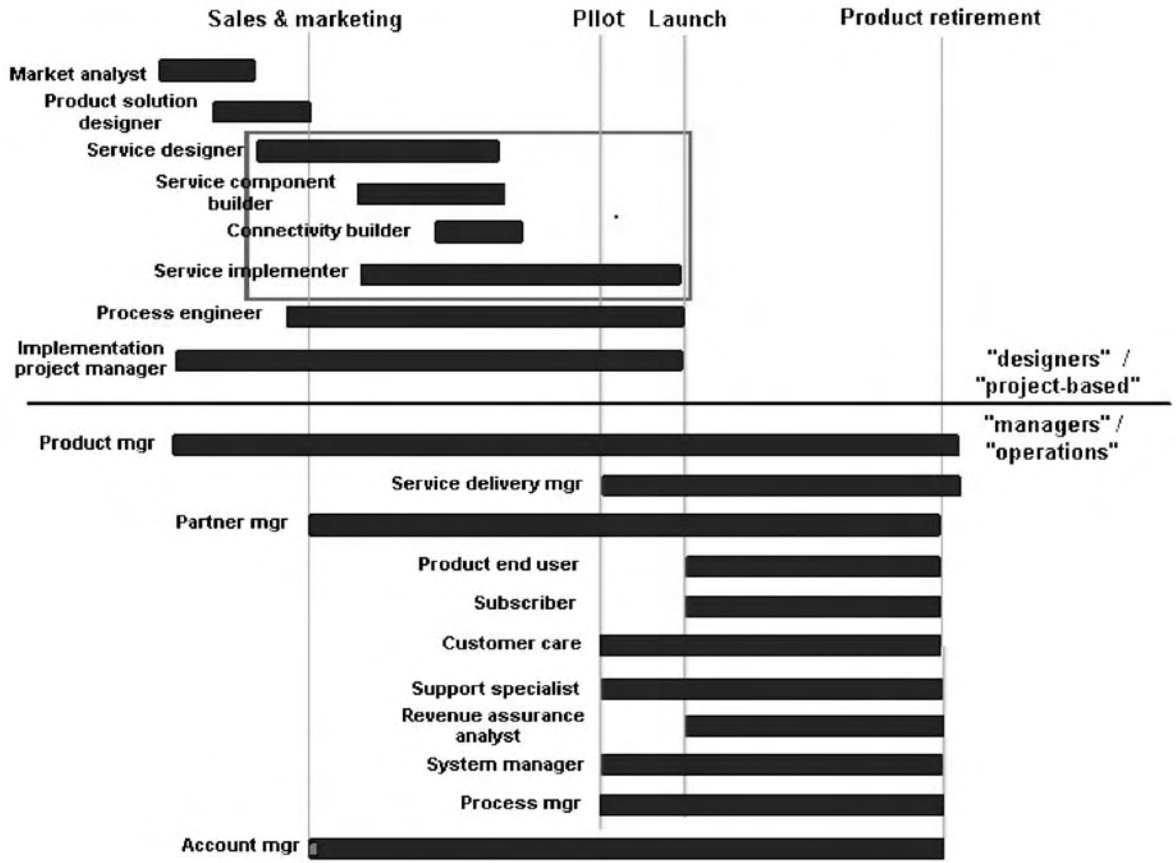

Figure 4.2 An illustration of service management roles. From (GB924). Reproduced by permission of TeleManagement Forum

an organization. A person or organizational unit within operator's organization often acts in more than one role. Also, some tasks may be shared between several roles. The TeleManagement Forum is in the process of standardizing the operating roles related to service management.

Figure 4.2 looks at service management and the different roles involved in it have been defined in TMF/SFT. It is easy to see in the diagram that there are two kinds of roles, "designer" type roles that have the responsibility for implementing the product and the service, and "operations" type roles that are responsible for the service when it is already operating. The roles indicated within the rectangle are the most central ones for service management.

4.2.3 Workflows and workflow management

In order to complete the picture we still need to add a missing part to the service management process. While the generic tasks based on service lifecycle define *what* need to be done, and roles define *who* does it, the workflows will define *how* it is done. Operating workflow is the glue between different tasks done by representatives of different roles, thus also coordinating the use of different systems in the operator's environment. The abstract workflow of a higher-level task defines which lower-level tasks need to be done by whom and in which order. When a task is done, it realizes as a workflow instance, where each lower-level task is assigned to a representative of the corresponding role. These lower-level tasks may have their own workflows, but finally it propagates to the elementary tasks done by a single employer or system.

One can think of the whole OSS as a means of simplifying and rationalizing the overall operator workflow. With effective service management tools, parts of the workflow dealing with service lifecycle can be automated, which potentially brings significant savings.

4.3 SERVICE MANAGEMENT ARCHITECTURES

If the operator wants to ensure the end-user service quality, he needs to implement capabilities for e-2-e management both for service configuration (Figure 4.3) and service assurance (Figure 4.4) areas. This completes the service management loop, as depicted in Figure 4.5.

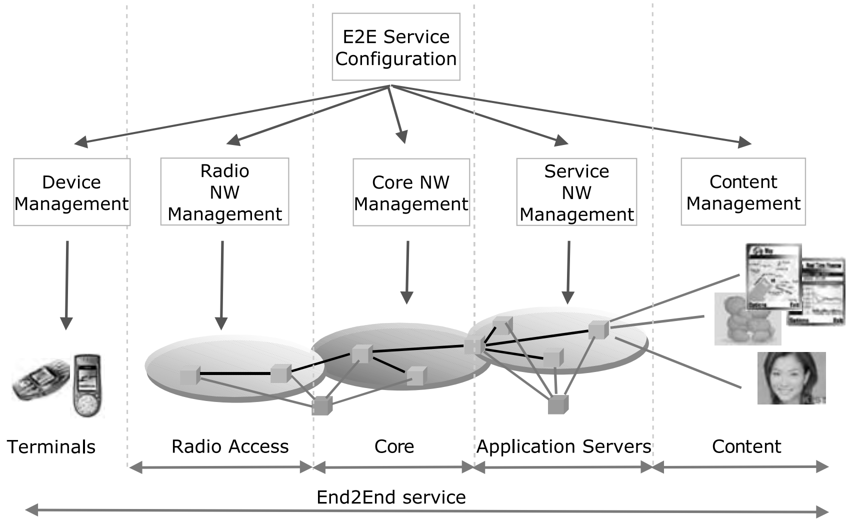

Figure 4.3 Service configuration in a mobile network. Reproduced by permission of Nokia

However, the operator needs to have the underlying network layers correctly managed before he can actually do that. When an operator wants to manage services, the network management and element management layers must be properly and reliably managed.

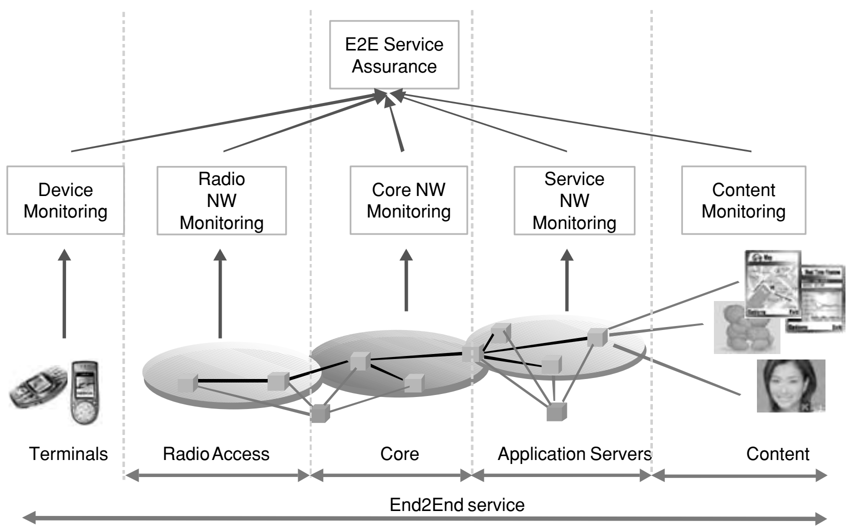

Figure 4.4 Service assurance in a mobile network. Reproduced by permission of Nokia

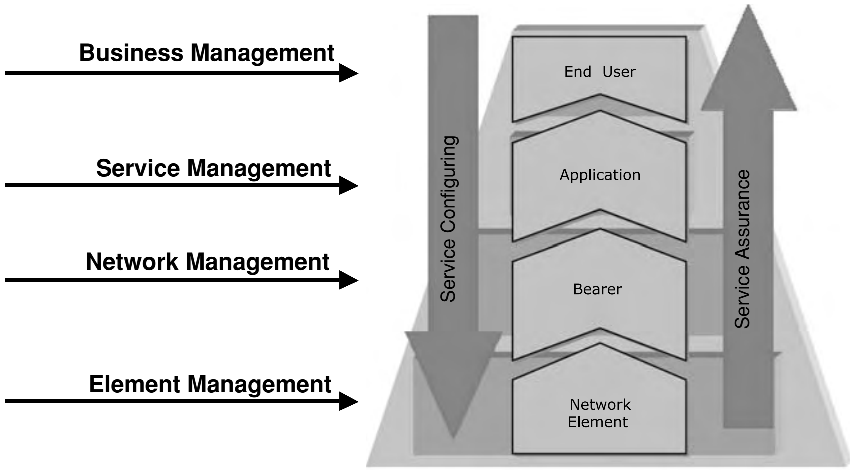

Figure 4.5 An illustration of management layers and corresponding 3GPP entity types. Reproduced by permission of Nokia

The end-to-end management of a service requires that the whole value chain is managed from the user device through the different bearer networks up to the value-added applications and operator business functions. The following aspects have to be properly configured:

- the user device itself
- applications located at devices, the operator network and external networks
- application server infrastructure
- end-to-end transport from device to device or to application server, including control and user plane functions at radio access, core and service delivery networks
- network infrastructure
- support functions such as service creation, billing and operator Information Technology (IT) resources.

Next we shall discuss ways of measuring the service experience of end-users. The usual way to estimate service performance is based on the measurement information collected from each network element or node. The measurement collection method can be based on counting transactions (counters for successful and unsuccessful events or actions in the network), collecting Call Data Records (CDRs), subscriber traces (for collecting detailed information for individual events, e.g. calls or handovers) or using probes in critical network components. Probes generate artificial traffic to the network to simulate end-user behaviour and collect information on the network reactions. All these mechanisms are very powerful and provide a lot of data for analysis. For circuit-switched data, these methods are successful and appropriate because the network has good knowledge of the service performance. Since data-centric services and applications – by nature packet-based – are getting more and more popular, it is difficult to build an understanding on the end-user experienced service performance on this information alone. Also, combining the disparate measurement information coming from thousands and thousands of network elements for purposeful service quality indicators is very complex. One is still missing the last bit between the end-user and the radio networks. The best way is to measure the service performance directly from the handset itself. After all, it is the most essential element in the service chain to judge whether or not the service experience has been good.

In service assurance, when one knows the service model, one knows how a fault in the network affects overall service performance. One can control and optimize one's network by monitoring an estimator for end-user service quality. Even if there is a network problem one doesn't need to resolve that problem immediately if it does not affect the service performance. This is important for the service provider in order to prioritize urgent maintenance tasks based on business or service performance. Therefore, it is essential for service providers to be able to continue to operate with identical basic concepts in the OSS and BSS systems after each individual network element upgrade. This is important for manufacturers to understand to restore the service provider-specific rules and relationships related to the service model during upgrades as well.

4.4 REQUIREMENTS FOR SERVICE MANAGEMENT

4.4.1 Implications of a multi-provider environment

Evolution is currently towards the co-existence of different business models. In many cases, services are multi-provider services, where a provider may only account for one aspect of the service. Traditionally, a single party, a network operator, managed the whole mobile service seen by an end-user. In future, the management of a service will be shared between multiple parties. The end-user might have only one contract with the service provider responsible for the service. Nevertheless, there are other providers who have crucial dependencies in terms of service delivery, quality and management, although the end-user is in most cases not aware of those dependencies. No matter which provider fails to provide their share of the service, it will inevitably affect the other partners as well, including the end-user. Also, it should be noted that especially in future multimedia services, the end-user himself is an important actor, capable of affecting the service functions in many ways.

It is a major challenge to establish a set of service management processes that work over a multitude of partnering providers. An OSS system is required to support those processes and to provide ways for each provider to control their part of the business. From end-users' point of view this should of course seem like a service provided by a single provider.

First of all, the roles and responsibilities between different providers need to be clearly defined. Second, information-sharing between the providers needs to be confidential and coordinated but still dynamic. Key areas to be covered in the latter case include billing and revenue-sharing models, service quality and Service Level Agreements (SLAs) between providers.

Effective service management necessitates:

1. *Common service model*: Communication, especially automated communication between partners, is not possible if the basic concepts of information structures are incompatible.
2. *Centralized interfacing between the providers*: Multiple different interfaces are not feasible. In practice, the use of standard and mainstream integration technologies is a must.
3. *Efficient centralized service data management*: enabling the deployment and inventory of continuously changing service data.

Globalization and the emergence of global operators will add yet another aspect: the service machinery and overall infrastructure need to be shared between global services (managed by a global operator), and local services (managed by affiliates or globally).

4.4.2 Device Management

One of the essential issues in service management is to get the right settings into the handset. Based on studies as well as practical experience, it is too difficult to configure the handset manually. There are many parameters that need to be correct, and often the task itself is quite complex. If any of the parameters is incorrect, the service will not work. This results in bad service usage experience for the end-user. After a bad experience, it takes a long time before one tries again. Therefore, it is necessary that settings are delivered remotely and the handset configured automatically before the end-user tries to use the service.

The best way to deliver the settings is to use Over-the-Air (OTA) mechanisms. There are many ways to deliver the settings. It can be done by a customer care person at the operator help desk, sales person at point-of-sales when an end-user is buying a new handset, content provider through a web services interface, or an end-user himself by using the operator's web portal or requesting a download via Short Message Service (SMS) or Wireless Application Protocol (WAP) portal. The download can also be activated automatically. When the network is able to identify that the end-user has a new terminal it can trigger the download of the handset and subscriber specific parameters. This identification can be based on, for example, finding new Mobile Systems Integrated Services Digital network (MS-ISDN), International Mobile Subscriber Identity (IMSI), International Mobile Equipment Identity (IMEI) combinations. If the IMEI has changed from the previous one, this means the end-user has inserted his Subscriber Identity Mobile (SIM for 2G systems) or UMTS Subscriber Identity Module (USIM for 3G systems) card into another handset. This means that the settings need to be activated in that handset.

The handset-specific settings need to be defined when specifying the service. There are two aspects of the settings from a service point of view. The first relates to settings that define how to access the service, i.e. where are the service access points. This could be the Internet Protocol (IP) address of the server where the application is located and/or a bookmark. Settings are needed for, e.g., Multimedia Messaging Service (MMS) and email. As data-centric services are getting more and more popular the need for remote device management is increasing all the time. Another factor is the format of the content. Handset capabilities vary significantly, meaning that the content has to be rendered for each handset type. Service modelling helps here because you can take the handset characteristics into account in the planning phase of the service.

The device itself has a critical role standing between the end-user and the service provider. Having excellent device management can also mean having a critical control point in the business for the service provider. It can have a decisive role in whether end-users are satisfied with the service experience and stay with the service provider. If not, end-users may select another service provider.

The whole service lifecycle is dependent on a working service management process. All elements from service planning, creation and deployment to service activation, assurance and reporting need to be in place. In an industry with multiple vendors, technologies, services, operator processes and business models, there needs to be fresh thinking to solve interoperability and compatibility issues at all levels without compromising innovations, variety and different business logics.

It has also been realized that common Key Performance Indicators (KPIs) for services is an important issue. As networks and service environments come from different vendors, it is important that KPIs should be similar across vendors. Good work has been done in this area by the TMF Wireless Services Measurement (WSMT) team, which has defined a set of service-related KPIs. They have provided a contribution on this issue to the Third Generation Partnership Project (3GPP) SA5 working group to standardize a uniform set of service-related KPIs (KQIs).

After solving the definition and monitoring of service quality, still more needs to be done. It needs to have proper business metrics in place, which are used when setting up SLAs between the service provider and a customer. The customer, in this case, is usually a corporate (enterprise) as SLAs with individual subscribers are rare, although not impossible. SLAs with subscriber classes (as a group) are more common. Defining SLAs has been widely studied and specified by the TMF SLA/Quality of Service (QoS) Management Team, which has written a popular SLA Management Handbook.

One important aspect of service management is to take into account the evolution of handsets, networks, service environments, OSS, BSS and the services themselves. How can one ensure that end-users' service experience is not decreased when any part of the service chain is upgraded? Each year, hundreds of new handset models are brought into the market, all with new and fancy features: how can one ensure that all of these handsets can guarantee the same level of support for existing services? How can the related device management systems be kept up-to-date? How can one make sure that all handset manufacturers are using the same OTA protocols? How the industry can solve the issue of interoperability (IOP) between all the handset manufacturers, network infrastructure and device management providers? These issues will become increasingly important before a common handset software platform gets more popular. The mechanisms to resolve issues in firmware update, application management and handset diagnostics have to be the same across the businesses. Standardization is carried out in the Open Mobile Alliance (OMA) and commitment from all parties is necessary.

Without common protocols and processes, service quality, uptake and new revenue will be compromised. One option is to activate a middleware component development in OSS for service and device management. Why implement the same protocols and drivers by each vendor when they could be shared across the industry? The basic functionalities of device management do not bring competitive advantage. The key thing is what is built on top of the standard platform.

The next challenge is making sure that new network elements and service environments are backward-compatible for existing services. Services may be created and development driven by service providers' own business interests the vendors are usually unaware of. Therefore, it is very important to use proper service modelling as part of the service lifecycle process. There one gets information about what services are available, what components they consist of, and what their relationship is to network and service resources. If one knows the relationship between a network element and a service (component), one also knows what services will be affected when upgrading related resources.

Considering all these various areas and aspects in the service chain and lifecycle, a holistic approach is needed to think about the service lifecycle all the way through from planning to assurance, from handsets through networks, to service environments and content. In addition to having the service lifecycle process, managing it brings another dimension. One then manages not only the services but also the underlying network and service environments, including individual network elements and handsets.

4.4.3 Personalization and differentiation

A key competitive advantage of any service provider is the ability to provide each customer with services that optimally fulfil the individual customer's requirements. Tailored service packages are a way to differentiate a company from its competition; they are a major commercial asset in retaining and attracting subscribers. However, when the complexity of the services in general is high, and the set of potential options in the details of the service functionality is almost infinite, it is not feasible to fulfil the needs of every customer by providing separate services for every different need. This is where the need for service personalization arises.

Maintaining a wide portfolio of services is very costly. If a service provider is able to move some of the service maintenance to the end-user, considerable OPEX savings can be achieved. Also, if an end-user is able to easily control his services by himself, it may lead to better customer satisfaction, strengthening the end-user's engagement to the operator, and thus reducing churn.

Thus, there is a clear need for self-service management, meaning, for end-users, the ability to buy, activate and parameterize services by themselves. However, service providers have so far been unsuccessful in providing good enough usability in their self-service portals. Only very simple service management tasks can be performed through self-service portals easily enough for most users to accept. This considerably impedes the supply of diverse services. Self-service management can be made more successful if there are a group of end-users, a corporate, for instance, whose services are managed at the level of the corporation. Then there is an operator who is able to specialize in service management tasks, which thus may be more complex.

In addition to service-specific self-service management, end-user involvement can be improved through more generic solutions that serve many different services. A good example of this kind of approach is presence, which allows the end-user to define his "status" in relation to services and other users.

4.4.4 Service convergence

The service environment will be diverse, consisting of traditional circuit-switched services, IP multimedia services provided by the operator, and multiple services by Value-Added Service Providers (VASPs), which may be more or less controlled by the operator. In this complex environment, users need a single, easy-to-use service environment that hides the technologies behind the services. For instance, users should be able to redirect their services with one single action, without having to know about the underlying technology.

All this emphasizes the importance of the single pre-integrated network and service management system that consolidates the management of different technologies.

4.4.5 Telecom – IT convergence

In second generation networks, the telecoms and IT were separate in each operator's organization and workflows. Information-sharing was rather limited. The introduction of new services, and the tightening time-to-market requirements, are changing this. Service can be seen as a common element in both sides. Certain aspects of a service need to be perceived similarly and synchronously, both in networks and in BSS systems.

An example of this is service charging. New flexible methods are needed to charge and bill new data and multimedia services. Charging can no longer be based on simple measures such as duration only. Furthermore, online charging needs to be arranged because of pre-paid service usage and other factors. But the implementation of online charging means that complex charging methods are visible not only at BSS systems, but also at certain "service-aware" network elements. Therefore, a change in a charging scheme that used to be visible only in the operator billing system now potentially requires a number of network elements to be configured.

The conclusion is that the clear division between OSS and BSS will be blurred. For example, service management, customer relationship management and billing will need to cooperate tightly. Examples of this include self-service management, management of the end-user experience, and need for end-user driven service production instead of technology-driven production.

4.4.6 Inventory

The management of a service necessitates managing a multitude of different resources and other items in the operator's environment. This can be done only if the resources and their status are well known. Inventory systems are needed to keep track of resources and their usage. A challenge here is that typically resources are not stable, but there is an ongoing rearrangement of the network and the business environment. The target is that underlying changes do not affect the end-user's view of the service. Thus, service should be able to adapt to changes.

4.4.7 Multi-vendor environment

Traditionally, in second generation networks, each vendor provided Element Management Systems (EMS) to manage their devices. As there were few services and their relationships were relatively simple, operator focus has been on element and network management. Thus, the need for interworking between different EMSs has been limited.

Configuring the network has been done mainly through vendor-specific tools. In third-generation networks with multimedia services, this state of affairs changes. Because service management is by nature a matter of whole operator organization, it does not recognize borders between different vendors. For example, implementing a service configuration task typically means that different vendors' devices need to be configured. As the operating focus moves from element and network management to service management, these tasks need to be automated where possible.

Most EMSs today have interfaces capable of providing higher-level service assurance systems with monitoring data. A problem is that the provided information is fixed. If the monitored services are complex and dynamic, it is difficult to combine the information flows from different EMSs and have an end-to-end view of the service. As a consequence, we can see that the multi-vendor capability of OSS systems is more important than ever. Also, devices and EMSs from different vendors need to provide open interfaces with well defined and stable information data models so that the higher-level OSS systems can integrate with them. A challenge here is that the OSS world lacks proper standards. Furthermore, there is no dominant OSS vendor or other player that could set de facto standards.

4.4.8 Conclusion

Potential service portfolio will be more and more disparate and complex. The effects on service management will be even more outstanding, as there will be no more separate service management processes and systems for different kind of services, technologies or vendors.

Because of convergence, service management will require global processes and centralized systems even more than it does today.

In a complex service and network environment with multiple services, providers, technologies and vendors, it is important that the separation between services and underlying network is clearly defined.

A way to achieve this is to build services from easily modifiable components, hiding the complexity of the underlying network. Services will automatically adapt to the network changes. Although users and services are segmented, it is important that the development of all kind of services is able to optimally utilize the common service components. This can be achieved, for example, through the creation of stereotype services that are diversified with customer-specific variations.

4.5 SERVICE MANAGEMENT FOR GSM NETWORKS

GSM Network architecture was implemented so as to enable wireless voice and voice services. Certain voice services could be implemented directly on the GSM Network architecture, whereas more sophisticated services were implemented on the Intelligent Network (IN), the cornerstone for executing service logic for calls handled on the MSC (Mobile Switching Centre) or SSP (Service Switching Point).

In IN architecture the following network elements may be identified:

- Service Control Point (SCP), the controlling node communicating with the controlled node (Mobile Switching Centre) with Signalling System Seven (SS7) signalling protocols such as Transaction Capabilities Application Part (TCAP) and ISDN User Part (ISUP) message sets.
- Service Management Point – typically, a centralized repository for service and subscriber data, serving as a focal point for service deployment and data management across the network.
- Service Creation Point – typically, a development and validation environment providing a unique combination of maximum control and efficiency in the creation, customization and testing of new, highly differentiated voice services.

- Home Location Register (HLR) – where subscription data and parameters for basic and supplementary services are stored.

Examples of voice services developed with the Intelligent Network technology are:

- first- and third-party originated and terminated calls such as call forwarding and call divert;
- voice virtual private networks (VPN);
- toll-free number translation;
- prepaid voice.

Note that GSM voice services were limited, had few variations, had limited adoption throughout the life of GSM, and involved few network elements. In principle, voice services were implemented using only MSC and HLR elements or involving the IN elements. In practice, voice services almost always involved the Mobile Switching Centre and could involve the Service Control Point when more advanced service logic had to be executed. For service designers and service developers it was easy to analyse the service flow with regards to the network elements involved. However, it was complex and time-consuming to analyse the service flow within the Service Switching Point and Service Control Point. Significant complexity resides on the communication protocols between SSP and SCP, effectively adding more time and resource requirements to service development, deployment and testing. The Service Creation Point would typically provide networks with proprietary scripting or other development environments that would inhibit fast service development and testing. In practice, few voice services have been widely used by GSM subscribers; the prepaid voice service has become very popular in certain countries. Otherwise, the VPN service and toll-free numbers have been popular services offered mainly to corporate customers.

In practice, no complete service management process or tools existed in the GSM world, because services were limited, few were widely adopted and – in general – implementation complexities resided within certain network elements and were handled with local element management tools. Service management standards did not exist, and apparently mobile network operators had to handle both network elements and BSS elements to create complete solutions for handling the service management process. And of course, issues such as security, quality of service and priority were not considered service attributes that had to be centrally managed and provisioned to the network.

In addition to voice services, GSM technology (through the use of the SS7 signalling channel) allowed for the transmission of a limited number of characters, (what is known as SMS). In fact, SMS started off as an extension to voice services for accommodating signalling requirements, but it has been widely adopted by GSM subscribers worldwide. SMS was one of the first services on the GSM network to gain such wide acceptance and become a significant medium of communication not only between subscribers but also between subscribers and applications. Today, SMS is used as a medium for implementing advanced content services and application. Although today SMS services represent a significant percentage of wireless data services usage, even when GPRS networks and terminals are widely available, their service management procedures and infrastructure are limited and restricted. So far, no de facto standard solutions exist for service development, service deployment or service testing for SMS services. On many occasions, service management is carried out through element management tools directly on the Short Message Service Centre (SMSC) and Messaging Gateways responsible for dispatching the SMSs to the applications. Also, few operators can currently offer SMS access to content and application providers with service-level agreements. Thus, content providers willing to offer timely, reliable and secure services over SMS can rarely get services guarantees from mobile network operators. On most occasions, SMS access offered by mobile network operators to the content providers is slow, unreliable and suffers significant delays and losses.

All the issues described above are effectively tasks in the service management process for SMS services, so that:

- content providers' data are stored in a centralized service repository;
- relationships to content providers can be managed centrally, allowing revenue-sharing terms and SLA to be defined;
- content and application can be defined either directly by content providers or network operators as applicable;
- services can be deployed to network nodes through the element management nodes;
- finally, the service can be tested before the commercial launch.

One could argue that highly differentiated SMS services are not commercially launched because one or more of the necessary tools to handle these tasks are missing from the supporting infrastructure. Consider services such as, "Who wants to be a millionaire?" where TV viewers can use SMS short codes and numbers in order to easily and quickly answer the questions on the TV screen. Such a service would need to be launched within a short time and would require timely delivery and processing of all SMSs sent from the TV audience as well as appropriate time stamping to prove that the SMS was indeed sent within the 30 or 40 seconds after the question was presented on the TV screen. Today, such services require a significant amount of development, deployment and testing since the service management process or the tools are incomplete and the supporting infrastructure is insufficient.

4.6 SERVICE MANAGEMENT FOR GPRS AND MOBILE DATA NETWORKS

Extensions to the GSM network architecture were designed so as to allow wireless data transmission from mobile terminals to applications through the GSM Network. The GPRS architecture was designed so as to enable the mobile terminal to be assigned an IP address and transmit–receive data packets with bit rates upto 384 Kbit/s using GSM radio access infrastructure. In practice, the GPRS architecture was the first step for turning the vision of the mobile Internet into reality. In order to implement the GPRS architecture, several network elements were introduced, and modifications and additions to existing network elements were also defined. In practice, the GSM architecture grew in complexity and diversity so as to accommodate the mobile data network infrastructure's needs. Services offered through the GPRS network infrastructure also grew in diversity, complexity and requirements compared to the GSM network services. The GPRS network offers data network connectivity to mobile terminals/mobile devices. However, the GPRS connectivity service can be offered as a standalone service or be used so as to implement premium services such as multimedia messaging, email or other data applications. In fact, the GPRS connectivity service must have specific features when used so as to enable premium data services. WAP services over GPRS are an example of an application running over GPRS as well as over dial-up on the GSM network. Subscriber experience when browsing with WAP over GPRS can be significantly improved due to bandwidth capabilities. The GPRS connectivity service attributes required for accessing mobile operators' WAP portals may differ from the GPRS connectivity service attributes used for accessing the Internet.

Effectively, configuration would also be needed in WAP gateways and applications in order to enable access to operator WAP portals or other content provider/corporate portals. In addition, the GPRS service can be offered to corporates to enable secure and trusted access to a corporate data network (VPN) or can be offered to content/application providers to allow subscribers to directly access their content or data applications. In any case, subscribers, content providers or corporates anticipate different behaviour from the GPRS connectivity service in terms of security, trust, encryption, privacy, authentication and authorization, logging and bandwidth.

Apparently, in order to enable fast, reliable and easy launch of GPRS services belonging to any of the categories described above, service management processes and tools are of great use. In fact, service management for any of the GPRS services described above can be a lengthy process involving many departments within the network operator organization as well as content providers and corporates. In addition, service deployment can involve several network elements with different roles in the GPRS network architecture as well as applications servers and gateways enabling high-value data applications. Content providers may be involved in the tasks of service design, service development and testing, since part of the content and data applications are typically provided by external parties.

