

## **SECTION C - DESCRIPTION/SPECIFICATIONS/WORK STATEMENT**

### **C1 INTRODUCTION**

#### **C1.1 Background**

The District of Columbia Metropolitan Police Department (MPD) is upgrading and modernizing their 20-year old Ultra-High Frequency (UHF) radio system from an analog 25 kHz channel system to a narrowband (12.5 kHz) digital system. This upgrade is a result of the need to modernize old equipment and to conform with Federal Communications Commission (FCC) regulations that will no longer type-accept non-narrowband equipment in an effort to promote refarming within the Very High Frequency (VHF) and UHF public safety frequency bands. Digital communications systems provide radio communications that are more robust and secure than their analog counterpart, and, in the future, more bandwidth-efficient.

This migration presents an opportunity to improve interoperability between neighboring public safety agencies, to integrate encryption capability for special police operations, and to eliminate coverage problems within the current system.

#### **C1.2 Objectives**

This specification includes Telecommunications Industry Association (TIA)-102-compliant narrowband digital radio equipment, software, systems, services, and ancillary equipment.

The MPD requires a TIA-102 (Project 25)<sup>1</sup>-compliant radio system. More specifically, the radio system shall conform to Class A standards of the TIA-102 specifications.<sup>2</sup> TIA-102 offers backwards compatibility with analog 25 kHz channels that will enable a gradual migration of the radio system channel by channel, from analog to digital signaling. It also sets a standard for public safety agencies recommended by the Association of Public Safety Communications Officials (APCO) International that promises to improve interoperability. The standard provides for a Common Air Interface (CAI) across which radio equipment from multiple vendors may interoperate securely.

The UHF Digital Radio System shall include the provision and installation of fixed end equipment to provide a complete UHF narrowband digital wide area coverage radio system. The system shall include digital encryption and Over-the-Air Rekeying (OTAR) functionality.

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<sup>1</sup> The TIA-102 documents were formerly known as Association of Public Safety Communications Officials (APCO) Project 25.

<sup>2</sup> Class A Standards, as defined in TIA document TSB102.CAAB, *Digital C4FM/CQPSK Transceiver Performance Recommendations*.

The contract resulting from this part of the specification will be a firm fixed contract with an option to buy additional equipment in an Indefinite Delivery, Indefinite Quantity (IDIQ). This contract shall also include a maintenance contract for one (1) year plus four (4) one (1)-year options. The contract will be awarded to a single vendor. Refer to Section B for pricing details.

The new UHF Digital Radio System must solve or improve several limitations that exist in the present MPD radio system:

- Several areas in the 2nd District experience radio communication coverage problems.
- The MCI Center and several other strategically important buildings experience in-building coverage problems.
- A single point of failure exists for the fixed-end station transmission of the 4<sup>th</sup> District, 6<sup>th</sup> District, 7<sup>th</sup> District, and TAC-3 channels, due to intermodulation problems.

### **C1.3 Existing System Description**

The present MPD UHF radio system consists of 13 frequency pairs (duplex channels), transmitted from base stations located on seven radio towers within DC. In addition, there is one UHF transmitter located in the I-395/I-95 tunnel near 3<sup>rd</sup> & C Streets NW, and 18 repeater sites located within various DC Metro (subway) stations.

The fixed-end equipment for each channel consists of a main transmitter (base station), a standby transmitter, several satellite receivers, a voting comparator, and miscellaneous tie line and ancillary equipment. The receivers are located at several of 33 total receive sites in DC. The MPD owns or has permission to use the space at all of the transmit and receive sites except for one: the receive site located at the site of the Washington National Cathedral, which is a Motorola managed site.

The current MPD system includes an MDC-1200 signaling tone remote control Motorola Centracom Gold Elite console located at the MPD Headquarters (300 Indiana Avenue) to perform dispatch and control.

### **C1.4 Scope of Work**

The new system shall be designed to provide the coverage requirements specified within this document. The design of the new system shall maintain the present locations of transmitters, except in situations where a single point-of-failure exists. A single point-of-failure is defined as a radio channel having both the main and standby transmitters located at the same site. Receiver site locations shall be limited to the

33 existing sites except in situations where the coverage requirement justifies the additional expense, and use of the proposed location is permitted.

Since the new system will be digital, digital comparators will be required to vote on the best signal from the subscriber units. Digital Interface Units (DIUs) shall be used to convert the composite digital signal from the comparator to intelligible analog signals that can be reproduced by the existing communication control console located at MPD Headquarters.

The MPD has a public safety requirement to operate their existing UHF radio system while the installation of the new system is in progress. Therefore, on a channel-by- channel basis, the new system shall be installed, tested, and confirmed to be fully operational while the existing system is functioning and operating. Transition to the new system shall be seamless to the MPD user. After completion of the new system, the Contractor is required to remove the existing system equipment without damage, harm, or disruption of service to the new system.

## **C2            GENERAL STANDARDS**

The following is an explanation of the terms, standards, functions, and protocols used within this specification.

### **C2.1            MPD Acronyms**

CID	Criminal Investigation Division
CW-1	Citywide-1 Radio Channel
ERT	Emergency Response Team
ISB	Investigative Services Bureau
MNB	Major Narcotics Branch
MPD	Metropolitan Police Department
SOD	Special Operations Division
TAC	Tactical Channel
Zone-X	X Channel, for example, Zone-1 is the 1D Channel
SOD Zone	SOD Channel

### **C2.2            Definitions**

- Portable Radio Unit  
A radio capable of operation in a mobile environment, and suitable for handheld operation.

- **Mobile Radio Unit**  
A radio capable of operation in a mobile environment, designed for installation and operation in a motor vehicle.
- **Subscriber Unit:**  
A portable or mobile radio unit.
- **Transmit and Receive Equipment:**  
Equipment that transmits, receives or interprets radio messages; includes portable and mobile radios, base stations, repeaters, receivers, and comparators.
- **Encryption Key Equipment:**  
Equipment used to load and store encryption keys, such as Key Variable Loaders (KVLs) and Key Management Facilities (KMFs).
- **Fixed-End Equipment:**  
Fixed, stationary equipment such as base stations, repeaters, receivers, comparators, DIUs, digital voice modems, remote controllers, consoles, and encryption key equipment.
- **Forward Link**  
The transmission and communication from a fixed-end transmitter to a subscriber unit.
- **Reverse Link**  
The transmission and communication from a subscriber unit to a fixed end receiver.

### **C2.3 Standards and Protocols**

- Analog radios, at a minimum, shall conform to the standards specified within TIA/EIA-603.
- Digital radios, at a minimum, shall conform to the standards specified within TIA- TSB-102.CAAB for Class A type radios.
- Digital radio testing: Data listed in the specifications shall be obtained conforming to methods of measurement described in Section 2 of TIA-TSB-102.CAAA.
- Common Air Interface (CAI) protocol: TIA-102-compliant protocol, per TIA-TSB-102.BAAA, BAAB-A, BAAC-A, and BAAD.
- Improved Multi-Band Excitation (IMBE) Vocoder: vocoder, per TIA-TSB-102.BABA, BABB-A, BABC, and BABD.

## **C2.4 Frequency Band Range**

UHF radios shall have the low-split frequency band.

- Low Split: Frequency range of 403 – 470 MHz

## **C2.5 Operating Modes**

### **C2.5.1 Analog**

Analog radio transmit and receive equipment shall be capable of operation in the following modes:

#### **C2.5.1.1 Analog Conventional 25 kHz channel spacing**

#### **C2.5.1.2 Analog Narrowband 12.5 kHz channel spacing**

### **C2.5.2 Digital**

Digital radio transmit and receive equipment shall be capable of operation in the above mentioned analog modes, as well as the following:

#### **C2.5.2.1 Digital Narrowband TIA-102 CAI 12.5 kHz channel spacing**

## **C2.6 Encryption**

Equipment specified to have the following encryption features shall be equipped with the necessary software. The key for the encryption shall be changeable only by a PC keyloader or OTAR.

### **C2.6.1 TIA-102 Digital Encryption Standard (DES)**

Capability of operation in the TIA-102 DES encrypted mode. The encryption shall be compliant with the following specifications: TIA-IS-102.AAAA-A for a description of the protocol and IS-102.AAAC for a description of the conformance testing.

## **C2.7 Over-the-Air-Rekeying (OTAR)**

Equipment specified to have OTAR features shall be equipped with the necessary software.

#### C2.7.1 TIA-102 Digital OTAR

Capability of changing encryption keys using TIA-102 OTAR. The OTAR shall be compliant with the following specifications: TIA-TSB-102.AACA for a description of the protocol, TIA-TSB-102.AACB for an operational description, and TIA-TSB-102.AACC for a description of the conformance testing.

### **C3 DESIGN REQUIREMENTS**

This section describes the existing MPD UHF and VHF radio systems, as well as the design requirements for the new radio system.

#### **C3.1 FCC Channel Licenses**

Table C-1 lists the details of the FCC licenses for the MPD's 13 UHF and 3 VHF channel pairs.

#### **C3.2 Existing Transmit and Receive Sites**

Table C-2 depicts the transmitters for each UHF channel stationed at various tower and tunnel sites.

In addition to the base station sites, there are also 18 sites that transmit and receive on the Citywide-1 channel within DC Metro (subway) underground stations. Table C-3 lists the locations of these repeaters. The radio signal is broadcast throughout the subway by means of leaky cabling.

#### **C3.3 General System Topology**

The new UHF radio system shall consist of one main site and one standby site base station transmitter for each of the current MPD UHF channels. Each base station shall have repeater capability. However, the repeater receive range shall not be used as part of the coverage – only satellite receivers shall be considered for coverage. The system shall include several satellite receivers for each channel to receive subscriber unit transmissions in the coverage ranges specified in the coverage requirements section of this specification. Digital voting comparators shall be used to determine the best signal from the multiple receivers.

**Table C-1. FCC Channel Information**

Channel	Xmit Freq. (MHz)	Output Power (W)	ERP Authorized (W)	Ground Elev. (ft)	Ant. Ht. To Tip (ft)	Antenna Lat.	Antenna Long.	Usage	Tower Name	Transmitter Address
1D	460.350	250	1514	160	102	38-51-16	077-00-01	Main	St. E's	2700 MLK Jr. Ave SE
		350	951	190	100	38-56-30	077-00-41	Standby	Park Rd	750 Park Rd. NW
		110	10	40	-30	38-56-30	077-04-47	UG	I-95	300 Block 3rd St. NW
2D	460.250	250	487	288	355	38-57-44	077-01-36	Standby	4D	6001 Georgia Ave. NW
		350	400	391	249	38-56-24	077-04-54	Main	WRC	4001 Nebraska Ave. NW
3D	460.025	250	586	288	495	38-57-44	077-01-36	Standby	4D	6001 Georgia Ave. NW
		350	1009	170	170	38-54-59	077-02-54	Main	Hilton	1919 Conn. Ave. NW
4D	460.500	250	461	288	480	38-57-44	077-01-36	Main	4D	6001 Georgia Ave. NW
		250	461	288	480	38-57-44	077-01-36	Standby	4D	6001 Georgia Ave. NW
5D	460.200	250	675	288	490	38-57-44	077-01-36	Standby	4D	6001 Georgia Ave. NW
		350	970	170	120	38-55-37	076-58-51	Main	1700	1700 Rhode Isl. Ave. NE
6D	460.150	350	912	280	167	38-51-10	076-58-12	Main	Engine 32	2445 Irving St. SE
		350?	912	280	167	38-51-10	076-58-12	Standby	Engine 32	2445 Irving St. SE
7D	460.475	350	859	280	121	38-51-10	076-58-12	Main	Engine 32	2445 Irving St. SE
		350	859	280	121	38-51-10	076-58-12	Standby	Engine 32	2445 Irving St. SE
TAC-1	460.100	250	586	288	465	38-57-44	077-01-36	Standby	4D	6001 Georgia Ave. NW
		350	708	390	200	38-56-24	077-04-54	Main	WRC	4001 Nebraska Ave. NW
TAC-2	460.400	350	1134	280	136	38-51-10	076-58-12	Main	Engine 32	2445 Irving St. SE
		110	10	40	-30	38-56-30	077-04-47	UG	I-95	300 Block 3rd St. NW
		350	991	170	120	38-55-37	076-58-51	Standby	1700	1700 Rhode Isl. Ave. NE
TAC-3	460.450	250	461	288	450	38-57-44	077-01-36	Standby	4D	6001 Georgia Ave. NW
		350	517	288	435	38-57-44	077-01-36	Main	4D	6001 Georgia Ave. NW
SOD	460.275	250	554	288	600	38-57-44	077-01-36	Main	4D	6001 Georgia Ave. NW
		350	1574	160	102	38-51-16	077-00-01	Standby	St. E's	2700 MLK Jr. Ave SE
Command	460.425	250	369	288	570	38-57-44	077-01-36	Standby	4D	6001 Georgia Ave. NW

