

# Table of Contents

1	Introduction .....	1
1.1	Why TETRA .....	1
	References.....	4
2	Modern Security Requirements in Private Mobile Communications Systems.....	5
2.1	Introduction .....	5
2.2	PMR Systems [1].....	6
2.2.1	PMR Configurations .....	6
2.2.2	Comparison Between PMR and Cellular [2].....	11
2.2.3	PMR Standards [1].....	14
2.3	PMR Limitations [4] .....	28
2.3.1	Edge of Coverage Voice Quality .....	28
2.3.2	Requirements of PMR Services .....	33
2.3.3	Interoperability [6] .....	37
	References .....	42
3	TETRA Providing an Acceptable Security System Solution .....	43
3.1	Introduction .....	43
3.2	Hierarchical analysis .....	44
3.2.1	Air interface specifications.....	44
3.2.2	GSM ASCI.....	45
3.2.3	Enhanced Multi-Level Precedence and Pre-emption service (eMLPP).....	45
3.2.4	Voice Group Call Service (VGCS) .....	46
3.2.5	Voice Broadcast Service (VBS) .....	47
3.3	TETRA .....	47
3.3.1	Comparison of specified features .....	48
3.3.2	Technical analysis .....	49
	References .....	66
4	Channel Assignment and Multiple Access in Trunking Radio Systems [1].....	67
4.1	Channel Assignment Techniques [1].....	67
4.1.1	Introduction .....	67
4.1.2	Channel Allocation Schemes .....	68

## XIV Table of Contents

4.2	Channel Assignment Optimization.....	80
4.2.1	Introduction .....	80
4.2.2	Model Formulation.....	80
4.2.3	One Layer Architecture using Erlang Model .....	82
4.2.4	Channel Assignment Scheme based on a Three Layer Architecture .....	84
4.2.5	Comparison of One layer with Three Layer Architecture .....	90
4.3	Multiple Access Techniques.....	102
4.3.1	CDMA Techniques in TETRA systems .....	102
	References .....	126
5	Video Transmission over TETRA .....	133
5.1	Introduction .....	133
5.2	Evolution of Public Safety Mobile Networks.....	134
5.2.1	Evolving Data services for public safety.....	135
5.2.2	The TETRA solution to PSDR communication environment.....	136
5.2.3	The Market Considerations .....	138
5.2.4	TETRA Enhanced Data Service-TEDS .....	139
5.3	Overview of DATA Transmission over TETRA .....	141
5.3.1	TETRA (V+D) Technical Characteristics.....	141
5.3.2	TETRA Network Services .....	147
5.3.3	High Speed Data service provisioning .....	149
5.4	Video Encoding Techniques.....	151
5.4.1	Background .....	151
5.4.2	Compression standards overview .....	153
5.4.3	Encrypted Video over TETRA.....	170
5.5	Performance Analysis of video broadcasting over TETRA .....	174
5.5.1	Performance Evaluation .....	175
5.5.3	Video Quality Measurements.....	178
5.6	Vision for Future Public Safety Communication Systems .....	181
5.6.1	Future Trends .....	181
5.6.2	All-IP convergence.....	182
5.6.3	TETRA – TEDS interoperability .....	183
5.6.4	TETRA over IP .....	183
5.6.5	Integrated TETRA-WLAN system .....	184
5.7	Conclusions .....	186
	References .....	188

6	TETRA as a Gateway to Other Wireless Systems.....	191
6.1	Introduction .....	191
6.2	TETRA Air Interface: Logical and Physical Channels .....	192
6.2.1	Logical Channels.....	193
6.2.2	Physical channels .....	194
6.3	TETRA Packet Data Transmission .....	195
6.3.1	Packet Data transmission and reception procedures .....	198
6.3.2	TETRA IP user authentication .....	202
6.4	SNDCP states and state transitions.....	205
6.5	UDP versus TCP on top of TETRA IP layer.....	211
6.6	TETRA Packet Data modems .....	213
6.6.1	Types of Packet-data Mobile Stations.....	214
6.7	TETRA and WLAN Integration for Improving Packet-Data Transmission Capabilities .....	216
6.7.1	Integrated WLAN/TETRA System Overview .....	220
6.8	System Architecture .....	223
6.8.1	Architecture Elements and Interfaces .....	223
6.8.2	Protocol Architecture .....	225
6.8.3	Packet Structure .....	227
6.8.4	WLAN Association and TETRA Location Update Procedure .....	228
6.8.5	Group Call Initiation and Participation .....	230
6.9	Conclusions .....	231
	References .....	233
7	TETRA as a Building block to WMNs.....	235
7.1	Introduction .....	235
7.1.1	Requirements.....	239
7.1.2	Discussion .....	244
7.2	Wireless Mesh Networks.....	245
7.2.1	Definition and classification of WMNs .....	245
7.2.2	MANET routing protocols .....	246
7.2.3	Influence of routing protocols on network performance...	253
7.2.4	Multicast in WMNs .....	259
7.3	TETRA DMO.....	263
7.3.1	DMO overview.....	263
7.4	TETRA Release 2.....	273

## XVI Table of Contents

7.5 TETRA extensions for building WMNs.....	275
7.5.1 Routing capabilities.....	277
7.5.2 Wireless Interface.....	283
7.5.3 Overview of network performance figures .....	287
7.6 Conclusion.....	293
References .....	295
Appendix.....	299