4.7 SERVICE MANAGEMENT FOR 3G AND MULTIMEDIA

As we move from a GPRS Network to a 3G Network and IP Multimedia Subsystem (IMS), network convergence is essential. Network complexity increases, network elements are introduced, and application servers are placed on the edge of the network so as to enable several multimedia, voice and data services. In addition, requirements such as network independence, reusability, flexibility, standards and interoperability prevail in the IMS architecture. Thus, the 3GPP standardization body has introduced SIP, Diameter and other protocols specified by the Internet Engineering Task Force (IETF) to implement the target of network convergence and interoperability. On the service development side, JAIN is a good example of an industry-wide initiative to develop a framework of Java Application Protocol Interfaces (APIs) for developing and deploying service-driven network applications and services. An example of a network IMS architecture using the JAIN standard for service development can be seen below.

Service design and service development together represent a significant part of the service management process in the IMS network architecture. A next-generation service creation environment should offer the flexibility to develop multiple service types and support multiple service elements within a single operating environment, improving asset utilization and reducing deployment and operational costs. The next-generation service execution environment should simultaneously support services requiring SS7 and IP connections.

Comparing the GSM network architecture with the IMS network architecture with regards to service design, development and deployment, the following differences and commonalities can be observed. In the GSM network, solutions typically come from a single vendor that supplies everything in one proprietary box: software, hardware and applications. Customers are locked in to their vendor: the service creation environment can be complex and difficult to use, leaving no room for innovation and often expensive to implement and maintain. On the other hand, in the IMS network using open standards for service development, solutions can come from multiple vendors at all levels who supply open standards-based products. Customers are free to choose best-in-class products to build their network: open standards can enable innovation and significantly reduce costs.

As an example of an open service creation environment, JAIN represents a set of integrated network APIs for the Java platform, providing a framework to build and integrate solutions (or "services") that span across packet (e.g. IP or Asynchronous Transfer Mode (ATM)), wireless, wireline and Public Switched Telephone Network (PSTN) networks. JAIN can enable service portability, convergence and secure access (by services residing outside the network) to such integrated networks. It is possible to create services communicating with different network elements while simultaneously using multiple message sets, providing integration into multi-vendor networks. For example, it could support Intelligent Network Application Part (INAP) or Advanced Intelligent Network (AIN) variants, Mobile Application Part (MAP) or Media Gateway Control Function (MGCF) as well as the SIP protocol for supporting IMS multimedia, voice and data services.

When considering the most critical requirements for service management in IMS networks, the following issues are of importance:

- *Service portability*: Technology and application development has traditionally been constrained by proprietary interfaces. Portability of applications has been almost non-existent. When considering the service management effort, lack of service portability could result in re-running the steps of specify and deploy as many times as there are different network elements. This would increase service development costs, time to market and maintenance requirements. Considering the steps of specifying and deploying services to the network, open standards approaches could result in portable applications, significantly reducing time to market.
- *Network convergence*: As stated above, network convergence is the key issue in the IMS network. Considering the GSM network, call or session logs for most of today's applications and services typically span only a single type of network element in a single network, although gateways to other networks could also exist. However, the service development environment should provide for services requiring to observe, initiate, answer, process and manipulate calls, where a call is understood to include a multimedia, multi-party, multi-protocol session over the underlying integrated network.
- *Secure network access*: Communication applications and services can run either inside the operator's trusted network or completely outside this network. The role of the external parties becomes more important since they not act only as providers of digital content but can host the data application or service. Application providers can use open interfaces such as Simple Object Access Protocol (SOAP) to directly access network resources carrying out specific actions or functions inside the integrated network. In practice, the service management process must enable mobile operators to manage their relationships with external parties, assign service components to external parties as well as ensure clear and common semantics so that service/service component descriptions can be easily accessed.

Furthermore, service management in GPRS and IMS networks has to fulfil requirements resulting from both technology and business challenges.

Service diversity results in subscribers willing to get involved in configuring and parameterizing the service experience. Although in the GSM network, self-service management is limited or non-existent, in the next-generation network it will be essential that subscribers can view and modify not only subscription and billing information but also important service data. Thus, when considering the overall OSS/BSS architecture, the roles of subscription management, billing systems, CRM and service management system become less clear.

Multi-access service data: When considering service data, consisting of fixed and configurable attributes as well as the service description, it is evident that in the IMS or even GPRS network several entities within or outside the mobile network operator domain need to get access to that data. In addition, due to increasing network complexity and to services spanning different network elements or even an entire network, the need for a centralized data repository is extremely important. Service management solutions would address the challenge, introducing a centralized service repository that would be synchronized with other systems to maintain parts of the information needed to build the service description. And of course, such a centralized repository should allow secure access to external parties that would be able to view all or parts of the service hierarchy according to the preconfigured relationship with the network operator. With regard to service modelling and service definition, standards such as TMF's New Generation OSS (NGOSS) would provide tools to build the common language for communicating service data among mobile operators, systems, external parties or even among Mobile Network Operator (MNO) organizations, which would need to get different views of the service repository according to their role in the organization as well as the segments of the network they manage.

Multiple network elements: In the GSM and even the GPRS network, service planning and service development would be tasks completed using in-house developed tools and processes specified within the mobile network operator organization. At the same time, service deployment would typically be handled as part of the service creation project implemented by domain experts using local element management tools. The transition from high-level requirements at the service planning stage to technical implementation at the service development stage would also be implemented as part of the service creation project. Similarly, service deployment would take as input requirements from the service planning and service development phase so as to configure network elements or even introduce new technologies. In order to handle the increasing network complexity and the significant increase in network elements involved in the service chain, service management process and tools must allow network complexity to be separated from service definition. In other words, services should be defined as consisting of parameterizable and reusable service component which effectively abstract certain network capabilities. Thus, maintaining stereotype service components that can be grouped together, parameterized and personalized so as to form premium services would be the ultimate solution to address the challenge of network complexity.

4.8 Reference

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5

Standardization Related to Service Management

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5.1 INTRODUCTION

In this chapter, we shall summarize standardization activities related to service management that have been or are ongoing in different standardization fora. In the interest of readability, we shall start with an overview of service management-related standardization organizations with respect to each other. As with service modelling, there are multiple viewpoints on services in the world of standardization, ranging from the design of high-availability systems to the development of ontologies describing relations between concepts. The basis of the future service-provisioning systems is likely to benefit from the diversity in innovation related to different approaches.

The interrelations between organizations could be (and have been) analysed from many different viewpoints. The viewpoint to be used at a given time should be selected to reflect the goal that needs to be achieved. Below, an attempt has been made to put different standardization fora into a service-oriented framework to attempt

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to show to what extent standardization organizations participate in the subject area of this book. Constructing a classification from another kind of viewpoint could yield an altogether different participation diagram.

The service-oriented framework includes three "technological" levels, namely:

- *Protocol/platforms*. This level is the basis for constructing interoperating systems that fulfil both technological and business needs. In addition to basic Internet protocols, a variety of protocols have been defined in order to create service-oriented architectures.
- *Bearers/architecture*. In certain areas such as cellular networks, the adoption of standardized architectures has made it possible to build complex and very large multi-vendor networks. Aside from the benefits to the network operators, concepts such as 3GPP bearer brings further industry-wide understanding about services.
- *Service enablers*. Since both mobile and "fixed" systems are complex, developing interoperable state-of-the art services requires further attention aside from mobile network-oriented standardization only. Individual services may require protocol profiles, data definitions and other constraints to enable interoperability functionality that meets business requirements. This is necessary in both the fixed and mobile Internet.

Some standardization fora have activities which span the different technological levels described above. Such activities have been called "process and information models" in the framework.

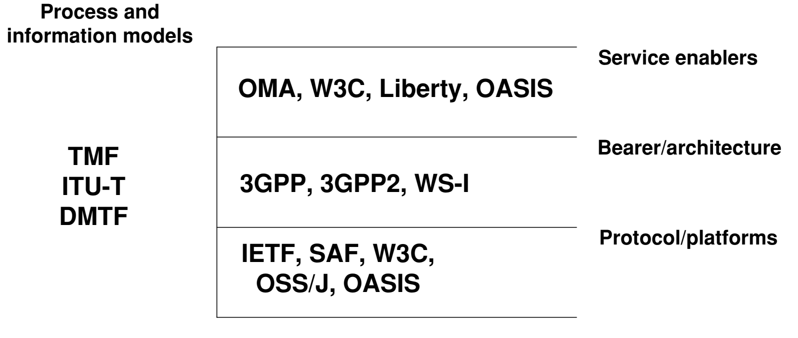

Figure 5.1 The relationships between standardization fora in the context of this chapter

Figure 5.1 shows a rough placement of the standardization organizations discussed below. Please note that standardization organizations may be located in multiple places within the diagram. Note also that the role of standardization organizations may evolve with time. For example, the Internet Engineering Task Force (IETF) has been involved in information modelling, but is now mostly involved with services protocol standardization.

For readers with no experience of standardization, it may be useful to say a few words about standardization practices. Different standardization fora have different foci. At the same time, they often attempt to reuse prior or parallel work in other organizations. Thus, earlier standards in other organizations are often referred to, and liaisons are made with "sister" working groups in other standardization organizations. Also, delegates from individual companies involved with service management typically participate in multiple related organizations of strategic importance to their company. Thus, for example, consensus on architectural design in the Third Generation Partnership Project (3GPP) may be reflected in IETF and Open Mobile Alliance (OMA).

Finally, a word about the standardization organizations selected for this chapter is in order. The scope of this book consists of packet-based services in GPRS/WCDMA-based systems, whereby an Internet-oriented viewpoint has been adopted. Consequently, for example, Parlay is not discussed in this chapter, even though it has also some activities related to packet-based services. Similarly, we are not going to discuss the Third Generation Partnership Project 2 (3GPP2) further. There is a need to limit the scope of the discussion in this book, but this does not mean that that organizations not discussed here have no role in service management.

5.2 IETF

The Internet Engineering Task Force (IETF) (www.ietf.org) (accessed May 2004) is an open international standardization organization with the mission of standardizing Internet base protocols. Anybody can participate in IETF standardization without being a member of IETF. The openness of the IETF standardization process has been a model for other standardization organizations.

Examples of IETF standardized protocols include the Internet Protocols (IPv4 and IPv6), Transmission Control Protocol (TCP), User

Datagram Protocol (UDP) and HyperText Transfer Protocol (HTTP), to name a few. The total number of Requests for Comments (RFCs) – which are either draft or approved standards in IETF – is almost 4000 at the time of writing.

With regard to services, the role of IETF at the moment is a standardization forum for Internet-related protocols. Please note that web services-related protocols are also being standardized in W3C and other fora, as will be discussed later. The IETF protocols are used as such in purely IP-based systems, or as building blocks in standardized architectures such as 3GPP and 3GPP2 systems.

IETF has standardized many management interfaces such as Simple Network Management Protocol (SNMP), Lightweight Directory Access Protocol (LDAP), Common Open Policy Service (COPS) and Management Information Bases (MIBs). IETF also has a working group for policy-based management, which has produced RFCs for the policy core information model [RFC3060] and QoS information model [RFC3644].

5.3 SERVICE AVAILABILITY FORUM

To quote the website of the Service Availability Forum (SAF) (which may be found at www.saforum.org) (accessed May 2004):

> The Service Availability™ Forum is a coalition of the world's premier communications and computing companies working together to create and promote open, standard interface specifications. The transition to packet-based, converged, multi-service networks requires a carrier-grade infrastructure based on interoperable hardware and software building blocks, management middleware and applications, implemented with standard interfaces.

The practical means to achieve the goal of the SAF include the development of framework and specifications that make it possible to develop carrier-grade systems using "off-the-shelf" components. SAF has so far developed two interfaces:

- *platform interface*: this interface is between applications and SAF; middleware;
- *application interface*: this interface is between SAF middleware and hardware.

5.4 3GPP

The Third Generation Partnership Project (3GPP) (www.3gpp.org) (accessed May 2004) is a collaboration agreement between telecommunication standardization bodies. The current list of organizational partners includes the Association of Radio Industries and Business (ARIB), China Communications Standards Association (CCSA), European Telecommunications Standardization Institute (ETSI), Alliance for Telecommunications Industry Solutions (ATIS), Telecommunications Technology Association (TTA) and Telecommunication Technology Committee (TTC).

3GPP standardizes Wideband CDMA (WCDMA), Global System for Mobile communications (GSM) and General Packet Radio System (GPRS)/Enhanced Data rates for GSM Evolution (EDGE)-based telecommunication systems. Work is also ongoing to integrate Wireless Local Area Network (WLAN) access into 3GPP systems. The 3GPP builds on the GSM/GPRS core network architecture, and has issued the following releases of complete specification sets: Release 99 (R99), Release 4 (R4) and Release 5 (R5). At the time of writing, the next 3GPP release, R6, is expected to be finalized during the second half of 2004.

The 3GPP has five Technical Specification Groups (TSG): one devoted to core networks, another to terminals, two groups to radio networks (separate groups for WCDMA-based radio access networks and GSM/EDGE-based radio access networks), and a group for services and system aspects. The last group also has a coordinating role in 3GPP. All TSGs have several working groups (WG). In TSG Services and System Aspects there are several working groups that are relevant to service management: WG1 is responsible for services and requirements, WG2 defines system architecture, WG3 deals with security aspects while WG5 creates telecom management specifications.

The basic service support capabilities of the 3GPP architecture in relation to different releases will be summarized in Chapter 6. Below, we discuss a couple of further aspects related to service management.

Generic User Profile (GUP) is a collection of user-related data, which affects the way in which an individual user experiences services and which may be accessed in a standardized manner [22.240]. The goal of the GUP work within 3GPP is to provide a conceptual description of user-related information in the 3GPP mobile system and access technologies such that these data could be created, accessed and managed in a harmonized manner by users, subscribers, network operators and Value-Added Service Providers (VASPs).

The 3GPP Core Network (CN) Workgroup 5 defines the Open Service Architecture (OSA) [22.127]. OSA defines an architecture that enables operator and third-party applications to make use of network functionality through an open, standardized interface (the OSA Interface). In this way applications become independent from the underlying network technology. The applications constitute the top level of the Open Service Architecture (OSA). This level is connected to Service Capability Servers (SCSs) via the OSA interface. The SCSs map the OSA interface onto the underlying telecommunications-specific protocols and are therefore hiding the network complexity from the applications.

The OSA work in 3GPP has been carried out in a good working relationship with the Parlay initiative.

The 3GPP TSG SA WG3 defines security architectures for 3GPP services. The main part of Release 99 and Release 4 security specifications are about access security to WCDMA- and GSM/EDGE-based systems. In Release 5, two new major areas are added: Network Domain Security (NDS) addresses security between different networks and an access technology independent security system has been designed for IP Multimedia Subsystem (IMS). The IMS is a Session Initiation Protocol (SIP) based service platform and it is the main extension of the 3GPP system in Release 5.

In Release 6 there are several security work tasks that have an impact on services and service management. There are several service enablers (e.g. presence, conferencing and messaging) that require specific security enhancements. The 3GPP also defines Generic Authentication Architecture (GAA) that builds on top of the existing General Packet Radio Service (GPRS)/UMTS security architecture (with tamper-resistant security modules on terminals as a cornerstone of the architecture). The purpose of the GAA is to make it possible to use the same mechanisms for authentication and authorization independently of the specific service. The GAA utilizes earlier work done in IETF and in OMA. The vision is that GAA can be used as a building block when systems are designed to meet the security requirements of, for example, OMA or Liberty. On the other hand, the GAA is going to be utilized for services defined in 3GPP.

One example is MBMS (Multimedia Broadcast/Multicast Service), which also requires other significant additions to the set of 3GPP security mechanisms. Indeed, even the trust model is different in the context of a service like MBMS: notably, users have a much greater incentive to deceive the system than is the case with other services. This is because exactly the same digital content is valuable to a huge number of consumers and forwarding digital content is technically easy to do.

Other major work items in Release 6 are security for WLAN interworking with 3GPP systems and authentication frameworks for network domain security. The latter defines Public Key Infrastructure (PKI) support for management of security keys used in communication between different networks.

5.5 OMA

5.5.1 History

The Open Mobile Alliance (OMA) was founded in June 2002 by nearly 200 companies. The Open Mobile Architecture initiative and Wireless Application Protocol (WAP) Forum formed the foundation for OMA. The Location Interoperability Forum (LIF), Synchronization Mark-Up Language (SyncML) Initiative, Multimedia Messaging Interoperability Process (MMS-IOP), Wireless Village, Mobile Gaming Interoperability Forum (MGIF) and Mobile Wireless Internet Forum (MWIF) integrated into OMA thereafter.

In October 2003, OMA had approximately 300 companies as members, including mobile operators, wireless vendors, information technology companies, content providers and others. The uniqueness of OMA lies in cross-industry participation from parties involved in the entire mobile services value chain. This allows for the industry to avoid isolated technologies specified by separate bodies. Instead, OMA fosters defining industry-wide requirements, a common architecture framework, open standards for enabling technologies, and end-to-end interoperability.

The goal of the Open Mobile Alliance is to promote and specify technologies for the mobile industry. The technologies are network and operating system agnostic – i.e. not dependent on their properties, promoting interoperability across various terminals, networks and operators. The wide acceptance and user adoption of mobile services is a key driver and success factor for OMA. The published specifications are available for everybody, not limited only to the members of OMA.

OMA releases open specifications of enablers (the general term for technologies specified by OMA). Each enabler specification defines and/or provides usage guidance for a particular technology by applications in a consistent and interoperable manner across the mobile industry.

OMA is organized into working groups. The following sections give a short overview of them.

Architecture

The OMA Architecture working group is responsible for the overall OMA architecture. It cooperates closely with the other technical working groups in OMA ensuring consistent and coherent specifications that adhere to the OMA overall system architecture. The main internal collaboration partner for the Architecture group within OMA is the Requirements group.

Browser & content (BAC)

The BAC working group is responsible for base content types such as XHTMLMP, ESMP, WCSS, Wireless Mark-up Language (WML), WMLScript, Synchronized Multimedia Interaction Language (SMIL), pictograms, download descriptor, Rights expression languages and others. It specifies the syntax and semantics for content types, as well as necessary interfaces for making it possible to use and render these content types in mobile handheld devices. BAC collaborates with the Architecture and Security groups within OMA. BAC liaises with external organizations, including W3C, IETF, European Computer Manufacturers' Association (ECMA) TC39, European Telecommunication Institute (ETSI), 3GPP, 3GPP2, the Recording Industry Association of America (RIAA), the International Federation of the Phonographic Industry (IFPI) and others.

Data synchronization

The Data Synchronization working group develops specifications for synchronization of data to and from mobile devices. The specifications include but are not limited to SyncML technology.

The Data Synchronization working group collaborates with other working groups in OMA, including Architecture, Requirements, Interoperability, Browsing and Content, Mobile Web Service and Device Management. The Data Synchronization work group liaises with external standards bodies and industry consortia including 3GPP, 3GPP2, IETF, Bluetooth Special Interest Group (SIG), GSM Association (GSMA), IrDA, OSGi, Java Community Process (JCP) and others.

Developers Interest Group (DIG)

DIG collects and publishes information that is relevant to developers. It also provides means for developers to communicate their needs back to OMA. DIG additionally identifies possible missing or inconsistent developer interfaces and makes recommendations to add or enhance such interfaces based on their findings.

Device Management

The Open Mobile Alliance (OMA) is standardizing the OTA protocols in the OMA Device Management workgroup. It is important to consolidate the used protocols because it is a huge cost factor for the industry if different proprietary protocols are used for each handset manufacturer. The OMA Client Provisioning (OMA CP) and OMA Device Management (OMA DM) are the protocols that will be dominantly used as OTA protocols. OMA DM also has to be configured to the handset and that takes place using OMA CP. All handsets need to have a mechanism for remote configuration settings and therefore at least OMA CP needs to be there. OMA DM is likely to be present mostly in more advanced handsets.

OMA DM enables a bi-directional information transfer between the handset and the device management server (client–server) as opposed to the other protocols where only push messages can be used. This allows the investigation of the handset configuration from the operator helpdesk. Furthermore, it is the basis for the more advanced functionality that is specified in OMA. The standardization will also cover firmware update, application management and diagnostics.

OMA CP was originally specified in the WAP Forum. OMA DM is based on SyncML.

Games Services

The Games Services working group defines interoperability specifications, application programming interfaces and protocols for network-enabled gaming. The intent is to provide significant cost reductions for game developers and service providers through enabling more efficient development and deployment of mobile games in OMA-compliant platforms and networks.

Interoperability (IOP)

The Interoperability group produces test specifications for testing the interoperability of OMA service enablers. It also maintains relevant processes, policies and test programs for ensuring the interoperability of OMA service enablers.

Location

The OMA Location working group develops specifications to ensure end-to-end interoperability of mobile location-based services. It provides mobile location service-related expertise and consultancy to other OMA working groups. It collaborates in defining the end-to-end architecture framework covering different critical aspects such as billing, security, privacy and others.

Messaging

The Messaging group is responsible for defining messaging enabler technologies along with methods by which other enablers should use messaging services. It also produces service conformance definitions for messaging services. These include dependencies on other components such as media formats, authentication methods, etc. The Messaging group liaises with external standards bodies and industry consortia including 3GPP, 3GPP2, IETF, GSMA and others.

Mobile Commerce and Charging (MCC)

The engagement between the consumer and retailer for billing, charging and payment are the fundamental components of commerce. The Mobile Commerce and Charging working group specifies a consistent interface for OMA enablers to facilitate charging for m-commerce(mobile commerce) services. It also analyses gaps in the m-commerce landscape and takes the necessary steps to ensure that these are properly addressed by initiating work in OMA, in external standards fora, or by endorsing an existing external standard when applicable. The MCC group liaises with external standards bodies and industry consortia including MPF, Mobey Forum, PayCircle, CDG, GSMA, IrDA, Liberty Alliance Project, MeT, OASIS, Parlay, ETSI, IETF and others.

Mobile Web Service (MWS)

The Mobile Web Service group develops specifications, recommendations and best practices that describe how to apply web services in OMA architecture. It addresses how to discover and access network- or client-based services and service enablers in a consistent manner by second- and third-party application developers and service providers. It is not intended to define technologies and standards that already exist, but rather to reference these wherever applicable. MWS group liaises with external standards bodies and industry consortia including OASIS, 3GPP, 3GPP2, W3C, IETF, UDDI.org, JCP, Liberty Alliance, Web Services Interoperability Forum (WS-I) and others.

Presence and Availability (PAG)

The Presence and Availability group produces specifications to permit the deployment of interoperable mobile presence and availability services. Presence and availability services enable applications to exchange dynamic information such as capabilities, status and location about resources and users. These specifications are intended to be network-agnostic so that they can be used in various network environments. The PAG MWS group has strong liaisons with external standards bodies and industry consortia including 3GPP, 3GPP2, IETF and others.

Push-to-Talk Over Cellular (PoC)

The Push-to-Talk Over Cellular working group develops specifications to enable interoperable Push-to-Talk services. The Push-to-Talk service is a half-duplex communications service that allows users of mobile handsets to engage in immediate communication with other users, similar to walkie-talkie type operation, by push of a button on their terminal. Because of the performance-critical nature of PoC services, some engagement of lower-layer network protocols is required. In order to coordinate this with other network defining groups, PoC group has strong liaisons with external standards bodies and industry consortia including 3GPP, 3GPP2, IETF and others.

Requirements (REQ)

Although the creation of requirements is generally distributed across OMA, the Requirements group is responsible for the overall coordination of requirements work. This includes collecting, consolidating and verifying consistency of requirements, prioritizing use cases specified in requirements documents and also providing requirements generated in REQ to other working groups within OMA.

Security

The Security group is responsible for specifying the operation of adequate security features, mechanisms and services by mobile clients, servers and related entities. It serves as a general source of security expertise in OMA and provides support to other working groups in identifying and solving security-related issues. The Security group maintains the following specifications: Wireless Transport Layer Security (WTLS), Wireless Profile of Transport Layer Security ("TLS Prof"), Wireless Identity Module (WIM), WMLScript Crypto Library ("Crypto API" and extensions), ECMAScript Crypto Object (ECMACR), Wireless Public Key Infrastructure (WPKI), Wireless Certificate Profile ("CertProf"), Signed Content (SCONT) and Online Certificate Status Protocol ("OCSP"). The Security group liaises with external standards bodies and industry consortia including 3GPP, European Electronic Signature Standardization Initiative (EESSI), ETSI, GSMA, IEEE, IETF, International Telecommunication Union (ITU-T), Liberty Alliance, MeT, OASIS, W3C and others.

In addition to technical working groups, there are also two administrative groups that define and provide guidance on processes used in OMA (Operations and Process group) and manage schedules of specification development and publication (Release and Planning management)

5.6 W3C, OASIS AND WS-I

These three organizations have a major influence on the creation and adoption of useful and interoperable standards, profiles and tools related to service-oriented architectures.

The World Wide Web Consortium (W3C) has the mission of "leading the Web to its full potential" by creating a trusted, decentralized network for interoperable information sharing. The W3C has created core standards essential to web services, including eXtensible Mark-up Language (XML), Simple Object Access Protocol (SOAP), Web Services Description Language (WSDL) and XML security standards.

OASIS is a consortium driving the development, convergence and adoption of e-business standards. This body develops standards related to the exchange of information appropriate to vertical industries, including efforts in eGovernment and LegalXML to give two examples, as well as core standards for interoperable business services, including UDDI for service discovery, SOAP Message Security to secure service interchanges, and SAML to enable identity-based services.

The Web Services Interoperability Organization (WS-I) is an industry effort chartered to promote web services interoperability across platforms, applications and programming languages [WSI-About]. The WS-I has created a Basic Profile for Web Services, describing how to use SOAP, WSDL and UDDI in an interoperable manner. It is also working on a Basic Security Profile that addresses interoperable SOAP message security and transport layer security for web services.

There is much commonality in the goals of these organizations as well as in the membership. In general, the W3C has the broadest mission and consequently has created a number of relevant core standards. OASIS has produced core infrastructure standards as well as standards appropriate for business verticals, complementing and extending the work of the W3C. WS-I has been profiling both W3C and OASIS standards, as well as creating tools and sample applications in order to drive the interoperability of web services.

5.6.1 W3C

The W3C (www.w3.org/) (accessed May 2004) is carrying out its mission by creating specifications, guidelines, software and tools [W3Cabout]. Specifications produced by the W3C may be treated as standards and are called "Recommendations". Other useful work is published as "W3C Notes" or as in-progress "Working Drafts" [W3CProcess]. The W3C was founded in October 1994 and currently has approximately 365 organizational members and nearly

55 full-time staff around the world who contribute to the development of W3C specifications and software.

The W3C is organized around four domains or focus areas [W3Cactivities]. The Architecture domain is concerned with enhancing the infrastructure of the web and in particular, enabling automation through the use of web services while supporting internationalization and the consistent use of global identifiers. The Technology and Society domain focuses on creating building blocks to address public policy, and includes work appropriate for business, including XML security and privacy. It also focuses on technologies necessary to create meaningful links between information suitable for automatic processing (the semantic web). The other domains are the Web Accessibility Initiative and the Interaction domain, that focus on user interface-related work such as voice browsing and multimodal interaction.

Work groups are chartered to complete specific deliverables appropriate to domains. Some activities, such as the XML Signature and XML Encryption Activities, have a 1:1 correspondence with their working groups. Others, such as the Web Services Activity, have multiple working groups, such as the XML Protocols, Web Services Description, Web Services Choreography and Semantic Web Services working groups. For example, the XML Signature working group in the XML Signature Activity has the following deliverables: XML Signature requirements, XML Signature and Syntax Processing, Exclusive Canonicalization and XML-Signature XPath Filter 2.0.

The W3C has produced numerous specifications that are at the core of web services, including:

- *Core standards*: Extensible Markup Language (XML), XML Schema, Document Object Model (DOM);
- *Web services*: Architecture Notes, SOAP, Web Service Description Language (WSDL);
- *XML security*: XML Signature, XML Encryption, XML Canonicalization, XML Key Management;
- *Infrastructure*: Resource Description Framework (RDF) and Web Ontology Language (OWL).

The W3C consists of its membership, an Advisory Committee, the W3C staff, an Advisory Board and a Technical Architecture Group.

The Intellectual Property Rights policy at the W3C is Royalty Free terms.

The core security and web services recommendations of the W3C have been implemented in a variety of toolkits, as well as being incorporated into the standards efforts of other organizations such as OASIS.

5.6.2 OASIS

To quote the OASIS web page (www.oasis-open.org/who/) (accessed May 2004):

> OASIS is a not-for-profit, international consortium that drives the development, convergence and adoption of e-business standards. Members themselves set the OASIS technical agenda, using a lightweight, open process expressly designed to promote industry consensus and unite disparate efforts. OASIS produces worldwide standards for security, Web services, conformance, business transactions, supply chain, public sector, and interoperability within and between marketplaces.
>
> OASIS was founded in 1993 under the name SGML Open as a consortium of vendors and users devoted to developing guidelines for interoperability among products that support the Standard Generalized Mark-up Language (SGML). OASIS changed its name in 1998 to reflect an expanded scope of technical work, including the eXtensible Mark-up Language (XML) and other related standards.
>
> OASIS has more than 3,000 participants representing over 600 organizations and individual members in 100 countries around the world. The Consortium hosts two of the most widely respected information portals on XML and Web services standards, Cover Pages and XML.org. OASIS Member Sections include UDDI, CGM Open, LegalXML and PKI.

OASIS standardization efforts fall into two groups, those that are independent technical committees proposed by members, and those that are associated with member sections. In this sense OASIS is very different from the W3C – members can decide what standardization is appropriate without the existence or approval of a “domain” or “activity”. This gives OASIS committees a wide scope, ranging from defining XML mark-up languages appropriate to vertical industries, to defining general security infrastructure for web services, to give examples.

OASIS member sections are a special case, since these incorporate previously independent standards organizations into the OASIS organization. For example, the PKI member section was previously the "PKI Forum".

OASIS has produced and is developing numerous specifications relevant to service-oriented architectures, including the following [OASISCommitees]:

- *Core standards*: Discovery (UDDI);
- *Web services*: Web Service Reliable Messaging, Web Services Notification, Web Services Distributed Management and others;
- *Security*: SOAP Message Security, Security Assertion Mark-up Language (SAML), Access Control (XACML), Signature services (DSS), PKI (member section) and others;
- *Infrastructure*: ebXML;
- *Industry verticals*: eGovernment, LegalXML and others.

