Understanding Changing Telecommunications

– Building a Successful Telecom Business

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John Wiley & Sons, Ltd

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Published by John Wiley & Sons Ltd, The Atrium, Southern Gate, Chichester,
West Sussex, PO19 8SQ, England

Telephone (+44) 1243 779777

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John Wiley & Sons Canada Ltd, 22 Worcester Road, Etobicoke, Ontario, Canada M9W 1L1

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British Library Cataloguing in Publication Data

A catalogue record for this book is available from the British Library

ISBN 0-470-86851-1

Typeset in 10/12pt Times by Laserwords Private Limited, Chennai, India
Printed and bound in Great Britain by TJ International, Padstow, Cornwall
This book is printed on acid-free paper responsibly manufactured from sustainable forestry in which at least two trees are planted for each one used for paper production.

Contents

Preface

Many readers can use this book as a ‘standalone’. For other readers it might favorably be combined with a ‘conventional’ book/other learning material covering the particular technical area of the reader. This would create an excellent combination of depth and breadth.

The chosen broad context-oriented approach does not only require a number of books, articles, standards, etc. as input. In fact, finding a suitable book structure has been the most demanding issue. For the main author it has taken years to acquire a reasonable conviction. Often, the evolving conviction tends to successively upgrade business aspects on behalf of technology, in order to justify the title word ‘Understanding’. Understanding is also firmly related to a pronounced pedagogical goal of the book.

Finding a good book structure for a broad subject is similar to building a house with a number of rooms for different purposes. Filling the chapters with content then corresponds to furnishing the rooms. Changing the rooms is difficult and expensive. Changing the furnishing is easier and mistakes can more easily be corrected. New modern furniture can replace older inventories.

To make the structure issue even trickier, the telecom complexity of today requires different types of ‘rooms’:

- **Functional** rooms devoted to a specific purpose, such as security or quality of service.
- More hardware and **implementation** oriented rooms, such as access and control equipment and its capabilities.
- **Process flow** oriented rooms, where we can identify the users, the various service providers (in a broad sense) and their planning, implementation and management, the technical development tracks and the related business models.

The *main* references mentioned in the reference section concern the important structuring of the ‘house’.

The ‘room furniture’ may be continuously changed, following the new standards from bodies such as 3GPP, ITU, IETF, ETSI and many others. Evidently, a book with a fairly long production time like this one cannot include all the latest ‘furniture’. However, the web often provides information on new standards.

About the Author

Anders Olsson has worked for many years as a network designer in Sweden (Televerket, nowadays TeliaSonera), Colombia (Telecom) and Tanzania (TP & TC), and in 1991 was appointed senior expert in Network oriented training at Ericsson.

References and Acknowledgements

FUNCTIONAL STRUCTURE AND RELATED ACKNOWLEDGEMENTS

The most important applied structure is called **Fundamental (Technical) Plans (FP)**. The plans can indeed also reach beyond pure technique, such as organization. The main author has worked within this area as a consultant and as a teacher for many years, starting in the 1970s. The students have represented operators from all over the world.

Historically, after a long stable period during the twentieth century, digitization brought the need for a synchronization plan in addition to a basic set of plans. The area of IN and mobility were the next challenges to the basic 'FP house design'. A main contribution was a mobility management plan. Then IP entered the overall telecom area, giving a new touch to the quality of service plan, urging for a separate security plan and for a controllable convergence.

The FP view supports no doubt an orderly convergence between technologies. After all, all technologies have a common target: to connect communicating parties in a satisfactory way, technically and economically.

Proceeding with the plans, the deregulation and the evolving global networks demanded more attention to the establishment of an interconnect plan.

In this book another two areas are included, without being necessarily labelled FPs: *service layer enablers* (other than those belonging to established plans; for example content-oriented functions, such as positioning) and *economy of service*. A main target for economy of service is to enable voice over IP with reasonable efficiency. Efficient voice and video coders, header compression techniques, many WAP features and concentrating and aggregating equipment can be included within the scope of economy of service.

A few more fundamental plans may be justified in practice, depending on the technical context.