		350	431	391	250	38-56-24	077-04-54	Main	WRC	4001 Nebraska Ave. NW
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**Table C-1. (Concluded)**

Channel	Xmit Freq. (MHz)	Output Power (W)	ERP Authorized (W)	Ground Elev. (ft)	Ant. Ht. To Tiip (ft)	Antenna Lat.	Antenna Long.	Usage	Tower Name	Transmitter Address
Citywide-1 (UHF)	460.325	250	461	288	675	38-57-44	077-01-36	Main	4D	6001 Georgia Ave. NW
		350	574	391	355	38-56-24	077-04-54	Standby	WRC	4001 Nebraska Ave. NW
		110	0	40	-40	38-56-30	077-04-47	UG	I-95	300 Block 3rd St. NW
Citywide-1 (VHF)	X159.150	250	304	288	535	38-57-44	077-01-36	Main	4D	6001 Georgia Ave. NW
	R155.250	350	512	190	100	38-56-30	077-00-41	Standby	Park	750 Park Rd. NW
ISB	X158.790	250	307	91	25	38-57-44	077-01-36	Main	4D	6001 Georgia Ave. NW
	R156.030	350	774	190	120	38-56-30	077-00-41	Standby	Park	750 Park Rd. NW
		350	22	40	-30	38-56-30	077-04-47	UG	I-95	300 Block 3rd St. NW
CID	X158.850	250	353	288	420	38-57-44	077-01-36	Main	4D	6001 Georgia Ave. NW
	R156.090	350	820	170	100	38-55-37	076-58-51	Standby	1700	1700 Rhode Isl. Ave. NE



**Table C-2. Base Station/Transmit Sites**

<b>Channel</b>	<b>St. Eliz. Hospital</b>	<b>Park</b>	<b>I-95</b>	<b>4D</b>	<b>WRC</b>	<b>Hilton Motel</b>	<b>1700</b>	<b>Engine 32</b>
1D	M	S	U					
2D				S	M			
3D				S		M		
4D				M,S				
5D				S			M	
6D								M,S
7D								M,S
TAC-1				S	M			
TAC-2			U				S	M
TAC-3				M,S				
SOD	S			M				
Command				S	M			
Citywide-1 UHF			U	M	S			
Citywide-1 VHF		S		M				
ISB			U	M				
CID				M			S	

M: Main Transmitter  
 S: Standby Transmitter  
 U: Underground (Tunnel) Transmitter

**Table C-3. Underground Metro Repeater Sites**

<b>Metro Line</b>	<b>Metro Station</b>	<b>Underground Repeater Location</b>
Red	Judiciary Square	5 <sup>th</sup> & F St. NW
Red	Farragut North	Connecticut Ave. & K St. NW
Red	Woodley Park-Zoo	Connecticut Ave. & Woodley Rd. NW
Red	Friendship Heights	Wisconsin Ave. & Jennifer St. NW
Red	Van Ness – UDC	Van Ness & Connecticut Ave. NW
Red/Green	Fort Totten	Galloway St. NE, east of S. Dakota Ave.
Green	Shaw – Howard University	7th & S Sts. NW
Green	Navy Yard	SE corner M & Half Sts., SE
Green	Anacostia	Shannon Pl. between ML King Ave. & Firth Sterling Ave. S. E.
Green	Columbia Heights (New Station)	14 St. between Irving & Harvard Aves. NW
Green/Yellow/ Orange/Blue	L'Enfant Plaza (2)	7 <sup>th</sup> & D St. SW
Orange/Blue	Potomac Ave.	14 <sup>th</sup> & Pennsylvania Ave. SE
Orange/Blue	McPherson Square	14 <sup>th</sup> & I St. NW
Blue	Benning Rd.	Benning Rd. & E. Capitol NE
Blue	Capitol Heights	Southern Ave. & East Capitol St. NE

Table C-4 depicts the receivers for each UHF and VHF channel stationed at various sites.

The design of the new system shall maintain the present locations of transmitters, except in situations where a single point-of-failure exists. Receiver site locations shall be limited to the 33 existing sites except in situations where the improved coverage requirement justifies the additional expense, and the use of the proposed location is permitted.

Transmitter and receiver fixed-end equipment shall be connected to remote sites for communication and control purposes. DIUs shall be provided to allow a tone remote control console to interface with the new digital fixed end equipment.

**Table C-4. Existing Receiver Sites**

<b>Zone (Channel)</b>	<b>1310 L ST NW</b>	<b>1700 RI Ave. NE</b>	<b>1D 415 4 St SW</b>	<b>4D Tower 6001 GA Ave.</b>	<b>5D 1805 Blad Rd. NE</b>	<b>5901 E. Capitol St. NE</b>	<b>Beck &amp; So. Ave. SE</b>	<b>Cathedral</b>	<b>E-18 414 8 St. SE</b>	<b>E-25 3203 MLK Ave. SW</b>	<b>E-28 3522 CT Ave. NW</b>	<b>E-30 #50 49 St. NE</b>	<b>E-32 2445 Irving St. SE</b>	<b>EOB 17 &amp; PA Ave. NW</b>	<b>Hilton 1919 CT Ave. NW</b>	<b>HQ 300 Indiana Ave. NW</b>	<b>Marriott - Arlington, VA</b>	<b>O St. 125 O St. SE</b>	<b>Soldiers Home</b>	<b>Washington Monument</b>	<b>Wingate 4660 MLK Ave.</b>	<b>WRC 4001 Nebraska Ave. NW</b>	<b>USPP 1515 NY Ave. NE</b>	<b>PEPCO 1900 PA Ave. NW</b>	<b>Post Office 1100 PA Ave.</b>	<b>Providence Hospital</b>	<b>RFK Stadium</b>	<b>SE Community Hospital</b>	<b>Sibley Hospital</b>	<b>ST. Elizabeth's DIX Bldg.</b>	<b>ST. Elizabeth's Center</b>	<b>Shrine</b>	<b>Park Rd. 750 Park Rd. NW</b>	<b>Channel Total</b>
1D	1		1	1					1				1			1				1				1										9
2D				1										1	1	1	1			1		1		1				1						10
3D	1			1							1			1	1	1				1			1	1									1	10
4D				1							1					1			1														1	5
5D	1	1		1	1											1			1				1		1									9
6D				1		1	1					1	1			1										1								7
7D				1						1			1					1		1	1					1	1			1				9
TAC-1	1	1	1	1	1	1	1		1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1			1	30
TAC-2	1	1	1	1		1	1		1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1			1	29
TAC-3	1	1	1	1		1	1		1	1		1	1		1	1	1	1	1	1	1	1	1	1	1	1	1	1		1			1	26
SOD	1	1	1	1		1	1		1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1			1	29
Command		1	1	1		1	1		1	1		1	1	1		1	1	1	1		1	1	1	1		1	1	1	1	1				23
Citywide-1 (UHF)	1	1	1	1		1	1		1	1		1	1	1	1	1	1	1	1	1	1	1	1	1		1	1	1	1				1	27
Citywide-1 (VHF)				1				1					1			1															1	1		6
ISB (VHF)				1				1					1			1																1	1	5
CID (VHF)				1				1					1			1																1		6
<b>Site Total</b>	<b>8</b>	<b>7</b>	<b>7</b>	<b>16</b>	<b>2</b>	<b>7</b>	<b>7</b>	<b>3</b>	<b>7</b>	<b>7</b>	<b>5</b>	<b>7</b>	<b>12</b>	<b>7</b>	<b>7</b>	<b>15</b>	<b>7</b>	<b>7</b>	<b>8</b>	<b>9</b>	<b>7</b>	<b>7</b>	<b>7</b>	<b>8</b>	<b>9</b>	<b>5</b>	<b>10</b>	<b>7</b>	<b>6</b>	<b>7</b>	<b>1</b>	<b>3</b>	<b>8</b>	<b>240</b>

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Table C-5 depicts the required locations for voting of each radio channel. A total of three remote sites are listed. The following are the addresses for those sites:

- MPD Headquarters (HQ): 300 Indiana Ave. NW, Washington DC 20001
- 4D Tower Site: 6001 Georgia Ave. NW, Washington DC 20011
- Radio Shop: 1501 South Capitol St. SW, Washington DC 20003

**Table C-5. Required Comparator Locations**

<b>Channel</b>	<b>Voting Comparator Location</b>
1D	MPD HQ
2D	MPD HQ
3D	MPD HQ
4D	MPD HQ
5D	MPD HQ
6D	MPD HQ
7D	MPD HQ
TAC-1	4D Tower Site
TAC-2	Radio Shop
TAC-3	4D Tower Site
SOD	Radio Shop
Command	MPD HQ
Citywide-1 (UHF)	MPD HQ
Citywide-1 (VHF)	MPD HQ
ISB (VHF)	MPD HQ
CID (VHF)	MPD HQ

Primary remote control shall be performed by the existing Centracom Gold Elite console located at the MPD Headquarters. The Contractor shall also provide and install a remote desktop console (or two, if required) for each of the three Regional Operations Command (ROC) Centers, as well as the Command Information Center (CIC). The ROCs are located at the addresses listed below. The channels that must be controlled at each ROC are also listed. The ROC North is a temporary location. The Contractor shall verify that the ROC centers are located at these addresses at the time of installation. If not, the Contractor shall install the consoles at the new location.

- ROC Central: 501 New York Ave. NW 20001  
(Control Channels 1D, 3D, 5D, TAC-3, Citywide-1)

- ROC East: #6 DC Village Lane SW, Bldg. 1B 20032  
(Control Channels 6D, 7D, TAC-2, Citywide-1)
- ROC North: MPD Headquarters, Rm. 3132  
(Control Channels 2D, 4D, TAC-1, Citywide-1)
- CIC: MPD HQ, 5<sup>th</sup> floor (Control Channels 3D, TAC-1, TAC-2, TAC-3, CW-1, SOD)

The Contractor shall make the connections to the tie lines for remote control.

A KMF shall be provided and installed at the MPD Headquarters facility for enabling and maintaining encryption operations.

### **C3.4 Coverage Requirements**

The term “coverage” shall be used within this solicitation to describe the successful detection, demodulation, and interpretation of a transmitted radio signal by receiver equipment. “Out-of-building” coverage shall be used to describe coverage when a subscriber unit is not located within a building. “Underground” or “tunnel” coverage shall include situations where a subscriber unit is located within a tunnel or Metro station. “In-building” coverage shall be used to describe coverage when a subscriber unit is located within a building.

When “portable coverage” is required, the system shall provide portable coverage over at least 95 percent of the geographic area in all regions served by the system, at least 95 percent of the time. When “mobile coverage” is required, the system shall provide portable coverage over at least 98 percent of the geographic area in all regions served by the system, at least 98 percent of the time.

The forward link shall be comprised of a base station or repeater transmitter, and subscriber unit receivers. The reverse link shall be comprised of a subscriber unit transmitter, and satellite receiver, base station, or repeater station receivers. The coverage shall be such that at least two receivers shall be capable of successful detection, demodulation, and interpretation of the portable radio unit signal 95% of the time if the subscriber unit is located at any location within the coverage area. Therefore the radio system shall also require a voting system using comparators.

The specifications for fixed-end and portable radio unit transmitter and receiver equipment are included in the Section C-6 of this document.

#### C3.4.1 Coverage by Channel

Table C-6 describes the minimum required coverage area for each MPD radio channel.

Mobile coverage is also required on the Anacostia and Potomac rivers on channels whose required coverage area incorporates the rivers.