OASIS standards such as SAML and SOAP Message Security are rapidly being integrated into vendor toolkits as well as being adopted by other standards organizations such as OMA.

5.6.3 WS-I

To quote the WS-I website (www.ws-i.org/) (accessed May 2004):

> WS-I is an open, industry organization chartered to promote web services interoperability across platforms, operating systems, and programming languages. The organization works across the industry and standards organizations to respond to customer needs by providing guidance, best practices, and resources for developing web services solutions.
>
> WS-I was formed specifically for the creation, promotion, or support of Generic Protocols for Interoperable exchange of messages between services. Generic Protocols are protocols that are independent of any specific action indicated by the message beyond actions necessary for the secure, reliable, or efficient delivery of messages; "Interoperable" means suitable

for and capable of being implemented in a neutral manner on multiple operating systems and in multiple programming languages.

WS-I focus has been to profile standards produced by the W3C and OASIS to enable interoperability, as well as to develop tools to enable parties to achieve interoperability and to provide sample applications to demonstrate best practices [WSIFAQ].

WS-I has produced and is developing numerous valuable deliverables related to web services interoperability, including the following [WSIDocumentation]:

- basic profile of web services core standards, including SOAP, WSDL and UDDI, profiling these standards for interoperability, also profiling the usage of HTTP with SOAP;
- conformance claims and extension point definitions for the Basic Profile;
- test tools to enable testing of conformance to the Basic Profile;
- a sample application to demonstrate the benefits of interoperability associated with the basic profile;
- a basic security profile to profile the use of Secure Socket Layer (SSL)/Transport Layer Security (TLS) and OASIS SOAP Message Security for interoperable web services;
- an attachment profile.

WS-I profiles such as the basic profile are being integrated into vendor toolkits and referenced by other standards organizations such as OMA.

5.7 LIBERTY ALLIANCE

5.7.1 History and organization

The widespread use of the Web for commercial purposes has led to an increasing demand for better, more privacy-friendly, more secure and robust identity management solutions. Competing technologies have been created since 1999, among them Microsoft Passport [MsPassport], part of the company's .NET initiative [MsHailstorm]. Microsoft tried to solve the problem but was heavily criticized worldwide, mostly because of end-user privacy issues.

Many companies have sought an open standard that suits their business needs better and can be contributed by anyone. As a result, these companies formally founded Liberty Alliance in September 2001 [LibHist]. Liberty Alliance published its first set of specifications, Identity Federation Framework (ID-FF) version 1.0 in July 2002. This version contained errors that represented a barrier to practical deployment [LibErrata]. ID-FF version 1.1 corrected these errors and became final in January 2003. The current set of specifications (also called Liberty Phase 2 specifications) became final in November 2003. ID-FF 1.2, Identity Web Services Framework (ID-WSF) 1.0 and Identity Service Instance Specification (ID-SIS) 1.0 contain specifications in the areas of identity management and web services.

In 2004 there were more than 150 member companies representing a broad spectrum of industries [LibMembers]:

- computer, mobile handset and other device manufacturers and software companies;
- telecom companies, Internet providers, wired and wireless phone operators;
- banks and other commercial institutes;
- multinational companies in various businesses.

There are different levels of membership, the most important one being sponsor members. Sponsor member companies have been the most active in the alliance and bear most responsibility for the development work.

5.7.2 Liberty and network identity

5.7.2.1 Mission

> "The Liberty Alliance's vision is one of a networked world in which individuals and businesses can more easily interact with one another while respecting the privacy and security of shared identity information" [LibVision].

To accomplish its vision, the alliance produces specifications that are implemented in the products of member or non-member companies.

5.7.2.2 Identity fragmentation

In many web-related services, there is a need for some kind of user management. Users need to have accounts in order to access specific services. Traditionally, this problem is solved by "creating an account" on the website of the specific service provider and quite often identifying the end-user with a username/password pair or a similar mechanism. This approach leads to a number of problems, such as work needed for registration, manageability of many username/password pairs, privacy and security issues, etc. As a result, the "identity" of the end-user will be scattered across many websites in a way that is difficult to control. This problem is often referred as identity fragmentation.

One possible solution is to provide a global centralized authentication service that provides authentication for all services around the world. This solves some issues, but raises new problems: since the central service is in a key position, all users and services have to trust that it will always act fairly and will not compromise the privacy of the users. It can also become a single point of failure in terms of availability.

5.7.2.3 Liberty concepts

The aim of Liberty Alliance was to create an architecture for decentralized authentication services that enable businesses to maintain their customer relationships without third-party authentication while providing a solution for the identity fragmentation problem.

Figure 5.2 shows the Liberty concepts. A Service Provider (SP) is an entity that provides a service for end-users that requires user authentication. An Identity Provider (IdP) is an entity that is capable of authenticating the user in some way. The Liberty architecture assumes that businesses that have existing relationships with either take the role of an SP or IdP (or both) and affiliate into a Circle of Trust, with the help of Liberty technology and mutual operational trust agreements.

Any IdP and SP can set up a mutual agreement. This means that the IdP is willing to authenticate the user for that particular SP, and that the SP accepts authentication tokens from the IdP.

The end-user may have existing, isolated accounts at some SPs and some IdPs. Once some of these providers enter into the same Circle of Trust, the user may federate his/her accounts with each

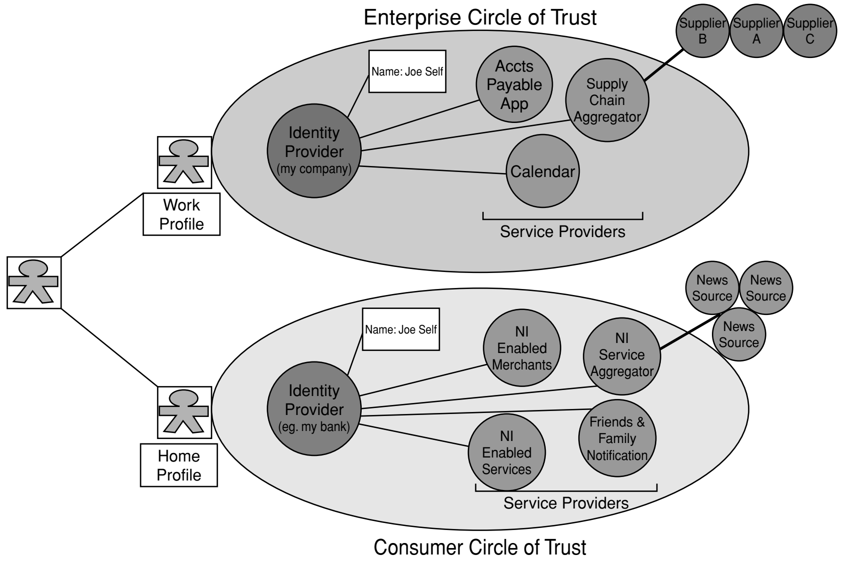

Figure 5.2 Federated network identity and Circles of Trust. Reproduced by permission of Liberty Alliance

other. This means that the local identity at the SP will be tied to the identity to the IdP. In practice, the user will not have to authenticate himself for each service. In federated accounts, SPs and IdPs can authenticate the user for each other.

In the mobile domain, one very likely candidate for the IdP role is the mobile operator of the user, since it already has an existing business relationship with the user and the technology to establish the identity of the user. Since the operator knows the identity of the user anyway, the user experience can be seamless, the user does not need to enter any information manually, only click on the 'Login' link.

From a privacy point of view, the benefit of the Liberty model is that user data is decentralized. The specifications favour identity exchange based on user consent and support pseudonymous linking.

During federation, the privacy of the end-user is respected as much as possible. The only information exchanged between the IdP and the SP is a random key to the user, they will not share any other personal information unless authorized by the end-user.

The Liberty specifications enable the IdP to interact with end-users to obtain permission to share data or collect attribute values during service usage, and allow for indication of a SP's privacy policy.

The user has to trust the IdP that it will act fairly and will not misuse personal information (this is the same as in real life, since we all have to trust our bank, mobile operator or other parties who issue certificates for us). However, a malicious SP cannot get any information about the user as long the IdP acts fairly.

The user has the freedom to chose his Identity Provider, and the Liberty specifications allow for the use of several Identity Providers.

5.7.3 The Liberty specifications in detail

5.7.3.1 Set of specifications

To achieve these ambitious goals, the Alliance has created a large set of specifications, grouped into different areas.

- At the lowest level, there are protocols that are commonly used by all higher-level specifications.
- The Federation Framework (ID-FF) contains specifications related to end-user authentication.
- The Web Services Framework (ID-WSF) specifies how different providers can communicate directly with each other and provide services that can be used by other services (commonly known as web services). It contains infrastructure-level services such as discovery, interaction and also common framework for higher-level services.
- Service Instance Specification (ID-SIS) builds on the ID-WSF framework and specifies instances of concrete higher-level services, such as personal profile service or location service.

The relationship of specifications is shown in Figure 5.3. These areas are discussed in detail in the following chapters. All referred specifications are freely available from [LibSpecs].

5.7.3.2 Architectural components

Liberty protocols use XML and SOAP protocol messages. The actual schema builds on existing XML formats such as SAML [SAML]. There are three architectural components that are reused in many places in different contexts, as shown in Figure 5.4:

- *Web Redirection*: makes it possible for entities using Liberty protocols to work with non-Liberty-enabled user agents installed today.

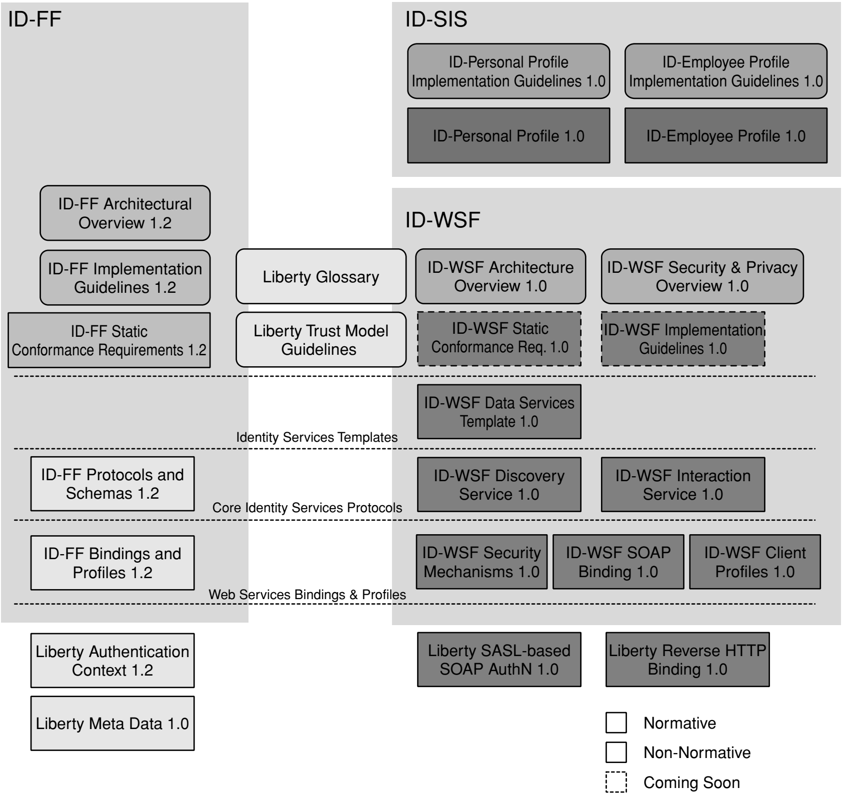

Figure 5.3 Liberty specifications. Reproduced by permission of Liberty Alliance

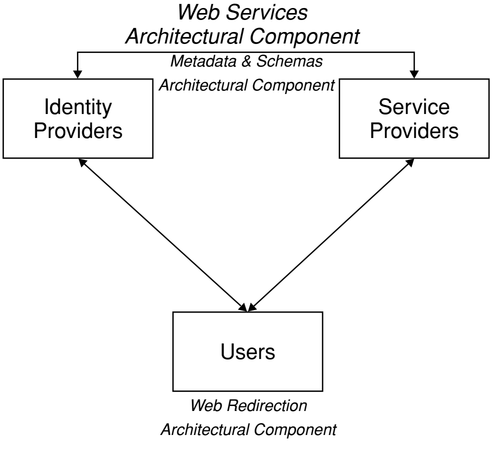

Figure 5.4 The building blocks of the Liberty architecture. Reproduced by permission of Liberty Alliance

- *Web Services*: Protocols used in direct communication between Liberty-enabled entities.
- *Metadata and Schemas*: A common set of metadata that contains standard and provider-specific information about Liberty-enabled entities.

5.7.3.3 The federation framework

The Liberty Federation Framework (ID-FF) contains specifications on the web or the mobile web, accessible directly by the end-user. The typical user agent is a desktop browser (HTML browser) or mobile web browser (i.e. WAP, XHTML or other browser) that presents hypertext directly to the user on a graphical user interface.

ID-FF specifies message exchange patterns for certain actions, called profiles in Liberty terminology. The most important ones are the Single Sign-On and Federation profiles, which describe the message exchange between IdP, SP and the user agent when the user is authenticated for a particular service.

ID-FF is designed to support legacy user agents that do not understand Liberty protocols, but Liberty-enabled user agents (LUADs) can actively influence how Single Sign-On happens, mainly by selecting the best IdP for the particular purpose. Depending on its capabilities, Single Sign-On can happen using the following profiles:

- *Liberty Artifact Profile*. This profile uses HyperText Transfer Protocol (HTTP) redirects and URL-encoded messages to transmit information between the SP and the IdP;
- *Browser POST profile*. This is similar except that it may use HTML-level (or WML, XHTML, etc.) redirects, and artifacts are passed as HTTP POST parameters to the providers in some cases;
- *Liberty-Enabled Client or Proxy (LECP) profile*. This assumes that the user agent processes Liberty protocol messages directly. The LUAD advertises this in a special HTTP header, and by indicating special Liberty content types in the HTTP Accept: header. The word “proxy” refers to the case when it is actually a proxy (typically a WAP gateway) between the user agent and the server that handles these messages, not the user agent itself.

If the user agent is a Liberty Enabled Client (LEC), then it should provide a user interface through which the user can configure his IdPs and SPs, and the rules by which the most appropriate IdP is selected for a certain SP. Liberty does not say anything about the algorithm; LEC or Liberty Enabled Proxy (LEP) providers are free to use any method.

Other profiles specify messages that either occur directly between the IdP and the SP, or the messages get to the user agent but it plays a passive role, i.e. information is transmitted using HTTP redirects or a similar mechanism, hence there is no need to treat them specially in the user agent.

Authentication is initiated by the SP at any point when the user agent contacts it. It is also possible to initiate passive authentication that will succeed only if authentication can be accomplished without any Graphical User Interface (GUI) side-effects, like asking something from the user.

The actual means of authentication – called the authentication context in Liberty terminology – is requested by the SP when it initiates the SSO sequence. Supported authentication contexts include clear text password, encrypted password, mobile subscription (contract, prepaid and other schemes), smart cards, PKI. In a successful authentication, the IdP issues an authentication assertion. This is a security token that can be verified by the SP, containing all relevant information such as what authentication context was used, possible limiting conditions for the validity of the assertion, etc. The assertion is based on SAML and contains XML signatures.

5.7.3.4 Web services framework

While ID-FF focuses on services facing the end-user, the web services framework provides specifications for machine-to-machine interfaces so that service providers can use different providers in order to provide better services for the user. The most important services are:

- ID-WSF SOAP Binding specifies how a consumer can use the ID-WSF-compliant services of a web services provider over the SOAP protocol.
- The Discovery Service (DS) is a central repository that contains "pointers" to all other services related to the individual. If john's personal attributes are stored in a personal profile service, then the discovery contains all information necessary to contact that personal profile service: URL, user id, possible authorization information, etc. The discovery service may be provided by the IdP of the user, but can be hosted by a different provider. In any case, the IdP should know the pointer to the DS so that it can point

other web services clients to the DS. This way, the IdP cannot only authenticate the user (using ID-FF), but can also be used by other services to get a pointer to the DS. This process is also called bootstrapping. Note that it is not necessary for real user authentication.

- In some cases, user John may need to give explicit permissions to control who can use his personal information or other resources. For example, a payment service may want to ask John whether he accepts a payment. Because the payment service is a web service, it does not talk directly to John, there should be a way that can be used by the payment service to contact John himself. This is provided by the Interaction Service (IS).
- The Data Services Template (DST) is not a service itself; it is a template that can be used to create data services. A data service in Liberty terminology is any service that stores some kind of attributes that can be queried or updated by other services. ID-SIS specifies two such services that build on DST: Personal Profile and Employee Profile.

Many web services are provided by network servers, i.e. they are addressable and reachable through HTTP protocol. However, ID-WSF also specifies means by which a service can be implemented on an end-user's device, for example, built into the user agent. This is made possible by reverse HTTP binding, or PAOS [LibPaos] (which is the reverse of SOAP): the SOAP request is bound to the HTTP response and vice versa. When the user agent contacts a website, the site can effectively "ask back" the user agent before providing the service. This way, addressability and other network issues can be avoided, and the user agent can act as a web services provider. Typical services implemented on a mobile terminal can include the Discovery Service, Interaction Service, etc.

While ID-FF provides a way to authenticate the end-user that is optimized for browsing, it not ideal on a machine-to-machine SOAP interface. Hence, an alternative way of authentication is provided: SASL-based SOAP authentication. In contrast to ID-FF, authentication is initiated by the web services consumer application.

5.7.4 Implementation status

There are many products that support Liberty web services protocols; the list of Liberty-enabled products can be found at [LibProds].

Now that the technology is mature enough and many companies and organizations are committed to use it, many forecast that Liberty has a good chance of becoming a mainstream technology in the next few years in the web services world. It is important to note, though, that there alternative technologies being offered by other big players such as Microsoft and IBM, and much depends on whether these technologies can find a common ground with Liberty.

Work is progressing in OASIS to converge the Liberty Federation Framework with the SAML standard in the Security Services Technical Committee (SSTC). This should reduce confusion, enhance interoperability and increase the adoption of identity-based service technology.

5.8 TMF

The following text is the official description of the goals of the TeleManagement Forum (TMF, TM Forum; www.tinforum.org) (accessed May 2004):

> TeleManagement Forum is an international consortium of communications service providers and their suppliers. Its mission is to help service providers and network operators automate their business processes in a cost- and time-effective way. Specifically, the work of the TM Forum includes:
>
> - Establishing operational guidance on the shape of business processes.
> - Agreeing on information that needs to flow from one process activity to another.
> - Identifying a realistic systems environment to support the interconnection of operational support systems.
> - Enabling the development of a market and real products for integrating and automating telecom operations processes.
>
> The members of TM Forum include service providers, network operators and suppliers of equipment and software to the communications industry. With that combination of buyers and suppliers of operational support systems, TM Forum is able to achieve results in a pragmatic way that leads to product offerings (from member companies) as well as paper specifications.

TMF's intent is to collect together industry knowledge so that it can be combined with corporation-specific knowledge. This work is currently being carried out within the New Generation OSS (NGOSS) framework, of which more later.

As of 2004, there were over 300 member companies in TMF. The members represent all business areas of the OSS and BSS industry, including:

- network operators and service providers;
- network infrastructure manufacturers;
- independent software vendors;
- system integrators;
- industry analysts and consultants.

TMF has previously undertaken many projects that have been perceived as important for the industry, some of which are listed below.

- *Telecom Operations Map (TOM)*: description and classification of processes relevant to TMF scope.
- *Service Level Agreement (SLA) management*: The Service Level Agreement and Quality of Service team produced a SLA Management Handbook, which gives practical recommendations how to establish an SLA between the customer and service provider. It defines the service lifecycle and the SLA parameter framework to support it. Work on future versions of the SLA management handbook is ongoing. New additions are expected to focus on SLAs for services over IP and how SLAs and reporting could be handled in case of multiple relationships. The SLA management and WSMT teams have joined to continue the work.
- *The Wireless Service Measurement Team (WSMT)* has looked at how to provide a mechanism to capture the end-user perception of the quality of service. Key Performance Indicators (KPIs), which have traditionally been used, are too network-oriented to satisfy requirements in service-level monitoring and management. The team developed a hierarchy where the relationship between services and service elements was visible with related KPIs. Aggregating KPLs led to the concept of Key Quality Indicators (KQIs), which can be used as part of SLAs. This is essential when implementing customer or end-user experience management. The team also made a successful contribution to 3GPP on preferred GPRS and 3G metrics (3GPP32.403).

Recently, the integration of network management with Business Support Systems (BSS) has been identified as an area of growing importance. The main drivers here are economical and temporal pressures on streamlining system integration work in launching new services. TMF has undertaken an umbrella activity called Next Generation Operations and Support Systems (NGOSS) to address this integration. Some of the activities making up the NGOSS project include:

- architectural framework;
- eTOM: enhanced telecom operations map. eTOM is targeted for both intra-enterprise use and as a basis for inter-provider process integration. Figure 5.5 shows an example eTOM view [GB921];
- NGOSS lifecycle. This activity seeks to ensure that different phases of the service lifecycle (business, system, implementation and deployment) are aligned and that traceability between different phases is implemented (Figure 5.6);
- SID: Shared Information/Data model targeting to serve the NGOSS framework information modelling needs falling within the scope of eTOM use cases [GB922]. The SID is meant to be the *lingua franca* of the NGOSS process. SID builds and improves on work done previously within Directory Enabled Networking (DEN), and contributes to DEN in the form of DEN-ng.
- SFT: the Service Framework Team studies service provision in terms of the roles involved in the service lifecycle, as well as information exchanged between the roles. In addition to role-related analysis, the team deliverable [GB924] discusses the use of components for service management.

The SFT also studies the reuse of service configurations using the conceptual model shown in Figure 5.7. The SFT work, as well as that of other teams, helps in identifying focus areas for the rest of the NGOSS work, the entire area covered being rather large. As an illustration of this, the current version of the SID model includes base concepts as well as more detailed models for a few selected use cases. The total page count of the system view of SID [GB922] with all appendices runs to over 1600 pages at the time of writing.

NGOSS work is still in progress, but already it is providing direction for the industry. The ITU-T has recently announced that it will embrace the eTOM framework.

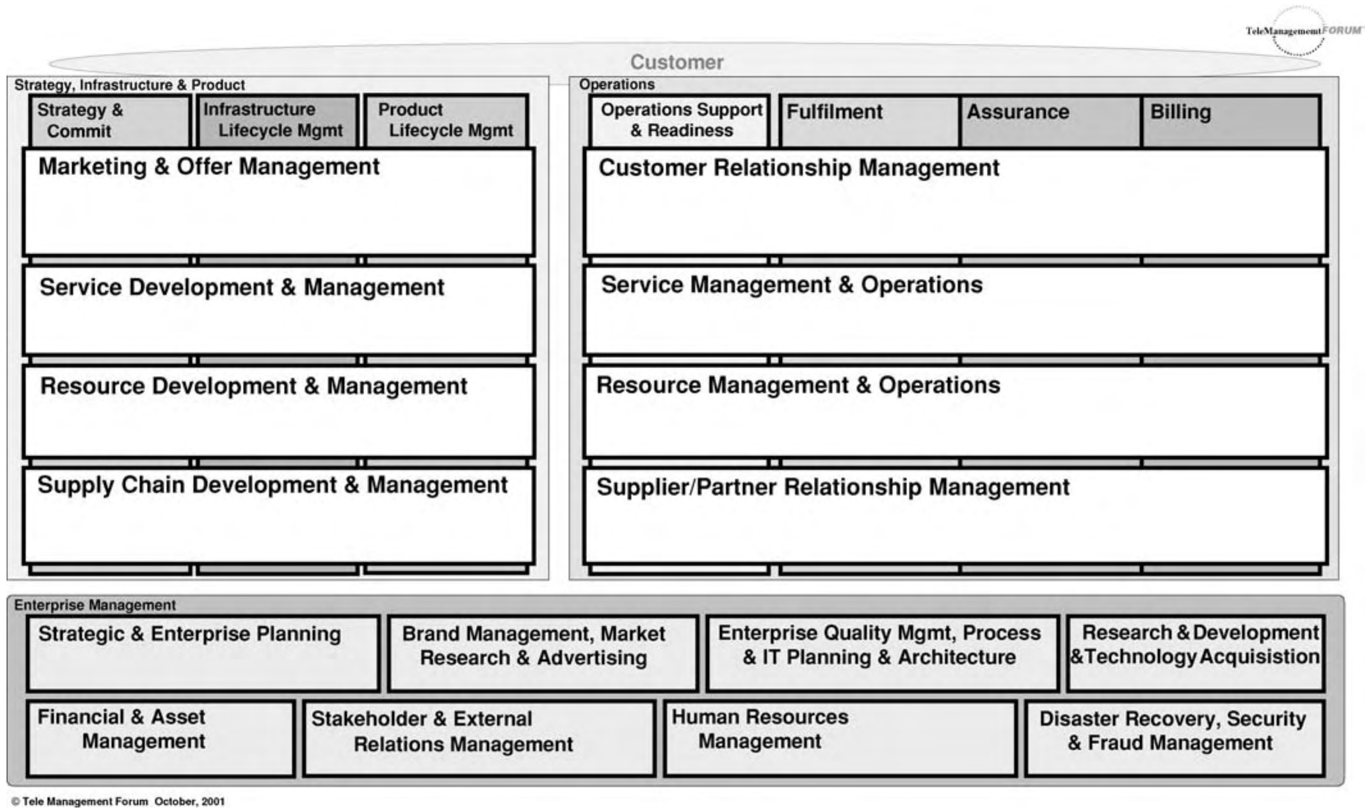

Figure 5.5 A level 1 view of eTom Processes (GB921). Reproduced by permission of TeleManagement Forum

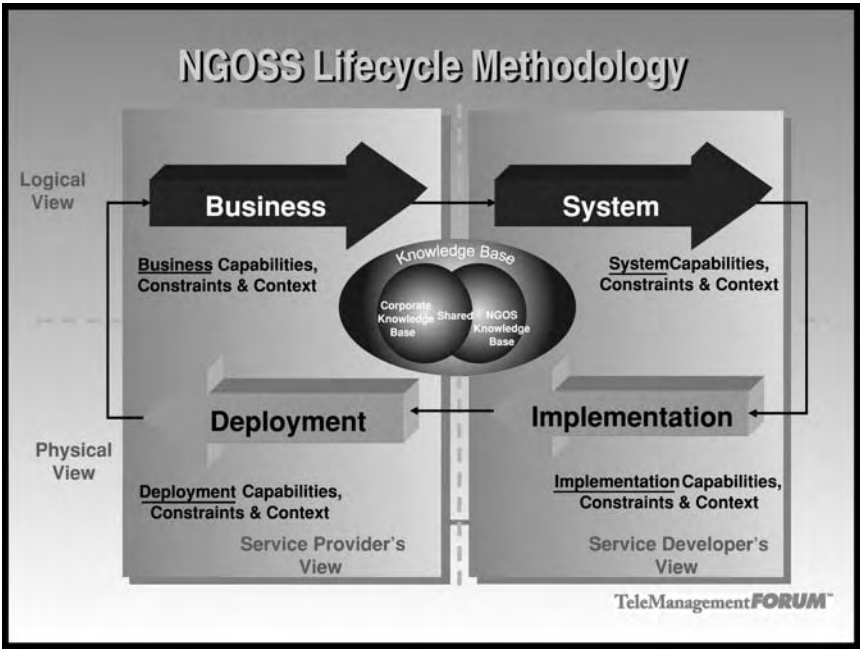

Figure 5.6 An illustration of the NGOSS lifecycle (GB927). Reproduced by permission of TeleManagement Forum

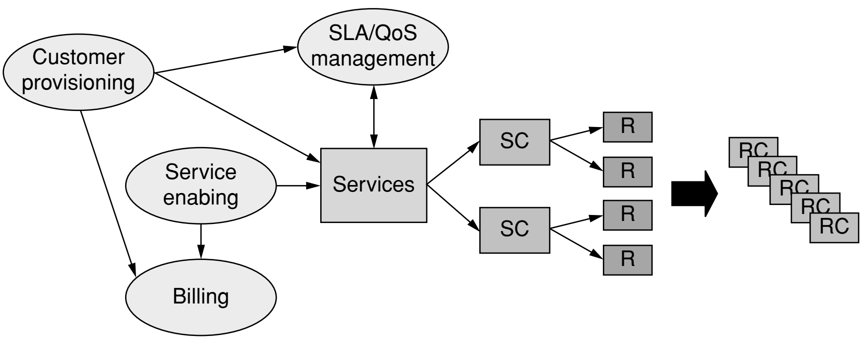

Figure 5.7 Abstract model for service decomposition (GB924). Reproduced by permission of TeleManagement Forum

5.9 DMTF

The two standardization fora discussed next relate to Policy-Based Management (PBM) of networks. With limited space available, we cannot fully cover this topic here. Interested reades are invited to study [Kos01] and [Str04], for example. The two books also include examples of how PBM could be used in management of IP-based systems. Further examples relating to potential application to multi-service traffic engineering systems can be found in [Rai03].

The Distributed Management Task Force (DMTF; www.dmft.org) (accessed May 2004) is an industry organization for the development, adoption and interoperability of management standards in Internet and enterprise environments. The DMTF has developed the Common Information Model (CIM) for the purpose of exchanging management information in a platform-independent and technology-neutral way. Other developments include Web-Based Enterprise management (WBEM), targeting the use of Internet technologies. CIM has been perceived as being too abstract to be practical [Str04], even though Quality of Services (QoS) was used as a representative application.

The Directory Enabled Networking (DEN) initiative was conceived to provide "building blocks" for management by mapping CIM concepts to directories and integrating this information with WBEM elements. In line with the use of CIM, the target has been providing generic policy-based management systems. Specifically, Lightweight Directory Access Protocol (LDAP) mappings for information models were produced by DEN. [Str04] mentions the need to use keys as a shortcoming of CIM. Kosiur [Kos01] points out that despite the name of the forum, the scope of DEN is not limited to information integration via directories.

