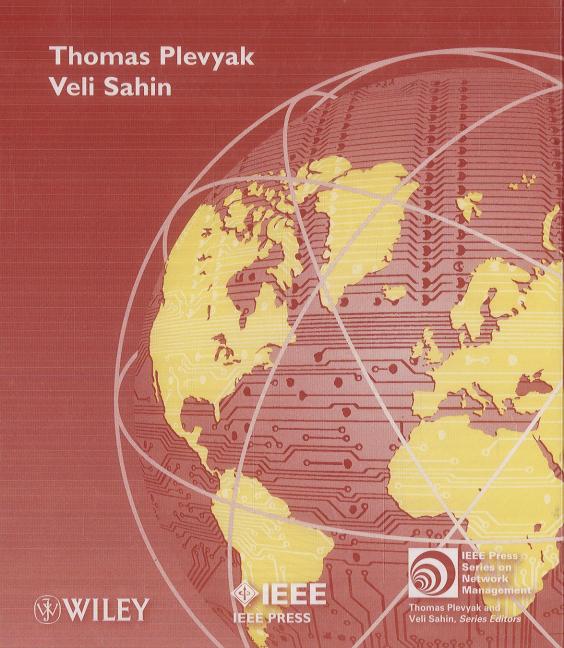
NEXT GENERATION TELECOMMUNICATIONS NETWORKS, SERVICES, AND MANAGEMENT



CONTENTS

GUE	EST INTRODUCTIONS	xv
EDI	TOR AND CONTRIBUTOR BIOGRAPHIES	xix
CHAI	PTER 1 CHANGES, OPPORTUNITIES, AND CHALLENGES	1
Veli .	Sahin and Thomas Plevyak	
1.1	Introduction 1	
1.2	Scope 2	
1.3	Changes, Opportunities, and Challenges 2	
	1.3.1 Major Life Style Changes: Desktops, Laptops, and Now Handtops	2
	1.3.2 Major Network Infrastructure Changes 3	
	1.3.3 Major Home Network (HN) Changes 4	
	1.3.4 Major FCAPS Changes 4	
	1.3.5 Major Regulatory Changes 5	
	1.3.6 Service Aware Networks to Manage Expectations and Experiences	5
1.4	Major Management Challenges for a Value-Added Service: Triple Shift	
	Service 7	
1.5	The Grand Challenge: System Integration and Interoperability of	
	Disjoined Islands 8	
1.6	Some Examples of Management System Applications 10	
	1.6.1 Event Correlation 10	
	1.6.2 Hot Spot Identification and SMS Actions 11	
	1.6.3 SLAs, Contracts, and Policy Management 12	
	1.6.3.1 Service Assessment 12	
	1.6.3.2 Contract Assessment 12	
	1.6.3.3 Service and Contract Assurance 12	
1.7	1.6.4 SMS Integration with Planning and Engineering Systems 13	
1.7	Overview of Book Organization and Chapters 13	
1.8	References 14	
CHAI	PTER 2 MANAGEMENT OF TRIPLE/QUADRUPLE PLAY SERVICES	
CHA	FROM A TELECOM PERSPECTIVE	15
Jean	Craveur	
2.1	Introduction 15	
2.2	Context of Triple/Quadruple Play for Telecom Operators 15	
2.3	The Economic, Service, and Commercial Challenges 18	
	2.3.1 General Conditions 18	
	2.3.2 Service Offer Requirements 19	
2.4	The Technical Challenge 20	