#### C3.4.2 Underground/Metro Coverage

The 3<sup>rd</sup> Street tunnel (I-95/I-395 tunnel) shall have 95 percent portable coverage on the Citywide-1 (UHF) channel. Also, the DC Metro underground subway system shall have 95 percent portable coverage on the Citywide-1 (UHF) channel. This coverage shall extend through the tunnels and to each station in between and including the following stations:

- Orange Line: Rosslyn to Stadium-Armory
- Blue Line: Rosslyn to Addison Road
- Red Line: Friendship Heights to Brookland-CUA
- Yellow Line: Pentagon to Mt. Vernon Square-UDC
- Green Line: Georgia Ave.-Petworth to Congress Heights (Note that the Green line shall include new stations such as Georgia Ave.-Petworth, Columbia Heights, and Congress Heights)

If there is more than one tunnel for each line, both tunnels shall have coverage.

The leaky cabling and other necessary propagation equipment are installed and maintained by the Washington Metro Area Transit Authority (WMATA). The Contractor is therefore responsible only for the provision and installation of new repeaters, as well as coverage testing. If improper coverage is found, the Contractor shall determine and substantiate whether or not the lack of coverage is due to the repeaters or the leaky cabling or other propagation equipment. If the problem is due to the repeaters, the Contractor shall solve the problem. If the problem is due to other equipment, the Contractor shall suggest a solution.

#### C3.4.3 In-building Coverage

There are several buildings within the District for which 95 percent portable coverage testing is mandatory on the Citywide-1 (UHF) and SOD channels, as well as on the channel for the

district in which the building is located (1D, 2D etc.). The degree of coverage within the building can be determined by the testing requirements described in Section E. The following is a list of the required buildings.

**Table C-6. Required Coverage Areas Per Channel**

<b>Channel</b>	<b>Minimum Required Coverage Area</b>
1D	Portable coverage within 1 <sup>st</sup> District boundaries. Mobile coverage citywide, as well as 10 km beyond 1 <sup>st</sup> District boundaries into the State of Virginia.
2D	Portable coverage within 2 <sup>nd</sup> District boundaries. Mobile coverage citywide, as well as 10 km beyond 2 <sup>nd</sup> District boundaries into the States of Maryland and Virginia.
3D	Portable coverage within 3 <sup>rd</sup> District boundaries. Mobile coverage citywide.
4D	Portable coverage within 4 <sup>th</sup> District boundaries. Mobile coverage citywide, as well as 10 km beyond 4 <sup>th</sup> District boundaries into the State of Maryland.
5D	Portable coverage within 5 <sup>th</sup> District boundaries. Mobile coverage citywide, as well as 10 km beyond 5 <sup>th</sup> District boundaries into the State of Maryland.
6D	Portable coverage within 6 <sup>th</sup> District boundaries. Mobile coverage citywide, as well as 10 km beyond 6 <sup>th</sup> District boundaries into the State of Maryland.
7D	Portable coverage within 7 <sup>th</sup> District boundaries. Mobile coverage citywide, as well as 10 km beyond 7 <sup>th</sup> District boundaries into the States of Maryland and Virginia.
TAC-1	Portable coverage citywide, Mobile coverage within and including the DC Beltway
TAC-2	Portable coverage citywide, Mobile coverage within and including the DC Beltway
TAC-3	Portable coverage citywide, Mobile coverage within and including the DC Beltway
SOD	Portable coverage citywide, Mobile coverage within and including the DC Beltway
Command	Portable coverage citywide, Mobile coverage within and including the DC Beltway
Citywide-1 (UHF)	Portable coverage citywide, Mobile coverage within and including the DC Beltway, Andrews A.F.B., the Laurel Children's center, and the Dulles Toll Road from DC to Dulles Airport. Also include underground/ tunnel coverage.

*Police Stations/Offices*

- All District Stations and Sub-Stations  
(1D, 1-D-1, 2D, 3D, 4D, 5D, 6D, 6-D-1, 7D)
- All ROC facilities
- MPD Headquarters
- Radio Shop
- SOD ERT (3<sup>rd</sup> St. NE)
- SOD Events (L St. NW)
- MNB (3<sup>rd</sup> St. NE)
- Harbor Unit & Bomb Squad (SW Waterfront)
- Police & Fire Clinic NE (at Providence Hospital)
- Property Division, Shannon Place SE
- Old Traffic Division (501 New York Ave NW)
- DC Police Training Academy
- Fire Department McMillan Drive Facility

*Hospitals*

- |  |                                    |
|--|------------------------------------|
| • Children's Hospital                  | • National Rehabilitation Hospital |
| • Columbia Hospital                    | • Providence Hospital              |
| • DC General Hospital                  | • Riverside Hospital               |
| • Georgetown University Hospital       | • Sibley Memorial Hospital         |
| • George Washington Hospital           | • St Elizabeth's Hospital          |
| • Greater Southeast Community Hospital | • Veteran Affairs Medical Center   |
| • Hadley Memorial Hospital             | • Voluntary Hospital Of America    |
| • Howard University Hospital           | • Walter Reed Army Medical Center  |
| • Medlink Hospital of Capitol Hill     | • Washington Hospital Center       |

*Miscellaneous Buildings*

- MCI Center
- DC Superior Court Building
- United States District Court Building
- Union Station, Union Station Underground
- RFK Stadium
- DC Armory



- Kennedy Center
- Convention Center (Existing)
- Convention Center (New)

In addition to these buildings, the MPD will provide the Contractor with a list of 6 buildings in each District that will also require coverage testing. This list will be delivered to the Contractor before testing begins.

### **C3.5 Eliminate Single Point-of-Failure Problems**

A “single point-of-failure” occurs when the main and standby transmitters of a particular channel are located on the same tower and powered by the same power source. Thus, a failure at that tower station eliminates the ability to use a backup transmitter.

The MPD has single point-of-failure problems with the 4D, 6D, 7D, and TAC-3 channels. These problems result from the fact that other possible locations of those frequencies result in intermodulation with co-located channels.

The Contractor shall resolve the single point-of-failure problems by relocating the standby transmitters to different locations, and redistributing the frequency channels, in accordance with the solution proposed in the design proposal submitted during the bidding phase. Note that this solution must be approved by the MPD.

The main transmitters must remain at their present locations. However, the relocation must be done in such a way that coverage is not sacrificed, the intermodulation problems are solved, and the changes are acceptable to the FCC.

The Contractor shall be responsible for all paperwork and modifications to the MPD’s licensing and frequency plans. Copies of the modifications shall be submitted to the MPD.

### **C3.6 Miscellaneous System Requirements**

#### **C3.6.1 TIA-102 Compliance**

The radio system and its components shall be compliant with Class A requirements of the TIA-102 specifications.

#### C3.6.2 Encryption

The radio system shall be capable of TIA-102 DES encryption on all channels after a software upgrade of the base stations. The SOD channel shall be equipped with the necessary software and fixed end equipment required for TIA-102 DES encryption. A KMF shall also be provided with the system.

#### C3.6.3 OTAR

The radio system shall be capable of TIA-102 OTAR of the DES encryption keys on all channels. The necessary software and fixed-end equipment required for the OTAR implementation shall be provided.

#### C3.6.4 Interoperation With DC Fire Department

The MPD requires interoperability with the DC Fire Department's 800 MHz trunked radio system. This interoperability shall be accomplished through channel "patching" at the consoles of both the MPD and the Fire Department. The Fire Department controls the eight channels of their 800 MHz system using a Motorola Centracom.

The Contractor shall provide and install the necessary software to install the MPD frequencies on all Fire Department console terminals, and the Fire Department frequencies on all MPD console terminals, to allow either console to enable any channel for patching.

#### C3.6.5 Simulcast VHF Citywide-1 Channel

The Contractor shall make provisions to enable the existing VHF Citywide-1 channel (25kHz analog) to simulcast the digital UHF Citywide-1 channel broadcasts.

#### C3.6.6 Relocate VHF Comparators

The Contractor shall relocate VHF comparators as described in Section C4, Installation.

#### C3.6.7 Repeater for MPD Communications Command Base

The contractor shall provide a repeater capable of transmitting and receiving on 16 different VHF radio channels. The repeater shall be powered by a 13.8 Vdc standard automobile battery and shall conform to the specifications listed in section C6 for vehicular repeaters. The contractor is not responsible for installing the equipment.

### **C3.7 Design Documentation**

All design documentation must be approved by the MPD before implementation.

#### **C3.7.1 System Diagrams**

The awarded Contractor shall provide to the MPD, 60 days prior to installation, design documentation, blueprint drawings, and wiring diagrams that detail all configuration and connection information about the new radio system. The Contractor shall also submit blueprint drawings that show the intended locations of all fixed-end equipment.

#### **C3.7.2 Testing Plan**

The Contractor shall submit a plan for testing the equipment to ensure proper functionality based on the requirements set forth in this solicitation. Also, testing shall include a method of verifying acceptable radio coverage within the system, as defined by the coverage requirements listed within this solicitation. These plans shall be submitted 30 days prior to installation.

## **C4 INSTALLATION**

### **C4.1 General Requirements**

All equipment shall be installed according to manufacturer's recommendations. All electronic equipment shall be installed at a minimum of six inches above finished floor.

#### **C4.1.1 Access to Equipment Locations and Space**

Where MPD equipment exists, the MPD will provide free and easy access, shelter, heat, light, and power at the fixed-end equipment locations. However, not all sites are owned by the MPD, and, therefore, access may be restricted. Therefore, the Contractor shall notify the MPD two weeks prior to requiring access to the site.

#### **C4.1.2 Conduit and Isolation Requirements**

The protection systems specified herein apply to all the telephone, control system, and power service (hereinafter called "systems wiring") connected to each piece of fixed location equipment furnished herein. The Contractor shall ensure that system wiring is isolated from all other wiring and that system wiring does not use conduits containing other wiring, unless said other wiring is protected and shielded.

#### C4.1.3 AC Power

All AC power shall be hard wired into equipment cabinets via conduit. All transmitters, receivers, and essential equipment shall be on separate fused circuits and shall be powered from the emergency transfer panel.

#### C4.1.4 Telephone Lines

Each telephone line connected to equipment shall be protected by connections across the line at the entrance box inside the building. The protector grounds shall be connected to the building grounds with #10AWG copper conductor. If the Contractor determines that installation of the protector at the telephone block is not practical, upon MPD approval, installation may be made at the equipment cabinets and grounded at the cabinets.

#### C4.1.5 Overcurrent Protection

The Contractor shall provide and install the separate circuit breakers for each major hardware component. For example, each transmitter shall be on a separate circuit breaker. A label shall be provided at each receptacle indicating from which circuit breaker the power is obtained. Circuit breakers shall be sized to accommodate each system requirement.

#### C4.1.6 Air Conditioning

The Contractor shall be responsible for connecting the system to the site power supply and air conditioning. The Contractor shall provide air conditioning for those sites that require it for the equipment.

### **C4.2 Site Requirements**

#### C4.2.1 Confirm Existing Site Adequacy

The Contractor shall visit the transmit and receiver sites prior to responding to this RFP. The Contractor is, however, fully responsible to confirm the engineering and economic desirability of these sites, prior to responding to this RFP, with respect to, but not limited to, the following:

- Adequate in-building coverage
- Sufficient secure space available for radio equipment
- Availability of backup power
- Availability of sufficient electrical power to support the new equipment

- Site accessibility for emergency and routine repairs
- Site ownership, rent required
- Site masked/shadowed by nearby building structure
- Intermodulation analysis

#### C4.2.2 Beck and Southern Avenue SE Site

Note that the Beck and Southern Avenue SE receiver site will no longer exist after the summer of 1999, and, therefore, shall not be used to accommodate any transmit or receive equipment and antennas.

#### C4.2.3 Permission

The Contractor shall be responsible for notifying the site owners, obtaining permission, and obtaining licenses and permits to use the particular site after contract award and prior to installation. The MPD will assist the Contractor as much as possible. The Contractor shall be held responsible for site changes. All site costs shall be borne by the Contractor.

#### C4.2.4 Alternate Sites

The Contractor is responsible for planning the secure and accessible installation of all equipment in the existing transmit and receiver sites. However, if proper space is not available, the Contractor shall make provisions for the necessary facilities, either by renting space or by providing new space and tower structures.

##### C4.2.4.1 DC Buildings and Modifications

The Contractor shall provide facilities that may be, but are not required to be, located in District-owned buildings. Government space, however, is very limited. Therefore, Contractors shall submit formal requests for use of any Government space needed for their equipment. Contractor requests shall include detailed information regarding needed contiguous floor space, ceiling height, electrical, environmental, and floor loading requirements for each location where ordinary offices and existing telephone closets and frame rooms provide inadequate space. In addition, each request shall state a primary and alternate site for each location or geographic area.