The application of NGOSS concepts to DEN is sometimes called DEN-ng (new generation DEN). Unlike DEN, DEN-ng does not require keys to be used, but rather specifies managed objects and their relationships.

5.10 OSS/J

The OSS/J (OSS through Java) (See http://java.sun.com/products/oss/ and www.jcp.org/en/jsr/tech?listBy=3&listByType=tech) (accessed May 2004) initiative was established at the end of 2000 by some of the leading OSS and BSS vendors in the industry: Sun Microsystems, Inc., Cisco Systems, Inc., Ericsson, Motorola, NEC, Nokia, Nortel Networks and Telcordia Technologies, Inc. The objective of the forum is to define and implement Application Interfaces (APIs) through collaborative engineering following the Java Community Process (JCP) based on Java technology for Operations Support Systems (OSS) and Business Support Systems (BSS). This is demonstrated in multi-vendor exhibitions at industry events. The target is to promote working and industry-accepted technologies for OSS development, in this case the Java 2 Platform, Enterprise Edition (J2EE). The numbers of members in this initiative increases constantly. At the time of writing, there were 25 companies as members.

The benefit of the OSS/J is that it discovers concrete ways of how to build the evolution in terms of architectural changes from closed legacy OSS systems to open and standardized OSS systems integration. This target architecture will reduce overall integration costs and enable a larger and richer variety of application offering. It will at the same time offer a means to gradually discontinue legacy technology. The OSS/J APIs are written for J2EE environment, which is becoming widely adopted, enabling more vibrant and vitalized third-party application development for the OSS industry. The APIs published so far focus more on the service management level, which is the focus point in the OSS industry. By leveraging mainstream technology, pragmatic standards and proven practices, OSS/J APIs save time and money by supplying reference implementations for how to successfully build interworking APIs between systems.

The APIs implemented so far include:

- OSS Trouble Ticket API;
- OSS Service Activation API;
- OSS Common API;
- OSS IP Billing API;
- OSS Quality of Service API;
- OSS Inventory API;
- OSS Service Quality Management API.

OSS/J and TMF work complement each other. OSS/J APIs can be considered to be one technology-specific reference implementation of NGOSS. OSS/J APIs are practical implementations of SID and future work intends to cover all areas of eTOM. OSS/J can be considered a major concrete and practical enforcement of making NGOSS live. These practical realizations of NGOSS have been successfully displayed and presented at TMF conferencs and exhibitions. The OSS/J works closely with associated industry fora; collaboration activities have been established with 3GPP, 3GPP2, IETF, TMF and MWIF.

5.11 CONCLUSION

Different standardization organizations have different goals and view the concept of "service" from different angles. For the Service Availability Forum, service relates to high availability of platforms; 3GPP considers GPRS and UMTS connectivity as a service; TMF considers services from the viewpoint of processes and information models; and OASIS from the viewpoint of web services, to name a few examples. To provide flexible and reliable services, different viewpoints are needed. Nevertheless, it is the viewpoint of the very process related to service management in the context of participating organizations and their interactions that has been largely missing, and has recently received deserved attention. A second important area is the organization of service management information in such a way that it is amenable to concepts of components, reuse and usability to different roles, and also suitable for service management processes.

The academic world has identified important issues and solutions to the above during recent years. The importance of common concepts, common language and flexible service provisioning schemes, which allow for reusing of service configurations, have emerged as concepts which are widely considered to be valid. Also, paying attention to processes and workflows, and the way that different service management roles participate in them have been identified as important.

Much of this has been adopted in the work on web services being developed at the W3C, OASIS and WS-I, and being referenced in mobile web services work at OMA. Liberty's work is being converged with work at OASIS as well as being considered within OMA. A general trend is the interaction of various standards organizations to reuse work and converge technology standards.

Additional work is being done in various telecommunications standards bodies to address the challenge of service-level agreements, operations systems and support systems. These efforts are critical to enable the business models discussed in other chapters, for example to enable consolidated billing and dynamic service provisioning.

Additional research is progressing to enable dynamic service creation, assembly of value chains composed dynamically of services, and the mechanisms needed to share meaning across domains. Increasingly advanced services bring new challenges with them, and new paradigms need to be developed to answer these challenges. Security and privacy are prime examples of this, and the standards work discussed in this chapter shows how standards organizations are working to define interoperable standards to address these challenges.

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6

Requirements and Characteristics of IP Services

Margareta Björksten, Gábor Marton, Zoltán Németh, Valtteri Niemi and Vilho Räisänen

6.1 INTRODUCTION

In this chapter, the technical requirements and characteristics of Internet Protocol (IP)-based services are discussed in a generic context. An understanding of services from a technical viewpoint is central to making adequate service models. This chapter builds on the discussion of services in a business setting in Chapters 1 and 2 and takes into account related standardization efforts discussed in Chapter 5. This chapter approaches requirements from the viewpoint of services, whereas Chapter 7, for example, will discuss requirements from the service management viewpoint.

Internet Protocol (IP) is an important enabler for bringing greater flexibility to accessing services. Summarized in an Internet Engineering Task Force (IETF) plenary speech a few years ago, the basic philosophy of IP is "everything over IP, IP over everything".

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That is to say, IP acts as a convergence layer for services, and interfaces to multiple lower-layer technologies, including Ethernet, IEEE 802.11 Wireless LAN (WLAN), Point-to-Point Protocol (PPP), General Packet Radio Service (GPRS) and Wideband Code Division Multiple Access (WCDMA) bearers.

Compared with circuit-switched connections, IP brings certain new challenges with it. Different from the traditional telecommunications mindset, the basic Internet Protocol suite does not attempt to solve all aspects of connections. Circuit-switched connections, such as digital fixed line telephony calls or GSM data calls, are set up by reserving capacity (radio interface time slots on a particular frequency) in the network. Voice samples are then transmitted via this channel. The Internet Protocol, on the other hand, has been devised to enable packet switching. In this mode, each data unit (IP packet) can in principle be routed independently of others. This means that IP routers need to select routes for packets separately for each packet, and that endpoints must be able to rearrange packets that have arrived out of order at the receiving end. Further, there is no concept of reserved capacity for connections in basic Internet Protocol, whereby mere IP does not guarantee reliable delivery of packets. Some consequences of these facts are that each packet must carry addressing and sequence number information, and that end-to-end delivery of individual packets is, in principle, independent.

From a technical perspective, services currently used in the Internet are predominantly based on the so-called best-effort delivery paradigm, meaning that services can assume little support from the network for guaranteeing small end-to-end latency and packet loss. This situation is mostly due to history: originally networks based on IP were perceived as best suited for delivery of data. The protocols developed for data transfer, such as Transmission Control Protocol (TCP), are based on assumption of a non-reliable link and network layers, to use the seven-layer International Standardization Organization/Open Systems Interconnection (ISO/OSI) protocol model as a framework. Since then, the situation has changed: the development of networking technologies such as Differentiated Services (DiffServ) [DiffServ] and Multi-Protocol Label Switching (MPLS) [MPLS] are building blocks for using IP networks for delivery of demanding traffic types. An example of this is the use of IP networks as Voice over IP (VoIP) trunk lines for long-distance conventional telephony. Such transport of connection-switched traffic over packet technology is already part of the Third Generation Partnership Project (3GPP) Release 4 (R4) systems. Bringing genuine multi-service capability, i.e. the ability to transport any packet-based content in an IP-based network, into access networks is more challenging, however [TR04]. Purely IP-based access networks are technically feasible, but would require architectural standardization in order to be commercially attractive for manufacturers and operators. Such standardization is not yet in place, and subsequently wide-scale support for IP-based service quality in access networks is missing at the moment.

Certain types of real-time services are already possible in the Internet, as testified by streamed services. In Internet streaming, the terminal (PC) compensates for the varying service quality support capabilities of the Internet by buffering and/or retransmissions. Introduction of true multi-service support suitable for delay-critical traffic into access networks is more challenging, and it is expected that the first wide-scale deployments of this type will be cellular networks, such as 3GPP WCMDA or GPRS ones [Rai03]. As will discussed later in this chapter, other link-layer access technologies are developing in terms of multi-service support: for example, at the time of writing, IEEE is in the process of standardizing more advanced WLAN link-layer service quality support mechanisms apart from 802.1Q-style prioritization, called 802.11e and 802.11h. In effect, 802.1Q has the ability to assign a priority level to 802.1 frames and can utilize this in scheduling of frames.

New forms of communication are emerging both in the Internet arena and mobile networks: Session Initiation Protocol (SIP)-based services promise not only to implement current Intelligent Networks (IN) services such as call forwarding more easily, but also act as an enabler of new ones such as forwarding incoming connections to a terminal of your choice. Presence information can be used in new collaboration forms such as text chat, group chat, online multi-player games, and Push-To-Talk (PTT). Terminal context information is viewed as a building block for advanced services; already Location-Based Services (LBS) can be used for locating the nearest restaurant or a city map.

It is also desirable to be able to reach the same service via different access technologies. Generally, customers are not really interested in the technologies as such, but expect to be able to access services without having to worry about details such as having to memorize technology-specific parameters and procedures. An example of this is using a Virtual Private Network (VPN) connection to a corporate email system via the fastest access technology available: LAN at the office, GPRS or WCDMA on a moving train, 802.11b WLAN at an airport lounge. In the near future, however, service quality support will vary across access technologies, meaning that the most demanding services with full mobility support will be available primarily in cellular access networks.

Mobile network standards are developing to keep up with – and sometimes better – the pace at which new services are being conceived. In addition to the advanced multi-service capabilities of Radio Access Networks (RANs) such as WCDMA-based Universal Terrestrial Radio Access Network (UTRAN), more direct service enabler developments are afoot. SIP support for mobile networks is being standardized in 3GPP Release 5 networks in the form of IP Multimedia Subsystems (IMS), allowing coupling of Session Initiation Protocol (SIP) sessions with 3GPP bearers. PTT standardization is ongoing in 3GPP and the Open Mobile Alliance (OMA). Inter-working between 3GPP core networks and WLAN access domains is being analysed in (3GPP) Release 6 (R6).

New kinds of services also set new kinds of challenges for modelling and management of services. For example, privacy and security issues have grown rapidly in importance, not least due to the need to balance the rights of individuals and combating organized crime. Privacy regulation is developing rapidly in many countries. Security and privacy issues are also setting new requirements for standardization work. Indeed, security issues are being extensively studied within the (IETF), OASIS, Web Services Interoperability organization (WS-I), OMA, and 3GPP, and privacy issues are being looked at in Liberty Alliance, OASIS and OMA.

First, however, let us develop a conceptual framework for the purposes of analysing requirements of different kinds of services and accommodating essential features relating to management of the services. The framework must be sufficiently expressive to cover different views on services, including those of end-users, service providers and network operators. It is assumed here that there can be multiple variants of a single service existing for different user segments and/or different access technologies. In what follows, the framework consists of four levels: aggregate service, service variant, service event type and service event. These concepts are illustrated in Figure 6.1, and will be described below and illustrated with an example.

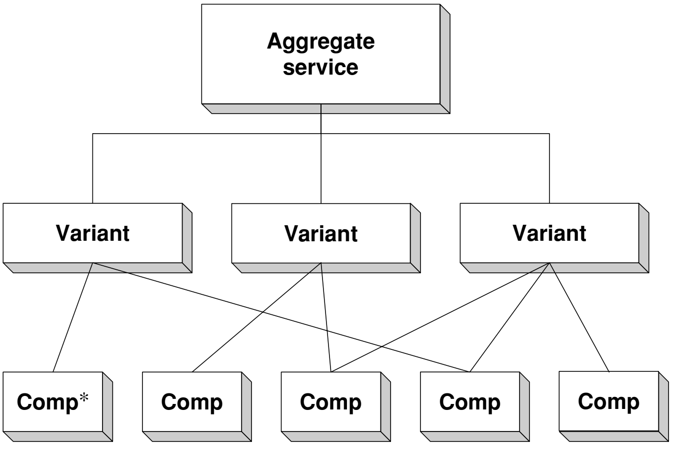

Figure 6.1 An illustration of a conceptual framework
*Comp. Signifies components that are used for implementing service events

The aggregate service level contains information that relates to the entire service and is common to all variants of the service. Examples of information within this category include:

- authentication of the users needed/not needed;
- Service-Level Agreements (SLAs) between operators and providers;
- information about the providers of service components;
- targeted user segments, terminal types, revenue targets and target usage;
- existing variants of the service;
- service-wide defaults (policies).

The service variant level contains information about a particular variant of a service. Different variants of aggregate service can be instantiated based on, for example, the following information:

- user agreement/subscription type;
- access technology;
- terminal capabilities.

An example of the "variant space" spanned by these three variables is illustrated in Figure 6.2. In this example, there are two kinds of end-user classes, business users and basic ones. There are three access technologies: WCDMA, GPRS and WLAN. Three types of

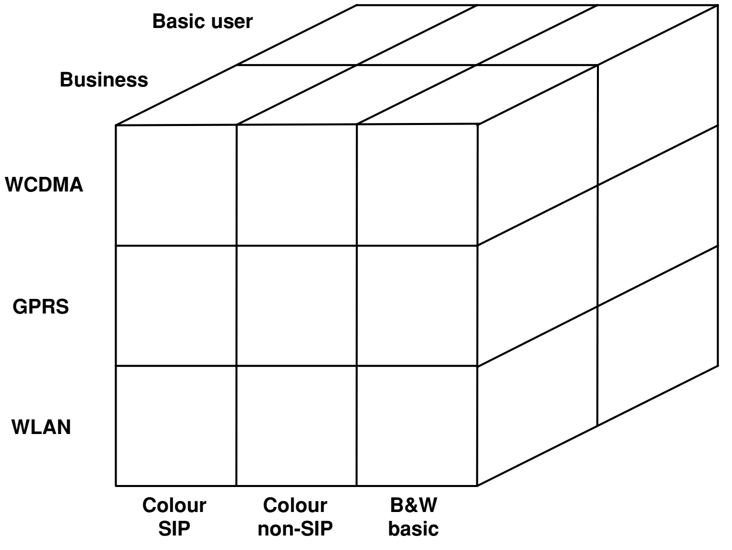

Figure 6.2 An example illustration of possible service variants

terminals are targeted: SIP-capable terminals with colour displays, non-SIP capable phones with colour displays, and black and white terminals.

Information belonging to a particular service variant can be the following:

- authentication method;
- allowed user or subscriber groups;
- allowed access technologies;
- geographical area of applicability;
- handover between access technologies may or may not be allowed. This is relevant for multi-access services;
- terminal capabilities (when known). This allows for terminal type specific service variants;
- service event types belonging to the service instance.

The service event type level defines the types of flows belonging to a particular class of service event. The information may depend on the service event type in question, but typical information belonging to this scope may include:

- charging mode applied to service event class, such as volume-based, time-based, hit-based or flat rate;
- tariff (may also be dynamic);

- server related to service event (e.g., Proxy Call State Control Function (P-CSCF) or Hypertext Transfer Protocol (HTTP) server);
- policy class (e.g. service quality, charging) and policy source (e.g. Policy Decision Function (PDF), static policy).

The service event level contains possible information about individual service events. The events can be considered to be instances of the service event type abstraction. Examples of information relating to service events include:

- allowed IP ranges (may be IPv4 or IPv6);
- allowed ports.

Such information could be used, for example, for identifying and policy control of individual (VoIP) media flows.

In addition to the above abstraction levels, it is useful to split service components into two categories. While these do not necessarily cover all possible services, they represent the most important varieties. We shall augment this list later in this chapter.

- content component: end-user accesses content on a server;
- connectivity component: end-user obtains connectivity to another end-user.

The two types of service are illustrated in Figure 6.3.

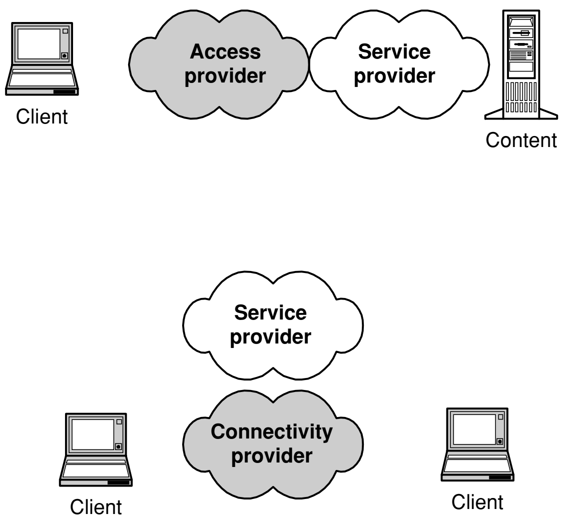

Figure 6.3 An illustration of content type component (top) and connectivity type component (bottom) (from (Rai03).)

Next, we shall first quickly summarize capabilities of mobile networking technologies, followed by a discussion on the requirements and characteristics of IP-based services. The “requirements” part describes what the services demand of the network in order to be used successfully. The “characteristics” part describes what the services look like, for example in terms of usage patterns.

6.2 CRASH COURSE IN MOBILE NETWORK TECHNOLOGIES

General Packet Radio Service (GPRS) access was originally mostly designed as a wireless extension to the Internet of the time, providing best-effort connectivity to the Internet from the viewpoint of an individual user. The GPRS Release 97/98 (R97/98), the original version, supported simple means of prioritizing traffic from different users with respect to each other, but throughput depended both on radio channel conditions and the number of concurrent users within a sector (i.e., the area served by a particular Transmitter/Receiver unit, TRX).

The Release 99 (R99) version of the GPRS standard is still based on the same GSM coding radio interface, but the user data prioritization mechanisms are more clearly defined than in R97/98. Service quality for a particular service usage session is determined by associating it with a bearer, associated with a Packet Data Protocol (PDP) context between the terminal and GPRS Gateway Support Node (GGSN). The parameters of the PDP context define how precisely service quality can be controlled, and which level of service quality is associated with the session. The service quality level is characterized with parameters such as bit rates, end-to-end packet delay values and packet loss rates [KP01]. Only terminal-activated PDP contexts are allowed at the moment. The terminal may request a particular level of service quality in requesting PDP context to be opened, or allow the network to define the parameters. Each service is accessed via an Access Point Name (APN) in the GGSN, and the maximum service quality level is defined per subscriber and APN in the Home Location Register (HLR) of a GPRS domain.

The next evolution step in the evolution of GPRS is the use of Enhanced Data Rates for GSM Access (EDGE)-capable TRXs, enhanced radio coding schemes increasing the maximum throughput of an individual user up to 384 kbit/s [Jam03]. Finally, the GERAN variant of the GPRS architecture brings support for real-time packet traffic types, including IP streaming and IP conversational traffic class.

The third-generation network of 3GPP (Universal Mobile Telephony System, UMTS) builds on GPRS core network architecture, but makes significant improvements to the radio network (Universal Terrestrial Radio Access Network) from the viewpoint of multi-service support. The use of WCDMA as the basis for radio access makes it possible to use soft handovers between base stations, making inter-Node B handovers for delay jitter sensitive real-time traffic types easier. The Radio Access Bearer (RAB) architecture of UTRAN makes it possible to provider multi-service support between Node B and terminal (known as User Equipment, UE), while achieving high spectral efficiency. From the viewpoint of end-users, UMTS architecture and UTRAN make it possible to engineer the performance of individual services. Maximum throughput achievable with UTRAN for a single user is 2 Mbit/s, but most likely throughput per user in operational networks will be lower, of the order of a few hundreds of kbits/s. 3GPP has also defined GSM/EDGE Radio Access Network (GERAN) as an alternative radio interface to UTRAN for an UMTS core network. The IP Multimedia System (IMS) architecture of 3GPP (R5) brings with it the capability of linking PDP context service quality levels automatically to (SIP) call parameters. This architecture makes it possible to ensure that expensive radio network resources are used efficiently, while providing ways of hiding technical complexity from the end-user. Release 6 developments will be discussed in Chapter 8.

Wireless LANs (WLANs) based on the IEEE 802.11 standard do not have standardized service quality support architecture at the moment in the same way as GPRS and WCDMA networks have. IEEE has defined some service quality support mechanisms for the 802 family of LAN protocols, including:

- 802.1Q: three priority bits for 802 frames;
- 802.1D: bridging between different 802 LAN technologies;
- 802.11e: use of priority bits in 802.11 access.

The 802.11 standard defines two modes, Distributed Coordination Function (DCF) and Point Coordination Function (PCF). The former means that terminals compete for access to wireless channel, whereas in the latter, the wireless Access Point (AP) schedules transmissions of terminals. The latter mode is not widely supported. LAN subnet-specific admission control architecture can be implemented using, for example, the Subnet Bandwidth Manager (SBM) scheme [RFC2815], an implementation of the Integrated Services (IntServ) architecture [RFC1633] of IETF for LANs. IEEE has defined a standard for mobility between access points, but support for mobility between access routers requires another protocol, such as Mobile IP. In the same vein, end-to-end service quality support architecture would need other building blocks apart from 802.1 technologies and SBM. The IETF has many standards that could serve as building blocks; analogously to the 3GPP R5 SIP inter-working described above, an IETF specification exists for correlating SIP sessions to available service quality support in the network [RFC3312]. The basic problem is that there is no standard end-to-end service quality support architecture for WLAN in IETF.

Summarizing the above information, the 3GPP architecture has both advanced architectural service quality support means, and a service quality support model at the correct level of abstraction. For other technologies such as 802.11 and other LAN technologies, there is currently no comparable architectural support for service quality. This means that end-user experience for advanced services such as multimedia streaming and multimedia conferencing cannot be engineered with the same degree of accuracy as for UMTS. Typically, the service quality would depend on the number of concurrent users of the same service. Thus, a service model targeting multi-access environment in future systems needs to be able to account for not only differences in bandwidth, but also in service quality support capabilities.

Ongoing standardization efforts in 3GPP Release 6 target integration of WLAN access into 3GPP core network as one access technology [AHP03]. In this case, the access zones may be operated by other parties than the core network. Also the use of Mobile IP in cellular systems has been analysed using example scenarios (see [FLP04]).

6.3 REQUIREMENTS OF SERVICES

Next we shall analyse the requirements of IP-based services. In the interests of clarity, this is done using two example services: a simple content service, and a composite one, called “augmented VoIP”. The findings of the examples are generalized after the example. All technical details given below are by way of an example only, but are nevertheless real-life examples of typical protocols involved.

6.3.1 Service class 1: content service

The first example is a content service, which is accessed via a mobile endpoint such as a GPRS/WCDMA handset. We are assuming a cellular endpoint since discussion about service quality and security is more clear-cut within 3GPP R99+ framework. The mobile endpoint uses the Public Land Mobile Network (PLMN) of a cellular operator for connecting to services. Charging is performed at an "Intelligent network edge" element. Provided that GPRS/WCDMA roaming agreements are in place, services can be accessed either from the home PLMN or from a visited PLMN. The overall set-up is illustrated in Figure 6.4, and there will be more discussion about this kind of set-up in Chapter 8.

It is assumed that there are different kinds of content available, including the following:

- city maps;
- timetables;
- streamed content (e.g. news footage or entertainment).

A single end-user service, for example tourism pages for a city, can have all kinds of content in it, including maps, timetables and videos.

City maps and timetables are assumed to be either in HTTP or Wireless Mark-up Language (WML) format. Real-time content such as audio or video is streamed using Real-Time Protocol (RTP) and Real-Time Control Protocol (RTCP) for delivery of the actual content, with Real-Time Streaming Protocol (RTSP) for streaming controls such as "play", "pause" and "stop".

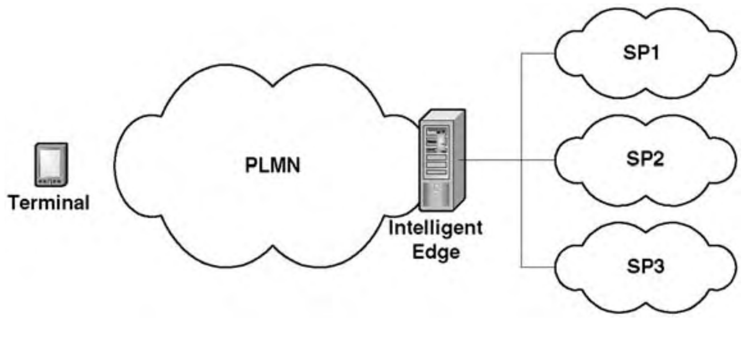

Figure 6.4 Content service overview

The content is assumed to be hosted by a service provider, either being a part of the mobile operator group, or an external provider. It is assumed that charging is performed by the PLMN operator in the latter case. The charging models for both HTML/WML format and streamed content are assumed to be based on one of the following schemes:

- charging based on number of times content is accessed;
- cost depends on the duration of content access events;
- access to content within a given period of time carries a certain cost;
- access is flat rate (including free access).

Different schemes from the above list may apply to different parts of the provider content. The scheme may also depend on the end-user class. Access charging (bearer charging in 3GPP terminology) may apply, or some content/end-user class combinations may be exempt from it.

Typical requirements are as follows:

- General usability:
  - charging scheme understandable
  - "point-and-click" access sufficient, i.e. service usability tailored for interactive usage experience
  - content access time is predictable and consistent
  - content adapted to the type of the device.

In the future, implementation and the user interface of web services agents will also be of importance.

- Connectivity:
  - RTP, RTCP and RTSP supported
- Service quality:
  - availability is high for critical information
  - response time for a request is a few seconds. This also includes the RTSP controls
  - for small HTTP/WML content, downloading time is a few seconds. For larger HTTP/WML content such as music or videos, throughput is reasonable
  - for streamed content, the bandwidth variations must not cause de-jitter buffer under-run in the terminal

- Security:
  - user is authenticated and authorized when needed
  - the content may be protected against unauthorized consumption by means of encryption
  - possible message integrity and/or confidentiality protection, provided by channel or message protection techniques
- Privacy:
  - user can define to whom personal profile data, such as identity, location, and preferences may be revealed
  - user can set preferences to determine acceptable service providers based on service providers' privacy policy or trust rating
  - user has an easy way to check the service provider's privacy policy
  - user is informed about what data is collected about her and for what purpose
  - user's data is not used or forwarded to third parties without her consent
  - user can use service anonymously/pseudonymously.

6.3.2 Service class 2: augmented VoIP

The second example is more complex because it includes both content access and connectivity. The imaginary service "augmented VoIP" is assumed to be designed to aid mobile collaboration, consisting of the following components:

- presence information;
- Voice over IP telephony bridge with conference management;
- shared whiteboard;
- chat;
- common document storage;

The connectivity type services are assumed to be hosted by a service provider, possibly based on IP Multimedia Subsystem (IMS). The service provider may subcontract some of the components from other providers, as shown in Figure 6.5. The service may also be used via multiple PLMNs in roaming scenarios, and as part of the 3GPP's "home approach", where services are provided from the home network for WCDMA and GPRS access technologies.

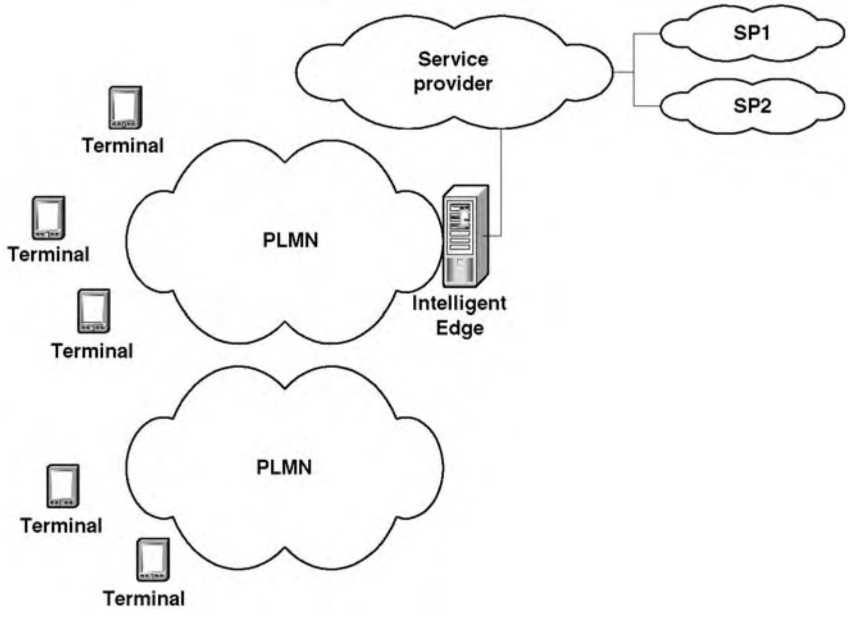

Figure 6.5 An illustration of a possible "augmented VoIP" service set-up

Presence information and VoIP are assumed to be based on Session Initiation Protocol (SIP). The shared whiteboard and chat are assumed to be using suitable protocols, the details of which are not important here. Common document storage is assumed to be using HTTP or WTP. The presence information is assumed to be updated to the presence server within a few seconds of status being changed in the terminal.

The voice over IP component consists of two parts: controls and media stream. The requirements for the control part – that is, telephony set-up and control signalling – stem from the performance requirements for IP telephony. These have been subject to standardization within the TIPHON project of the European Telecommunication Standardization Institution (ETSI) [TIPHON1], for example. Note that conference controls may have different requirements from the actual set-up of the call.

The media stream requirements for IP telephony VoIP media streams are most demanding. The actual performance targets vary according to the source. For example, for ETSI EP TIPHON the recommendation for "best"/Network class I IP telephony were end-to-end delay less than 100 ms, delay variation less than 10 ms, and end-to-end packet loss less than 0.5 per cent [TIPHON2]. Note that end-to-end delay must also include delay effects resulting from audio coding and decoding, as well as from jitter buffer. Such performance is not achievable in country-wide mobile systems involving handovers and bit error concealment schemes, and is challenging even for fixed Internet if long-distance calls are taken into account. Indeed, the TIPHON specification says that the highest class terminal mode (A) may account for up to 50 ms of end-to-end delay, into which one needs to add the effect of de-jittering buffer. For GSM telephony, typical end-to-end delays are closer to 200 ms than 100 ms. Please note that GSM telephony is circuit-switched.