Regarding FP I would like to refer to ITU and an extensive cooperation during the 1990s with Herbert Leijon. See for example:

http://www.itu.int/itudoc/itu-d/dept/psp/ssb/mpg/ch08.html
http://www.itu.int/itudoc/itu-d/dept/psp/ssb/planitu/plandoc/corplan.pdf
http://www.itu.int/itudoc/itu-d/dept/psp/ssb/mpg/ch00.pdf

The fundamental plans are parts of the 'ITU Master Plan Guide'. See for example:

http://www.itu.int/ITU-D/bdtint/baap/sec1_03.html

I have myself earlier treated the area in a couple of books, called Understanding Telecommunications 1 and 2, (ISBN 91-44-00212-2 and ISBN 91-44-00214-9), especially in section A.10.8.5.

If still available, see http://www.ericsson.com/support/telecom/ and proceed to A.10.8.5 Fundamental technical plans.

I would also like to mention my cooperation with Ludvig Widell, the father of the PTP (Particular Technical Plans) concept, mentioned in the second reference and also in this book. Ludvig covered both fixed and mobile networks during the 1990s.

FP and PTP can no doubt significantly support and integrate many operator processes.

The cooperation with Thomas Muth has also been very valuable. Thomas covers both functions and implementation. His first book is called *Modeling Telecom Networks and Systems Architecture: Conceptual Tools and Formal Methods*. See position 317 in:

http://www.isbn.nu/sisbn/telecommunication%20engineering::6

His next book is called *Functional Structures in Networks* (Springer Verlag).

Thomas has been a source of inspiration especially for parts of Chapter 3.

REFERENCES AND ACKNOWLEDGEMENTS FOR SEPARATE PLANS

Security

Acknowledgement: the cooperation with my daughter Helena Andersson on IT security has been very valuable. Many thanks! Helena is researching IT security from a legal point of view and will produce her thesis on that subject.

Säkerhet vid trådlös datakommunikation. SIG Security Studentlitteratur 2001.
Handbook i IT-säkerhet. Predrag Mitrovic.pagina.se.
Communications Security in an all-IP world. *Ericsson Review*, 2, 2000.
Johan Gustafson: Kroppen som lösenord. *Nätverk och Kommunikation*, September, 2000.
Intermec White Paper on wireless security.
http://epsfiles.intermec.com/eps_files/eps_wp/WirelessSecureWPWEB.pdf

Quality of Service

UMTS Quality of Service (QoS) – An End-to-End View. Brad Stinson, Narayan Parameshwar, Ramki Rajagopalan. See:

http://www.awardsolutions.com/downloads/Award_solutions_UMTS_QoS_wcnc1.3_(0801).pdf

The challenges of voice-over-IP-over-wireless. *Ericsson Review*, 1, 2000.

Interconnect

Interconnect acknowledgement: the cooperation with Håkan Åkerstedt, who participated in a group for interconnection within the European Commission, has been valuable. Håkan has in addition written the appendices on MGW dimensioning and development tracks.

Implementation Structure

The network structure applied in the book is called the all-access architecture, supposing a fairly complete convergence except for the access area. The convergence is partly based on layering and horizontalization.

This does not mean that such development is the obvious short-term one. With the present circuit-mode voice networks still being a cash-cow, there are strong conservative forces advocating a limited convergence, initially, for economical reasons.

Some references and acknowledgements are:

The stupid network. David Isenberg. See:
http://www.camworld.com/att.html.
Cooperation with Håkan Wolf who participated in ACTS (Advanced Communication Technologies and Services) Program of the European Commission CONVAIR Project. See:
http://www.etic.be/convair/Documents/teams-cv.pdf
Building the GII, *Telecom Journal of Australia*, 47(2), 1997.
Carrier Grade Voice Over IP. Daniel Collins. McGraw-Hill, 2001.
Network Evolution the Ericsson way. Erik Örnulf and Steinar Dahlin, *Ericsson Review*, 4, 1999.

Acknowledgement: Miltos Tricopoulos assisted significantly in writing the chapters on access network, packet backbone and control network.