The District will provide the Contractor with access to each District location for the purpose of conducting site surveys and installation planning prior to the scheduled installation dates. The Contractor shall specify in writing the time required for the site survey and to install the

equipment. Contract requests for use of District-owned space shall be submitted in writing to the District and the MPD no later than 60 days after contract award.

Any necessary space modifications to District buildings shall be the responsibility of and at the expense of the Contractor, subject to the District's approval of proposed modifications. Insofar as the District is unable to accommodate Contractor space requests, Contractors are responsible for locating and obtaining any required space for their equipment and facilities. In any event, all required site preparation remains the sole responsibility of the Contractor.

#### C4.2.4.2 Contractor Provided Sites (if used)

If the Contractor determines that new antenna (tower) support structures are required, the Contractor shall design each tower to accommodate multiple antenna arrays and microwave style dishes. The tower's structural design shall conform to American National Standards Institute (ANSI)/EIA-222-D and shall support expansion without degrading structural integrity. Fault alarm equipment shall be installed to monitor tower obstruction lights, where applicable. The new tower shall comply with all Federal and District regulations to include:

- FAA – Air Navigation Safety Rules
- FCC
- OSHA
- EIA RS-222
- DC Zoning regulations

In addition, transmit sites shall comply with ANSI safety levels with respect to human exposure to radio frequency electromagnetic fields (3300 kHz - 100 GHz), as detailed in the IEEE and ANSI publication, IEEE C95.1-1992.

### **C4.3 Grounding Requirements**

The Contractor shall bear sole responsibility for all equipment grounding. Building grounds may be used, but impedances shall be verified prior to installation and shall be recorded by the Contractor to ensure the correct grounding is available at each site. All grounding shall conform to the National Electric Code (NEC) requirements. Grounding tests shall be conducted under the MPD's supervision.

#### C4.3.1 Equipment Grounding

##### C4.3.1.1 Cabinets

The ground wire shall enter the cabinet and be attached to the equipment rails. A star washer shall be used on every ground connection. Ground wire shall be supplied along with lugs, which shall be crimped or soldered. Each coaxial lightning protector ground wire shall be connected to the ground bus directly.

#### C4.3.1.2 Tie Lines

A telephone line lightning protection device shall be installed in the telephone equipment room or other location if approved by the MPD. The MPD will not approve another location for the protector unless room access or equipment access dictates otherwise.

#### C4.3.1.3 Other

Grounding requirements for equipment other than enclosed in cabinets or racks shall be consistent with the cabinet grounding requirements.

#### C4.3.2 Control Cables Grounding

Cables shall be secured to the equipment rails and laced in a neat and orderly manner to the terminal strips. Tie straps or wire lacing shall be used throughout. Tape shall not be used to secure a cable of any type to a rail, pipe, or conduit. Only tie straps or hangers shall be used to secure cables to support structures.

Conduit shall be used if cable is exposed to mechanical abuse or damage by accidental contact. All wires shall be connected to terminal strips by means of lugs.

All cable entries shall be through holes in the cabinets. No holes shall be left in cabinets where insects or animals may enter. Holes edges shall be protected by plastic or rubber grommets or other devices to prevent stripping cable.

Cable runs through a building shall be neat in appearance, tight and without droops, and shall be concealed where possible. If the Contractor uses existing pipes or conduits, the pipes or conduits shall be of sufficient strength to support the weight. Steam, fuel, or gas pipe, or any other pipes not designed to withstand weight, or which may cause damage to the cable, shall not be used.

### **C4.4 Equipment Requirements**

#### C4.4.1 Antennae

#### C4.4.1.1 General

Each antenna supplied by the Contractor shall incorporate lightning protection that is either inherent in the design of direct ground antennae that spark over, or that is provided by short circuits to grounded elements at frequencies present in lightning strokes.

The Contractor shall select and take full responsibility for any new antennae used in the system. The Contractor shall provide each new RF antenna system and include those elements required to carry the RF signal from the receiver and transmitter to and including the radiating antenna. The antenna system configuration shall provide for simultaneous duplex operation of all channels without degradation on any one channel. The antenna system configuration shall be such that the failure of any one RF channel shall not result in the loss of any other RF channels.

All exposed antenna hardware (e.g., mounting brackets) shall be fabricated from stainless steel (17-7 pH), galvanized steel, or 6061-T6 type aluminum.

#### C4.4.1.2 Gain

The antennas shall be 6 to 9 dBd gain units. The Contractor shall not use tower-mounted amplifiers in the receiver circuits.

#### C4.4.1.3 Testing

All fixed station antennae and transmission lines shall be tested with a time domain reflectometer or swept return loss devices. A chart recording of the test results shall be made and retained in the site log. No Voltage Standing Wave Ratio (VSWR) in excess of 1.5:1 is permitted at any fixed station.

If the tests reveal problems with the existing equipment, the MPD shall be notified immediately.

#### C4.4.1.4 Connections to Transmission Lines

If the antenna system is new, the Contractor shall determine the correct transmission line lengths for each site and provide an opening in the wall for the entrance of the line. All cable must be secured with stainless steel clamps and hardware and put in troughs by the Contractor. The use of coaxial adapters and/or splices is not permitted.

#### C4.4.2 Transmission Lines



The Contractor shall be responsible for all RF transmission line installation, where necessary, and successful integration into the system. If existing transmission lines are to be used, the Contractor is responsible for determining that the existing lines are functional and capable, and for making connections from the transmit and receive equipment to the lines.

#### C4.4.2.1 General

All antenna transmission lines shall be grounded at the antenna base, at the base of the antenna tower, and at the point of entry to building housing and attached equipment. Cable earthing clamps shall be used and shall be connected to the tower and the earth ground with #4AWG copper conductor.

#### C4.4.2.2 Cabling

All new fixed station RF transmission lines used in conjunction with the new radio system shall exhibit no more than 1.5 dB total attenuation. Air dielectric shall be used where long cable runs (over 250 feet) are required. Jumper cables used between the main feeders and antennae and between the main feeder and antenna combiners shall be flex-type cable.

#### C4.4.2.3 Connectors

All connectors used must be fully compatible with interfacing equipment in the system. No splices or adapters shall be used. All RF connects shall be of the soldered type. It is permissible to use different connectors on opposite ends of a cable to avoid the use of adapters. When transforming from one diameter cable to another, it is acceptable to use flange reducers, so long as the cable VSWR specification is met. The Contractor shall provide layout drawings for each site showing the cable runs, connectors used, and grounding methods used, as part of the blueprint drawings to be submitted 30 days prior to installation.

Loss due to installation of the connectors shall not exceed 0.25 dB per connector. In addition, any connectors/connections used outdoors shall be protected from corrosion and shall be fully weatherproof. Care in hardware selection must be made to resist galvanic corrosion between dissimilar metals. The use of vinyl tape is not acceptable.

#### C4.4.3 Equipment Sites Other than Receiver-Only

The AC service providing power to equipment shall be protected. Protectors shall be installed across each leg of the AC service at the facility power entry panel that provides power to the equipment. The protectors shall be connected to each leg and the neutral bus at the panel with #2AWG copper conductor. If the protector is installed at the distribution panel, which is not located at the service entrance, the protector ground shall be connected to the building ground

with a #2AWG copper conductor, rather than to the neutral bus. If other than single phase power is used, the Contractor shall furnish all equipment for protection of each phase leg of the existing facility entrance panel. All wiring shall be #2AWG copper. Fuses and pilot lamp indicators shall be supplied.

All equipment cabinet housing, including transmitters, receivers, and all consoles, shall be connected to building grounds with #4AWG copper conductor. Equipment cabinets in the same room shall be interconnected with #4AWG copper conductor.

#### C4.4.4 Receiver-Only Sites

At each receiver-only site, the receiver cabinet shall be connected to building earth with #6AWG copper conductor. A secondary arrestor shall be installed across the AC supply inside the cabinet.

#### C4.4.5 Rack Mounting

All equipment that is rack-mountable shall be mounted in a 19" wide steel rack enclosure. The Contractor may use MPD-owned rack space where available, upon MPD approval.

New racks shall be secured with a keyed lock. The Contractor shall provide three sets of keys for each lock type to the MPD. If the Contractor desires to provide locks for existing rack enclosures, the Contractor shall provide three sets of keys to the MPD for each of the existing rack locks.

### **C4.5 Installation Schedule**

#### C4.5.1 Schedule

The Contractor shall provide an installation schedule 60 days prior to starting installation. This schedule shall include anticipated start date, task duration, and completion date for all major installation activities.

The schedule shall also adhere to the channel priorities listed below. It shall describe the plan for phasing the new system into operation and removing the existing system with a minimum disruption to MPD radio operations.

#### C4.5.2 Phasing

The new equipment shall be installed channel by channel. This installation shall occur with the following order/priority, provided that the order has no adverse affect to the design:

- SOD
- Citywide-1
- All Others

The Contractor shall provide any and all equipment and control facilities required to permit the existing systems to continue operation while the new systems are being installed and rendered operational.

#### **C4.6 Special Installation Requirements**

##### **C4.6.1 Tie Line Connections**

The Contractor shall be responsible for connecting all fixed end and control equipment to the appropriate tie lines and tie line equipment.

##### **C4.6.2 Install Repeaters in Metro Stations**

The MPD presently owns 11 UHF Motorola Quantar Model T5365 repeaters that have yet to be installed. Each of these repeaters is equipped with ASTRO CAI and Spectra-TAC software, as well as a 30" indoor cabinet. The Contractor shall install the repeaters in equipment closets proximate to existing repeaters in the DC Metro system. Refer to Table C-3 for the addresses of the locations.

The Contractor shall provide and install seven additional repeaters so that the existing Metro repeaters are replaced on a one for one basis. The Contractor shall obtain the required permission from the WMATA to perform the installation within the tunnels.

All installation procedures shall be according to manufacturer directions. The repeaters shall be connected to existing tie lines and leaky cable runs in the Metro facility. The Contractor shall coordinate with the MPD to determine a specific location for the repeater.

##### **C4.6.3 Install MPD Owned Base Stations**

The MPD presently owns five UHF Motorola Quantro Model C99ED base stations that have yet to be installed. Each of these base stations is equipped with ASTRO CAI software,

repeater functionality, modems, and 225 watt transmitters. The Contractor shall install these base stations as main or standby transmitters for channels in the radio system.

#### C4.6.4 Relocate VHF Analog Comparators

The comparators for the VHF channels for the ISB, CID and Citywide-1 channels shall be relocated to a single 19" rack cabinet separate from the new digital comparators.

### **C4.7 Post-Installation Requirements**

After acceptance of the system, the following is required:

#### C4.7.1 General

The Contractor shall sweep floors and remove any trash, dirt, dust, oil, grease, or any other undesirable waste left after installation of the equipment. Proper cleanup of the area shall be determined by the MPD.

The Contractor shall repair or replace any equipment damaged during the installation.

#### C4.7.2 Documentation

The Contractor shall execute and deliver detailed as-built drawings and design documentation for all equipment. Documentation shall include all floor plans, equipment, layouts, wiring diagrams, and cable runs. Also, the Contractor shall provide all applicable installation manuals for the equipment that has been provided.

#### C4.7.3 Removal of Existing Equipment

The existing equipment for the radio channel that has just been installed and accepted shall be removed. The MPD shall be notified five days prior to removal, and shall be allowed to witness the removal. The removal shall not cause disruption to any existing equipment.

The following removed equipment shall be delivered to the MPD:

- Up to 3 MSF-5000's To Be Determined (TBD)
- Up to 3 MSF-2000's, base station equipment (TBD)
- Up to 5 Metro Repeaters (TBD)

The Contractor shall be responsible for the disposal of all other equipment.

## **C5 MAINTENANCE AND SUPPORT**

A maintenance contract shall be provided with the UHF radio system. The purpose of this contract is to restore any defective, damaged, or improperly operating equipment to a functional, operating condition to keep the system working at an optimum level and at factory specifications. The maintenance contract shall provide such services at no additional cost to the MPD.

### **C5.1 Services**

The Contractor shall provide a maintenance service contract for a period from initial acceptance of the complete radio system to one year after acceptance. In addition, the Contractor shall offer four 1-year options for maintenance after the initial first year.

During the first year, the 1-year warranty covers all parts and labor to repair the equipment. However, the response time for the repair and restoration of equipment shall be according to the time requirements listed for the maintenance contract.