The performance requirements for both whiteboard and chat are that the contributions from participants of the collaboration are reflected on others' screens within a few seconds.

For common data storage, the requirement is that uploading and downloading performance is predictable. It is assumed that the user of the collaboration service is "technically educated" so that he can estimate the duration of uploading and downloading from the size of the document. To do this, the average throughput should be stable. In general, TCP throughput is affected by end-to-end delay, delay variation, and by packet loss rate [PFT+00].

Summarizing, the components requirements are as follows:

- General usability:
  - availability is high
  - service continuity is very important
  - invocation of different kinds of components is logical and easy
- Connectivity:
  - IPv4 and IPv6 supported. The role of IPv6 is more important for peer-to-peer communications than for content access components
  - RTP, RTCP, SIP supported
- Service quality:
  - "interactive feel" performance for presence information, VoIP group call controls, chat and whiteboard application
  - stable throughput for VoIP media streams: delay and delay variations small
  - stable average throughput for document up/downloading

- Security:
  - support for end-user and service authentication
    - users of the service are authenticated, possibly with several different methods
    - user may also authenticate the server
  - the VoIP communication data is protected by encryption
  - optional authentication, based on service requirements
  - integrity and confidentiality protection of messages and/or user content
- Privacy:
  - user can set access rights to data provided to service providers and other users
  - user can set preferences to determine acceptable service providers based on service provider policy parameters
  - user has an easy way to modify access rights and policy preferences
  - user has an easy way to check the service provider's privacy policy
  - service provider's privacy policy is understandable
  - user is informed about what data is collected about her and for what purpose
  - only data needed to complete the service or transaction is collected
  - user's data is not used for purposes other than specified, or forwarded to third parties without her consent
  - user has an easy way of checking data relating to her
  - user can use service anonymously/pseudonomously (depending on context/service).

Note that presence and group calls introduce a new conceptual component, one related to accessing the context of a service user.

6.3.3 Summary

Next, we shall summarize and generalize the above findings about requirements for IP services made as part of the two examples discussed above. The findings shall be discussed in terms of business requirements (why they are important) and technical requirements (how they should be implemented).

Business requirements

There are a variety of IP-based services. There should be adequate support for services that have a sound financial basis. The support should be good enough for the services to be meaningfully usable and attractive, preferably no more than that, and definitely not less than that. The "preferably no more than" means is a consequence of resource management having to do with a finite resource pool, especially in the case of mobile networks. Furthermore, the temporal consistency of end-user experience is of great importance [BSD00]. This means that variations in service quality should be avoided.

End-user experience of service usage should be as independent of the access technology as possible, given technological constraints. Naturally, it is important to make use of easy-to-understand advantages of particular access technologies, such as higher bandwidth available in hotspots. At least for the time being, the service quality support capabilities of access technologies vary, whereby not all the services may be available in all access technology domains.

Personalization of services, e.g. self-management of SIP call preferences, should be supported.

6.3.3.1 Security

Security requirements are implied by threats that are caused by potential actions by malicious parties. Here we do not refer to actions that intend to harm the business of the target (e.g. a mobile operator) by legal competitive means (for example, by offering cheaper services to gain market share). Instead, the benefit obtained from these actions can be categorized as fraud. Phishing attacks that use spoofed e-mails and fraudulent Web sites to lure users into entering personal data such as credit card numbers and passwords, which can then be used for purposes such as identity and financial theft, have risen rapidly during last few years. For instance, a fraudster could arrange a post-paid subscription for mobile phone calls with an operator under a false identity, and then sell long-distance calls for cheap prices from phone booths. Naturally, the bill is never paid, but another subscription is set up.

An example of a security requirement that addresses the type of threat described above is user authentication. It should be noted, however, that authentication alone could not stop the specific fraud given in the example. Indeed, the false identity can be authenticated separately for each call. What is needed in addition to authentication is control of the number of phone calls made using the same identity. In particular, it should be possible to prevent simultaneous phone calls being carried out by the same user.

Often the attacker does not try to obtain any financial benefit but there are still significant financial losses for the target as a result of the attack. A typical example is a denial of service (DoS)-type of attack. These threats are well recognized on the Internet and their importance in the mobile domain increased with the introduction of IP-based services. There are some people who would like to try to bring down a mobile network just because it might be possible. They may even tolerate a certain amount of financial cost to achieve their goal.

It is typically extremely difficult to fully protect against denial of service threats because the protection itself leads to a lower service level, as some resources are used for protection purposes. As a concrete example of this, we want to present the following mechanism (called a client puzzle) [ServicePuzzle]: users who try to access services are always asked to carry out a straightforward but relatively time-consuming computation task before access to service is granted by the network. This guarantees that an attacker who tries to launch a massive denial of service attack also needs a massive amount of computation power. The intention is to guarantee that the attack costs more to the attacker than to the target. However, this also means that legitimate users have to devote part of their resources to the protection mechanism, i.e. it takes longer to access the service and there is power consumed before access to service is granted.

6.3.3.2 Privacy

Privacy requirements relate to end-user needs, technical and legal requirements, brand image and trust. Since it is the customers who care the most about their privacy, the most straightforward way to formulate requirements is to identify possible privacy threats to which customers may be exposed to, and to aim at avoiding or reducing those. Below we give an overview of the most important privacy requirements.

Untraceability. All the user's actions (both online and off-line) can be traced based on a unique identifier that is disclosed during each transaction. Such a unique identifier can be a physical address of the user's device (e.g. IP address, Bluetooth address) or an identity certificate issued by a certificate authority under a traditional Public Key Infrastructure (PKI) system. Service providers should avoid unnecessary use of self-authenticating records.

Unlinkability. Pieces of personal information that are disclosed during multiple transactions can cause the user's transactions to be linked together by a third party. Moreover, it is important to know that even ensuring untraceability of individual transactions is not sufficient to prevent different transactions of an individual from being linked together. The ability of linking allows third parties to get a broader trace on the user and also to build a more comprehensive profile of the individual than they would have been able to otherwise.

Data handling practices. Businesses requesting customer data may be asked about their information handling practices. Individuals are eager to know exactly what data is stored about them, how long it is stored, and for what purpose it is collected and stored. Users should have the opportunity to check their personal data, correct it or have it deleted.

Control over personal data. Individuals are concerned that if they disclose a certain piece of personal information then it gets out of their control. Special care therefore needs to be taken when designing the collection of personal data, i.e. specifying what personal data are needed to complete a specific operation. Collection of personal data should not be excessive for the purpose.

Service providers' handling of personal information is governed by laws and regulations, and organizational and sector-specific privacy guidelines. Privacy laws and regulations vary from one country to another, as well as from one industry sector to another. Regulation is in general stricter in Europe than in the USA and Asia, and in sectors dealing with health, financial and location data.

Two bodies, the Organization for Economic Cooperation and Development (OECD) and the European Union (EU) have had a strong influence on the development of privacy practices and enactment of privacy protection laws around the world. The OECD regulations require that personal information is obtained fairly and lawfully, is adequate and not excessive for the purpose, is kept secure and used only for the original purpose, is accessible by the subject, and destroyed after its purpose is completed The data protection principles in EU regulations are defined in two directives. The 95/46/EC directive on "Protection of individuals with regard to the processing of personal data and on the free movement of such data" provides general rules applicable to all processing of personal data and is in line with the OECD principles. The main principles of the directive are the following:

- *Notice*: An organization must inform individuals about the purposes for which it collects and uses information about them.
- *Choice*: An organization must offer individuals the opportunity to choose whether their personal information can be disclosed to a third party or be used for a purpose that is incompatible with the purpose(s) for which it was originally collected.
- *Onward transfer*: To disclose information to a third party, organizations must apply the Notice and Choice principles.
- *Security*: Organizations creating, maintaining, using or disseminating personal information must take reasonable precautions to protect it.
- *Data Integrity*: An organization may not process personal information in a way that is incompatible with the purposes for which it has been collected.
- *Enforcement*: Effective privacy protection must include mechanisms for assuring compliance with the Principles.
- *Access*: Individuals must have access to personal information about them and be able to correct it.

The 2002/58/EC "Directive on Data Protection in the Electronic Communications Sector" is a technology-neutral directive that ensures protection of all information transmitted across all different electronic communications media. The Electronic communication sector directive complements the 1995 data protection directive, and includes provisions regarding security, confidentiality of communications, including the use of cookies and other hidden identifiers, handling of traffic and location data, billing, and restrictions related to unsolicited communications and subscriber directories.

In the USA, there are no comprehensive privacy protection laws. Instead there are sector-specific statues, such as the Graham-Leach Bililey act in the financial sector, the Health Insurance Portability and Accountability Act (HIPAA), and the Children's Online Privacy Protection Act, which set the framework for privacy protection. In addition, several organizations and interest groups have defined codes of practice to guide the collection and use of personal information.

These guidelines play an important role in several industries, e.g. marketing. They cover:

- trust
- support for user/subscriber groups
- ease of use.

Next, we shall discuss related legal and regulatory aspects. Relating specifically to security, we shall discuss issues of export control and lawful interception. In the past, cryptographic mechanisms were under heavy export control as they were seen as "dual-use" machinery. Although there has been movement towards liberalization, export control regulation is still applied in many countries. This is especially true for network elements, e.g. radio network controllers and base stations. In addition to export control, some countries apply import control of cryptography as well. For instance, the Chinese government has decided that only domestic cryptoalgorithms may be used in China.

Electronic surveillance of telecommunications is used as a regular method of law enforcement in most countries, e.g. in Finland. For GSM systems, support for lawful interception was built in afterwards but for 3G systems the specification of lawful interception interfaces has proceeded with the rest of the specification work. Interception is always done on the core network elements, and therefore, it does not prevent the use of strong encryption in the radio network. Furthermore, there are miscellaneous legal aspects, some of which are discussed next.

Cellular networks allow emergency calls even without user authentication. In GSM, emergency calls are the only type of calls allowed without a Subscriber Identity Module (SIM) card. This creates, of course, a trade-off with security goals. More recently, a requirement for the ability to make emergency data connections has also been established. For example, in the U.S., there are requirements for using location information for emergency purposes, and accuracy requirements are strict. The tendency seems to be that whenever a certain service may be used in emergency situations, corresponding regulatory requirements are created.

There may be legal limitations regarding to content and user's age. In principle, this would call for verification of the user's age when a service is being activated. This is often simply impossible, and in today's Internet, service providers can only display a warning about such limitations to the user of the service. A similar problem arises with e-commerce regarding nationality checking. While it is possible to identify the nationality of the cellular "home operator", this may not be enough. Emerging multi-access roaming technologies may further complicate this. There is specific legal regulation for financial and health services, which service providers must adhere to. Such regulations define what kinds of parties can carry out particular tasks.

Certain industry branches or interest groups may also be involved in self-regulation to avoid potentially harmful legislature. In these cases, regulations do not have the status of laws, but are binding on the participating parties.

Technical requirements

Technical requirements will be discussed under the headings "connectivity", "security", "privacy" and "service quality".

6.3.3.3 Connectivity

Connectivity requirements relate to the following aspects:

- What kinds of endpoints need be supported (handhelds, PCs)?
- What kinds of application stacks are needed for operating the service?
- Which IP versions are supported (IPv4 / IPv6)?
- Is mobility support needed:
- between access technologies?
- within an access technology?

6.3.3.4 Security

Some of the most important security features are as follows.

- *Confidentiality*: Information is not made available or disclosed to unauthorized individuals, entities or processes;
- *Authentication*: The provision of assurance of the claimed identity of an entity. In practice, authentication amounts to proof of claimed identity. Note that authentication is typically only possible after identification has occurred first;
- *Data integrity*: Data must not be altered in an unauthorized manner;
- *Non-repudiation*: An entity cannot deny previous commitments or actions.

In addition to these, availability is an extremely important security feature: authorized access to data and services is always possible. Indeed, it would be simple to create a very secure system or service if we ignore the requirement for availability.

The following security requirements are taken from 3GPP TS 21.133. These serve here as examples of technical security requirements for services.

8.1.1.1 Requirements on secure service access

- R1a A valid USIM (UMTS Subscriber Identity Module) shall be required to access any 3G service except for emergency calls where the network should be allowed to decide whether or not emergency calls should be permitted without a USIM.
- R1b It shall be possible to prevent intruders from obtaining unauthorized access to 3G services by masquerading as authorized users.
- R1c It shall be possible for users to be able to verify that serving networks are authorized to offer 3G services on behalf of the user's home environment at the start of, and during, service delivery.

8.1.1.2 Requirements on secure service provision

- R2a It shall be possible for service providers to authenticate users at the start of, and during, service delivery to prevent intruders from obtaining unauthorized access to 3G services by masquerade or misuse of priorities.
- R2b It shall be possible to detect and prevent the fraudulent use of services. Alarms will typically need to be raised to alert providers to security-related events. Audit logs of security-related events will also need to be produced.
- R2c It shall be possible to prevent the use of a particular USIM to access 3G services.
- R2d It shall be possible for a home environment to cause an immediate termination of all services provided to certain users, also those offered by serving networks.

R2e It shall be possible for the serving network to be able to authenticate the origin of user traffic, signalling data and control data on radio interfaces.

R2f It shall be possible to prevent intruders from restricting the availability of services by logical means.

R2g There shall be a secure infrastructure between network operators, designed such that the need for HE trust in the SN for security functionality is minimized.

The convergence between Internet technologies and telecommunications have many consequences for security. For instance, traditional telecommunication networks were accessible only to a closed community of trusted organizations. This is not the case for IP networks, although it should be noted that it is possible for a fully closed network to make extensive use of IP-based protocols. Denial of service attacks are relatively common in the IP world, whereas in the telecom world there are very high availability expectations.

Another dimension of security requirements consists of issues with policies and configuration. The usefulness of any security mechanism is dependent on the underlying policies. An example of this is the following. Assume our policies allow a certain security mechanism to be turned off in case the other communicating party does not support this mechanism. Then it is clear that the benefit gained by the mechanism is completely lost if there is a possibility for active attackers to masquerade as authorized users and disable the security mechanisms by claiming lack of support. The relationship between security mechanisms (e.g. authentication, encryption) and security policies can be illustrated by the following analogy: security mechanisms are tools, but we also need policies to give guidance about when and where to use a certain tool. In addition, social engineering techniques can be used to thwart even most advanced security mechanisms.

Some categories of security mechanisms are:

Physical protection (e.g. locked or guarded facilities, wires dug deep into the ground). This is a fairly expensive method and clearly not always possible.

- *Access control lists*: these define the authorized users (of a certain service) and their privileges. This method is cheap and relatively easy to operate. However, it also has restrictions because it is limited to, e.g. the entry points of a system.

- *Cryptology* contains mathematical and computational mechanisms that manipulate the data to be protected in such a way that the original data is protected even where the attacker has unlimited access to the manipulated data (and, furthermore, the attacker can manipulate further). These mechanisms are also fairly cheap, and usually allow scalability.
- *Compromise detection*: e.g. intrusion detection systems and software that searches for viruses. This type of method typically complements other methods.

6.3.3.5 Privacy

The most important thing to understand during network design is that privacy is not something that can be handled independently from the entire design nor can it be added easily to existing designs afterwards. Instead, privacy is a *cross-cutting concern* which means it should influence the design in all levels or layers of the product design and value chain.

Privacy-aware design. When designing a system that has privacy as a desirable property, the following worst-case assumptions need to be made:

- *Persistence.* Whenever a piece of information is disclosed, that act cannot be undone.
- *Loss of control.* Whatever can happen to a piece of information, will happen.
- *Linkability.* Whoever gets to be able to link different pieces of data together, will do so.

Data control. The assumptions above reveal show that network design should enable the user to retain control over their data to the best possible extent, to avoid these worst-case possibilities.

Trust management. One of the key notions in privacy-aware system design is *trust* from both the value proposition and technical implementation point of view. From a strictly technical point of view, it is a general observation that introducing a trusted party can provide appropriate solution to all privacy-related problems. However, as gaining or granting trust is not a technical question, special effort needs to be made to set up proper trust relations by specifying what parties are in the system and to what extent they need to be trusted in order to accomplish each operation.

Avoid global unique IDs. If the system design contains globally unique identifiers that travel with users and are exchanged during each transaction, it is an inescapable privacy compromise, as they can serve as self-authenticating records at later time. Identifiers should not last longer than they need to.

Always opt in. Giving the users the possibility of opting in to services ensures they are in better control of the use of their data.

6.3.3.6 Service quality

Service quality requirements can be discussed in terms of the conceptual model introduced earlier. On an aggregate level, the following requirements can be expressed:

- overall availability level
- service instantiation time.

On the service variant level, requirements of different instantiations of the service can be described:

- maximum bandwidth
- service quality support type
- service event types supported for a particular access technology and terminal type.

Depending on the network technology, the terminal may need to be able to instantiate service quality support for services, or the network may be able to do this on behalf of the endpoint.

The technical requirements of individual service event types are:

- per-service event type bandwidth. Also bandwidth utility indicators may be given here
- latency requirements
- packet loss rate requirements.

Related standardization for performance targets for different content types can be found in [G.1010] and [TIPHON2].

6.4 CHARACTERISTICS OF SERVICES

Next, we shall study characteristics of services, using as tools the same two examples as for our previous undertaking, the analysis of the requirements of services.

6.4.1 Service class 1: content service

In terms of traffic patterns, perhaps the most obvious observation about content service is the asymmetry of traffic in different directions. The "request" from the communication endpoint is typically small in size compared to the "response". The degree of asymmetry can vary quite a lot: for accessing a purely text-format WML portal, the response may also be small in size (hundreds of bytes), whereas downloading of music or video to the terminal may mean – depending on the terminal – hundreds of kilobits or even megabytes of response. Another obvious aspect of content service is the temporal correlation of request and response: at least for small content, the response should follow within a few seconds of the request.

Other characteristics of interest relate to usage patterns in terms of chronology, geography and demography. These are typically related to the type of content in question, so let us study a few examples.

Access to business information can be expected to be most frequent during work hours and working days of the week and be concentrated geographically in areas with the highest density of enterprises needing access to that particular kind of information. The most important "demographical aspect" for this service is most likely the fact that the subscriptions are typically paid for by the employer.

Recreational content such as gossip about celebrities, popular music or videos can be expected to enjoy some level of usage throughout the day, but most likely demographical distribution during working hours consists mostly of teenage users and other segments exempt from the curse of having to work for a living. Given that the content in question is of interest to adults of working age, a usage peak can be expected after working hours in suburban or residential areas. Naturally, the above statistics can be advantageously collected at finer granularity than aggregate service, at service variant and service event type levels.

6.4.2 Service class 2: augmented VoIP

The "Augmented VoIP" service is business-oriented in nature, but can also be used outside business hours for planning events or parties, for example.

Characteristics of different components of the service vary according to the component in question. Most participants in the collaboration service are expected to join almost simultaneously, but participants may join and leave at any time. The VoIP component is the glue of the service, and can reasonably be expected to be active for all participants throughout the service usage session. The participants are also assumed to be constantly following the presence, whiteboard and chat components. Document up/downloading, issuing of chat comments and active contributions to the whiteboard are assumed to take place sporadically on average.

Thus, the service event type characteristics could be summarized as follows:

- *Presence information*: Uplink traffic mostly at the beginning of the meeting, each event reflected as temporally correlated downlink traffic for all participants.
- *VoIP component*: Patterns culturally dependent. On average, each participant is expected to contribute frequently to the discussion. During each oral contribution, constant bandwidth traffic for the speaker in uplink direction. One of the participants is assumed to be speaking at any time, whereby it is assumed that there is downlink VoIP traffic towards all participants almost 100 per cent of the time.
- *Whiteboard and chat*: A small amount of uplink traffic followed by temporally correlated downlink traffic of almost equal size to all participants.
- *Document transfer*: Almost constant bandwidth traffic in the direction of document transfer, small packets (e.g. TCP ACKs) in the reverse direction.

During working hours, the service can be used anywhere, since this is a mobile service that could be used by sales staff, for example. Outside working hours, geographical usage can be expected to be equally diverse. During working hours, usage can be expected to be concentrated on the business user segment. Outside working hours, the service may be used both by business users who use it at work, and by technically advanced amateurs who need advanced collaboration tools.

6.4.3 Summary

As with the requirements of IP services, we shall discuss our findings in terms of business aspects and technical aspects.

6.4.3.1 Business aspects

The business aspects of service characteristics relate mostly to the ability of the operator to monitor service usage and service quality of deployed services. Service usage information can be useful in deciding how successful a service is, whether it has been targeted to the right consumer segments, and to which extent the geographical coverage is correct.

Service quality information of individual service event types and service events – together with corresponding usage information – can be used to

- check that planned service quality is implemented;
- optimize service quality support parameters in the network to correspond most closely to an actual traffic situation.

The latter aspect is often called traffic engineering, and has been discussed in, e.g., [Wan01, Rai03]. We shall touch on this issue from a service assurance viewpoint in the next chapter.

6.4.3.2 Technical aspects

The technical side of service characteristics is the ability to gather the necessary information about service usage and service quality of individual service components. For multi-component services such as the "augmented VoIP" above, the monitoring functionality needs to be able to accommodate heterogeneous components, each with particular needs.

6.5 IMPLICATIONS FOR SERVICE AND NETWORK MANAGEMENT

Service management needs to be able to cope with services that are composed of components that are different in nature, have different requirements and different characteristics. It must be possible to be able to configure and monitor the necessary parameters relating to each component type, and to link the parameters of an individual component to the aggregate service. Taking service assurance as an example, this means that rules need to be constructed for defining adequate performance for aggregate service, given particular levels of performance of the individual service components. Such a situation is also challenging from the viewpoint of optimizing the use of network resources: on one hand, the different components require different kinds of network resources to function, and on the other, commercially viable services may require certain components to be part of the aggregate service.

A further dimension to requirements and characteristics is presented by the creation of different variants of a particular service for different end-user groups and/or different access technology. The parameters of individual components may vary from variant to variant, and also the components making up a particular variant may be different in each case.

New kinds of services and service components also require careful consideration of the related security and privacy issues. For example, at the time of writing, services making use of location-based information are already being tested.

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7

Service Modelling

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7.1 INTRODUCTION

In this chapter, we shall discuss service modelling from the viewpoint of procedural requirements, that is: requirements from a service management viewpoint. This can be contrasted with the approach of Chapter 6, where we discussed requirements and characteristics of services from the viewpoint of services themselves. Thus, the service modelling framework described in this chapter can be thought of as building on work done in Chapters 4 and 6, the former dealing with service management processes. We shall also build on previous discussion in Chapters 1 and 2 about the types of services anticipated to be of future importance.

This chapter on service modelling does not discuss network management configurations such as network settings required for setting up mobile bearers. Instead, the focus is on the service management layer making use of the configuration of the network management layer. This chapter also focuses on the mobile network operator viewpoint of service modelling, although some notes about the applicability to service provider business will be made at the end of the chapter.

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We shall first discuss some generic issues for service modelling. After that, we shall discuss requirements stemming from terminals and new services. The requirements for service modelling will be summarized in the form of business and technical requirements. After that, existing service models will be discussed. Next we shall discuss the service modelling framework and illustrate it with an example. The chapter concludes with a summary.

7.1.1 Generic issues

The business environment is increasingly competitive, whereby all actors need to target efficient yet flexible modes of operation. This calls for flexibility with respect to operational processes, the parties involved, and the technological solutions used for implementing the services. Obviously, the service model also needs to be flexible with respect to value chain business models between the service providers. On a high level, the participants in a generic end-to-end value chain of service creation could be described as follows:

- *end user*: a person using services with a mobile device;
- *access network operator*: a party that manages and maintains the access network;
- *core network operator*: a party that manages and maintains the core network;
- *service provider*: a party that provides services to end-users;
- *application provider*: a party that provides applications to service providers or end-users;
- *content aggregator*: a party that bundles content from different sources;
- *content provider*: a party that provides content to aggregators or service providers.

The generic value chain is illustrated in Figure 7.1. Not all of the participants need to be present in every value chain.

To be generic enough, the service model needs to cater for both long-term mass services and short-term, more transient services. Basic Multimedia Messaging Service (MMS) is an example of the former, whereas a limited-time theme service targeted for the aficionados of, say, SuperBowl, Soccer World Championships or ice hockey world championships would be an example of the latter. Whereas the long-term services remain in essence the same – from

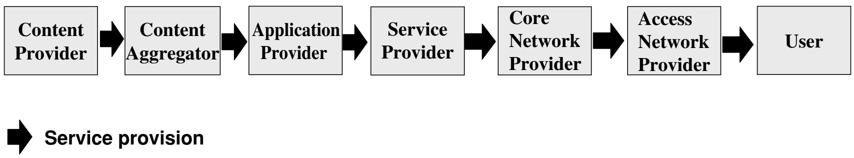

Figure 7.1 The value chain of service provision

the end-user's viewpoint – the short-term services come into existence, persist for the targeted duration of the campaign, and then are retired. The duration for transient services can be weeks or months, for example.

7.1.2 User classification

Analogously to the broad versus focused temporal coverage, the set of target end-users can have a wide or a narrow basis, too. The operator may choose to implement directed services for a chosen customer segment. This immediately raises the question of how end-user classification is performed. Classifying users into segments helps service providers analyse their customers and enables the service provider to develop services that better meet their customers' needs.

There are several ways of classifying users into different segments. Geographic, demographic or psychographic variables are commonly used as classification criteria. Dividing users according to the region or the size of the city they live in, is a way of classifying users geographically.

Dividing users into *business* and *leisure* users provides a rough way of classifying users demographically, and gives an indication of the type of services the users consume. Another way to classify users is to divide them into different segments based on their age, e.g., children, adolescents and adults. Nationality, income and education are other commonly used demographic classification variables. A more granular classification can be achieved by dividing users into psychographic segments based on their lifestyle. The report from the Finnish State Technology Research Centre [VTT] provides one example of how users can be classified according to their lifestyle:

Advantage oriented users

are users who mainly consume information services such as news, stock rates, weather reports, timetables, etc. Business users who want to acquire information quickly and efficiently are typical representatives of this group.

Pastime-oriented users

are users who mainly consume amusement and recreation services, such as horoscopes and jokes. Young people, who are consumption oriented and not price sensitive, are typical representatives of this group.

Communication-oriented users

are users who are heavy users of communication and information sharing services such as chat, email, text and multimedia messaging. Pioneers using the latest mobile devices are typical representatives of this group.

Joint-activity oriented users

are users who mainly consume amusement and recreation services with a social aspect such as group games. Users who focus on being part of a community represent this group.

Life-design oriented users

are users who want to have better control over their personal and professional life through the use of services that make their life easier to manage socially and professionally. This includes services such as calendar, NetMeeting and chat.

Another classification example is provided by the well-known SRI VALS (values and lifestyles) system, which classifies users (based on their motivation and resources) into innovators, thinkers, believers, achievers, strivers, experiencers, makers and survivors [VALS]. Note that in many of the above classifications, an individual's classification typically changes over time. A person also may belong to multiple segments simultaneously.

7.1.3 Service provisioning in wireless systems

As discussed in Chapter 6, services have technical requirements and characteristics associated with them. Analogously, IP access technologies have characteristics of their own, a fact illustrated with a few examples below. Please note that circuit-switched access technologies are not discussed here at all. The capabilities of mobile networking technologies were described in Chapter 6. Notes about service provisioning assumptions have been made in passing as well. We shall use the Third Generation Partnership Project (3GPP) networking technologies as an example, and a user interested in other networking technologies, such as Third Generation Partnership Project 2, can refer to [Jam03], for example. Here, the term "service quality support" means the capability of the network to provide the requested service quality level. Service quality support may also involve negotiation between the network and requesting party [Rai04].

The service model needs to cater for necessary abstractions in service provision. An example of this is the 3GPP separation between *user services* and *bearer services*. End-user services, such as streamed multimedia, are provisioned to make use of bearer services, such as interactive traffic class Packet Data Protocol (PDP) context between Wideband CDMA (WCDMA) network and the terminal. Other examples of service models include the European Telecommunications Standardization Institute (ETSI) TIPHON telephony quality model and related Quality of Service (QoS) architecture [TIPHON3]. In addition to bearer services, the 3GPP also provides certain other means of supporting service provision, as discussed in Chapters 6 and 8. Generalizing the concepts of 3GPP architecture, the service model needs to support linking of end-user services to network means of providing adequate delivery in the network [Rai04].

Given the plurality of available access technologies, the means of supporting service quality in the network may vary [Rai04]. However, a certain degree of commonality is to be expected, in view of the anticipated and perceived trend of Internet Protocol (IP)-enabled convergence. In addition to basic cellular technologies such as GPRS and WCDMA, IEEE 802.11 Wireless LAN (WLAN) inter-working is being addressed in 3GPP Release 6. A possible outline of 3GPP2/WLAN service quality inter-working can be found in [TR04]. In view of the great potential of convergence, service models should not be limited to particular networking technologies, but should be flexible enough to allow application to a variety of access technologies, including wireless and wired.

The 3GPP bearer concept provides a good illustration of the central concepts related to service provision, which is why we shall be using it here as a tool. A service model links services to service support classes in the network, all technical details of which do not need to be covered by the service model (Figure 7.2). Note that these concepts can be generalized for managing services in purely "wired" access domains. While the actual service model should be

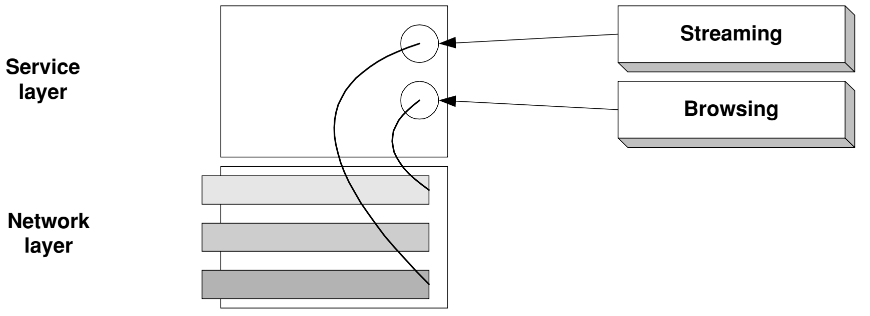

Figure 7.2 The relationship of service management to network management

generic rather than technology-specific, it is useful to discuss the state-of-the-art in service related modelling to understand the limits of current standards and avoid being overly abstract in discussing service models. The information discussed next is meant to help in understanding what kinds of variants of services could be expected to be supported in particular access technologies.