2.4.1	The Technical Tool Box 21
	2.4.1.1 Customer Equipment 21
	2.4.1.2 Access Line and Aggregation/Backhaul Networks 21
	2.4.1.3 Backbone Networks 22
	2.4.1.4 Control Platform 22
	2.4.1.5 Service Platform 22
	2.4.1.6 IS Equipment 22
2.4.2	The Global Vision 23
	2.4.2.1 Vision for an Overall Architecture Supporting Triple and Quadruple Play 23
2.4.3	Key Issues to Consider When Designing Network and IS Infrastructures for
	Triple and Quadruple Play 24
	2.4.3.1 Convergence and Mutualization 25
	2.4.3.2 Quality of Service (QoS) 25
2.4.4	Customer Premises Equipment (CPE) and Home Network 26
	2.4.4.1 The Home Network Complexity 26
	2.4.4.2 Distribution of Functions between Network and IS Platforms and
	Residential Gateways 27
	2.4.4.3 The Home Network Paradox 27
	2.4.4.4 The Home Device and Applications 28
2.4,5	Access Lines 28
2.4.6	Access Networks, Aggregation, and Backhauling 29
2.4,7	An Illustration of the Fixed Access Network Transformation from Internet
	Access Support to Triple Play Support 30
2.4.8	Backbone Networks 31
	2.4.8.1 Content Delivery 32
2.4.9	Service and Resource Control 33
	2.4.9.1 Core Control and Application Servers 33
	2.4.9.2 Service Platforms 33
2.4.10	Information System 33
	2.4.10.1 A Renovated IS Architecture for Triple/Quadruple/Multiple
	Play Business 35
	2.4.10.2 The Customer Front-End 36
	2.4.10.3 The Aggregation Layer 37
	2.4.10.4 The Back-End 37
	2.4.10.5 Order Management and Delivery 39
	2.4.10.6 A Crucial Cooperation between IS, Network, and
	Service Platform 39
The Or	perational Challenge 40
	Focus on the Service Management Center Function (SMC) 42
2.5.2	IS Tools for the SMCs 43
2.5.3	Operating IT and Service Platforms in Triple and Quadruple
	Play Contexts 44
2.5.4	Roles and Responsibilities of the Different Functions 45
2.5.5	New Skills in Operations 47
The Cu	stomer Experience in Broadband Triple Play 47
2.6.1	Definition of the Offerings 48
2.6.2	Distribution Channels 49
2.6.3	Relationship with the Local Operator 49

2.5

2.6

2.8	Conc	lusions 51
2.9	Ackn	owledgments 52
2.10	Refer	ences 52
2.11	Sugge	ested Further Reading 52
СНАР	TER 3	MANAGEMENT OF TRIPLE/QUAD PLAY SERVICES FROM A CABLE PERSPECTIVE
		TROM A CADEL I EASI LCTIVE
Davi	d Jacob	DS .
3.1	Introd	fuction 53
3.2	The f	HFC Network 55
	3.2.1	HFC Planning and Inventory 55
	3.2.2	HFC Network Maintenance 56
	3.2.3	HFC Network Upgrades 56
3.3	Digita	al TV 57
	3.3.1	Digital TV: Coding and Transmission of Analogue Information 58
	3.3.2	· / · · · ·
	3.3.3	5 5
	3.3.4	υ
	3.3.5	
	3.3.6	
	3.3.7	5
	3.3.8 3.3.9	- ·
	3.3.3	3.3.9.1 Enhanced TV Binary Interchange Format 69
	3.3.10	
	3.3.11	- · · · · · · · · · · · · · · · · · · ·
	3.3.12	•
	3.3.13	
3.4	Data	over Cable Service Interface Specification (DOCSIS) 73
	3.4.1	Physical Layer 74
	3.4.2	Data Link Layer 76
		3.4.2.1 Media Access Control (MAC) Sublayer 76
		3.4.2.2 Link Layer Security 78
		3.4.2.3 Logical Link Control (LLC) 79
	3.4.3	Network Layer 79
	3.4.4	<u>*</u>
	3.4.5	- T
	3.4.6	IP Detail Records 81
	3.4.7	DOCSIS Evolution 82
3.5	Cable	e Telephony 83
	3.5.1	Cable IP Telephony 84
		3.5.1.1 Network Control Signaling PacketCable 1.0 and 1.5 85
		3.5.1.2 Distributed Call Signaling 90
		3.5.1.3 Embedded MTA Start-up 90
a .		3.5.1.4 PacketCable 2.0 91
3.6	Wirel	ess 96