REFERENCES AND ACKNOWLEDGEMENTS FOR SEPARATE NETWORK PARTS

Service Network

Here I would like to mention contacts with Christoffer Andersson, who wrote the book *GPRS and 3G Wireless Applications*. See:

http://www.wiley.com/WileyCDA/WileyTitle/productCd-0471414050,descCd-authorInfo.html

This book is one of the main references. Another contribution by Christoffer deals with Enablers – The link between Terminals, Networks and Applications. See:

http://www.ericsson.com/mobilityworld/sub/articles/other_articles/enablers_the_link_between?PU

Open Mobile Alliance is another input. The principles are described in

http://www.openmobilealliance.org/docs/OMA-principles.pdf

Many articles in *Ericsson Review* deal with the service network. See for example no. 1, 2003. A meeting with some of the involved service layer staff was indeed valuable.

MGW Chapter

Media gateway for mobile networks. *Ericsson Review*, 4, 2000.
http://www.ericsson.com/about/publications/review/2000_04/files/2000042.pdf. All *Ericsson Review* articles are accessible by means of the general part of the address above.

Control Network Chapter

Control servers in the core network. *Ericsson Review*, 4, 2000.

Packet Backbone Chapter

Reference article, example: The big question: carriers that want to build out their networks must first address another fundamental issue: What type of traffic will their networks carry – and why?, See *Telephony*, December 13, 1999.

Access Chapter

There is a huge number of books and web articles available on both mobile and fixed access. Let us mention two web examples:

Universal Mobile Telecommunications System (UMTS):
Real-Time Multimedia in UMTS (UMTS 22.72 version 0.0.0)
http://www.3gpp.org/ftp/tsg_sa/WG1_Serv/TSGS1_02-Edinburgh/Docs_All/Tdocs_All/S1-99126.pdf

UMTS 3G IP Multimedia System
System Description. Summary of 3GPP System Standards, Network Architecture, and Applications and Services (based on 3GPP Standards)
http://www.seas.upenn.edu/~hphuang/Networking/PCS/UMTS%203G%20IP%20Multimedia%20System.pdf

PROCESS FLOW ORIENTED REFERENCES AND ACKNOWLEDGEMENTS

Process Flow Structure and Techno-economics

A general source is TeleManagement Forum: info@tmforum.org
FlowThru: Co-operative Secure Management of Multi Administrative and Technology Domain Network and Service Management Systems: AC335 TeleManagement Forum Business Process to TINA-C Business Role Mapping. See:

http://www.cs.ucl.ac.uk/research/flowthru/content/bmp-role-map/bmp-role-map.pdf

Acknowledgement: the cooperation with my daughter Christina Teden regarding a wide area of techno-economics has been very stimulating and valuable, indeed, and a lot of thanks go to her.

Playground

New Telerica, a fictitious country used for the process of network design, has been extensively used in network-oriented courses. Although not explicitly mentioned it has also been a source of inspiration for this book It is mentioned or utilized in:

http://fc.it.kth.se/~asa.skog/studie/KS-projekt.pdf

Group work at Royal Institute of Technology in Stockholm (access network), and in

http://www.fek.su.se/ProfUpdate/botco.htm

Chapter 2

Acknowledgement: my cooperation with Jonas Selen at Ericsson Consumer lab has been very valuable. Thanks a lot! Regarding Consumer lab see for example:

http://www.3gnewsroom.com/3g_news/apr_02/news_2062.shtml

Håkan Wolf has written much material related to this chapter, and also brief parts in a couple of other chapters.

Chapter 4 and Other Chapters

Analysts such as Kearney, Arthur D. Little, Ovum, Forrester etc. provide much information. Contacts with Bengt Alm, teacher in techno-economics, have been very valuable.

Chapter 16 Telecom Management

A very valuable cooperation and co-writing with Adrian Faduaga, Buenos Aires, on telecom management and other subjects should be mentioned. Adrian conducted a seminar on Voice and Data Convergence and Multi-Service Networks at the University of Buenos Aires in 2001.

http://www.aefconsultores.com/PDF_Files/Espanol/AEF-Corporativa-Marzo_2003.pdf

Appendix 1

My partner within this area has been Teledrom AB.

Appendix 2

A partner within this area has been Chris Fletcher.

Appendix 3

This appendix is written by Håkan Åkerstedt.