7.1.4 Terminals

The spectrum of different mobile terminal types has been greatly enlarged recently. Not only are there ever more makes and models of terminals available, but also the capabilities and characteristics of terminals vary widely. In line with the earlier description of different consumer segments, different user groups need different kinds of terminals. For example, technically oriented consumers may want a terminal that supports a wide spectrum of different protocols and allows for browsing of Wireless Application Protocol (WAP) and eXtensible Hypertext Mark-up Language (XHTML) pages, reading emails, and Internet connectivity for laptop via Bluetooth™ connection. Aesthetically inclined consumers, on the other hand, may value small size and form factor higher than technical capabilities. Older terminals still in use may have lower processing power and simpler display capabilities than newer ones. Further, mobile workers such as sales representatives may use a PC as their interface with mobile services and use either a handset as a GPRS/WCDMA modem, or a PCMCIA GPRS/WCDMA card, or some other wireless means of obtaining connectivity.

Aside from the obvious technological differences stemming from the evolution of display, memory and data processing technologies, there are also subtler differences between terminals. Many aspects of 3GPP standards are optional, whereas they may not be implemented in simple or older terminals. As discussed in Chapters 4 and 6, a terminal may not be able to request all parameters in activating a (PDP) context. Unless helped by the network, such terminals could get different kind of service quality from the network than terminals, which would be able to request service quality in an optimal format. One approach to deal with the issue is for terminal application writers to use a terminal software platform to develop software, hiding the details from the developer and enabling more efficient development. Such web services platforms may support, for example, the web services and the related technologies for implementing the services.

3GPP terminals also typically require settings to be made in order to operate correctly in a GPRS or UMTS network. As discussed previously, GPRS Access Point Names (APNs) need to be configured into the terminal. Also, applications may have parameters that need to be configured into the terminal, such as:

- address of Multimedia Messaging Service Centre (MMSC);
- address of Proxy Call State Control Function (P-CSCF);
- security provisioning (private keys, certificates etc.);
- web services endpoint definitions (discovery service etc.).

Configuration of the above parameters into the terminal, as well as querying of terminal capabilities, is possible via Over-the-Air (OTA) technologies such as SyncML, an Open Mobile Alliance (OMA) standard for data synchronization. Such automated mechanisms may be used to simplify the deployment of services.

7.1.5 New service requirements

Upcoming IP-based services bring with them new challenges and opportunities for service management. These issues will be discussed in this section.

The Session Initiation Protocol (SIP) framework of the Internet Engineering Task Force (IETF) is a flexible framework for implementing advanced services that also allow different kinds of presence information options and subscriber preferences personalization, in addition to run-of-the mill call set-up signalling. The SIP framework can be used for locating IP communication partners, not just recipients for telephony. This could be called *presence information maintenance*. As an example of user preferences, a subscriber can use the SIP framework to indicate with which endpoint he wishes his SIP Universal Resource Locator (URL) to be associated with for incoming connection requests. For example, subscriber Donald might indicate that during working hours the SIP URL *Donald.Duck@duckburg.org* refers to his multimedia-enabled PC, but outside working hours he prefers to receive calls on his 3GPP Release 5 (R5) SIP-capable handset. He is also able to check the (self-proclaimed) presence status of Huey, Luey and Dewey in the terminal that he happens to be using at the time. In the context of service management, this relates to the need for supporting and managing end-user editing of call-handling preferences.

The ability to map SIP URL to multiple end-user devices brings us to the next topic: context awareness. It might make sense to devise different variants of services for different access technologies and/or terminal types. Advances in terminal technology such as Over-The-Air (OTA) interfaces and Synchronization Mark-Up Language (SyncML) make it possible to query endpoint capabilities and help in choosing the most appropriate representation of content for a particular communications endpoint. The capabilities of the endpoint may mean protocol stacks, available bearers, screen resolution, availability of colour display, and so on. An example of the needed protocol stacks is Digital Rights Management (DRM) – the terminal needs to support DRM so that protected content can be sent to it. What this means in practice is that the service model needs to be able to link a particular subscriber or user to certain (possibly access technology-specific) variants of the service. It is also possible that only a subset of the variants is available to a particular subscriber or user group.

The W3C Composite Capabilities/Preferences Profile, or CC/PP for short, provides an extensible framework for expressing device capabilities and user preferences [ICP, CCP, RDF]. A profile of CC/PP, such as the OMA UAProf profile, allows device capabilities to be defined, enabling content negotiation or even automated content transformation for an appropriate representation for the user device.

Location-Based Services (LBS) are some of the first examples of context-sensitive information, with information about terminal location used as a component of services. The canonical example for this class of services is a restaurant finder, where a visitor to a foreign city can summon up information about nearby restaurants upon a click of a button on her terminal. The user should be able to prevent her location information from being used by the operator. Anonymized information about terminal location statistics is already being made available to service providers by mobile network operators. If the user/subscriber so chooses, his location information may also be made known for a particular service provider. Typically this needs to be explicitly enabled.

New services also allow for more diverse value chain structures. The adoption of the new service management paradigms discussed in previous chapters means in practice that not only different organizations, but also different kinds of users within each organizations, have access to service management information. The part of service information that a particular kind of user in a particular organization is allowed to view may be larger than information that the same personnel group is allowed to edit. Thus, service models need to include means of granting reading/writing access rights for organizational groups in the same way as, say, multi-user computer systems. Naturally following on from such a distributed access environment, logging capabilities are also of importance.

7.2 REQUIREMENTS FOR SERVICE MODELLING

In this section, we discuss requirements for service modelling, referring to issues that were discussed above. First, let us formulate a generic target for service modelling.

The service model should be usable end-to-end along the service value chain and available – for relevant parts – to the different roles within the organizations participating in the value chain. An example of the parties of a generic value chain was shown in Figure 7.1. The service model should address both the business and technical aspects of service management, and should provide sufficient input for technical provisioning and control of network services. The service model should be technology-independent, which means that it should interface to technology-specific data models. The service model should be generic enough to cover at least all IP-based services. The service model should allow flexible and efficient execution of all phases of the service lifecycle.

Next, we shall describe selected aspects of the above in more detail.

7.2.1 Business requirements

The service model should be flexible with respect to business models between actors and provide a framework for the analysis of revenue distribution between the different players in the value chain based on different service types, user segments and technological choices. It should also allow for the analysis of value chain players, as described earlier.

In addition to this, the business model should allow for analysis of the information flow between the different players of the value chain, and the characteristics of the business environment.

In addition to the aforementioned players, the analysis should therefore take into account the manufacturers and suppliers, which supply the value chain players with the suitable equipment, and environmental factors, such as the legislative framework that defines the opportunities and threats of the specific business environment.

Separate information relating to the access network operator may be needed, for example, in case of the WLAN hotspot operator interfacing to a cellular network core domain. An example of a business environment for the service model is illustrated in Figure 7.3. Each actor in the end-to-end service provision value chain operates its resources according to its own business goals. Note that legislative constraints could be viewed as policies in the business frameworks.

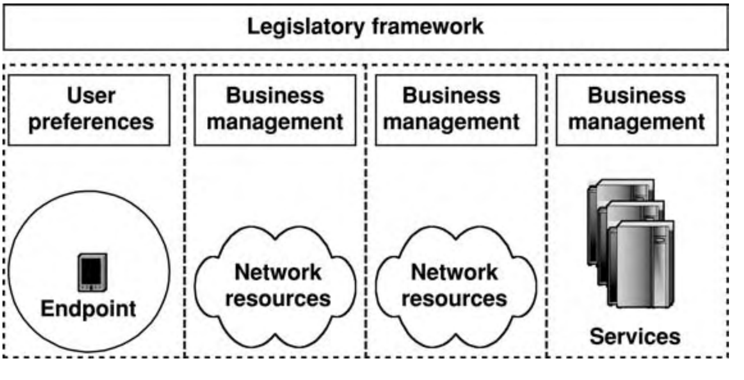

Figure 7.3 The business environment for service management, consisting of an end-user, an access network operator a core network operator and a service provider. Note that there may be multiple parties of a particular type

The service model should support expressing relevant aspects of business interactions between organizations, such as unique identification of service components across organizational boundaries, and Service Level Agreements (SLAs), for example. The service model should allow for rapid and accurate service creation and modification between multiple organizations. It should also create services that are short-lived and targeted at narrow consumer segments. It should also be possible to create multiple variants of the same service for different subscriber groups and usage environments.

The service mode should support multiple organizational roles within each organization, having different kinds of "access rights" to the data. The roles include:

- "business roles": requirements for service management;
- "technical roles": design and implementation of service;
- "operational roles": operating the service;
- "managerial roles": managing the service throughout the lifecycle.

Access rights relate to both the type of the role and to the organization within which the role is carried out (see Figure 7.4 for an example). In general, access rights for roles may need to be maintained during the lifecycle of a service so that different roles participate to the process at different times.

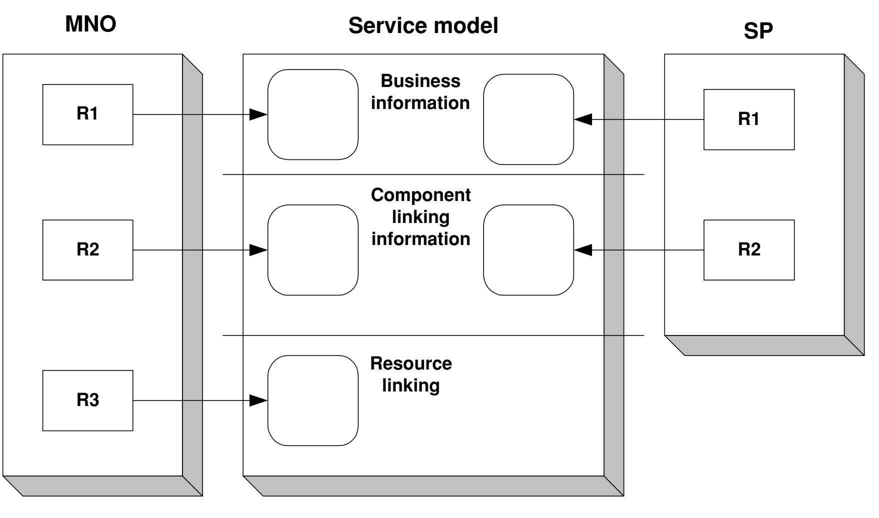

Figure 7.4 The relationship of different roles within organizations (Mobile Network Operator, MNO and Service Provider, SP) to the service model

Service model needs to accommodate information that is needed both during the lifecycle of individual services, and for optimizing the set of available services and components. There should also be sufficient information available for optimizing the mapping of services to network resources, and for setting service quality support parameters in the network in an optimal way.

The service model should also allow for expression policies at different levels:

- cross-organizational policies (e.g. legislation);
- inter-organizational policies (for example, business practices of operators or service providers);
- service-specific policies across different variants;
- end-user policies.

Organizational policies could be viewed as being part of the business management functions in Figure 7.3.

7.2.2 Technical requirements

Technical requirements are partly more precise expressions of the business requirements, and partly follow from the technical environment that the service model needs to integrate with. Within the TeleManagement Forum (TMF) New Generation Operations Support Systems (NGOSS) framework, this is described using contracts within a lifecycle. The service model should not be technology-specific, yet it should allow for modelling of different kinds of systems within the generic framework of Figure 7.3. In particular, dynamic service-related capabilities of mobile networks should be supported, in addition to relatively simple provisioning of IP-based systems. Similarly, both "static" provisioning of services and "dynamic" models such as web services should be supported, in the interests of generality.

Looking at the above from the viewpoint of services, the service model should not be limited to current services, but should contain the essential concepts needed for also expressing future services. An example of a topic area (the importance of which appears to be on the rise) is management of terminal information; many of the services require settings to be made in the endpoints, and it is anticipated that usage context information may increasingly be utilized to provide the right kinds of services to end-users.

The service model should allow for detailed enough information to be derived from service control, yet be simple and logical enough to allow for service management without getting lost in details. As we shall see later in this chapter, the state-of-the-art for achieving this is the formulation of technology-neutral models which interface to technology-specific models. In addition to supporting different subscriber groups in the form of separate service variants, different access technologies and different terminal types should also be catered for in this respect.

The service model needs to support expressing of end-to-end requirements for services, even though the end-to-end service performance may be composed of multiple autonomously managed components. One of the roles needs to do the end-to-end design for the service, and make sure that the end-to-end design is implemented.

Next we shall discuss requirements relating to specific aspects of services.

7.2.2.1 Service quality

Depending on the type of service in questions, end-to-end service quality requirements may originate from the inherent nature of the service, or from designed end-user experience, or both. Typical parameters include:

- end-to-end delay;
- packet loss;
- throughput.

For all of the three types of parameters listed above, there can be two kinds of definitions: limits for the averages, and limits for temporal variations. The former type could be of the following form, for example: 99 per cent of end-to-end delays of IP packets must be smaller than 250 ms. Such a definition, however, does not yield information about the temporal relation of the (at the maximum 1 per cent) packets exceeding the criterion with relation to each other. For delay, the most important factor is the rate of change in end-to-end delay. Thus, a time limitation could state that 99 per cent of the delay differences of two consecutive packets should be smaller than 20 ms, for example. For packet loss, temporal correlations map to loss correlations, and, for throughput, to bearer throughput stability in terms of token rate parameters [Rai03].

7.2.2.2 Privacy

As non-wanted end-user profiling and more direct ways of misuse of personal data are increasing, users are becoming increasingly concerned about their privacy. Users are concerned about what information is collected about them, for what purpose the information collected is used, with whom it is shared and how it is combined with other data about them. They want to have a ways to check the service provider's privacy policy and set their preferences regarding acceptable policies.

When it comes to sharing personal data, users want to have control of the release of their data. They need tools to define different access rights for different types of personal data, and for different groups of people and types of service providers. Users do not want to be profiled without their knowledge, and need the tools to prevent "spyware", web bugs and cookies from logging their actions without their knowledge. Users also want to be sure that the party they are communicating with really is who they claim to be, and want to know if the party is trustworthy. This becomes especially important when the communication involves financial transactions.

When interacting with service providers and other users, there may be a need to use different identities. Users need the flexibility to be anonymous, pseudonymous or verinymous in different contexts. They are willing to share their preferences with parties they trust, and receive messages that are tailored according to their needs, but do not want to be disturbed by unsolicited and unwanted email. Last but not least, they want privacy protection tools that are easy to use and understand and do not require much effort or in-depth technical knowledge. Translating this into technical requirements, this means support for the following:

- authentication and authorization;
- anonymous, pseudonymous and verinymous identities;
- privacy policy management;
- profile management;
- firewalls and filtering of unwanted messages;
- trust rating mechanisms;
- privacy protective default settings.

7.2.2.3 Security

The technical requirements for security are closely related to the requirements given above for privacy. For instance, user authentication is extremely important for network operators and service providers. The authentication is a cornerstone of reliable charging. In addition to *entity authentication* at the start of a session, the operator/service provider needs a way to prevent session hijacking during the session. This can be guaranteed by integrity protection of the communication (or *message authentication*). Fairly good protection against session hijacking can also be provided by encryption of the communication. At the same time confidentiality (or privacy) of the user data is ensured.

Security of services can itself be modelled in several ways. One popular view is to define *security primitives* first. These are purely technical means that could be used as building blocks for more complex features. Examples of primitives are encryption algorithms, tamper-resistant (physical) modules and access control lists. Primitives can be combined in many ways to form security features (e.g. confidentiality or authenticity). We could then complete the modelling task by assigning a set of security features to each service.

It may even be possible to define a formal framework inside which certain security properties can be proven. It is, however, important to note that these proofs are only valid in the context of the framework and no far-reaching conclusions can be drawn based on them.

To be able to decide whether the supporting set of security features is sufficient for a given service, the key ingredients are a threat model and a related risk model. What needs to be done is to check that the security features can mitigate the identified threats (and consequent risks) in a satisfactory manner. Some threats may remain unaddressed, but then the associated risk (caused to any of the stakeholders) must be small. The reason for low risk level could be, for example, that it is costly to perform an attack realizing the threat, while the possible benefit for the attacker is very small.

The critical role of a threat model has the following implication. Assume that a new threat is identified and, therefore, the threat model needs to be modified. This may have another and more severe consequence: the set of security features is no longer sufficient for a certain service. Then we also have to be able to dynamically modify security features. On the positive side, an appropriate model for security features makes corrective actions easier to execute.

7.2.2.4 Other aspects

The service model needs to support sufficient service assurance information for monitoring service performance and for the optimization tasks discussed above. The service model needs to support the expression of Key Quality Indicators (KQIs), as well link them to SLAs and Key Performance Indicators (KPIs). Such capability makes it possible to "close" the traffic engineering loop [Rai03].

A service model should provide sufficient means of configuring and controlling charging, billing and revenue assurance. End-user self-management and personalization of services also need to be supported. Summarizing the challenge faced by developers of service models, they need to be flexible, yet concrete. This is challenging, but possible to achieve. The key to making it all happen is to provide a generic and flexible enough basis and then apply technology-specific understanding to the problem.

7.3 EXISTING SERVICE MODELS

Next, we shall review existing previous and ongoing activities relating to service models and frameworks. Before discussing service models, a few words about modelling in general are in order. The reason for this the fact that a service model is also a representation of what is being managed.

Parsons [Par96] discusses a formal information structuring model based on the premise that an information system represents knowledge about entities in an organization. The model is based on classification theory, and relative cognitive foundation is discussed in the article. The authors point out that an information model doesn't need to be an ontological model of the real world, but rather one that is natural from the viewpoint of human perception. Some of the important factors from a cognitive viewpoint include the principle of cognitive economy, and a suitable basis for performing cognitive inference. Parson's model includes (as basic constituents) objects, their properties, structural and relational properties, the ability to represent change, generalization of entities to classes, and composition of instances of concepts into aggregate ones having emergent properties not contained in the element instances. The author argues that multiple classifications should be supported.

Mayer [May89] uses data from experiments for providing guidelines for devising conceptual models. In line with Parsons' argument, Mayer stresses the importance of inference, listing some criteria for a successful conceptual model in the form of seven Cs:

- completeness
- conciseness
- coherence
- concreteness
- conceptuality
- correctness
- consideration.

The bottom line is that the model should contain the essential features, but no unnecessary details. The model should also be concrete and coherent.

Let us next study some service models within the research literature. The definition of the concept of service having been interpreted in various ways, the sources cited below approach service modelling from different angles. Nevertheless, they provide useful insights into our attempt to list the essential features of a service model.

Garschhammer *et al.* approach service management by proposing a top-down methodology for analysing actors and relationships that belong to service management [GRH+01]. The methodology seeks to model organizations, workflows and service lifecycles by studying and classifying interactions during different phases of the lifecycle. This, in turn, leads to identification of relevant objects and interrelations. The authors also address the need to develop common terminology by proposing a generic service model, which has provider-specific, customer-specific and common definitions. Service quality parameters are cited as an example of the latter.

Hasselmeyer considers issues of importance for dynamic linking of services in [Has03]. A service within the context of this work means an entity in a distributed system offering functionalities to other entities. Clients, in turn, make use of functionalities but do not provide them. A component may be either a service or a client. In the system, called Dynamic Service Network, clients and services can link to each other dynamically (run time) in this paradigm. Components are not tied to a particular host. This means that the system needs to be able to cope with replacement of services from one provider with substitutes, should the original service become unusable. Each service is considered to have its own lifecycle, consisting of design, implementation, activation, operation and withdrawal phases. Service management architecture is only involved in the lifecycle once a service is ready to be deployed. Service management operations include installation, activation, deactivation, removal, migration, replication and updates. The system being dynamic, there is a need to express dependencies between components. Hasselmeyer goes on to analyse the consequences of managing the distributed service system with dependencies. The most important ones relate to the need of the management system to discover inter-dependencies between services, and for the entities to try to take dependencies into account during planned shutdown of services.

Rodosek has considered a generic service model for Information Technology services and service management in [Rod03]. He argues that the paradigm shift from device management to service management requires a generic service model to accommodate linking of services as managed objects into device-oriented ones. Rodosek goes on to say that development of a common service model is a fundamental issue. In a reference model for the service model, he considers three parts: customer, service and provider. Customer and provider are roles. The service part includes role-independent definitions, such as information about constituent sub-services and Quality of Services (QoS) parameters. Each role, in turn needs information relevant to them. The provider-centric part of the service model includes steps required in managing services, definition about quality of services in the form of provider-centric QoS parameters (quality, cost and market demands), and policies related to operating services. The most important part of the customer-centric part, in turn, is considered to be QoS parameters. A workflow is outlined in the article for constructing the different parts of the model, in the form of three steps:

1. A Service Template Model (STM) is created for the service-centric part.
2. An STM is devised for the provider-centric part.
3. An STM is devised for the customer-centric part.

An STM beneath another STM is considered to be a refinement of the one above. Rodosek describes in more detail the contents of each STM type.

Rodosek and Lewis discuss dynamic service provisioning in [RL01]. The central idea is that customers are able to review a set of service packages, select and customize packages, send their selection to a service provider, and have the selected set of services implemented by the service provider. The implementation part includes deployment, monitoring and other management aspects. The proposed scheme requires automated case-based reasoning, for which the use of service templates as an enabling technology is discussed. What is needed is mapping between user viewpoints. A user is typically interested in service functionality, service level definition and reporting. The provider, in turn, needs to define functionality, resources, provisioning and management steps, and policies. The use of service templates for accommodating the user and provider parts for this is discussed in the article.

Martin-Flatin *et al.* discuss management information models in [MSW03]. The authors start by referring previous efforts within in IETF, Distributed Management Task Force (DMTF), the International Telecommunications Union (ITU), the International Organization for Standardization (ISO), the Open Management Group (OMG), The Object Group (TOG), TMF, the Internet Research Task Force (IRTF) and the Global Grid Forum (GGF). In the authors' view, the management information models devised up to now have been incomplete and even incorrect. Furthermore, the authors say that in the area of management information models reusing the work of other standardization fora has not succeeded. A third challenge, the balance between an abstract model and one riddled with too much low-level information, is described as one that has been difficult to achieve. Finally, the learning curve for the existing models is viewed as being too steep. The authors propose a new model, in which "universal information models" (UIMs) are object-oriented abstract models independent of particular technologies that are shared between standardization organizations. The UIM is then mapped to technology-specific data models, such as Common Information Model (CIM) schemas or Simple Network Management Protocol (SNMP) Management Information Bases (MIBs). For complex systems, there may be separate conceptual UIMs and specification UIMs on a technology-independent level. The authors also consider lifecycle issues for the management model itself, stating that during UIM creation, the phases of prototyping and refinement should be carried out. The reason for this is that it is difficult to get the models right in the first attempt. Furthermore, the maintenance and refinement steps can be used later to update the model.

Garg *et al.* discuss the challenge of automatically determining service configurations in a dynamic environment in [GGM03]. They propose an auto-discovery mechanism for services. The following aspects of service discovery are discussed: specification of which services to discover, efficient means of distributing service discovery, and matching of instances of services into groups. The importance of configuration discovery is discussed in the concept of the lifecycle of a service; service management needs to deal with relationships between entities, the effective execution of which requires that information about configurations of components can be conveniently acquired. The authors' solution to the technical challenge includes templates, models, scripts, agents and software bus. The discovery "engine" makes use of instances of service templates. The service template may also include information about the order in which components are discovered.

We now move on to discuss service models in the industry and in the standards. Activities within standardization and other industry initiatives are based on related research both within the academic world and inside corporate R&D centres.

3GPP faces the multiplicity of packet-based services by classifying services into four *traffic classes* [HT00, KP01]:

- conversational;
- streaming;
- interactive;
- background.

Of the four traffic classes, roughly speaking *conversational* is suitable for supporting (multimedia) telephony, *streaming* is suitable for content streaming, *interactive* is suitable for browsing and *background* is suitable for data transfer. A 3GPP terminal may specify the traffic class (as well as other service quality and connectivity parameters) upon requesting bearer activation or modification. The 3GPP bearer model supports multiplexing multiple flows onto a single bearer as well as dynamic linking of bearers to SIP session information.

The DMTF has worked on a object-oriented information model called CIM. The CIM was devised for the purpose of integrating existing management architectures, and includes formal definitions of services, allowing for hierarchical and modular composition of services using other services. The CIM had no notion of domains in the model.

The Policy Management working group of the IETF has developed an object-oriented information model for representing Quality of Service-related information needed by network management within the scope of IETF [RFC3644]. The model covers Differentiated Services (DiffServ) and Integrated Services (IntServ) variants of IETF service quality support schemes.

As part of the Next Generation OSS (NGOSS) programme, the TeleManagement Forum considers various aspects of service modelling, as described in Chapter 5. The enhanced Telecom Operations Map (eTOM) team studies processes relevant to operators' and providers' business and technical environments, of which service management is a part. Shared Information/Data (SID) team studies models for information that is needed for executing eTOM processes, making use of prior achievements of DMTF and IETF. The Lifecycle team studies lifecycle aspects by considering the effect of different NGOSS views (business, system, implementation and deployment) on the work of other TFM teams. As practical tools, the lifecycle uses the concepts of contracts and policies. The Service Framework Team (SFT) studies service management from the viewpoint of a service lifecycle and roles participating in it. At the time of writing, there is no single fully validated service model existing that would cater for all the needs described earlier in this chapter. The NGOSS framework of TMF, however, is probably the most credible attempt at a comprehensive framework at the moment, and experience brought in with implementation experience can be expected to bring in the missing practical aspects. The mapping between SID and OSS/J concepts provides a way of validating the concepts, and SID has been successfully used in individual system integration projects.

The business view of the service model of the Shared Information/Data team is built around three kinds of key entity types [GB922]:

- *products* describe commercially sellable items;
- *services* are technical implementations that are used as building blocks for products;
- *resources* are used by services.

Each key entity type has a specification associated with it, so that – for example – *service*s are described as parts of *service specification*s. A *service* interfaces to a *product* via a *customer-facing service*, and to

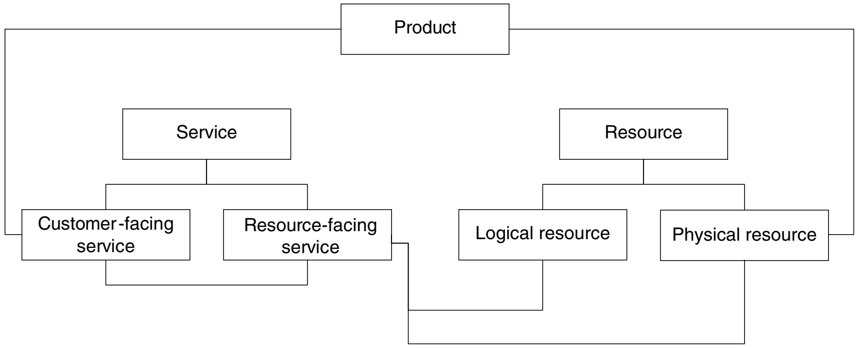

Figure 7.5 The interrelationships of core service-related SID concepts

resources via a *resource-facing service*. The *customer-facing* and *resource-facing services* are viewed as specializations of the class *service*. Aggregation on *service* and *service specification* levels is not allowed, but SID allows for composing of aggregate *customer-facing* and *resource-facing services* by linking together other *customer-facing* and *resource-facing services*, respectively. Requirements for a *service* are managed via characteristics of a *product* through *customer-facing service* abstraction. The interrelations of the central SID concepts are illustrated in Figure 7.5. The figure is a simplification, and the actual SID model is described using Unified Modelling Language (UML).

The SID also includes a framework view for linking SID to eTOM processes.

Universal Business Language (UBL) is an e-business standard that is being standardized within OASIS, with the main goal of providing a basis for system integration within business support systems. The goal is to develop a library of basic business tools such as invoices in XML format. UBL constructs business tools using basic building blocks. UML is used for providing a high-level view to conceptual models. Currently, UBL has not yet been widely adopted.

Next, we shall provide a few examples relating to service modelling relating to the application of standards within conceptual frameworks.

Papazoglou and Georgakopoulos introduce the concept of service-oriented computing in the form of architectural components in [PG03]. This concept is one formulation of the "Service-oriented Architecture" (SoA) concept. They list the relevant components of service composition, such as coordination and monitoring. The service management architecture allows the existence of service aggregators who make use of other providers' services. Such a value chain, in turn, is an enabler for open service marketplaces.

Curbera and co-authors discuss the web services framework in [CKM+03]. The framework supports composing aggregate services by using other services. The core standards are SOAP, Web Services Description Language (WSDL) and the Universal Description, Discovery and Integration (UDDI) registry [CDK+02]. SOAP is an extensible mark-up language (XML)-based application protocol, typically conveyed on top of HyperText Markup Language (HTML). This protocol may be used to convey XML documents or to implement Remote Protocol Calls (RPCs). WSDL, in turn, is an XML format for describing web services and collections of communication endpoints that can exchange certain messages. UDDI allows the discovery of services in a directory by providing means of defining information that needs to be stored for each service, and the definition of API for accessing and updating the information within the directory. The specification proposal Business Process Execution Language for Web Services (BPEL4WS), in turn, seeks to go beyond the basic operations of describing, publishing and discovering the services. In particular, service composition, transactions, security, reliable messaging and policy are targeted with the proposal [CKM+03]. The OASIS SOAP Message Security standard defines how security functionality, specifically integrity, confidentiality and authentication may be provided at the SOAP messaging layer. The Web Services Interoperability Forum (WS-I) Basic Security Profile currently under development will clarify and amend this standard to promote interoperability.