53

2.6.4 The Customer Journey 49
The Organizational Challenge 51

2.7

4.4.7

CHAP	TER 4	NEXT GENERATION TECHNOLOGIES, NETWORKS, AND SERVICES 101
Bhum	ip Khas	
4.1	Introdu	action 101
4.2	Next G	Jeneration (NG) Technologies 102
	4.2.1	Wireline NG Technologies 102
		4.2.1.1 Fiber to the Premises (FTTP) 103
		4.2.1.2 Long-Haul Managed Ethernet (over Optical Gears) 103
	4.2.2	Wireless NG Technologies 104
		4.2.2.1 Broadband Bluetooth and ZigBee 104
		4.2.2.2 Personalized and Extended Wi-Fi 104
		4.2.2.3 Mobile Worldwide Inter-operability for Microwave Access
		(M-WiMax) 105
		4.2.2.4 Long Term Evolution (LTE) 106
		4.2.2.5 Enhanced HSPA 106
		4.2.2.6 Evolution Data Optimized (EVDO) and Ultra Mobile
		Broadband (UMB) 106
		4.2.2.7 Mobile Ad Hoc Networking (MANET) and Wireless Mesh
		Networking (WMN) 106
		4.2.2.8 Cognitive (and Software Defined) Radios and
		Their Interworking 107
	4.2.3	Software and Server NG Technologies (Virtualization) 107
4.3	Next G	Generation Networks (NGNs) 108
	4.3.1	Transport Stratum 108
	4.3.2	Service Stratum 110
	4.3.3	Management 110
		4.3.3.1 Fault Management 110
		4.3.3.2 Configuration Management 110
		4.3.3.3 Accounting Management 111
		4.3.3.4 Performance Management 111
		4.3.3.5 Security Management 111
	4.3.4	Application Functions 112
	4.3.5	Other Networks: Third-Party Domains 112
	4.3.6	End-User Functions: Customer Premises Devices and Home Networks 113
	4.3.7	Internet Protocol (IP): The NGN Glue 113
		4.3.7.1 Internet Protocol version 4 (IPv4) 113
		4.3.7.2 Internet Protocol version 6 (IPv6) 114
		4.3.7.3 Mobile Internet Protocol version 6 (MIPv6) 114
4.4	Next G	eneration Services 114
	4.4.1	Software-Based Business Services 114
	4.4.2	High-Definition (HD) Voices 115
	4.4.3	Mobile and Managed Peer-to-Peer (M2P2P) Service 115
	4.4.4	Wireless Charging of Hand-Held Device 115
	4.4.5	Three-Dimensional Television (3D-TV) 116
	4.4.6	Wearable, Body-Embedded Communications/Computing Including Personal
		and Body-Area Networks 116

Converged/Personalized/Interactive Multimedia Services 116

	4.4.8	Grand-Separation for Pay-per-Use Service 117	
	4.4.9	Mobile Internet for Automotive and Transportation 117	
	4.4.10	Consumer- and Business-Oriented Apps Storefront 117	
	4.4.11	Evolved Social Networking Service (E-SNS) 118	
	4.4.12	NG Services Architectures 118	
	4.4.13	Application Plane's Requirements to Support NG Services 120	
	4.4.14	Transport Plane's Requirements to Support NG Services 120	
4.5		ement of NG Services 121	
.,,	4.5.1	IP- and Ethernet-Based NG Services 121	
	4.5.2	Performance Management of NG Services 122	
	4.5.3	Security Management of NG Services 123	
	4.5.4	Device Configuration and Management of NG Services 123	
	4.5.5	Billing, Charging, and Settlement of NG Services 124	
	4.5.6	Faults, Overloads, and Disaster Management of NG Services 124	
4.6		eneration Society 124	
-1.0	4.6.1	NG Technology-Based Humane Services 125	
	4.6.2	Ethical and Moral Issues in Technology Usage 125	
4.7		sions and Future Works/Trends 126	
4.8	Referen		
7.0	KCICICI	ICCS 127	
CHAP	TER 5 À	IMS AND CONVERGENCE MANAGEMENT	129
Keizo	Kawaka	ımi, Kaoru Kenyoshi, and Toshiyuki Misu	
5.1		rchitecture 129	
	5.1.1	Serving CSCF (S-CSCF) 130	
	5.1.2	Proxy CSCF (P-CSCF) 131	
	5.1.3	Interrogating CSCF (I-CSCF) 132	
5.2	IMS Se		
J.2	5.2.1	Push to Talk over Cellular (PoC) Service 133	
	J.2.1	5.2.1.1 Service Authentication 133	
		5.2.1.2 Floor Information Management 133 5.2.1.3 Message Duplication and Transmission in 1-to-n	
	5.2.2		
	3.2.2		
		5.2.2.1 CSCF 134	
	500	5.2.2.2 PDG 134	
5 2	5.2.3	IMS-Based IPTV Service 134	
5.3	-	control and Authentication 135	
	5.3.1	QoS Control in NGN 135	
	5.3.2	RACS 136	
		5.3.2.1 Functions Provided by RACS 136	
		5.3.2.2 Function Blocks Comprising RACS 137	
	5.3.3	Authentication in NGN 138	
	5.3.4	NASS 138	
5.4		k and Service Management for NGN 139	
	5.4.1	Introduction 139	
	5.4.2	Network Management Operation Requirements 141	
	5.4.3	Service Management Operation Requirements 142	
	5.4.4	Service Enhancement Requirements 143	
	5.4.5	B2B Realization Requirements 143	