Appendix 4

This appendix is written by Håkan Åkerstedt, assisted by Göran Ekstedt. Göran has also contributed to chapters 11, 12, 14 and 15. Many thanks!

GENERAL REFERENCES AND ACKNOWLEDGEMENTS

Platform Knowledge

This area is for example represented by *Understanding Telecommunications 1 and 2*

The books have been available for years at http://www.ericsson.com/support/telecom/authors.shtml (Telia-Ericsson) but are now probably removed. ISBN 91-44-00212-2 and ISBN 91-44-00214-9

IP Internetworking Learning Product

See www.ericsson.com/services/globalservices/training.shtml

Acknowledgement: the stimulating cooperation with Hans Nihlen, who led the development of this product should be mentioned.

Chapter 1 provides some ***basic terminology***. Among supporting material is for example:

LoL@: a UMTS location-based service. Günther Pospischil, Harald Kunczier, Alexander Kuchar.

http://lola.ftw.at/homepage/content/a40material/LoLa_a_location_based_service.pdf

This book has been much inspired from the course Understanding the New Telecom, with Miltos Tricopoulos as one of the main teachers.

http://www.ericsson.com/ie/training/courses/prd138.shtml

Miltos has worked a lot with the figures in the book.

IT Support to the Author

Many thanks for a professional computer support go to my son, Staffan Olsson. Thanks a lot!

Other Acknowledgements

Other acknowledgements go to my patient and supporting wife Marianne, Erik Oldmark, who initially ordered the book project, Tessa Hanford, who did an excellent job as my copyeditor in the U.K, and finally Lars Jansson, Leif Karlsson, Georg Lewin, Mikael Lundgren and Christer Mildh who have been my most important contact persons at Ericsson.

Glossary

3G	Third generation (mobile systems)
3GPP	Third generation partnership project
3GPP2	Third generation partnership project 2
AAA	authentication, authorization, accounting
AAL	ATM adaptation layer (AAL1, AAL etc)
ACL	access control list
ADM	add-drop multiplexer
ADSL	asymmetric digital subscriber line
AES	advanced encryption standard
AF	assured forwarding
AH	authentication header
AIN	advanced IN
AMR	adaptive multi rate
AN	access network
AP	access point
API	application programming interface
APN	access point name
"APZ"	symbolizes processor part of a telephone exchange
ARPU	average revenue per user
ASP	application service provider
ASuS	application support services/server
ATM	asynchronous transfer mode
AV	adding value
AUC	authentication centre
B2B	business to business
B2C	business to customer
BD	bridging distance
BER	binary encoding rules
BER	bit error rate
BGCF	border gateway control function
BGP	border gateway protocol

BGW	billing gateway
BICC	bearer independent call control
B-ICI	broadband inter-carrier interface
BSP	business service provider
BSS	base station system
CA	certificate authority
CAGR	compound annual growth rate
CAPEX	capital expenditure
CAMEL	customized applications for mobile network enhanced logic
CAGR	compound annual growth rate
CAP	CAMEL application part
CATV	cable TV
CAS	customer administration system
CAU	customer access unit
CC/PP	composite capabilities preference profiles
CDPD	cellular digital packet data
CDMA	core code division multiple access
CDR	call detail record
CE	circuit emulation
CHAP	challenge-handshake authentication protocol
CLI	calling line identification
CMIP	common management information protocol
CMN	call mediation node
CMTS	cable modem termination system
CORBA	common object request broker architecture
CPN	customer premises network
CR-LDP	constraint based routing – label distribution protocol
CRM	customer relations/relationship management
CSCF	call state/session control function
CSF	call serving function
CWDM	coarse wavelength division multiplex
DCN	data communication network
DEN	directory enabled networking
Des	data encryption standard
DESP	development environment service provider
DHCP	dynamic host configuration protocol
DMZ	demilitarized zone
DNS	domain name system
DOS	denial of service
DOCSIS	data over cable service interface specification
DRM	digital rights management
DSCP	diffserv code point
DSL	digital subscriber line
DSLAM	DSL access multiplexer