Berners-Lee *et al.* describe the motivations, methods and goals involved in building the Semantic Web [BHL01]. A vision of the future is presented in the article, where software agents are able to search for medical services in the right geographical area such that the services meet users' preferences with respect to time and other preferences. In addition to software agents, supporting protocols also need to be developed to make such a use of information via the Internet possible. XML is a subset of Standard Generalized Mark-up Language (SGML), and an extension to HTML, with the capability of describing the type of information contained within an XML document using embedded tags. Such a description, however, is not universal, but can be rather viewed as adding document-specific structure to documents. The meaning of the information can be expressed using Resource Description Framework (RDF). The use of RDF is further complemented by ontologies describing the relationships between different concepts. Such rules allow for automated inference. More technological discussion about semantic web services can be found, for example, in [MSZ01].

An application of the Semantic Web, Lassila and Dixit discuss the relation of ontologies to web services in [LD04]. DARPA Agent Mark-Up Language for Services (DAML-S) is a web services ontology. DAML – together with Ontology Inference Layer (OIL) – has been proposed as a starting point for Ontology Web Language (OWL), building on RDF [MFH+02]. The authors of [LD04] study a simplified version of DAML-S for automatic discovery, composition and invocation of simple web services. Specifically, they analyse requirements for performing automatic substitution of service components in a dynamic environment. The basic task is to locate a suitable replacement for a component which becomes unavailable. The challenge is that exact match for the missing component may not be available. In such a situation, the search for a new component may yield no matches. In such a case, the software agent may need to make a search with less detailed search criteria. If no exact match is found, it is also possible that further components may be needed.

7.3.1 Summary

The following concepts can be identified from the above literature and standards overview as being useful for service management.

End-user related aspects:

- cognitive aspects of service models;
- classification and parametrization of end-user services;
- end-user customization of services.

Service management aspects:

- service management roles;
- processes;
- workflows;
- lifecycles;
- policies.

Modelling aspects:

- different levels of service models, specialization of generic descriptions into domain-specific technologies;
- support for automated case-based reasoning;
- use of templates;
- reusable components;
- web services model: service registries;
- Semantic Web: ontologies support automated reasoning.

7.4 SERVICE MODEL FRAMEWORK

Next, we shall describe an outline for service model accommodating the above requirements. We are not going to describe the actual service model, but rather a framework in which the necessary actions can be carried out, and necessary information provided to relevant parties. High-level procedural steps defining the service model are:

1. Identify market requirements for the service.
2. Write technical requirements for the service.
3. Design the composition of the service.
4. Implement the service.
5. Pilot the service.
6. Launch the service.
7. Service is in operational use.
8. Retire the service.

In NGOSS, the above steps could be distributed among the business, system, implementation and deployment views. Note that the process is not always strictly linear, but could involve iterative steps as well. Some requirements for service modelling relating to the above steps are:

1. Service model needs to have a placeholder for market requirements.
2. Service model needs to have a placeholder for technical requirements.

3. Service model needs to be able to accommodate components and their attributes and inter-dependencies.
4. Service model needs to provide sufficient information for the implementation of components.
5. Service model needs to accommodate gathering information about service performance.
6. It shall be possible to link services to users or subscribers.
7. As in step 5 + gathering of usage information.
8. Interdependency analysis between components must be accurate.

Again, bear in mind that the process is not necessarily sequential, but returning to previous steps may be needed. The service model needs to relate to roles by allowing different roles to view and edit information that is relevant for them. The service modelling framework shall support the maintenance and accessing of a directory of service components. Two basic types of use cases can be identified for the directory:

- *Internal use*: This use case means maintenance of internal and external components which are relatively stable. For example, directory-enabled policy-based networking could be used for achieving this, but is not the only way.
- *External use*: This use case provides services for external use on a dynamic basis. The technical solution for implementing this needs to pay more attention to distributed solutions than the former.

The first of these use cases is the primary topic area of this book, making the implementation of new mobile services less of a system integration project and speeding it up. It calls for a precise definition of different management roles in the workflow related to service management. The management of the workflow typically takes place using a service management system.

Web services technologies are applicable to both use cases, since web services technologies may be used to "wrap" legacy systems and promote service interoperability, both internal to an organization and between organizations. Web services are gaining support and achieving rapid deployment as a technological step towards service-oriented architectures, both for internal and external uses, and web services offer a simple mechanism allowing incremental deployment. Future extensions to web services technology will allow more extensive workflow and business process management, work such as BPEL4WS, but full support for dynamic service-oriented architectures is challenging. Regardless, web services are applicable to the service models discussed in this section.

In addition to the issues discussed earlier, the contents of a "wish list" for the technical requirements for service model will be discussed next.

The service model shall be able to represent entities, their properties and interrelations. The model should be sufficiently generic so that new kinds of services can also be expressed with the basic model. At the same time, the model should be simple and understandable. Furthermore, in view of cognitive aspects discussed earlier in this chapter, the model should also be coherent and concrete. It should include abstractions suitable for the reusing of configurations, such as service templates and components. Some more detailed issues include

- linking of resources
- linking of services into aggregate ones
- dependencies between components.

The model shall support multiple abstraction levels so that services can be composed without having to worry about technology specific details. The preferred way at the moment is using a technology-independent model and a technology-specific model. In the TeleManagement Forum, this goal has been pursued with the Technology Neutral Architecture (TNA). In view of the anticipated importance of multi-access networks, the technology-independent model should be able to express, for example, service quality-related aspects of services in a generic manner such that they can be mapped on to technology specific parameters such as 3GPP bearer parameters or 802.11 WLAN parameters. Similarly, the service model should allow for creating different variants of services for different end-user classes and different terminal types.

The service model should be able to express policies related to different actors. Specific examples of this include:

- policies related to legislature
- operator-or provider-specific policies
- end-to-end policies for a service class or a service
- end-user policies (preferences).

The service model should accommodate service assurance and usage data in such a form that it can be related to services that are configured to the network. This information is needed both for business management of the services, upgrading and maintaining the network, service assurance, and for optimizing the network for a particular mix of services. The service model should also support anonymization of service information relating to a particular end-user so that it could be provided to service providers.

Terminal and service usage context-related information should be accommodated. Relating to terminals, the service model should be able to store the following information: terminal capabilities, supported protocol stacks and supported access technologies. Relating to usage context, the information that would go into the service model can only be guessed at. Location information is a present-day example. Privacy aspects are again important here – the end-user should be in control of what kind of context information is available for particular kinds of actors.

The service model needs to be able to express requirements and characteristics for services end-to-end, from the service providers' domains to the end-user. The model should also allow for partitioning of end-to-end parameters into domain-specific parameters. As discussed in Chapter 6, such requirements fall into several technical categories. Taking an example relating to service quality, the end-to-end delay for streaming service could be designed, allowing for parts of the end-to-end "delay budget" to be allocated to service providers' domains, mobile access network and end-user terminal [Rai03]. The last part in this particular example would include de-jitter buffering and decoding of streamed content. This example is a good one in the sense that it explicitly includes terminal-related parts, indicating that knowledge of terminal properties is important for service management.

Over the longer term, dynamic linking of services should be allowed for, including:

- discovery of services
- maintenance of service descriptions
- automated replacement of components
- Maintenance of the necessary ontologies.

The reuse aspect of service management can be implemented by modelling services and resources as components, which are linked

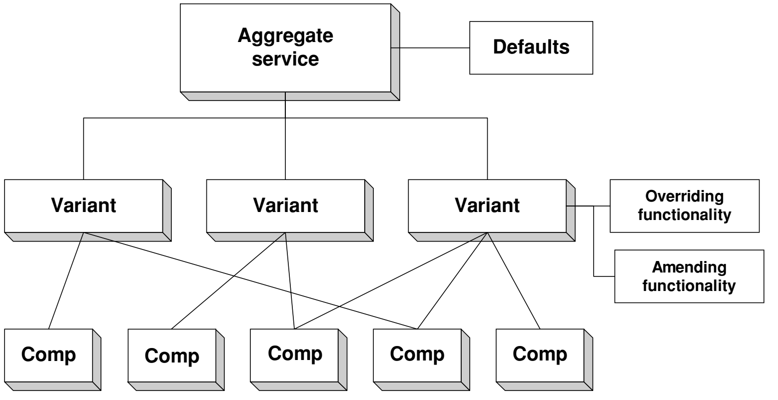

Figure 7.6 The relationship between aggregate service, service variants and service components

together. An example of such a component approach from TMF was shown in Chapter 4.

One way of devising a service model is shown in Figure 7.6. The aggregate level describes defaults for the entire service, including default functionalities, requirements and characteristics. The aggregate level also describes the components that can be used.

Separate service variants are created for particular access technologies and user groups, which can use the defaults of the aggregate service, override some of the defaults, and also amend the default functionality set. The variants are linked to a subset of the available component space. Note that parametrization of components may depend on the variant.

7.5 EXAMPLE: AUGMENTED VoIP

The commercial product in this case is a collaboration package for mobile users. The customer segments the product is targeting are business users on one hand, and special interest groups within "economy" users. Planning for public events could be an example of the latter. The "business" segment, it is assumed, possesses more capable terminals with advanced business applications, whereas the "economy" segment terminals only support basic communications (telephony, GPRS transfer, chat). The supported access technologies are GPRS and WCDMA. All components are assumed to be hosted by the service provider in this example for simplicity. End-to-end performance requirements for components are defined for the product on a high level: for example, the data transfer rate must be high for business users.

The service implementing the commercial product is called "augmented VoIP", and it consists of a subset of the following components:

- Voice over IP service
- multiparty chat
- document sharing
- data storage.

Detailed component-specific default performance levels are defined as part of the (aggregate) service definition. Resources required for implementing each service component are also defined at this stage. The resources used in implementing the service are:

- GPRS access:
  - interactive traffic class bearers
  - background traffic class bearers
- WCDMA access:
  - conversational class bearers with dynamic authorization
  - interactive class bearers
  - background traffic class bearers
- IMS server
- chat server
- collaboration server
- data storage server.

Two different variants are defined for the aggregate service:

- business variant:
  - includes all components
  - high throughput for data transfer
- Economy variant:
  - does not include document sharing
  - does not include data storage.

The workflow for product and service creation proceeds as follows:

1. *Product is defined.* This means design of the targeted user segments and access technologies, as well as high-level design for the properties of the products.
2. *Service is designed.* Business requirements are mapped to technical requirements to service components. Examples of these include service quality targets.
3. *Requirements for resources are generated.* This phase relates to assessment of the kinds of resources required to implement the service.
4. *Resources parameters are filled in.* This phase means implementation of service design criteria by adding the missing parameters of the components, such as GPRS bearer parameters and configurations of servers.
5. Service is enabled for subscribers.

From a service lifecycle viewpoint, the following phases can be identified:

1. Product creation phase
2. Service creation phase
3. Piloting phase
4. Service deployment phase
5. Service monitoring
6. Modifications to service composition and component parameters
7. Service retirement phase.

7.6 CONCLUSION

Service modelling is important for facilitating flexible service creation processes with multi-party participation as well as for workflow management. The requirements for service modelling have been identified based on discussions in previous chapters, as well as prior literature and standards. A framework was presented for accommodating service modelling. Promising standards are being developed for facilitating these needs. Nevertheless, there will be a need for corporation- and vendor-specific modelling, in addition to generic service models.

An emerging area in standardization, the lifecycle of business processes needs to be taken into account in constructing service models. The service model needs to lend itself to being associated to business, system and implementation information. The service model can be thought to be a language for operating the lifecycle of a service. The model does not need to be a single information model, but the data needed by different phases of the lifecycle need to interface to each other as seamlessly as possible.

The model cannot be expected to be perfect, and in any case needs to be reviewed and tailored according to evolving business process needs and technologies. Thus, the process of maintaining the service model needs to be considered.

An interesting issue for service management is the role of Web Services Interfaces (WSI). The current situation can be viewed from two viewpoints: those of mobile network operators and service providers.

The role of web services are expected to increase for both operators and service providers, in order to rapidly bring new mobile services to end-users:

- *short term*: support automation of service provisioning;
- *mid-term*: web services deployed to enable interoperability of web services; use of web service platforms such as Serene used to simply service development;
- *Long term*: dynamic web services used to create service-oriented architectures that assemble services dynamically according to business processes. Semantic web and ontologies can be used in conjunction with web services.

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8

Focus Topic 2 – Service Control

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8.1 INTRODUCTION

This use case describes service control in mobile networks. With service control, it is possible to improve the user experience of various services. Improving the user experience is particularly important in mobile networks where the radio spectrum is typically expensive. Capabilities described in this use case have thus been developed for various types of mobile networks, e.g. for General Packet Radio Service (GPRS), Wideband CDMA (WCDMA) and Wireless LAN (WLAN). Those capabilities may, however, be used in other types of networks, e.g. in fixed networks, as applicable.

Actors of this use case are as follows:

- *End-user (subscriber)*: An end-user may have multiple subscriptions towards a mobile network operator. The end-user may be using a GPRS/WCDMA handset for telephony and real-time services, or a laptop with a GPRS Personal Computer Memory Card International Association (PCMCIA) card for data-type services as the endpoint. The endpoint may have varying capabilities, and may implement only the bare minimum of features required by standards.

Managing Mobile Services U. Koivukoski, V. Räisänen
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- *Mobile network operator*: A mobile network operator is assumed to have a subscriber base and/or provide prepaid services. It is assumed that the core network of the mobile network operator may also interface to non-cellular access domains, such as WLAN.
- *Service provider*: A service provider may be external or part of the mobile operator group. Services may be subcontracted by the mobile network operator and provided to the end-user as part of the subscription, or may require a separate subscription.

The technical capabilities of access technologies – for example, in relation to service quality support – are assumed to be according to current standards, as described in Chapter 6.

8.2 MAIN CONCEPTS

8.2.1 Services

In this use case, a service refers to a subscriber service, which is subscribed to either by the subscriber herself, or by the mobile network operator. The subscribed services are visible in the subscription profile, which the mobile network operator stores for the subscriber.

Voice has been the most important service for quite some time and will continue to be so in the near future. New services are, however, rising and many of them are built on top of the IP protocol (e.g. content downloading, browsing, streaming video, rich calls, etc.).

8.2.2 Service flows

For service control purposes, a service is identified by one or more service flows. A service flow consists of sequential packets and is detectable in packet classification by a service flow classifier. The main purpose of defining a service flow is to enable the detection of the service flow in order to apply a set of data handling functions to the packets of the service flow. The data handling functions to be applied to the service flow depend on the service and subscription requirements. As an example, a service flow may have to be charged online and may have specific Quality of Services (QoS) requirements to be fulfilled.

8.2.3 Access bearers

The end-user needs one or more access bearers to send and receive service flows of IP-based services. Access bearers are logical connections between the terminal of the end-user and the gateways of the mobile network. Typical examples of access bearers are primary and secondary Packet Data Protocol contexts of GPRS/WCDMA, or security tunnels of WLAN.

Service flows may be multiplexed into an access bearer. The current trend is to decrease the number of access bearers an end-user needs for his services. For example, in GPRS/WCDMA, early terminals and network nodes support a limited number of Packet Data Protocol (PDP) contexts per end-user. In order to use various types of services, service flows are multiplexed into a PDP context.

8.2.4 Rules

In this use case, a rule consists of a rule classifier and a rule instruction. The rule classifier is used to identify packets to which the rule instruction is to be applied. The rule instruction identifies the data handling function to be applied. As an example, the rule classifier may indicate a service flow, and the rule instruction may indicate how to charge the service flow. Both the rule classifier and the rule instruction may be static or dynamic. If both are static, the rule is static. If either is dynamic, the rule is dynamic. Static rules can be configured to the system, and service management plays an important role in the rule configuration. If a rule is dynamic, the service control is involved in the rule provisioning. Multiple rule instructions may be applied to the packets identified by the rule classifier. As an example, a rule instruction for charging and a rule instruction for QoS may be applied to the same service flow.

8.3 BUSINESS SETTING

Original GPRS and WCDMA networks have been designed for operator provisioned services. Service quality, charging and other aspects of the services are determined by allocating them to a particular provisioning point at the network edge. This point is called an access point in the standard GPRS/WCDMA terminology. The Access Point Name (APN) needs to be configured to the terminal in order for respective services to be used. The proper allocation of resources for the services is important due to the high price of spectral resources for mobile networks operating on licensed frequencies. Third Generation Partnership Project (3GPP) Release 5 (R5) and subsequent releases also support dynamic allocation of resources according to parameters negotiated for a Session Initation Protocol (SIP) session.

The GPRS/WCDMA service provisioning scheme supports external service providers. Charging by both the mobile network operator and service providers is possible within the framework. Operators may wish to present a single monthly or bi-monthly bill to the subscriber about a core set of services, in which case charging information needs to be made available to the mobile network operator. It is typically easier to perform charging at the mobile network operator domain.

The standard GPRS/WCDMA provisioning scheme is clear and understandable. It has, however, one clear drawback: the APNs need to be configured into terminals. If differentiated charging and service quality allocation at service granularity is desirable, a large number of APNs should be configured to the terminals. This is not desirable.

A further challenge for service provisioning is management of terminal capability diversity. The 3GPP standards are rich in features, but the set of mandatory features is much smaller than the set of all features. To give an example, a GPRS or WCDMA terminal is not required to fill in all parameters when requesting an access bearer (i.e. a Packet Data Protocol context). For these reasons, work has been ongoing in 3GPP and the Third Generation Partnership Project 2 (3GPP2) to make service control granularity finer at the network edge. At the same time, there has been pressure to support multi-access aspects in 3GPP and 3GPP2. The work encompassing these aspects will be summarized in the following sections under the title of "Intelligent Edge", an adequate name for the next-generation architecture.

8.3.1 Core network evolution – intelligent edge

The core network offers connectivity to end-users. The connectivity is a basic requirement to use services. Current cellular networks have shortcomings, e.g. in respect of bandwidth and delay, with which some of the services may be inconvenient to use. Additional functionality above connectivity is needed to improve the user experience.

The core network is constantly evolving for improved user experience and efficient mobile network resource usage. The evolved core network, the Intelligent Edge, resides between access networks and services. Various access networks can be connected to the Intelligent Edge through gateways as presented in Figure 8.1. The cellular access networks (e.g. GPRS and WCDMA) may be complemented by wireless access networks (e.g. WLAN).

The service core of the Intelligent Edge offers a set of common functions, which are available for various services. The service core consists of the connectivity layer and the service control layer. The former offers access to the services and the latter controls access based on service and subscription requirements. The service control layer offers various functions such as an authentication function, an authorization function, various policy control functions and functions for offline and online charging. The service enablers of the Intelligent Edge are elements, which have become a prerequisite for service implementation. Typically, these are servers and proxies offering support for a particular service implementation, such as support for content download, browsing, streaming video or rich calls.

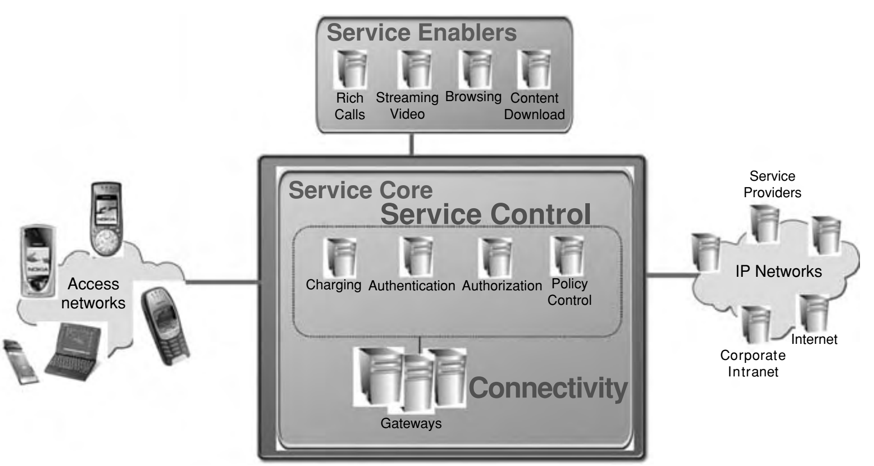

Figure 8.1 The Intelligent Edge. Reproduced by permission of Nokia

The characteristics of the access networks may not be on the same level. For example, from the QoS point of view, cellular access networks such as GPRS and WCDMA fully support both non-real-time and real-time services, whereas in complementing wireless access networks such as in WLAN, only non-real-time services are supported. The access networks are, however, continuously evolving to meet the requirements of the arising services.

8.3.2 Connectivity

The connectivity layer offers connections, e.g. GPRS, WCDMA and WLAN connections, to end-users. In this use case, these connections are called access bearers. In the connectivity layer, the gateways (e.g. the Gateway GPRS Support Node of GPRS and WCDMA or the Packet Data Gateway of WLAN) play a key role. Access to services is offered in the Intelligent Edge through access points located in the gateways. The terminal may request a specific access point to use services supported within that access point. If the access point is not requested by the terminal, the network determines the access point. The access points authorized for the subscriber are provisioned in the subscription profile, which is stored in the service control layer.

To send and receive service flows of IP-based services, the terminal initiates access bearer establishment. The access bearer is a logical connection between the terminal and an access point in the gateway, and it enables the gateway to forward packets to and from the terminal. At access bearer establishment, the attributes for the access bearer are indicated to the gateway. Such attributes may be, for example, the identity of the user requesting the access bearer establishment, the requested access point or the QoS attributes requested for the access bearer. The gateway is allowed to modify some of the attributes, and the result of the access bearer establishment is indicated to the terminal. The terminal may leave most of the attributes undefined, in which case the network determines those attributes.

The access bearer may be modified during its lifetime. There may be a need to modify the QoS attributes of the access bearer, for example. The access bearer modification may be initiated by the terminal or by the network, and it results in applying the new set of agreed attributes in both of those. The access bearer is released when it is no longer needed for packet forwarding. Release may be initiated by the terminal or by the network. The terminal may release the access bearer e.g. when a service is not used, and the network may release the access bearer e.g. when packets on the access bearer have not been received for a certain time. In the connectivity layer, network functions such as packet classification, charging, QoS functions (e.g. policing, shaping or marking) and packet forwarding/dropping are performed for the packets on the access bearer.

Summarizing, the connectivity layer enforces rules assigned by the service control layer. We shall discuss the service control layer next.

8.3.3 Service control

The network functions performed in the connectivity layer are controlled by the service control layer. The service control layer contains functions such as authentication, authorization, various policy control functions and functions for offline and online charging.

8.3.3.1 Authentication

Authentication of the end-user is typically performed in the access networks, such as in GPRS and WCDMA, but the gateway also has the capability to initiate authentication. This may happen if authentication in the access network has not taken place in a trusted manner. Authentication verifies the claimed identity of the subscriber. Various authentication mechanisms may be supported. A commonly used mechanism is based on a username and password pair. Authentication may also be performed by subscriber certificates: the terminal requests a subscriber certificate and can later use that for authentication purposes.

8.3.3.2 Authorization

At access bearer establishment, the gateway may validate whether the usage of the requested access point is granted to the subscriber. This authorization is performed with the help of a subscription profile, which is stored in the service control layer.

As part of authorization, the set of services allowed on the access bearer may be determined. The end-user is supposed to use the access bearer only for this set of services, and the gateway forwards packets of those services.

The subscription profile may be modified. This in turn may result in a need for an authorization update. For example, a previously authorized access point may be removed from the subscription profile. This kind of authorization update should result in the network releasing the relevant access bearer(s).

8.3.3.3 Policy Control Functions

The service control layer may contain various policy control functions. These functions are used when there is a need to apply dynamic rules for access bearers or service flows.

Control of Gating

In the user plane, a gate is implemented in the gateway. A gate is a policy enforcement function that interacts with the service control layer for authorization of a unidirectional flow of packets. Open/close gate operations are used to enable/disable service flows. The gate operates on a unidirectional flow of packets, i.e. in either the upstream or downstream direction. When a gate is enabled, the packets in a flow are subject to treatment by the data handling functions in the connectivity layer (e.g. charging and policing/shaping/marking). When a gate is disabled, all the packets in a service flow are dropped.

As an example, when an IP multimedia session is established, the gate(s) for the media components of the session may be disabled until the media components are allowed to be sent or received. When the media components are allowed to flow, the gate(s) are enabled.

Control of Charging

An access bearer and service flow may be associated with a charging rule. The charging rule of a service flow enables service-specific differentiated charging. A charging rule contains information that enables the classification of traffic on an access bearer to identify the packets belonging to a particular service flow and define how the access bearer or service flow is to be charged. Charging rules are defined by the operator and are available for both offline and online charging. For example, an operator may want to charge the media components of an IP multimedia session so that the real-time media components are charged per second whereas the non-real-time media components are charged per octet. Online charging can be applied for prepaid customers whereas offline charging can be applied to those customers wishing to receive a bill for the services used.

Control of QoS

Control of QoS applies to access bearers or service flows. The QoS class and bit rate of an access bearer or a service flow can be controlled. The QoS class may be mapped to access network-dependent QoS attributes in the gateway. The QoS of an access bearer is supported end-to-end between the terminal and the gateway, whereas the QoS of a service flow may be supported by the gateway.

For example, the media components of an IP multimedia session, e.g. audio or video, may have different QoS characteristics. The QoS requirements of the media components can be indicated to the gateway, which takes them into account when deciding on the QoS treatment to be applied to the media components.

8.3.3.4 Online Charging – Credit Control

Credit control controls and monitors charges related to service usage. This contains checking whether credit is available for an end-user, reserving credit from an end-user's account and determining remaining credit after service usage.

As an example, if the end-user establishing an IP multimedia session is a prepaid customer, credit for the media components is checked and reserved at session establishment and during the session. When the session is released, the remaining credit is determined.

8.3.3.5 Offline Charging

Offline charging applies to access bearers or service flows. The gateway collects information on the access bearers or service flows into charging data records (CDRs) and sends the charging data records to the service control layer for billing purposes. The charging data records contain information identifying the end-user and information about the network resources used (e.g. QoS of the access bearer/service flow, octets forwarded or lifetime of the access bearer/service flow). For example, if the end-user establishing an

IP multimedia session is a postpaid customer, charging data records for the session and media components of the session can be created and used to bill the customer for the session.

8.3.3.6 Binding Information Handling

Binding information associates an access bearer or service flow with attributes used for service control purposes. Binding information is dependent on the service, and it may be sent by the terminal or determined by the network. Binding information is received by the gateway and is forwarded to the service control layer. For example, when establishing an IP multimedia session, a token is allocated for the session. At access bearer establishment or modification, this token is sent by the terminal to the gateway, which then forwards the token to the service control layer, where the token is used to determine the attributes to be used when performing service control for the access bearer. If attributes from the subscription profile are to be used for service control purposes, user identification is used as the binding information to locate the subscription profile.

8.4 SERVICE INFORMATION

Service information includes all the configuration information which is stored, shared and used by different Intelligent Edge elements in order to apply the required data handling functions to access bearers and service flows.

The term "service information" means in this case information that is required for controlling services within the Intelligent Edge. It is useful to contrast this with "service model" as used in Chapter 7. The service model in Chapter 7 is a high-level description of service composition (also known as service topology), which makes use of service information, as described below. Figure 8.2 illustrates the relation between the two conceptual levels.

A common service information structure is used to communicate configuration information to Intelligent Edge elements. The service information structure is shared by those elements, still allowing different elements to utilize different views of the service information structure. The service information structure is synchronized between the Intelligent Edge elements at service creation, modification and deletion. This is performed by service management.

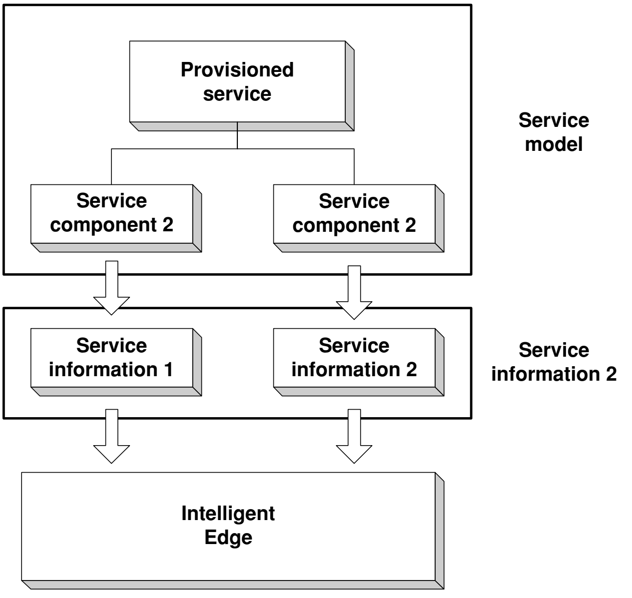

Figure 8.2 An illustration of the relationship between a service model and service information. Reproduced by permission of Nokia

In this use case, the service information structure contains access point-specific information, service-specific information and rule instruction-specific information. The access point-specific information contains, e.g., the name of the access point and the addresses of various servers within the access point. The service-specific information contains, e.g., the name of the service, the related service flows and their classifiers, and the static rule instructions of the service and service flows. The rule instruction-specific information contains, e.g., the name of the rule instruction and the actions required when enforcing the rule instruction.

8.5 SERVICE CONTROL PROCEDURES

The following sections present examples of service control procedures. The procedures are simplified in the figures and following descriptions so that the most important signalling messages and attributes are included and explained.

8.5.1 Service control at access bearer establishment

Figure 8.3 shows the communication that takes place between the gateway and the service control layer at the access bearer establishment.

When receiving a request for access bearer establishment (1), the gateway may perform authentication by communicating with the authentication function (2).

When the user has been authenticated, the gateway contacts the authorization function (3). The gateway indicates the identity of the user and the requested access point to the authorization function. The identity of the user is needed to fetch the subscription profile from the subscriber directory (4). The subscription profile is used as the basis for the authorization decision. The authorization decision (i.e. access granted/not granted) and the list of allowed services are indicated to the gateway.