	5.4.6 Compliance with Legal Restrictions Requirements 144
5.5	IMS Advantages 144
	5.5.1 Reduction of Maintenance and Operating Cost 144
	5.5.1.1 Reduction of Time Required for Introducing New Services (Time
	to Market) 145
	5.5.1.2 Cost Merits 145
	5.5.2 Roles of SDP and Development and Introduction of New Services 145
	5.5.2.1 Positioning of SDP in NGN 145
	5.5.2.2 Features of SDP 146
	5.5.2.3 Examples of Application Servers 146
	5.5.2.4 API 149
	5.5.3 Services Implemented on NGN 150
	5.5.3.1 Push to X 150
	5.5.3.2 IPTV 151
	5.5.3.3 IPTV Architectures 151
	5.5.3.4 Advantages of NGN (IMS-based) IPTV 152
5.6	References 153
5.7	Suggested Further Reading 153
	THE OTHER DESIGNATION OF THE OTHER DESIGNATION
CHAP	TER 6 NEXT GENERATION OSS ARCHITECTURE 155
Steve	Orobec
6.1	Introduction 155
6.2	Why Are Standards Important to OSS Architecture? 156
6.3	The TeleManagement Forum (TM Forum) for OSS Architecture 158
6.4	Other Standards Bodies 159
6.5	TM Forum's Enhanced Telecommunications Operations Map (eTOM) 159
	6.5.1 Relationship to ITIL (Infrastructure Technology Information Library) 162
6.6	Information Framework 163
6.7	DMTF CIM (Distributed Task Force Management) 165
6.8	TIP (TM Forum's Interface Program) 166
6.9	NGOSS Contracts (aka Business Services) 167
6.10	MTOSI Case Study 170
	6.10.1 Will Web Services and MTOSI Scale? 170
6.11	Representational State Transfer (REST)—A Silver Bullet? 176
6.12	Real Network Implementation of a Standard 177
6.13	Business Benefit 179
6.14	OSS Transition Strategies 181
6.15	ETSI TISPAN and 3GPP IMS 182
6.16	OSS Interaction with IMS and Subscriber Management (SuM) 183
6.17	NGN OSS Function/Information View Reference Model 187
6.18	Designing Technology-Neutral Architectures 189
6.19	UML and Domain Specific Languages (DSLs) 189
6.20	An Emerging Solution: The Domain Specific Language 192
6.21	From Model-Driven Architecture to Model-Driven Software Design 193
6.22	Other Standards Models (DMTF CIM, 3GPP, and TISPAN) 194
6.23	Putting Things Together: Business Services in Depth 195
6.24	Building a DSL-Based Solution 200
	6.24.1 Problem Context 200
	6.24.2 Proposed Initial Feature Content 200

	6.24.3	6.24.2.2 Desired Outputs 201 Open-source Tool Environments 201	
6.25		Thought 205	
6.26	Bibliog	graphy 205	
CHAI	PTER 7	MANAGEMENT OF WIRELESS AD HOC AND SENSOR NETWORKS	20
Mehi	met Ulem	a	
7.1	Introdu	action 207	
7.2	Overvi	ew 208	
	7.2.1	Wireless Ad Hoc Networks 209	
	7.2.2	Wireless Sensor Networks 210	
	7.2.3	Wireless Ad Hoc Networks vs. Sensor Networks 211	
	7.2.4	Network Management Aspects and Framework 212	
7.3	Function	onal and Physical Architectures 213	
7.4	Logica	l Architectures 214	
7.5	Inform	ation Architectures 216	
	7.5.1	Manager-Agent Communication Models 217	
	7.5.2	Management Interfaces and Protocols 223	
	7.5.3	Structure of Management Information and Models 223	
	7.5.4	Others 228	
7.6		ary and Conclusions 228	
7.7	Referen	nces 229	
 Mick	nael Farg	NEXT GENERATION MANAGEMENT STANDARDS ano	23
8.1	Introdu		
0.1	8.1.1	General Drivers for Standards 232	
	8.1.2	Management Standards History 232	
8.2		ll Standards Development Process 233	
· · · ·	8.2.1	Key Attributes of Standards Development Process 234	
	8.2.2	General SDO/Forum Types and Interactions 235	
	8.2.3	General Standards Development and Coordination Framework 235	
		8.2.3.1 Project Execution and Cross-Organization Interactions and	
		Handoff Points 238	
8.3	Manag	ement SDO/Forum Categories 239	
	8.3.1	General Network/Service SDO/Forum 239	
	8.3.2	Specific Network/Service SDO/Forum 239	
	8.3.3		
	8.3.4	Management-Standards Focused SDO/Forum 240	
8.4		oles, Frameworks, and Architecture in Management Standards 240	
		nes, Franceworks, and Architecture in Management Standards 240	
	8.4.1		
	8.4.1 8.4.2		
8.5	8.4.2	Principles and Concepts in Management Standards Development 240	
8.5	8.4.2	Principles and Concepts in Management Standards Development 240 Frameworks and Architecture 241	
8.5	8.4.2 Strateg	Principles and Concepts in Management Standards Development 240 Frameworks and Architecture 241 ic Framework for Management Standards Development 244	

