

# TABLE OF CONTENTS

<b>The National Law Enforcement and Corrections Technology Center–Rocky Mountain</b> .....	ix
<b>Acknowledgments</b> .....	ix
<b>Introduction</b> .....	1
<b>Part 1. Planning and Managing a Communications Project</b> .....	3
<b>Chapter 1. What It Takes to Succeed</b> .....	5
A Plan .....	5
Time, Money, and Resources .....	5
Getting Started .....	6
What Do You Have Now? .....	6
What Do You Need? .....	6
What Are Your Options? .....	7
How Much Will It Cost? .....	8
How Do You Implement the Project? .....	9
Getting Help .....	9
Other Agencies .....	9
Consultants .....	9
Vendors .....	10
<b>Chapter 2. Planning the Project</b> .....	11
Realistic Schedule .....	11
Project Team(s) .....	11
Project Manager .....	12
Responsibility .....	12
Authority .....	12
Time .....	12
Management Support .....	12
Physical Resources .....	12
Other Team Members .....	12
Budget .....	13
<b>Chapter 3. Obtaining Funds</b> .....	15
Types of Funds .....	15
Sources of Funds .....	15
Federal Sources .....	15

---

Block Grants .....	17
Discretionary Grants .....	17
Federal Asset Forfeiture Funds .....	17
State Sources .....	18
Local Sources .....	18
Single Agency Versus Multiple Agencies .....	19
“Selling” Your Need .....	19
Getting Help .....	20
<b>Chapter 4. Buying What You Need .....</b>	<b>23</b>
How to Buy .....	23
Competitive Procurement .....	23
Noncompetitive Procurement .....	23
Sole Source Procurement .....	24
Contract for Operational Services .....	24
Cooperative Purchasing .....	24
Western States Contracting Alliance .....	24
Leasing .....	25
Outsourcing .....	26
Request for Information (RFI) .....	26
Competitive Procurement (RFP) .....	26
Request for Proposal (RFP) .....	27
RFP Process .....	27
Develop the RFP .....	27
Issue the RFP .....	28
Evaluate Responses .....	29
Select Vendor .....	30
Negotiate Contract .....	30
Manage the Project .....	31
Acceptance Testing .....	32
<b>Part 2. Wireless Communications Technology .....</b>	<b>33</b>
<b>Chapter 5. Voice Versus Data .....</b>	<b>35</b>
Voice Versus Data .....	35
Analog Versus Digital .....	36
Analog Radio Systems .....	37
Digital Radio Systems .....	37
Transmission Differences .....	38
Encryption .....	39
<b>Chapter 6. Characteristics of Radio Systems .....</b>	<b>41</b>
Understanding Radio Terms .....	41
Wave .....	41
Wavelength .....	42

---

Cycle .....	42
Frequency .....	42
Spectrum and Bands .....	43
Public Safety Bands .....	44
Channels .....	44
Mobile Radio System Frequencies .....	46
Frequency Selection Considerations .....	46
Coverage .....	46
Building Penetration .....	46
Skip .....	47
Noise .....	47
Antenna Size .....	47
Transmitters and Receivers .....	47
Transmitters .....	47
Receivers .....	48
Antennas .....	50
Antenna Gain .....	50
Types of Antennas .....	52
Base Station Antennas .....	52
Directional Antennas .....	52
Mobile Antennas .....	53
Portable Antennas .....	53
Smart Antennas .....	54
Effective Radiated Power (ERP) .....	55
Interference .....	55
Radiation .....	56
Local Regulations Controlling Antennas .....	56
Radio Coverage .....	56
Duplexers, Combiners, Multicouplers .....	58
Duplexers .....	58
Combiners .....	59
Multicouplers .....	61
Multiple Access Systems .....	61
Frequency Division Multiple Access (FDMA) .....	61
Time Division Multiple Access (TDMA) .....	62
Code Division Multiple Access (CDMA) .....	62
Frequency Hopping .....	63
Direct Sequence .....	63
Packaging Data .....	63
<b>Chapter 7. Current Public Safety Radio Systems .....</b>	<b>65</b>
Paging Systems .....	65
Short Messaging Systems (SMS) .....	66
Two-Way Simplex Radio Systems .....	66
Two-Way Mobile Relay Systems .....	67