The Contractor shall provide all qualified personnel, test equipment, standard service vehicles, tools, material, supervision, and other items necessary to perform troubleshooting, repair, preventive maintenance, and all operational checks and adjustments. The Contractor shall perform all actions required to keep the system working at an optimum level and at factory specifications. An operational check of the repaired equipment shall be made following completion of any repair actions.

The cost of any enhancements, upgrades, replacements, re-installations, or new installations of software that are necessary to repair or solve a defect, malfunction, or any other lack of proper operation in the radio system or equipment, or encryption and OTAR functionality shall be borne by the Contractor.

If significant repairs to the equipment are required, the Contractor may replace the defective equipment with a Contractor-provided spare until the original unit can be repaired and reinstalled.

Existing VHF equipment for the three VHF channels shall also be maintained under the maintenance contract.

The Contractor shall provide a description of the maintenance facilities with the Bid Proposal. A Training Plan, as described in the Training section, below, shall also be included in this documentation.

## **C5.2 Response Time and Location**

Maintenance shall be provided 24-hours per day, 7 days a week. The Contractor shall provide the maintenance and restoral service response within two hours of the initial request. If the problem causes the loss or inoperability of an entire channel, the problem shall be determined and fixed within 24-hours of notice. If the problem does not disrupt the entire channel, but rather causes a degradation of performance or loss of service to a specific coverage area, the problem shall be determined and fixed within 48 hours of notice.

The lack of adherence to the required response times will be used when evaluating acceptance of an option year at the end of the present contract year. Also, the MPD reserves the right to cancel the maintenance contract after any such violation of the required response times.

The service shall be provided at the location of the equipment. The MPD will provide free and easy access, shelter, heat, light, and power at the fixed end equipment locations.

## **C5.3 Equipment Covered**

Table C-7 lists the equipment that shall be covered under the maintenance contract:

**Table C-7. Equipment to be Maintained**

<b>Maintained Equipment</b>
Base Stations and Repeaters
Digital Comparators
Digital Satellite Receivers
Digital Interface Units (DIUs)
Digital Voice Modems
Key Management Facilities (KMFs)
Remote Consoles

Where telephone lines or third party supplied/maintained items are used in conjunction with Contractor-maintained products, the Contractor has no obligation or responsibility for such telephone lines or items. However, the Contractor shall notify the telephone company and follow up on the response if a problem with the line is detected.

#### **C5.4 Preventive Maintenance (PM) Inspection**

Preventive Maintenance (PM) shall be performed semiannually during the contract period on the equipment installed under this contract to assure that performance, reliability, and availability requirements are successfully achieved throughout the life of the maintenance contract. The PM shall include existing equipment used for the three (3) VHF channels.

Within 60 days after contract award, the Contractor shall submit to the MPD for approval a schedule of all preventive maintenance for the first year of operation. The PM schedule shall be updated quarterly thereafter and shall cover a period of no less than the following six months. The MPD and the Contractor shall mutually agree on the schedule.

The required PM checklist shall be completed for each piece of equipment. Any deficiencies shall be corrected by adjustments, alignments, or repair as required by the procedures established in the commercial manuals for the equipment.

Preventive maintenance shall be performed during normal business hours unless otherwise requested by the MPD. The MPD will provide escorts, when required, and access to facilities for Contractor personnel to conduct scheduled preventive maintenance.

Following each PM inspection, the Contractor shall submit a report to the MPD within 15-days of testing that details the tests that were performed, results, and actions taken to correct problems, including additional equipment installed, adjustments, and software enhancements.

The Contractor shall also provide 24-hour hot line technical assistance to MPD technicians to resolve minor problems over the phone.

#### **C5.5 Warranty**

In addition to the standard warranties of equipment, the Contractor shall submit a Warranty Statement for the radio system.

The Contractor shall guarantee all equipment and parts for a period of one year against defects in materials and workmanship. The warranty period shall begin upon acceptance of the system, and shall cover both parts and labor.

Notwithstanding inspection and acceptance by the MPD, the Contractor warrants, represents, and assures that the software and services to be provided hereunder shall conform in all respects to the requirements of this contract, and, as designed, will meet the functional and performance standards contained therein and will meet or exceed the representations in the Contractor's proposal, including, but not limited to, the representations concerning equipment specifications, installation and maintenance characteristics and requirements, operating characteristics, and training requirements.

The Contractor shall warrant and guarantee further that the equipment furnished hereunder is of good workmanship and materials and that the same is properly designed, operable, and equipped for the proposed use by the MPD and is in strict conformity with the technical specifications.

If the Contractor's performance hereunder such as system design, equipment installation, and any subsystem are not free from defects in workmanship or are not in conformity with the requirements of this contract, the Contractor shall correct or re-perform the defective or nonconforming services at no expense to the MPD.

If it becomes necessary for the MPD to contract out for warranty repairs due to inability or failure of the Contractor to perform such repairs in reasonable time, the Contractor shall reimburse all MPD invoices for labor and/or materials required to perform such repairs.

The cost of any enhancements, upgrades, replacements, re-installations, or new installations of software that are necessary to repair or solve a defect, malfunction, or any other lack of proper operation in the radio system or equipment, or encryption and OTAR functionality, shall be borne by the Contractor.

## **C5.6 Spare Parts**

The Contractor shall provide a list of recommended spare parts for non-technical routine maintenance, as well as items that can be used by the MPD maintenance personnel. The list of recommended spare parts shall be provided to the MPD by the Contractor 90 days after contract award. Parts and modules recommended by the Contractor, but not manufactured by the Contractor, shall be indicated as such, and the manufacturer shall be identified. The unit price of each item shall be shown.

Spare parts for the radio equipment, including base stations, control, and encryption equipment, shall be included in routine maintenance. Equipment includes subassemblies, modules, plug-in units, and loose parts. Spare parts for the microprocessor-based equipment shall be included in



routine maintenance. This includes spare boards that can replace defective boards. The Contractor shall describe the facilities available for return of units, subsystems, subassemblies, boards, and modules to the manufacturer for repair.

The Contractor shall maintain replacement parts and modules for all proposed hardware and software equipment for 10 years after acceptance of the system.

The Contractor shall also provide a recommended list of test and support equipment for each of the various subsystems. Although physical and functional testing will not be performed by the MPD, the Contractor shall allow the MPD to witness all testing.

## **C5.7 Training**

The Contractor shall provide training for MPD personnel who operate and presently maintain the radio system. The training shall take the form of technical, operations, and maintenance courses. The instructor for the training shall be a qualified individual with a minimum of five years of experience in the training topic.

### **C5.7.1 Training Plan**

A plan for the training shall be included with the Bid Proposal. At a minimum, the plan shall specify the objectives and course outlines, number of instructional hours proposed, minimum and maximum number of students per class, training materials, titles and descriptions of all proposed documentation, instructor qualifications, and type of training (e.g., formal, classroom, self-study). The plan shall be subject to MPD review and approval.

The Contractor shall provide all relevant and necessary manuals and publications required to learn, operate, and maintain the proposed system. Where available, the Contractor may use commercial documentation for off-the-shelf products.

The Contractor shall provide a user reference manual for every transmitter location. The manual shall provide detailed information about the system operations. This manual shall contain, at a minimum, the following information:

- Description of the system's capabilities
- Description of all aspects of the system with sufficient detail so as to provide a reference for both normal and abnormal diagnostic and recovery operations
- Description of all user procedures organized by application area

- Examples of all possible types of operations

The Contractor shall provide the capability for training courses at the Contractor's facilities within 25 miles of the District.

The training curriculum shall include, but not be limited to, the following:

C5.7.2            Technical System Training

*Duration:*        *One 8-hour course*  
*Class Size:*     *1 class of 4 students*  
*Location:*       *Contractor Facility or MPD Facility of MPD's choice*

This training shall describe the new UHF radio system in detail, including the architecture, the location of all equipment, the contract/lease agreements with owners of equipment sites, the coverage for each channel, and changes to channel arrangements.

It shall also explain details of the components of the system, differences with the previous system, and potential problems that may arise. The course shall review the capabilities of each component, review its compliance with TIA-102 specifications, and explain any special features.

Also included shall be a detailed description of how to program the fixed-end and encryption key management equipment, and how to perform computer diagnostics.

The Contractor shall videotape the entire session on standard-sized VHS high-quality tape, and deliver the taped session to the MPD. The Contractor shall give all rights to the MPD to replay it at the MPD's discretion.

The contents of the course shall be summarized in a 3-ring binder for each student. Documentation shall include diagrams of the system architecture, charts on 8-1/2 x 11" paper as well as in Excel 97 Spreadsheet format (delivered on 3-1/2" floppy diskettes), similar to the charts shown in Section C3 of this document, and depicting the following at a minimum for every transmit and receive location, whether or not the equipment is new or existing:

- All categories listed for Tables C-1, C-2, C-3, C-4, and C-5.
- Street address and name/designation of transmitter/receiver
- Telephone numbers for the facility

- Tie line numbers and associated information
- FCC call sign for the channel
- Antennas: model, specs, downtilt, gain, height, location on tower, length and type of feedline
- AC power loading requirements (wattage) of Contractor-installed equipment, totaled per site
- Grounding type, location, length and size of conductor

#### C5.7.3 Dispatcher Training

*Duration: One 1-hour course*  
*Class Size: 3 classes of 25-30 students*  
*Location: Contractor Facility or MPD Facility of MPD's choice*

This training shall review the general properties and differences between digital and analog communications over UHF and VHF radio, including the functionality, how voice may sound different, etc. The training session shall include a live demonstration using portable radios, and shall instruct the students on the basics of the usage of a typical portable radio, such as channel select, PTT, volume control, display readout, etc.

The session shall also explain the amount of channels on the system and show the locations of the transmit and receiver towers for each channel. A brief explanation of encryption, keys, and OTAR shall also be included.

#### C5.7.4 Encryption Training

*Duration: One 4-hour course*  
*Class Size: 3 classes of 15-20 students*  
*Location: Contractor Facility or MPD Facility of MPD's choice*

This training shall review the basics of encryption, including analog scrambling, digital encryption, their differences, and a brief description of DES, DES-XL, DVP, and DVP-XL. The course shall describe the encryption that is to be used in the MPD's radio system, TIA-102 DES, and the similarities/differences with the previously mentioned encryption standards.

It shall describe what encryption keys are, and how they are loaded, stored, and generated. The course shall include a live demonstration of how key loading is performed, using a portable radio and a Key Variable Loader (KVL). It shall explain the display readouts of the KVL and portable radio unit during key loading.

A brief overview of a KMF and OTAR and the implementation shall also be given.

#### C5.7.5 OTAR Training

*Duration: One 4-hour course*  
*Class Size: 1 class of 10 students*  
*Location: MPD Facility of MPD's choice*

This training shall review the features and functions of OTAR, key management techniques, OTAR protocol, Key Management Messages (KMM), keysets, crypto groups, and basic key management procedures, as outlined in Sections 5.1 and 5.2 of the TIA-102 document TIA/EIA TSB-102.AACB, entitled *Over-The-Air-Rekeying (OTAR) Operational Description*.

The course shall include a live demonstration of the key loading, zeroizing, and enabling/disabling radios, using MPD equipment.

The course shall describe how to maintain, operate, and program the KMF. It shall detail how to rekey, modify keys, update, delete, and zeroize keys, load, store and generate keys, and enable/disable radio units.

#### C5.7.6 Maintenance training

*Duration: One 4-hour course*  
*Class Size: 1 class of 4 students*  
*Location: Contractor Facility or MPD Facility of MPD's choice*

The Contractor shall provide fundamental maintenance training designed to familiarize the MPD maintenance personnel with systems and equipment, and to enable them to set up operation and routine maintenance practices.

## C6 EQUIPMENT AND ACCESSORIES

The following equipment is specified within this section:

Fixed-End Equipment

- Base Stations and Repeaters
- Digital Satellite Receivers
- Digital Comparators
- Digital Interface Units (DIUs)
- Digital Voice Modems

Encryption Equipment

- Key Variable Loader (KVL)
- Key Management Facility (KMF)

Subscriber Equipment

- UHF Portable Radios
- UHF Mobile and Motorcycle Radios

Remote Control Equipment

- Remote Desktop Console

**C6.1 General**

The following shall apply to all equipment, unless otherwise noted.