DSS1	digital signalling system no. 1
DTMF	dual tone multi-frequency
DWDM	dense wavelength division multiplex
DXC	digital cross-connect
E1	2.048 Mbit/s transmission capability/rate/facility/path
e2e	end-to-end
EAP	extensible authentication protocol
EDI	electronic data interchange
EDGE	enhanced data rates for global (or GSM and TDMA) evolution
EF	expedited forwarding
EIR	equipment identity register
EMS	enhanced messaging service
EMSP	e-mail and messaging service provider
ERP	enterprise resource planning
ESP	enterprise service provider
ESP	e-business service provider
ESP	encapsulating security payload
eTOM	enhanced telecom management map
ETSI	European telecommunications standards institute
E(V)LL	emulated (virtual) leased line
FAB	fulfillment, assurance and billing
FAST	fast active queue management scalable TCP/IP
FDD	frequency division duplex
FDMA	frequency division multiple access
FEC	forwarding equivalence class
FTTH	fibre to the home
FTTA	fibre to the antenna
FP	fundamental technical plans
FNR	flexible numbering register
FSC	fibre switching capability
FR	frame relay
FTAM	file transfer access and management
FTP	file transfer protocol
GCP	gateway control protocol
GERAN	GSM/EDGE radio access network???
GGSN	gateway GPRS support node
GIX	global interconnect point
GIF	graphics interexchange format
GMPLS	generalized MPLS
GPRS	general packet radio service/system
GPS	global positioning system
GRE	generic route encapsulation
GRX	GPRS roaming exchange

GSM	global system for mobile communication
GSN	gateway serving node
GSTN	general switched telephone network
GTP	GPRS tunnelling protocol
HE	home environment
HFC	hybrid fibre-coaxial
HLR	home location register
HSCSD	high speed circuit switched data
HSP	hosting service provider
HSS	home subscriber server
HTML	hypertext mark-up language
HTTP	hypertext transport protocol
IAM	initial address message
IBSP	Internet business service provider
ICMP	Internet control message protocol
ICT	information and communication technologies
IETF	Internet Engineering Task Force
IGMP	Internet group management protocol
IMAP	Internet message access protocol
IMS	IP multimedia subsystem
IMSI	international mobile subscriber identity
IN	intelligent network
IP	Internet protocol
IPBCP (BICC) IP	bearer control protocol
IPsec	Internet protocol security
IRR	internal rate of return
ISDN	integrated services digital network
IS	information systems
ISUP	ISDN user part
ISP	Internet service provider
ISN	interface serving node
ITU	International Telecommunication Union
JAIN	Java API for integrated networks
JDBC	Java data base connectivity
JPEG	Joint Photographic Experts Group
L2TP	layer 2 tunnelling protocol
LDAP	lightweight directory access protocol
LEO	low earth orbit
LER	label edge router
LMDS	local multipoint distribution system/services
LSC	lambda light-wave switching capability
LSP	label switched protocol/path
LSR	label switch router

M3UA	message transfer protocol 3 – user adaptation layer
M2M	machine to machine
MG	media gateway ?
MAC	media access control
MExE	mobile execution environment
MGC	media gateway control
MGCF	media gateway control function
MGW	media gateway
MIB	management information data base
MIME	multipurpose Internet mail extensions
MM/IP	multimedia over IP
MMS	multimedia messaging service
MO	managed object
MP-3	MPEG-1 layer 3
MPC	mobile positioning centre
MPEG	Motion Picture Experts Group
MPLS	multi-protocol label switching
MRF	media resource function
MRFC	media resource function control
MSC	mobile switching centre
MSISDN	mobile station international ISDN number
MSN	multi-service network
MSP	management service provider
MSS	mobile satellite service fig 13.28/13/29
MSSP	managed security services provider
MT	mobile terminal
MVNE	mobile virtual network enabler
MVNO	mobile virtual network operator
NAS	network access server
NAT	network address translator
NE	network element
NGN	next generation network
NGOSS	new generation operation support systems
NIST	National Institute of Standards and Technology
NMC	network maintenance/management centre
NPV	net present value
OFDM	orthogonal frequency division multiplexing
OMA	Open Market Alliance
OMC	operation and maintenance centre
OOP	object oriented programming
OPEX	operating expenditure
OSI	open systems interconnection
OSA	open systems architecture
OSPF	open shortest path first