If the access is granted, the gateway contacts the policy control function (5). The gateway indicates the identity of the user and the requested access point to the policy control function. As in authorization, the identity of the user is needed to fetch the subscription

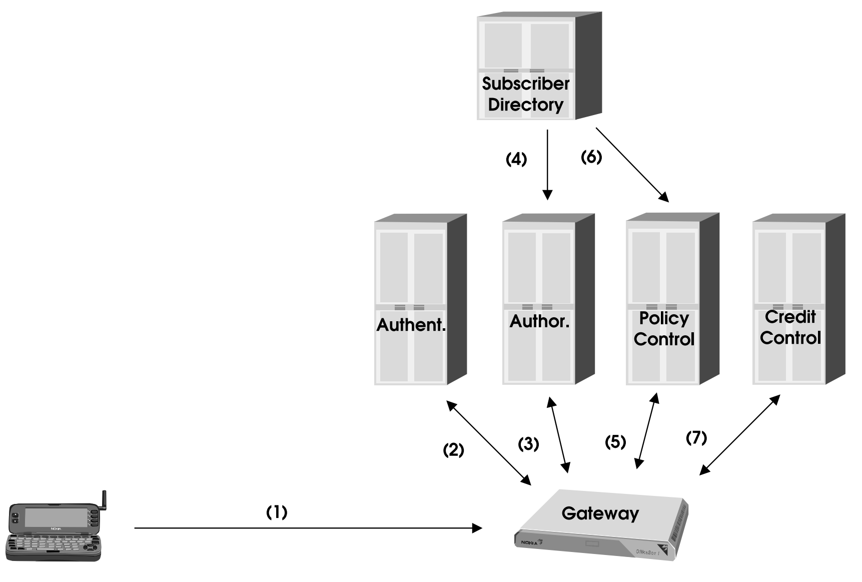

Figure 8.3 Service control at an access bearer establishment. Reproduced by permission of Nokia

profile from the subscriber directory (6). In the policy control function, the subscription profile is used as the basis for creating various types of rules for the policy control decision. The policy control function indicates the rules for the access bearer and/or service flows to the gateway. With a charging rule, the rule instruction may indicate, for example, whether online or offline charging is to be performed. With a QoS rule, the rule instruction may indicate, e.g, the maximum QoS class and bit rate to be enforced.

If the charging rule instruction indicates "online charging", the gateway contacts the credit control function (7), which allocates a quota for the access bearer and/or service flows. This quota is indicated to the gateway. After successful communication with the service control layer, the gateway acknowledges the access bearer establishment.

In this example, the access bearer is controlled mainly using the subscription profile. Additional information for service control may also be provided by the application function (not shown in the figure). This option is particularly useful in IP multimedia services offered by the IP multimedia subsystem. In this case, the proxy call session control function of the IP multimedia subsystem acts as the application function and provides information on IP multimedia sessions and the media components of the sessions to the service control layer for rule creation purposes.

8.5.2 Service control update

During an access bearer's lifetime, there may be a need to update previously made decisions by the service control layer. In this example, the subscription profile has been updated, which results in a need to update the previous rules (Figure 8.4).

The policy control function detects that the subscription profile has been updated. It then fetches the updated subscription profile from the subscriber directory (1).

The policy control function determines which gateway has to be informed about the subscription profile update. The policy control function indicates the updated rules for the access bearer and/or service flows to the gateway (2). The gateway enforces the updated rules. This enforcement may involve initiating access bearer modification by the gateway if an updated QoS rule for the access bearer is received (3). In this example, the subscription profile update acts

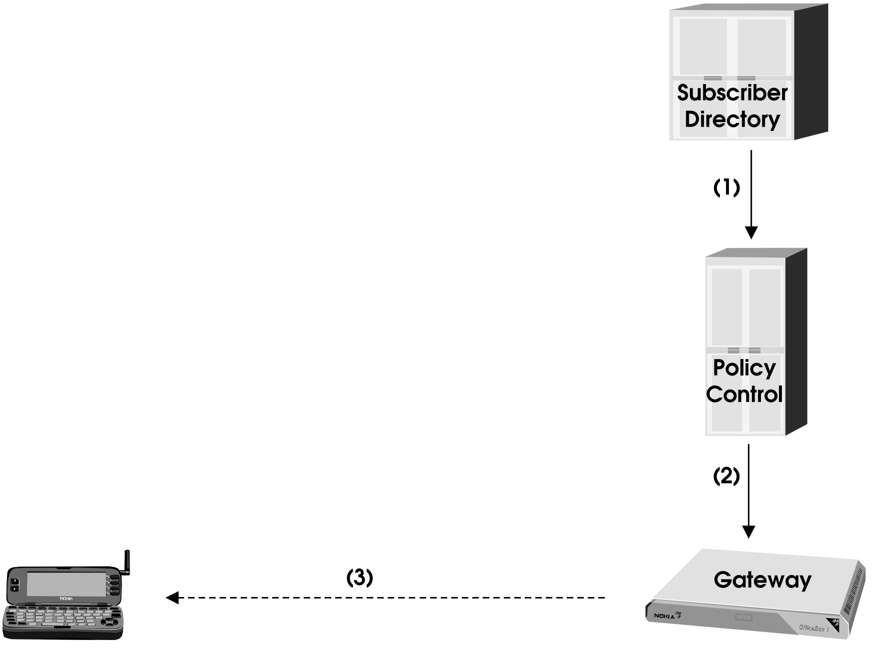

Figure 8.4 Service control update. Reproduced by permission of Nokia

as a trigger to update the rules. The update of the rules may also be initiated by the application function (not shown in the figure). This option is particularly valid in IP multimedia services offered by the IP multimedia subsystem. A state change in an IP multimedia session may result in a need to update the rules. In this case, the application function provides information on the new state of the session to the policy control function, and the policy control function indicates the updated rules to the gateway.

8.5.3 Service control at access bearer release

The access bearer may be released e.g. by the terminal when it is no longer needed for packet forwarding. The network may also initiate access bearer release due to various reasons (e.g. in case of congestion, or to release an access bearer of lower priority to admit an access bearer of higher priority). This is illustrated in Figure 8.5.

The gateway determines that an access bearer is released. The gateway informs the authorization function (1), the policy control

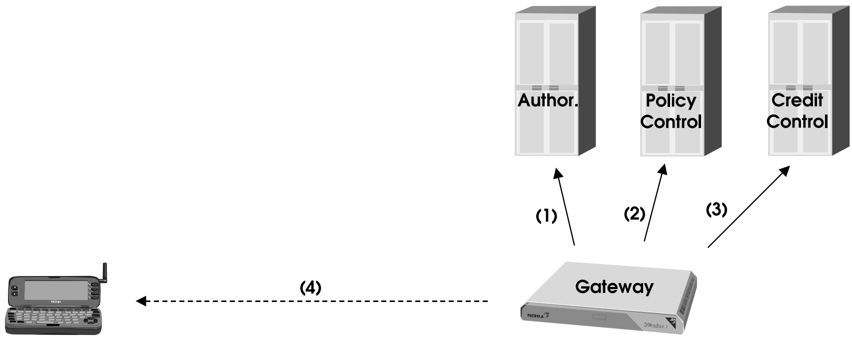

Figure 8.5 Service control at access bearer release. Reproduced by permission of Nokia

function (2) and the credit control function (3) of the access bearer release. These functions of the service control layer may remove the state of the access bearer either immediately or after a timer expiry. When informing the credit control function, the gateway also indicates the unused quota. If the access bearer release was initiated by the network, the gateway sends a request for the access bearer release to the terminal.

8.6 KEY FINDINGS

Hence, the service control capabilities have been defined primarily for the gateway and to serve the needs of the gateway. Service information configured to Intelligent Edge elements may be used for service control purposes, and the service control layer is involved, e.g. when subscription specific service control is to be applied or when dynamic rules are to be created.

Personalization is supported by subscription profiles. A subscription profile is shared by the Intelligent Edge elements so that different elements may utilize different views of the subscription profile.

Authorization and policy control of access bearers or service flows is performed on an access bearer basis. Authorization and policy control updates are allowed. The attributes carried in real-time service control signalling are generic and applicable to various access networks, and the gateway maps from the generic attributes to access network-specific attributes.

Openness is a key principle in the Intelligent Edge. There is a clear need for the products of various vendors to be able to communicate with each other. Open, standardized interfaces allow interworking of these products and reduce the need for interface customizations in product implementations. Due to these reasons, standardization of the Intelligent Edge concepts, elements and interfaces is ongoing in various standardization organizations, e.g. in the Internet Engineering Task Force (IETF), 3GPP, 3GPP2 and the Open Mobile Alliance (OMA).

9

Trends For The Future

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9.1 INTRODUCTION

This chapter discusses potential trends for the future. Some of the emerging technologies and business models have been already discussed in the preceding chapters. Thus, it is useful to clarify what is meant by "future trends" in this chapter.

Regarding the technologies and models that have been previously introduced, this chapter shows how they could be used to provide more value to the different parties in the value chain. This chapter also discusses technologies and models that are in earlier phases than the ones that have been discussed earlier in this book. Finally, this chapter also studies trends related to services from a more general viewpoint than was possible in previous chapters. The ultimate solution that is adopted in a few years may not be the product of technologies or selected value chain models only, but is also subject to factors that affect the global market economy.

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There are many potential future technologies and trends in the making. Not only is the list of "winning ones" unclear, but which will be relevant to service management in the future is also unknown. Indeed, the whole concept of service management and the systems that support it may be subject to change. In any case, new business models and technologies will have an impact.

In an attempt to capture the different aspects of this multiplicity, we shall approach future trends from three viewpoints:

- end-user viewpoint
- business viewpoint
- technology viewpoint.

Traditionally, the technology viewpoint has been considered the major driver for change, with service providers adopting technology because of competitive advantage. Partly because of this, today there is a great variety of technologies to choose from. Today, businesses are more likely to use technology for implementing business models and fulfilling customer needs. Subsequently, changes are driven by the business view to a larger extent than previously. Because of this, in turn, end-users and business models are in a key position to determine the technologies to be deployed. The end-user viewpoint can be seen as providing guidance for the two other viewpoints, ensuring that usability aspects are taken into account.

We shall start by discussing the end-user viewpoint, move on to the business viewpoint, and then cover some of the relevant technologies.

9.2 THE END-USER VIEWPOINT

The end-user viewpoint describes how the different aspects of service use that relate to an end-user may develop in the future. The first aspect relates to the end-user's awareness of the access technology. It can be predicted that the trend is towards services that can adapt to the available access technologies and hide the differences from the end-user. This relates both to different mobile access technologies as well as to the convergence of the mobile and fixed Internet. This sets extra requirements for interoperability and security. It can be also predicted that networking technologies will mature, as increasingly advanced service quality support systems are taken into use. Thus, the end-user's experience of service quality will be improved. This will lead the end-user to expect a stable and predictable service quality. He will not be required to know about the details of service quality to use the services. Should he choose to do so, the technology will nevertheless allow him a greater control of service quality than has been previously possible.

The user will have an easy way to check the cost of different services in order to make informed decisions regarding the use of different services. Support for service personalization will increase in the future. This will mean not only call-forwarding preferences, but also storing of generic preferences that can be used by multiple services. The use of identity-based systems such as Liberty will enable users to experience streamlined and easy-to-use service interactions, even when multiple providers are involved.

Identity management tools that enable users to easily manage their user accounts and the sharing and use of their profile information will play an increasingly important role in the future. Identity management solutions will become necessary to meet legal and business requirements on privacy, to prevent the unnecessary release of personal information and allow communications with multiple providers without enabling providers to correlate activities and jeopardize privacy.

Security will become increasingly important, not only to protect the integrity and confidentiality of information, but also to protect privacy and integrity of systems. This will require ways for users to evaluate whom to trust and share information with, as well as ways to control unwanted messages ("spam"), spy-ware, and other attacks on user systems.

Sharing of personal information will in many cases take place between parties that are previously unknown to each other. When deciding whether to share their information, end-users need an easy way to check the service provider's trustworthiness and privacy policy.

The role of spontaneous group communications is increasing. To complement current group-oriented services such as chat and push-to-talk, *ad hoc* group communications without fixed infrastructure will grow in importance, and may involve an increasing number of services.

Users will expect to use a variety of devices to access services and will expect services to adjust to the needs and the devices of the users and the devices they are using. Device profiles and context awareness for services will become increasingly important. Subsequently, services will be able to acquire and utilize information about the usage situation. It is critical that the end-user is in control of the information that is available to other parties.

Some forms of intelligent agents can be expected to come into being and help end-users by performing data mining in the semantic web as well as automatically monitoring end-user behaviour and suggesting ways of making life easier.

There is a technology programme ongoing within the sixth Framework Programme (FP) of the European Union (EU) that directly targets end-user issues [AHK04]. This kind of research holds great potential for providing new and useful concepts.

9.3 THE BUSINESS VIEWPOINT

There is undeniable potential to make money with mobile services. The greatest business challenges are related to the design of attractive customer value propositions and the underlying business models, driving up service usage and increasing operational efficiencies. Creating strategies for cost leadership and differentiation will be combined with more focus on streamlining the services creation process from idea or solution procurement to a successful launch. Marketing of mobile services is still in its infancy and this area is likely to present lots of innovation in addition to the services themselves. Awareness of the importance of business models and related intellectual property will increase. To take a recent example, in a WCNC 2004 (Wireless Communications and Networking Conference) conference discussion about WiMAX[1], one of the first questions was about the feasibility of the overall business model of WiMAX. Its real business value is yet to be determined.

Operators are considering outsourcing as an increasingly viable option for managing at least part of their service offerings. This would mean increased business for new and streamlined third parties, which can also make themselves useful to content providers, who do not wish to extend their core competencies into service provisioning. Generally, there is likely to be greater diversity in business models related to service provision. There will be special service aggregators that make use of the capabilities of providers of "elementary" services. Eventually there will be protocol-based automatic

[1] Trade name for 802.16 technology.

markets for networking and computing resources to support a variety of service offerings.

Business value chains are already complex, involving a number of partners. They are also becoming increasingly dynamic in nature, when various mobile service providers launch and discontinue service offerings – operating like supermarkets with quick response rates to customer whims and requirements. Although some technology efforts, such as electronic business Extensible Mark-up Language (ebXML), are designed to support dynamic business arrangements, the non-technical aspects of business relationships may hinder the deployment of dynamic business models that available technologies might otherwise facilitate. Most likely, legal and risk management-related issues will be of importance (these are outwith the scope of this book).

Increasingly, intelligent end-user agents may play a role in helping end-users in network selection between multiple providers, if multiple network connectivity or service providers are available in a particular usage situation [CW01].

The creation of multi-channel services – that is, services that are presented to the target segment via multiple different media – can be expected to become easier. Converging technologies and business models could cater more for customer needs than the current scattered media offering, where the same services are paid for in different ways and usase is not yet intuitive. Certainly, communications and media are part of the lifeblood of network economies, but customers are still selective about the channel they use, whether it is communicating via one-to-one, one-to-many or multicasting methods. Even though content supposedly is the king, it won't be, unless enough attention is first paid to the reign of the customers.

The business evolution of mobile services is an interesting area; stimulating focus areas include predicting service evolution, analysing the various plays in value chain evolution and, finally, evaluating strategic options in business model evolution. The old saying "the only constant is change" holds particularly true in this industry.

9.4 THE TECHNOLOGY VIEWPOINT

The technology viewpoint describes what kinds of technologies will be used in the connection of provisioning and providing of services. The spectrum of different technologies available for service provision is still increasing rapidly, but – at the same time – convergence is also on the agenda in different standardization organizations. For example, Wireless Local Area Network (WLAN) and third-generation (3G) networks and mobile/fixed interworking is on the agenda in many standardization organizations.

Bandwidth is increasing for both mobile and fixed Internet. Throughput of the order of hundreds of kilobits per second will soon be commonplace for mobile handsets, and throughput of megabits or tens of megabits per second can be achieved in different kinds of hotspots.

The spectrum of available Internet Protocol (IP) access technologies will widen. At least for the foreseeable future, there will be a difference between "full service" mobile networks that support seamless handovers and advanced traffic types, and "hotspot"-type access technologies designed for particular use. The core network and/or terminal will be able to use most forms of access technology for a particular usage scenario and service.

Service quality support technologies will improve. At least for "full service" networks, service quality support technologies will not limit the types of service that are available to mobile users. Service quality will be a must for network operators and service providers, not a differentiating factor. This calls for high availability of services and platforms.

Service quality allocation technologies will also improve. The core network will have advanced means of allocating the most suitable access technology and service quality support type for a particular service. There will also be advanced means of monitoring service performance, both at the aggregate level and at the level of individual users.

Technologies for location-based services will further mature and become commonplace. There will be more services available using location-based information. One could view the future of location-based services as generalizing the current concept of instant messaging.

Security will remain an important issue. The use of terminals or credentials related to them will increase the importance of mobile handsets. It will be possible to evaluate the true importance of biometrics and other related technologies, only on a longer-term perspective. Communication technologies and platforms will have increasingly advanced security features.

End systems will have ways of identifying optimal connections and service parameters for particular uses. These concepts are described in Massachusetts Institute for Technology (MIT's) personal router white paper [CW01].

Business-oriented or economy inspired networking technologies may be expected to play some role in the future Internet. Examples of such technologies are

- *Simple Integrated Media Access* (SIMA) [RK98]. SIMA is a traffic management scheme for IP networks based on differentiated services framework.
- *Distributed admission control architectures* [KS02]. This kind of technology has the potential to provide a relatively lightweight basis for service quality support, at least for some kinds of services.

Such technologies may be expected to be deployed at least in some parts of networks. As discussed earlier, access networks are generally more challenging from a service quality support viewpoint than are core networks. Several authors have argued that, especially in backbone networks, the average load levels are often low and queuing delays small [Kel00, Odl99], from which one may deduce that relatively simple mechanisms would be sufficient.

Ad hoc and peer-to-peer networking technologies will continue to be developed. Endpoints will be able to use peer-to-peer protocols for *ad hoc* tasks that do not require infrastructure. At the same time, *ad hoc* networks will be able to use existing infrastructure flexibly when it brings value.

The technology support for dynamic service linking will mature. Composite services will be able to locate and replace components depending on the dynamic availability of resources and on the usage of services. Semantic web technologies have great potential in this area [MSZ01].

The widespread adoption of protocols that form the basis for web services will also make it possible to more easily create content for other kinds of media.

9.5 CONCLUSION

Prediction of the future is notoriously difficult, but technologies that are currently under development provide a basis for making life easier for both the end-user and other participants in the value chain. The trends-in-the-making also help different actors to tackle both the challenges brought by new services, as well as existing ones, in particular, privacy, security and service quality control. At the same time, automation of service management processes makes it possible to automate the implementation of market mechanisms, bringing down cost and time-to-market. Service-oriented architectures hold great promise in this respect. Irrespective of which technologies will emerge as winners, most of the participants in the service provision chain need to cope with legacy equipment. It remains to be seen how exactly the future will unfold, but the new possibilities are certainly exciting.

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10

Summary

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In this chapter, we shall summarize the central themes of this book. At the time of writing, the mobile industry was well on its way in recovering from a period of "telecom downturn", a period of low spending in the early 2000s. Interest in new services is recovering among end-users, service providers and operators. In particular, services related to the Multimedia Messaging Service (MMS) have caught on during 2003 and 2004. Packet-based services create new opportunities for end-users, service providers and mobile operators, but also pose new challenges. Customers are getting used to advanced services and as reliability increases, so do the expectations of end-users. Good service quality will not be a differentiating factor in the future, but rather a must-have feature that needs to be in place to reduce churn.

The adoption of new services benefits from novel ways of doing things. New charging models are needed to replace traditional time-based charging with charging schemes suitable for a particular type of content. With services becoming more complex and having different types of content, new kinds of value chains are possible where each provider can focus on its own strengths. This means that new roles such as service aggregators will emerge and, indeed, have already emerged. Furthermore, there will be no single rigid

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value chain in existence, but business model innovations are to be expected.

Services do not need to be altogether new to be valuable. "Amended" services such as Tune-to-Radio or Visual Radio create win-win-win situations for service providers, mobile operators and end-users. To enable this kind of development, both the service management machinery and service control in a mobile domain need to be agile to flexibly facilitate different kinds of content and combining them in novel ways. The mobile network must also support automation of mobile endpoint configurations to make it easier to try new services. Furthermore, customers appreciate personalization of the service usage experience.

Up to now, service creation has been slow due to technical challenges. The example in Chapter 2 illustrates that even a simple-looking task can take months without adequate support from service management system. On a larger scale, operation of multi-vendor mobile network domains is increasingly challenging due to the increasing complexity of systems. To address this problem, multiple developments are ongoing in standardization in the areas of procedure and modelling. Taking examples from TeleManagement Forum (TMF) New Generation Operations Support Systems (NGOSS) activities, service management paradigms are evolving, lifecycle aspects and roles are being studied from the viewpoints of business, system, implementation and deployment. Other organizations study related issues from their own viewpoint: Third Generation Partnership Project (3GPP) studies effects on Wideband Code Division Multiple Access (WCDMA) and General Packet Radio Service (GPRS) architectures, and Open Mobile Alliance (OMA) concentrates on service enabler-related analysis. Further activities are ongoing in multiple fora related to privacy-enabling technologies. Reference implementations of standards are increasingly important.

As a consequence of the industry-wide perception of the importance of the problem area and subsequent efforts to address it, developing technologies and processes make it easier to provide consistent service quality to end-users while using network resources efficiently. For example, the need for a service management information model that can be used by multiple service provision operators is widely acknowledged. In addition to being accessible for different parties of the value chain, the model should preferably also accommodate both service creation and service assurance. Making a model that suits all needs related to service management is a sizable undertaking but one worth pursuing. Not only should the ideal model be like a Swiss army knife when it comes to modelling, but the user of that "knife" should also be able to find the right blade at the right time, while avoiding accidentally puncturing one's pocket. Making the model understandable and logical goes a long way to meeting this goal.

A parallel enabling technological development, understanding of the packet-based services themselves is developing. From a technological perspective, both the requirements and characteristics of services need to be understood during the service creation process to make best use of available resources. Technological solutions such as the Intelligent Edge, introduced earlier, one powerful tools for enabling advanced packet-based services.

There are interesting technologies being developed at the time of writing, including different kinds of web services technologies and ones related to the semantic web. It appears that decisions about which technology to deploy and when are increasingly controlled by business processes, which in turn are guided by end-users' needs. Indeed, the technologies that are being developed, ranging from Intelligent Edge elements and terminal management solutions in the near future to semantic web tools further away, help to keep unnecessary technical details out of sight of the end-user. It is now the responsibility of the entire industry to make new and existing services more usable and useful for humans, instead of making humans conform to technology.

Appendix: Service Framework Team Roles

The role descriptions below are based on [GB924], with more description added. The participation of the roles in different phases of the lifecycle of a product is represented in Figure 4.2 (see page 64). The order of the roles is the same as in this figure, i.e. design type and project-based roles are listed first, and managerial and maintenance roles after that.

As described in Chapter 4, roles do not map one-to-one to persons within organizations, but a single person may participate in several service management roles and a single role may be attended to by multiple persons. In a multi-provider scenario, the same role may be carried out in multiple organizations. There are examples of this in the role description below.

It should be noted that these roles do not cover the entire enhanced Telecom Operations Map (eTOM), but relate only to service management.

The descriptions given below give an overview of the roles with respect to each other, to processes and to the service-related information they need to work with. A more detailed description of the relationship of the roles to the service framework can be found in

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[GB924]. The list of the roles is expected to be complemented as TeleManagement Forum (TMF) work progresses.

Below, the following (TMF) terminology is used:

- *Product*: commercial concept that can be sold to end-users;
- *Service*: technical implementation of a product;
- *Resource*: logical or physical functionality needed to operate the service.

The relationship between a product and a service does not need to be one-to-one, but multiple services may be used as part of commercial products.

The roles described in more detail are listed below for convenience.

Designers and project-based roles:

- market analyst
- product solution designer
- service designer
- service component designer
- connectivity builder
- service implementer
- process engineer
- implementation project manager.

Managers and operational roles include:

- product manager
- policy manager
- policy engineer
- service delivery manager
- partner manager
- product end-user
- subscriber
- customer care staff
- support specialist
- revenue assurance analyst
- system manager

- process manager
- account manager.

Below, the roles are described in more detail.

Market analyst

A market analyst carries out market analysis for commercial products based on the competitive situation, customer basis, market segmentation and existing product base. She creates the requirements for service. From a technical perspective, a market analyst needs information about product and service performance.

Product solution designer

A product solution designer is an architect-type role, which implements a realization of the commercial product according to marketing requirements. This is realized by translating business requirements into service requirements.

A product solution designer has knowledge of existing services and decides whether new services need to be created or existing ones modified in order to implement new products. This role also performs generic system-level requirements definition for services where appropriate.

A product solution designer also needs to be able to map business requirements into an end-to-end service performance level definition, as well as creating requirements for related reporting. Discussion about relevant end-to-end performance characteristics can be found in Chapter 6. Key Quality Indicators (KQIs), key Performance Indicators (KPIs) and Service-Level Agreements (SLAs) are typically needed for carrying this out.

Service designer

Technical responsibility for a service belongs to the service designer. A service designer defines detailed service specifications based on requirements from the product solution designer. In particular, services are designed to meet end-to-end performance criteria.

A service designer needs to define requirements for a management system relating to the service particular.

A service designer needs to map requirements into feasible technical implementation. This means, for example, the selection of adequate attributes. The role will import relevant attributes from system-level design performed by the product solution designer, and fill in the missing attributes based on service design work. Where relevant, this role will create different variants of a single service. The service designer also defines the composition of a service in terms of service components and resources, and defines high-level requirements for components where they need to be created or modified. For example, end-to-end performance criteria need to be mapped into requirements for components and connectivity between them. As part of the definition of component composition, requirements for resources need to be identified.

Related to service assurance, a service designer needs to define links between KPIs and KQIs and their relation to end-to-end performance. He also obtains usage information.

Service component builder

A service component builder analyses the requirements for service components based on high-level requirements from the service designer, and performs more detailed design. This role also implements, validates and commissions the components. The service component builder needs to make sure that information about the deployed component is reflected in the relevant repositories. Implementation of component-specific performance criteria is one aspect of this role.

Regarding assurance, this role also needs to define statistics collection and requirements for service components. For example, mapping between KPIs and counters needs to be performed by the service component builder.

She also needs to participate in system infrastructure development.

Connectivity builder

A connectivity builder provides connectivity between service components according to system-level requirements from the service designer role. Implementation of end-to-end performance according to the design is one of the tasks of this role. For example, in a scenario where one of the service components is provided by an external party, the connectivity builder at the network operator makes sure that the correct firewall configurations are in place and that external content is mapped onto adequate bearers. It is likely that a corresponding role need to be in operation at the content provider organization.

To carry out the task in practice, the connectivity provider also needs to have an understanding of the service components.

Related to service assurance, this role also needs to take into account monitoring requirements. The connectivity builder needs to participate in system infrastructure development processes. This role also needs to participate in testing.

Service implementer

A service implementer integrates, tests, commissions and releases a particular service and makes sure that requirements are fulfilled for OSS and BSS. This role needs to develop an operational plan for managing and deploying the service. The service implementer needs to make sure that all relevant support systems are in place for managing and monitoring the service. This may also include effecting changes to some of the support systems.

The service implementer makes sure that service management and KPI/KQI/SLA rules (policies) are put into practice. He is also responsible for validation of service models in practice, testing of service operability requirements and testing of business processes related to the service . The role needs to be in contact with customer care, service operations and billing. Participation in testing against SLAs as well as building and development of systems infrastructure is also involved.

Process engineer

The process engineer takes care of implementation of processes relevant to service management. As part of this, this role participates in and influences – in principle at least – all the processes related to other roles.

Implementation project manager

The implementation project manager is responsible for the implementation project.

Policy manager

The policy manager carries the responsibility for development and management of policies relevant to service management.

Policy engineer

A policy engineer is responsible for the implementation of policies relevant to service management.

Product manager

The product manager is responsible for the creation and management of the commercial product during its entire lifecycle. This role is responsible for the business case and profitability of the product.

A product manager needs to make sure that different aspects of the commercial product have owners and stakeholders from the viewpoints of processes and roles. This needs to be carried out for the entire end-to-end business process. For example, the product manager is responsible for making sure that adequate business metrics are available for the deployed service. The product manager represents a common point of contact for business processes associated with the product and services associated with it.

Service delivery manager

The service delivery manager is responsible for the delivery of the service against designed performance targets. This role uses support systems which typically provide real-time and historical performance data, as well as information about the implementation and deployment of services and components associated with them.

Partner manager

The partner manager role is responsible for agreements with external parties such as subcontractors providing service components.

Product end-user

The end-user is the consumer of the commercial product. The end-user and the subscriber may or may not be identical roles; please see the description on the next role.

The product end-user role is interested in the apparent performance of the service and is not necessarily directly aware of the SLA obligations related to the service.

Subscriber

The subscriber role has an agreement related to the commercial product, and may be different from the product end-user role. For example, the employer of the product end-user may be responsible for the subscription. The subscriber is aware of the SLA related to the service, when this exists. From a service provider viewpoint, the classification of subscriber may be helpful in market segmentation and product/service design.

Pre-sales customer care staff

This role provides pre-sales support for subscribers and end-users. To perform this task, pre-sales customer care staff need access to information relating to service performance objectives and actual service performance information.

Post-sales customer care staff

This role provides post-sales support for subscribers and end-users. To perform this task, post-sales customer care staff need access to information relating to service performance objectives and actual service performance information.

Support specialist

A support specialist is a technical expert role, carrying out tasks such as root-cause analyses, capacity management and implementation of improvements. This role needs to have access to information about service composition and attributes, and reporting information including reporting data.

Revenue assurance analyst

A revenue assurance analyst can be viewed as a special type of support specialist with responsibilities related to revenue assurance. This role needs information about actual usage of service components.

System manager

The system manager is responsible for the management of resources needed by services. This role needs information about service quality objectives and their violation, as well as data relating to service usage and system utilization. The system manager can use these data to assess the impact of failures and provide input for resource and service development.

Process manager

A process manager is responsible for operations processes required for managing a commercial product and associated services. The process manager defines requirements which the process engineer implements. To carry out these tasks, the process manager needs information about delivery and performance targets of services. Service creation, management and modification need to be taken into account in this role.

Account manager

An account manager is responsible for managing relationships for aggregate subscribers. This role uses information relating to performance design targets and delivery in participate to product performance and development activities.

Reference

[GB924] *Service Framework*, GB 924 version 1.6, August 2004, TMF.

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