**C6.1.1 Construction and Components**

All component parts shall meet the applicable EIA standards and shall operate within specified ratings. Construction, including assembly and wiring, and finishes shall conform to commercial practices for high-quality equipment. The equipment shall be mechanically sound.

**C6.1.2 Equipment Stability**

Equipment shall not display instability due to any electronic, mechanical, or other causes that tend to make the receiver or transmitter critical in tuning or unstable in operation.

**C6.1.3 Fuses and Overload Protection**

All equipment shall be provided with adequate fuses or other standard devices to protect the equipment in case of overloads or short circuits within the equipment. The protective device shall be conveniently located for quick and easy replacement, or reset. All base station and remote control equipment shall be equipped with lightning and surge protectors on primary power and control lines.

**C6.1.4 Alignment/Ease of Service**

Test points shall be provided for routine checks and alignment/service of the transmitter and receiver. These test points shall be readily accessible and marked for ease of servicing. Measurement shall be possible using conventional test instruments and/or PC and software. The receiver and transmitter alignment procedures shall be clear, straightforward, and easy to accomplish.

#### C6.1.5 RF Termination

The RF input circuit of all receivers and the output circuit of all transmitters shall be designed for operation into unbalanced transmission lines having a nominal impedance of 50 ohms. Self-contained antennas shall have provisions for external connection of RF termination with 50 ohm impedance.

#### C6.1.6 Manuals

User manuals shall describe the features of the specific radio equipment and how to use it. The manuals shall be the same English language manuals that are provided to commercial customers. Where applicable, additional "installation manuals shall be provided to describe installation instructions and procedures.

##### C6.1.6.1 Subscriber Units

Provide one technical and service manual for every 10 radio units.

##### C6.1.6.2 Fixed-End Equipment

Provide one technical and service manual with each unit.

#### C6.1.7 Y2K Compliance

The Contractor warrants that each commercial and non-commercial service, features, support systems, and/or hardware, software, and firmware product delivered under this contract shall be able to accurately process date data (including, but not limited to, calculating, comparing, and sequencing) from, into, and between the 20<sup>th</sup> and 21<sup>st</sup> centuries, including leap year calculations, when used in accordance with the product documentation provided by the Contractor, provided that all products (e.g., hardware, software, firmware) external to this contract used in combination with products delivered under this contract properly exchange date data with such products. If the contract requires that products must perform as a system in accordance with the foregoing warranty, then that warranty shall apply to those products as a system. The duration of this warranty and the remedies available to the MPD for breach of this warranty shall be as defined in, and subject to, the superior of the terms and limitations of the

Contractor's standard commercial warranty or warranties contained in this contract. Notwithstanding any provision to the contrary in such commercial warranty or warranties, the remedies available to the MPD under this warranty shall include repair or replacement of any product whose non-compliance is discovered and made known to the Contractor in writing within 90 days after acceptance. Nothing in this warranty shall be construed to limit any rights or remedies the MPD may otherwise have under this contract with respect to defects other than Year 2000 performance.

The Contractor/Vendor shall submit a copy of the Y2K compliance statement with the delivered and/or installed equipment.

#### C6.1.8 Warranty

A 1-year warranty shall be included with any equipment purchased separately from the new radio system.

The Contractor/Vendor shall agree that proper operation of the equipment as per these specifications is unconditionally guaranteed (user-caused damage excepted) for the time specified in the Contractor's commercial warranty or a period of one year from the date of acceptance, whichever is greater. The Contractor/Vendor shall submit a copy of the warranty statement with the delivered and/or installed equipment.

The Contractor/Vendor shall either restore to proper operating condition or replace any defective unit within 30 days of receipt, except where a maintenance contract requires quicker response. All warranty work shall be without charge for labor, materials, or shipping. In the event that the equipment repair or replacement exceeds 30 days, the warranty period shall be extended by the time required for the shipment and repair/replacement of the equipment. Other terms and conditions shall be in accordance with the Contractor's/Vendor's commercial warranty.

#### C6.1.9 Identification Tag

Each complete piece of communications equipment shall have an identification tag permanently affixed on the exterior of the unit for quick, positive identification. At a minimum, the equipment model number and serial number shall be given.

#### C6.1.10 Spare Parts Availability

The Contractor shall identify and make available a source for spare parts for all equipment ordered under this contract for a period of at least 10 years from the date of delivery.

C6.1.11 Environmental

The equipment shall be fully functional within the temperature range of –30 to +60 degrees Celsius. It shall be compliant with all environmental requirements specified within TIA TSB-102.CAAB for Class A type radios and radio equipment.

C6.1.12 Power Sources

C6.1.12.1 Portable Units

Portable radios shall be capable of being powered by a commercially-available detachable battery pack containing either rechargeable cells or disposable alkaline cells.

C6.1.12.2 Mobile Units

Mobile radios shall be powered from a negative ground 12 volt or 13.8 volt vehicle battery. The unit shall be protected from transient power surges generated by ancillary equipment connected to the source.

C6.1.12.3 Fixed-End Equipment

Fixed-end equipment shall be powered from a 120 VAC, 60 Hz source. Provide 13.8 VDC battery revert power when noted.

**C6.2 Transmit and Receive Equipment - General**

The following shall apply to all transmit and receive equipment, unless otherwise noted. Note that some of the tables below contain specifications for VHF equipment. This information is provided for reference only.

C6.2.1 Programmability

C6.2.1.1 Standard Feature Programming – Subscriber Units

The standard features of the radio shall be capable of being programmed from a PC with the appropriate software and equipment.



#### C6.2.1.2 Programmable Buttons – Subscriber Units

Subscriber units shall have the capability of programming auxiliary buttons to perform a standard feature.

#### C6.2.1.3 Fixed-End Equipment

Fixed-end transmit and receive equipment shall be able to have functions programmed by a PC. The programming shall also support diagnostic testing.

#### C6.2.2 Software

Software shall be included with the each radio, which, at a minimum, shall enable the radio to operate with all required features listed within the specifications, as well as the following:

- Common Air Interface (CAI) protocol
- Improved Multiband Excitation (IMBE) vocoding

#### C6.2.3 Hardware – Fixed-End Equipment

To facilitate maintenance and upgrades, the equipment shall have field-replaceable hardware modules to allow for easy removal and replacement.

#### C6.2.4 Transmitter

##### C6.2.4.1 Power Levels

##### C6.2.4.1.1 Power Level Adjustment

The level of power output shall be adjustable from a low power setting to be used for longer battery life, to a high power setting for better communication range. The power level shall be adjustable by a computer. The unit shall also allow for power level adjustment by the user.

##### C6.2.4.1.2 RF Power Output

Refer to Table C-8 for a listing of the required power ranges for portables, mobiles, and base stations/repeaters. Ranges for low-power and mid-power models are listed. Power levels shall comply with TIA TSB-102.CAAB Paragraph 3.2.1.

**Table C-8. RF Power Output**

Unit	Portable	Mobile	Base Station
Low	--	15W	--
Mid	1 – 4W	20 - 40W	50 - 110W
High	--	--	250W

#### C6.2.4.2 Analog Specifications

Transmitters shall comply with all standards specified in TIA/EIA 603 under the Transmitter Section of Standards.

The transmitter for each type of equipment shall meet or exceed the requirements listed in Table C-9.

**Table C-9. Transmitter Requirements - Analog**

Specification Measurement	Portable	Mobile	Base Station	
			VHF	UHF
Frequency Stability/Accuracy (Maximum permissible departure in PPM)	5	5	5	2.5
Maximum Audio Distortion at 1 kHz (%)	3			
Audio Response using a 1 kHz reference	300 to 3000 Hz			
Frequency Spread – 25 kHz	+/- 5 kHz			
Frequency Spread – 12.5 kHz	+/- 2.5 kHz			
Spurious and Harmonics	70 dB			
Maximum Hum and Noise – 25 kHz	-45 dB			
Maximum Hum and Noise – 12.5 kHz	-39 dB			

#### C6.2.4.3 Digital Specifications

Digital transmitters shall comply with all standards specified in TIA TSB-102.CAAB under the Transmitter Section of Standards for Class A equipment.

The digital transmitter for each type of equipment shall meet or exceed the requirements listed in Table C-10.

#### C6.2.5 Receiver

##### C6.2.5.1 General

Note that digital satellite receivers shall comply with all standards required for the receivers of digital base stations.

#### C6.2.5.2 Analog Specifications

Receivers shall comply with all standards specified in TIA/EIA 603 under the Receiver Section of Standards.

The receiver for each type of equipment shall meet or exceed the requirements listed in Table C-11.

**Table C-10. Transmitter Requirements - Digital**

Specification Measurement	TSB-102 CAAB Paragraph	Portable		Mobile		Base Station	
		VHF	UHF	VHF	UHF	VHF	UHF
Frequency Stability/Accuracy (Maximum permissible departure in PPM)	3.2.2	2.5	2.0	2.5	2.0	1.5	0.5
Electrical Audio Performance	3.2.3	(See TIA-102 Document)					
Acoustic Audio Performance	3.2.4	Not to exceed 90 dB SPL					
Sideband Spectrum	3.2.5	(See TIA-102 Document)					
Radiated Spurious Emissions	3.2.6	Not to exceed -13 dBm					
Conducted Spurious Emissions	3.2.7	Not to exceed -13 dBm					
Adjacent Channel Power Ratio	3.2.8	>= 70 dB					
Intermodulation Attenuation	3.2.9	Not Applicable				>= 40 dB	
Conducted Spurious Emissions into VSWR	3.2.11	(See TIA-102 Document)					
Transmitter Encoder Attack Time	3.2.12	Not to exceed 100 milliseconds					
Transmitter RF Power Attack Time	3.2.13	Not to exceed 50 milliseconds					
Modulation Fidelity for C4FM	3.2.14	(See TIA-102 Document)					
Symbol Rate Accuracy	3.2.16	Error not to exceed 10 PPM					
Transient Frequency Behavior	3.2.17	(See TIA-102 Document)					

**Table C-11. Receiver Requirements – Analog**

Specification Measurement	Portable	Mobile	Base Station	
			VHF	UHF
Frequency Stability/Accuracy (Maximum permissible departure in PPM)	5	5	5	2.5
Sensitivity (uV) per 12 dB SINAD	0.35	0.35	0.35	
Selectivity (dB)	75	85	85	

Spurious Attenuation (dB)	75	90	100
Intermodulation (dB)	75	75	75
Audio Output Power (Watts)	0.5	8	5
Audio Distortion (%)	5	5	3
FM Hum and Noise (dB)	45	50	50
Analog Adjacent Channel Rejection - 12.5 kHz	60	60	60
Conducted Spurious Emissions (dBW)	-80	-80	-80

### C6.2.5.3 Digital Specifications

Digital receivers shall comply with all standards specified in TIA TSB-102.CAAB under the Receiver Section of Standards for Class A equipment.

The digital receiver for each type of equipment shall meet or exceed the requirements listed in Table C-12.

**Table C-12. Receiver Requirements – Digital**

Specification Measurement	TSB-102 CAAB Paragraph	Portable		Mobile		Base Station	
		VHF	UHF	VHF	UHF	VHF	UHF
Radiated Spurious Emission (Radiated power at 3 meters in - dBm)	3.1.1	71 - 79	76 – 79	71 - 79	76 – 79	71 - 79	76 – 79
Conducted Spurious Emissions	3.1.2	Not to exceed –57 dBm					
Power Line Conducted Spurious Emissions	3.1.3	(See TIA-102 Document)					
Reference Sensitivity	3.1.4	-116 dBm					
Faded Reference Sensitivity	3.1.5	-108 dBm					
Digital Adjacent Channel Rejection	3.1.6	60 dBm					
Co-Channel Rejection	3.1.7	Not to exceed 9 dB					
Spurious Response Rejection	3.1.8	70 dB		80 dB		90 dB	
Intermodulation Rejection	3.1.9	70 dB		75 dB		80 dB	
Signal Displacement Bandwidth	3.1.10	Minimum shall be 1000 Hz					
Audio Output Distortion (Tested at both rated audio power and 17 dB below rated)	3.1.11	Shall not exceed 5%					
Residual Audio Noise Ratio – Silence Pattern	3.1.12	45 dB					
Residual Audio Noise Ratio – Muted	3.1.12	-35 dBm					
Average Radiation Sensitivity	3.1.13	(See TIA-102 Document)					
Acoustic Audio Output	3.1.14	(See TIA-102 Document)					
Bit Error Rate Floor	3.1.15	Maximum shall not exceed 0.01%					

### **C6.3 Subscriber Unit Equipment**

#### **C6.3.1 Standard Features**

The subscriber unit radio shall have the following features as part of its standard capability of operation.