OSPF-TE	OSPF traffic engineering
OSS	operation support system
OTA	over the air
OXC	optical cross-connect
P2C	person-to-content
P2P	peer-to-peer
P2P	person-to-person
PAP	push access protocol
PABX, PBX	private automatic branch exchange
PCM	pulse code modulation
PDA	personal digital assistant
PDP (context)	packet data protocol (context)
PDC	personal digital communication
PDCP	packet data convergence protocol (fig 5.14)
PDP	packet data protocol
PDSN	packet-data service node
PG	peer group
PGI	peer group identifier
PGL	peer group leader
PGP	pretty good privacy
PHB	per hop behaviour
PKI	public key infrastructure
PLMN	public land mobile network
PNNI	private network-network interface
POI	point of interconnect
POP	post office protocol
POTS	plain ordinary telephony service
PPP	point-to-point protocol
PPG	push proxy gateway
PPTP	point-to-point tunnelling protocol
PSC	packet switching capability
PSEM	personal service environment management
PSTN	public-switched telephone network
PTD	personal trusted device
PTP	particular (fundamental) technical plans
PXC	photonic cross-connect
QoS	Quality of Service
QAMS	Quantitative assured media playback service
RADIUS	remote authentication dial-in user service
RAB	ratio access bearer
RANOS	radio access network operation support
RBS	radio base station
RFC	request for comments

RIP	routing information protocol
RLC	radio link control
RNC	radio network controller
ROI	return on investment
ROCE	return on capital employed
ROHC	robust header compression
RLC	ratio link control
RSVP	resource reservation protocol
RSVP-TE	RSVP – traffic engineering
R-SGW	roaming signalling gateway
RTCP	real time control protocol
RTD	round trip delay
RTP	real time protocol
RTSP	real time streaming protocol
RTT	round trip time
SAT	SIM application toolkit
SDP	session description protocol
SCM	supply chain management
SCP	service control point
SCS	service capability server
SCTP	stream control transmission protocol
SDH	synchronous digital hierarchy
SDP	service description protocol
SGSN	serving GPRS support node
SGW	signalling gateway
SHDSL	single pair high bit rate digital subscriber line
SIGTRAN	signalling transport (working group)
SIM	subscriber identity module
SIP	session initiation protocol
SIP	strategy, infrastructure and product
SLA	service level agreement
SLS	service level specification
SME	small and medium enterprise
S/MIME	secure multipurpose Internet mail extensions
SMPP	short message peer-to-peer protocol
SMS	short message service
SMTP	simple mail transfer protocol
SNMP	simple network management protocol
SOAP	simple object access protocol
SOHO	small office/home office
SOP	service-oriented programming
SONET	synchronous optical network
SPC	stored program control
SPI	security parameter index
SQL	structured query language

SS7	signaling system No 7
SSH	secure shell
SSID	service set identifier
SSL	secure socket(s) layer
SSP	storage service provider
SSP	service switching point
T1	1.544 Mbit/s transmission capability/rate/facility/path
TCA	traffic condition agreement
TCAP	transaction capabilities application protocol
TDD	time division duplex (fig 13.28/13.29)
TDM	time division multiplex
TDMA	time division multiple access
TD-SCDMA	time division – synchronous code division multiple access
TE	traffic engineering
TeS	telephony server
TLS	transport layer security
TMN	telecommunications network, telecommunication management network
TOM	telecom operations map
TOS	type of service
TRAM	tools for radio access management
TSC	transit switching centre
T-SGW	transport signalling gateway
TSN	transit serving node
TTC	time to customer
TTM	time to market
TTS	time to service
UDDI	universal description, discovery and integration
UDP	user datagram protocol
UNI	user-network interface
UMTS	universal mobile telecommunication system
URI	uniform resource identifier
USIM	universal subscriber identity module
UTRAN	universal terrestrial radio access network
VASP	value-added service provider
VC-4	virtual container at level 4 (140Mbit/s in PDH, plesiochronous digital hierarchy)
VDSL	very high bit rate digital subscriber line
VHE	virtual home environment
VLR	visited location register
VML	vector mark-up language
VoATM	voice over ATM
VoFR	voice over frame relay