---

Repeater Innovations .....	68
Mobile Repeaters .....	69
Trunked Radio Systems .....	69
Specialized Mobile Radio (SMR) .....	71
APCO Project 16 Trunked Radio System .....	72
Project 25 Digital Trunked Radio System .....	72
TERrestrial TRunked RAdio (TETRA) .....	74
220 MHz Narrow Bandwidth Band .....	74
Cellular Radio/Telephone Systems .....	75
Personal Communications Systems (PCS) .....	77
Cellular Digital Packet Data .....	77
Point-To-Point Microwave Communications Systems .....	78
Microwave System Engineering and Licensing .....	79
Wireless Local Area Networks (WLAN) .....	80
802.11b Networks .....	81
Wireless Local Links - Bluetooth .....	83
<b>Part 3. Wireless Communications Issues .....</b>	<b>85</b>
<b>Chapter 8. FCC Licensing, Rules, Regulations, and Related Issues .....</b>	<b>87</b>
Licensing .....	87
FCC Rules and Regulations .....	88
Part 90 .....	88
Docket 92-335 .....	88
Part 22 .....	88
Part 24 .....	89
Part 101 .....	89
Refarming .....	89
Frequency Reallocation .....	89
Computer Assisted Pre-coordination Resource and Database (CAPRAD) .....	91
4.9 GHz Band .....	92
<b>Chapter 9. Tower Siting and Radio Frequency Electromagnetic Radiation Exposure .....</b>	<b>95</b>
Towers .....	95
Radio Frequency Electromagnetic Radiation Exposure .....	96
<b>Chapter 10. Federal Government and Other Initiatives .....</b>	<b>99</b>
NCIC 2000 .....	99
Public Safety Wireless Network (PSWN) .....	100
Program Overview .....	100
The National Institute of Justice and Its Interoperability Program .....	101
Advanced Generation of Interoperability for Law Enforcement (AGILE) Program .....	101
Developing Interoperability Standards for Public Safety .....	101
Integrating, Testing, and Evaluating Interoperability Technology .....	102
Raising Awareness of Interoperability .....	102

---

---

Mobile Broadband for Emergency and Safety Applications (MESA) .....	102
<b>Chapter 11. Interoperability</b> .....	105
Three Types of Interoperability .....	105
Interoperability Obstacles .....	108
Interoperability Solutions .....	108
Classes of Systems .....	108
Conventional Systems .....	108
Analog Trunked Systems .....	109
Project 25 Digital (Conventional or Trunked) .....	109
Infrastructure-Based Patching .....	109
Cost .....	109
 <b>Part 4. Wireless Communications Options</b> .....	 111
 <b>Chapter 12. Voice Systems</b> .....	 113
Dedicated Radio Systems .....	113
Sample Vendors .....	113
E.F. Johnson Division of EFJ, Inc. ....	113
M/A-COM Division of Tyco International. ....	114
Motorola, Inc. ....	114
Advantages of Dedicated Systems .....	115
Disadvantages of Dedicated Systems .....	116
Cellular and PCS Radio .....	115
System Coverage .....	116
Pricing .....	116
Sample Vendors .....	117
AT&T Wireless Services. ....	117
Cingular Wireless. ....	117
Sprint. ....	117
Verizon Wireless. ....	117
Advantages of Cellular/PCS Radio .....	117
Disadvantages of Cellular/PCS Radio .....	118
Voice—SMR/ESMR .....	118
A Special Case: Conventional Radio System for the Township of Upper St. Clair, Pennsylvania .....	119
Sample Vendor—Nextel .....	119
System Coverage .....	120
Pricing .....	121
Sample Vendor—Lower Colorado River Authority .....	121
Advantages of an SMR/ESMR System .....	121
Disadvantages of an SMR/ESMR System .....	121
 <b>Chapter 13. Wireless Data Systems</b> .....	 123
Cellular Digital Packet Data (CDPD) .....	123

---

---

<b>Sample Vendors</b> .....	123
AT&T Wireless .....	124
Verizon Wireless .....	124
Advantages of CDPD .....	124
Disadvantages of CDPD .....	125
General Packet Radio Service (GPRS) .....	125
IXRTT Service .....	126
<b>Private National Data Networks</b> .....	127
<b>Sample Vendors</b> .....	127
Motient Wireless Data Network .....	127
Cingular Wireless (formerly RAM Network) .....	127
Advantages of Private National Data Networks .....	128
Disadvantages of Private National Data Networks .....	129
<b>Regional Voice and Data Systems</b> .....	129
<b>Sample Vendor</b> .....	129
RACOM .....	129
Advantages of Regional Voice and Data Systems .....	130
Disadvantages of Regional Voice and Data Systems .....	131
<b>Chapter 14. Latest Developments</b> .....	133
<b>Mobile Satellites</b> .....	133
<b>Voice Communications Satellites</b> .....	133
Example System—Iridium .....	133
Other Voice Satellite Systems .....	136
<b>Data Communications Satellites</b> .....	137
High Altitude Long Endurance (HALE) Platforms and High Altitude Platforms (HAPS) .....	138
Ultra Wide Band (UWB) Devices .....	139
Software Defined Radio (SDR) .....	140
Voice Over Internet Protocol (VoIP) .....	141
Motorola Greenhouse Project .....	143
<b>Summary</b> .....	145
<b>Glossary and Acronyms</b> .....	147
Glossary .....	149
Acronyms .....	153
<b>Appendixes</b> .....	157
Appendix A. State Agencies Administering Byrne Program Grants .....	159
Appendix B. Resources .....	163

---