##### **C6.3.1.1 Repeater Talk-Around**

The radio shall have the capability to bypass a repeater to contact other portable and mobile units directly.

## C6.3.1.2 Channels

The radio shall have a minimum capacity for the number of channels listed below in Table C-13 for portables, and Table C-14 for mobiles.

**Table C-13. Portable Radio Features and Functions**

Function	Radio Model	
	II	III
Channel Capacity	255	255
Analog 12.5 and 25 kHz Channels	?	?
TIA-102 Digital 12.5 kHz Channels	?	?
Alphanumeric Display	?	?
DTMF Keypad		?

**Table C-14. Mobile Radio Features and Functions**

Function	Radio Model			
	I	Ia	II	III
Channel Capacity	128	128	255	128
Power Level	Mid	Mid	Mid	Low
Analog 12.5 and 25 kHz channels	?	?	?	?
TIA-102 Digital 12.5 kHz channels	?	?	?	?
Keypad	?	?	?	?
DTMF Keypad			?	?
Audio Recording Jack		?		
Hand-Held Control Head			?	
Motorcycle Mounting				?

## C6.3.1.3 Push-to-Talk (PTT) ID – Digital Radios Only

Each time the PTT button is pressed, an ID unique to that radio shall be sent to allow the dispatcher to identify which radio is transmitting.

## C6.3.1.4 Scanning – Digital Radios Only

The radio shall have the capability of scanning from a list of programmed frequencies.

## C6.3.1.5 Clear/Coded Toggle – Digital Radios Only

The radio shall have the capability of switching between clear, unencrypted communications and encrypted communications.

#### C6.3.1.6 Cloning – Digital Radios Only

The radio shall have the ability to transfer all radio operating parameters from radio to radio without the use of a PC or modem. Scrambling and encryption codes and keys shall not be transferred during the cloning process. The cabling necessary to perform such a transfer is specified within as an accessory. It shall not be included with the radio.

#### C6.3.2 Keypad (when specified)

A radio keypad shall consist of backlit navigation keys to be used to facilitate the operation of a menu system through a display. Radios with keypads shall have the following features:

##### C6.3.2.1 Backlighting

The display and the keypad shall be backlit illuminated when a key is pressed.

##### C6.3.2.2 Scan Editing

The radio shall have the capability to edit the scanning list from the radio unit.

##### C6.3.2.3 Password Protection

The radio shall have password protection after power-up to allow only authorized users access to radio operation. Keypad programming shall also be protected by password.

##### C6.3.2.4 Call Selection

The radio shall have the ability to call individual radios or groups as selected by the keypad or menu system.

##### C6.3.2.5 Editing Standard Features

The following additional standard features listed under this radio type shall be capable of being programmed: keypad backlight, scan editing, keypad programming, and password protection.

##### C6.3.2.6 Keypad Programming

The radio shall have the capability of keypad programmability, to allow the user to reprogram the standard features from the keypad, without using a PC. This keypad programming capability shall be password protected.

#### C6.3.2.7 Channel Group Edit

The radio shall have the capability of editing group and/or fleet lists of pre-programmed frequencies from the portable unit.

#### C6.3.3 DTMF Keypad (when specified)

The backlit keypad shall include a 4 x 3 Dual-Tone Multi-Frequency signaling (DTMF) keypad (numbers 0 through 9, \* and #) and four additional special function keys. The keypad shall provide unlimited DTMF dialing to allow the user to operate remote control devices or access telephone interconnect systems. All functions and features listed under the standard keypad are applicable to the DTMF keypad.

#### C6.3.4 Portables – Additional Features/Functionality

Portable radios shall also have the following features/functionality.

##### C6.3.4.1 Standard Features and Controls

##### C6.3.4.1.1 Standard Radio Controls – Analog Radios

The radio shall have, at a minimum, a PTT button, top mounted on/off volume (with graduated control) and 16-position rotary channel selection knobs, an LED transmit indicator, and an accessory slot/connector for attaching Hirose connector-compatible accessories and programming devices.

##### C6.3.4.1.2 Standard Radio Controls – Digital Radios Only

In addition to the controls listed above for analog radios, the digital radio shall have, at a minimum, a three position toggle switch to change channel/group frequencies, two programmable side buttons, and a distinguishable emergency button to provide automatic emergency call.

##### C6.3.4.2 Included Accessories

Include the following accessories with each portable radio unit.



C6.3.4.2.1 Leather Carry Case

High-activity swivel leather case designed to fit the radio shape. Include a swivel belt loop and T-strap

C6.3.4.2.2 Antenna

A Heliflex, non-adjustable antenna covered with injection molded rubber. Standard antenna optimized for use in UHF bands, or dualband usage in VHF and UHF bands.

C6.3.4.2.3 Battery

An ultra-high capacity NiMH battery capable of providing at least 8 hours of life under a 5-5-90 duty cycle. Batteries are specified below under accessories.

C6.3.4.3 Display (when noted in Table C-13)

The display on the radio shall be alphanumeric or pixel graphic LCD with at least 8 characters, and shall have icons to show status such as encrypted transmission, digital/analog transmission, transmit and receive modes, and programming mode. RF transmit power level and remaining battery power shall either be indicated on the display or by LED indicator light.

The radio shall also include a standard keypad, as defined in the definition section of this specification.

C6.3.4.4 DTMF Keypad (when noted in Table C-13)

The radio shall include a DTMF keypad, as defined in the definition section of this specification.

C6.3.5 Mobiles – Additional Features/Functionality

Mobile radios shall also have the following features/functionality.

C6.3.5.1 Standard Features and Controls – Analog and Digital Radios

C6.3.5.1.1 Volume Control

The volume level on the audio output of the speaker shall be controllable by means of either a rotary or electronic volume control knob/button.

C6.3.5.1.2 Radio Controls

The radio shall have, at a minimum, face-mounted volume, mode and channel controls, a scan button, an LED transmit indicator, and a hand-held microphone with a PTT button.

#### C6.3.5.1.3 Display

The display on the radio shall be a backlit alphanumeric or pixel graphic LCD with at least 8 characters, and shall have indicator lights or icons to show status such as encrypted transmission, digital/analog transmission, transmit and receive modes, and programming mode.

#### C6.3.5.1.4 Speaker

12W minimum, internal or external. If the speaker is internal to the assembly, the unit shall have a jack to be able to accommodate an external speaker.

#### C6.3.5.1.5 Handheld Microphone

The radio shall include a handheld microphone that shall, at a minimum, include a large PTT switch, a swivel clip, and a minimum 12" (retracted) coiled cord. It shall have an audio output of 1.0 watts at 8 ohms, and a microphone sensitivity of -64 +/- 4 dB at 74 dBSPL, measured at 1 kHz.

#### C6.3.5.1.6 Siren/PA Control

The unit shall be able to control the siren/PA functions directly from the keypad.

#### C6.3.5.1.7 Remote Mounting

The unit shall be capable of being mounted remotely in the trunk of a police car. Provide a minimum of 18 feet of cabling.

#### C6.3.5.2 Standard Keypad (when noted in Table C-14)

The radio shall include a standard keypad, as defined in the Definition Section of this specification.

#### C6.3.5.3 DTMF Keypad (when noted in Table C-14)

The radio shall include a DTMF keypad, as defined in the definition section of this specification.

#### C6.3.5.4 Audio Recording Jack (when noted in Table C-14)

The radio shall be equipped with an audio recording jack with microphone level input.

C6.3.5.5 Handheld Control Head (when noted in Table C-14)

The radio shall include a handheld microphone that shall, at a minimum, include a large PTT switch, a swivel clip, and a minimum 12" (retracted) coiled cord. The handheld microphone shall also serve as the control head for the radio. It shall comply with the following.

C6.3.5.5.1 DTMF Keypad

The keypad shall consist of a 3 x 6 keypad with programmable soft keys. It shall be backlit.

C6.3.5.5.2 Display

The display shall be a minimum of 2-line/14 character alphanumeric.

C6.3.5.5.3 Controls

The handheld microphone shall serve as the control head for the radio. The controls shall, at a minimum, enable the user to adjust volume, adjust power level, select channels, perform radio menu functions, and toggle between clear and coded transmission.

C6.3.5.5.4 On/Off Controls

The handheld microphone shall have the capability to turn the radio on and off.

C6.3.5.6 Motorcycle Mounting (when noted in Table C-14)

The Motorcycle mobile shall be suitably designed to mount on a motorcycle. The control head shall be mountable on the steering column of the vehicle, and a separate transceiver with enclosure shall be mountable above the rear wheel of the vehicle.

C6.3.5.6.1 Transceiver

The transceiver shall be black in color. It shall be housed in a weatherproof enclosure, which shall support the mounting of the antenna.

C6.3.5.6.2 Weather Resistance

The radio shall have a weather resistant control head, microphone, transceiver, and speaker.

#### C6.3.5.6.3 Dimensions

The following equipment shall not exceed the dimensions listed below:

- Transceiver: 9" L x 7 1/2" W x 2 1/4" H.
- Transceiver Weatherproof Enclosure: 16"L x 14"W x 6 1/2"H.
- Control Head: 2 1/2" L x 7 1/4" W x 2 1/4" H

#### C6.3.5.6.4 Weight

The following equipment shall not exceed the weights listed below:

- Transceiver: 5.5 lbs.
- Transceiver Weatherproof Enclosure: 15 lbs.
- Control Head: 3 lbs.
- Microphone: 1 lb.
- Speaker: 2 lbs.

#### C6.3.5.6.5 Features

Interface cable shall be included with the radio for connection to headsets. The speaker shall be equipped with a 9-ft. cable.

### **C6.4 Base Stations and Repeaters**

#### C6.4.1 General

Base Stations and repeaters shall have the following features (see Table C-15):

**Table C-15. Base Station/Repeater Features and Functions**

Function	Radio Model				
	I	II	III	IV	V
Power Level	Mid	High	Mid	Mid	Mid
Analog 12.5 and 25 kHz channels	!	!	!	!	!
TIA-102 Digital 12.5 kHz channels	!	!	!	!	!
TIA-102 DES Encryption	!	!	!	!	!
Local Control	!	!	!	!	!
Remote Control via Wireline	!	!	!		
Desk Top				!	!
Repeater Operation			!		
Vehicular repeater					!

- Size: Standard EIA 19" rack mountable, 8.75" H x 19" W x 17" D maximum
- Weight: 55 pounds maximum
- DC battery revert power
- Programmable Channel Scan: The base station shall be capable of performing programmable channel scans for all channels furnished
- Microphone: A test microphone shall be provided with each station
- Speaker: An integral ½-watt (minimum) speaker matched to the audio amplifier shall be furnished
- Encryption: The base station/repeater shall be capable of TIA-102 DES Encryption

#### C6.4.2 Automatic Station Identifier

Each base station or repeater transmitter shall be equipped with an automatic station identifier that is capable of transmitting the appropriate FCC station call sign at intervals ranging from 1-99 minutes. The identifier shall be capable of a Continuous Wave (CW) or Modulated Continuous Wave (MCW) operation. The speed shall be capable of 1 to 99 words per

minute, and CW tone frequencies from 100Hz to 3000Hz. The identification message shall be field programmable, with all programming stored in a nonvolatile EEPROM.

#### C6.4.3 Control Capabilities

Each base station shall be capable of being configured for control operation with the options listed below, as noted in Table C-15:

##### C6.4.3.1 Wireline Operation

The base station shall be capable of being configured for wireline control operation.

- The control of the station in a wireline configuration shall be via telephone lines, one pair for transmit and one pair for receive, and via RF utilizing either tone remote signaling for analog mode or digital signaling in compliance with TIA-TSB.102 CAI standards.
- The station shall have remote diagnostics capability accessible via modem connectivity.

##### C6.4.3.2 Local Control Operation

The base station shall be capable of local control.

#### C6.4.4 Repeater Operation (when noted in Table C-15)

##### C6.4.4.1 Repeat Mode

In the repeat mode, the station must have the capability to be transparent to incoming modes of operation, using the same modulation scheme that it receives in the repeated transmission.