6.24.2.1 Desired Inputs 200

8.6			
0 ***	-	ing of NGN Management Standards Areas and SDO/Forums 245	
8.7		ary and Conclusions 248	
	8.7.1	Chapter Summary 248	
	8.7.2	General Standards Development Process 248	
	8.7.3	Management SDO/Forum Categories 248	
	8.7.4	Principles, Frameworks, and Architecture in Management Standards	248
		8.7,4.1 Principles 248	
	075	8.7.4.2 Frameworks and Architecture 249	
	8.7.5	Strategic Framework for Management Standards Development 249	
		8.7.5.1 Strategic Progression of Standards Work 249	
	0.5.6	8.7.5.2 Strategic Human Side of Standards Development 249	
	8.7.6	Key Lessons Learned for Strategic NGN Management Standards	
	o 	Development 250	
	8.7.7	Challenges and Trends 250	
8.8	Refere	nces 250	
CHAP		FORECAST OF TELECOMMUNICATIONS NETWORKS	
		AND SERVICES AND THEIR MANAGEMENT (WELL)	
		INTO THE 21ST CENTURY	253
D 1			
Kobei	rto Sara	cco	
<i>Robei</i> 9.1		cco We Reached the End of the Road? 254	
	Have V		
9.1	Have V	We Reached the End of the Road? 254 d' Innovation 257	
9.1 9.2	Have V	We Reached the End of the Road? 254 d" Innovation 257 I Storage 259	
9.1 9.2 9.3	Have V "Gloca Digital	We Reached the End of the Road? 254 d' Innovation 257 l Storage 259 sing 261	
9.1 9.2 9.3 9.4	Have V "Gloca Digital Proces	We Reached the End of the Road? 254 dl" Innovation 257 I Storage 259 sing 261 s 262	
9.1 9.2 9.3 9.4 9.5	Have Y "Gloca Digital Proces Sensor Displa	We Reached the End of the Road? 254 dl" Innovation 257 I Storage 259 sing 261 s 262 ys 263	
9.1 9.2 9.3 9.4 9.5 9.6	Have V "Gloca Digital Proces Sensor Displa Statisti	We Reached the End of the Road? 254 Il Innovation 257 Storage 259 sing 261 s 262 ys 263 ical Data Analyses 265	
9.1 9.2 9.3 9.4 9.5 9.6 9.7	Have V "Gloca Digital Proces Sensor Displa Statisti Autono	We Reached the End of the Road? 254 Il Innovation 257 Storage 259 sing 261 s 262 ys 263 ical Data Analyses 265 pomic Systems 267	
9.1 9.2 9.3 9.4 9.5 9.6 9.7 9.8	Have V "Gloca Digital Proces Sensor Displa Statisti Autono New N	We Reached the End of the Road? 254 d' Innovation 257 I Storage 259 sing 261 s 262 ys 263 ical Data Analyses 265 pomic Systems 267	
9.1 9.2 9.3 9.4 9.5 9.6 9.7 9.8 9.9	Have V "Gloca Digital Proces Senson Displa Statisti Autono New N Busine	We Reached the End of the Road? 254 d' Innovation 257 Storage 259 sing 261 s 262 ys 263 ical Data Analyses 265 pmic Systems 267 Vetworking Paradigms 268	
9.1 9.2 9.3 9.4 9.5 9.6 9.7 9.8 9.9 9.10	Have V "Gloca Digital Proces Sensor Displa Statisti Autono New M Busine	We Reached the End of the Road? 254 dl' Innovation 257 I Storage 259 sing 261 ss 262 sys 263 ical Data Analyses 265 omic Systems 267 Networking Paradigms 268 ess Ecosystems 270	

INDEX 281