If configured for digital communications, the station is not required to automatically switch to analog communications capabilities. If configured for analog communications, the station is not required to automatically switch to digital communications capabilities.

##### C6.4.4.2 Full Duplex Operation

The station shall be equipped with full duplex operation, thus enabling transmit and receive operations simultaneously.

##### C6.4.4.3 Operational Modes

The station shall provide transparent operation in a stand-alone application, handling signals in both the clear and coded modes without operator intervention.

#### C6.4.4.4 Multimode

Multimode radios shall automatically retransmit in the mode that they receive.

#### C6.4.4.5 Repeater Function

The base station/repeater unit shall include software enabling the base station/repeater to perform transmit and receive repeater functions. Controls are to provide for automatic repeater operation of the equipment as follows.

- The receiver shall provide positive and stable operation of the associated transmitter.
- In analog mode, the audio from the receiver shall be capable of modulating the transmitter at its rated deviation. The speaker volume control shall not affect the repeated deviation or signal when adjusted from minimum to the specified audio power output.
- In analog mode, the repeat deviation shall not change more than 10 percent when the unit is operated over a primary power supply voltage range of +/- 20 percent of the specified operating voltage.
- The repeat operating frequencies shall be selected when repeater controls are activated.
- There shall be no false operation due to spurious transmitter emissions or transients of any nature during switching cycles with the transmitter connected to a non-radiating load.

#### C6.4.4.6 Time-Out Timer

A programmable time-out timer shall be included in all repeaters to turn off the transmitter from a minimum of zero to three minutes of continuous operation. It shall reset within one second after the transmitter PTT circuit is deactivated.

#### C6.4.5 Desktop Station (when noted in Table C-15)

- Size: 8" H x 16" W x 17" D maximum
- Weight: 30 pounds maximum

C6.4.6            Vehicular Repeater when noted in Table C-8

C6.4.6.1           The station shall be capable of transmitting frequency on 16 separate UHF radio channels.

C6.4.6.2           The station shall be capable of being covered by a standard 13.8 vdc automobile battery

C6.4.6.3           Size: Standard EIA 19" rack mounted

## **C6.5            Digital Satellite Receiver**

The following is a specification for a Satellite Receiver to operate in a wide area coverage environment. The receiver shall work in conjunction with a multiple port digital audio comparator. Two or more satellite receivers shall connect to the comparator, specified below, which shall select the receiver with the best audio for transmission.

- Size: Standard EIA 19" rack mountable
- DC battery revert power
- Receiver: In addition to specifications listed above for digital receiving equipment, the receiver shall comply with the following:
  - Receiver Bandwidth: 4.0 MHz

## **C6.6            Digital Comparator**

The following is a specification for a digital capable comparator that shall have the capability to interface with multiple external receivers in both analog and digital modes of operations, and combine/select the best possible receive signal. This voting shall be based on Bit Error Rate (BER) in digital mode.



#### C6.6.1 General Specifications

- Size: Standard EIA 19" rack mountable, 11" H x 19" W x 20" L maximum
- Capacity: The comparator shall be capable of comparing from 4 to 48 channels in one cabinet
- DC battery revert power
- Interfacing with other equipment: The comparator must be able to be used in a voted repeater system, interfacing with consoles, base stations and repeaters

#### C6.6.2 Electrical

- Input and output line impedance: 600 ohms balanced
- Input line sensitivity: -37 dBm to 0 dBm at 1 kHz at 3.0 kHz deviation
- Outputs Per Chassis: The following number of independent, adjustable line outputs/inputs shall be provided to each chassis, at a minimum:
  - Transmit Line Outputs: 2
  - Console Line Inputs: 1
  - Line Outputs: 4
- Signaling rate: The digital signaling rate on any I/O port shall be 9600 bps
- Voting rate: The comparator shall be capable of the following voting rates:
  - Minimum voting rate: 33 votes/second
  - Maximum throughput delay: 80 milliseconds

#### C6.6.3 Features

##### C6.6.3.1 Diagnostics

The comparator shall include an RS-232 interface capable of accommodating an external printer, computer, or software programming terminal.

#### C6.6.3.2 Indicator Lights

The comparator shall include LED indicators to indicate the following, at a minimum: "Control ON," "Control Fail," "Intercom," "Console Active," "Tx Active," "Rx Active," "Link Fail," "Auxiliary," "Wireline ON," and Wireline Fail."

#### C6.6.3.3 Test Ports

The comparator shall have a test microphone and speaker port available for service functionality.

### **C6.7 Digital Interface Unit (DIU)**

The following is a specification for a DIU that is compatible with TIA-102 digital signaling. The DIU shall allow a tone remote control console to interface with the digital infrastructure.

The DIU shall convert tone remote control commands to digital commands acceptable to and compatible with TIA-102-compliant digital signaling equipment. It shall contain the vocoding circuitry used to perform the analog-to-digital signal conversion of outbound voice messages and the digital-to-analog signal conversion of inbound voice messages.

#### C6.7.1 DC Battery Revert Power

#### C6.7.2 Digital Signaling Rate

The digital signaling rate shall be 9600 bps.

#### C6.7.3 Encryption and Signaling Requirements

- Encryption type: TIA-102 DES
- Encryption key generation: External Key Variable Loader (KVL)
- Capacity: The DIU shall be capable of at least two encryption algorithms

- Encryption key erasure: Tamper detection and/or manual erase shall be performed via the keyboard
- Transmission control: Tone Remote Control from a console and Digital Remote to a digital base station.

#### C6.7.4 Wireline Interface

- Physical: 600 ohms balanced, 4-wire
- Sensitivity: -25 dBm
- Audio output:
  - To Console: 0 dBm at 600 ohms to lines
  - To Base Station: 0 dBm at 600 ohms to lines

#### C6.7.5 Features

- Diagnostics: The comparator shall include an RS-232 interface capable of accommodating an external printer, computer, or software programming terminal
- Indicator Lights: The comparator shall include LED indicators to indicate the following, at a minimum: "Transmit," "Monitor," "Fail," and "Battery."
- Keypad: A 16-button keypad shall be included to assist in operating the device
- Display: The display shall be an 8-character LCD display

### C6.8 Digital Voice Modem

The following is a specification for a Digital Voice Modem that will allow a DES Key at a 9.6 kbps rate or a 12 kbps rate to be transmitted over a standard 3002 voice grade telephone line. It shall allow encrypted messages to be transmitted from a central dispatch point to a subscriber unit by providing connectivity between a DIU and a remote base station or receiver.

#### C6.8.1 Size

The modem shall be rack mounted and shall not exceed 19" W x 9" D x 7" H.

#### C6.8.2 DC Battery Revert Power

#### C6.8.3 Encryption and Signaling Requirements

- Line impedance: 600 ohms balanced
- Hum and noise: Residual hum and noise at the output shall be at least -50 dBm using a test tone of 1000 Hz at 0 dBm
- Audio Distortion: Measured audio distortion shall no greater than 2 percent while using a 1000 Hz test tone at 0 dBm
- Telephone line level: 0 to -26 dBm at 1 kHz
- Data/voice level: +11 dBm to -15 dBm at 1 kHz

#### C6.8.4 Phone Line

- Type: 3002 Unconditioned
- Impedance: 600 Ohms nominal
- Frequency translation: +/- 10 Hz maximum
- Signal-to-noise ratio: 35 dB (from 300 to 3000 Hz)
- Insertion loss: (From 500 to 2900 Hz) 20 dB maximum (16 dB nominal)

#### C6.8.5 Features

##### C6.8.5.1 Signals/Modes

The modem shall be able to accept both digital and analog signals. It shall be capable of operating in the full duplex, transmit only, or receive only modes.

##### C6.8.5.2 Encryption

The modem shall be compatible with TIA-102-compliant DES.

##### C6.8.5.3 Alarms

The modem shall monitor the telephone circuit and send an audible alarm if the line quality degrades below the specified limits. Also, in times of inactivity on the telephone line for periods exceeding 40 minutes, the modem shall automatically initiate a handshake with its counterpart to ensure that the telephone line is operational.

## **6.9 Key Variable Loader (KVL)**

The following is a specification for a KVL that will assemble and transfer encryption keys into encryption equipped radios and peripheral equipment.

### **C6.9.1 General Specifications**

#### **C6.9.1.1 General**

The KVL shall be compliant with the testing procedures listed in TIA/EIA/IS-102.AAAC.

#### **C6.9.1.2 Power**

Rechargeable Nickel Cadmium or Nickel-Metal Halide battery.

#### **C6.9.1.3 Key Variable Storage**

The unit shall store up to 32 keys in non-volatile electronic memory (16 traffic keys and 16 shadow keys).

#### **C6.9.1.4 Keyloading Method**

Manual operator entry via keypad. Selective key transfer to download codes from one code loader to another.

#### **C6.9.1.5 Key Transfer Method**

Via temporary patchcord connection to the radio

#### **C6.9.1.6 Display**

The KVL shall have a 16-digit LED display to monitor the operational status and provide for review of manually entered key variables prior to transfer into non-recallable memory.

### **C6.9.2 Features**

#### **C6.9.2.1 Verification Test**

The KVL shall conduct verification tests after each key is transferred to the radio. If the key is loaded successfully and is operating correctly, an audible tone shall be emitted from the radio's speaker, and a visual message shall be indicated on the KVL display.

#### C6.9.2.2 Key Recall

After keys have been loaded into the KVL memory, they cannot be recalled and displayed by the KVL.

#### C6.9.2.3 Programmable Lock

The KVL shall have a programmable electric lock that will allow the user to enter a "combination" into the KVL memory to lock the unit. The KVL shall remain inoperable once the unit has been locked until the same "combination" is re-entered into the KVL.

#### C6.9.2.4 Receiving Keys

The KVL shall be capable of connecting to a fast-back modem and receiving keys via a standard telephone line from a Key Management Facility (KMF), specified below.

#### C6.9.2.5 Non-Volatile Memory

The KVL shall have non-volatile memory to eliminate the potential for losing lock or key information due to weak or removed batteries.

#### C6.9.2.6 Power-Down Timer

The unit shall be equipped with an automatic power-down timer to extend battery life.

#### C6.9.2.7 Power-Up Memory

The unit shall be equipped with power-up memory, remembering the last key used.

#### C6.9.2.8 Remote Keyloading

The KVL shall be capable of remote keyloading operation. It shall provide codes to radios that are normally out of range of the KMF, over phone lines.

#### C6.9.2.9 OTAR Compatibility

The KVL shall be compatible with other communications equipment used in the Over-The-Air-Rekeying environment (OTAR).

## **C6.10 Key Management Facility (KMF)**

The following is a specification for a KMF to be used for secure key management, rekeying of various devices, key storage, and key generation. The KMF shall be able to interface with an RF inter-structure to perform OTAR. The KMF shall conform to the standards listed within the TIA-102 document TSB102.AACB *Over-The-Air-Rekeying (OTAR) Operational Description*.

The KMF shall maintain key management related data bases for each subscriber unit for which it is responsible. The data bases shall store such information as inventory records of all crypto groups, keysets, Key Encryption Keys (KEKs), and Traffic Encryption Keys (TEKs), as defined and explained in TSB102.AACB.

### **C6.10.1 General Specifications**

#### **C6.10.1.1 General**

The KMF shall be compliant with the testing procedures listed in TIA/EIA/IS-102.AAAC.

#### **C6.10.1.2 Algorithms**

The KMF shall be capable of one or more encryption algorithms. It shall be capable of TIA-102 compliant DES, as specified within TIA IS-102.AAAA-A.

#### **C6.10.1.3 Key Storage**

The KMF shall contain 50,000 or more secure keys.

#### **C6.10.1.4 Messages**

The KMF shall be capable of creating appropriate data messages and passing them to the secure interface unit, the radio subscriber unit (via the secure interface), and to a secure key loader TIA-102 encrypted signaling.

#### **C6.10.1.5 PTT ID**

Acknowledgements received from the radios shall be decoded and downloaded. The unit shall be able to process and track PTT IDs sent by radio units.

C6.10.1.6 Database Tracking

The KMF shall be capable of tracking all information concerning the keying operations of the system and storing this information in a separate record keeping database.

C6.10.1.7 ID Storage

The KMF shall be able to store the IDs of all radios within the system range, store all device communication with the key manager unit, and be able to verify if the subscriber unit is operational before attempting to send the OTAR information.

C6.10.1.8 Downloading Keying Information

The KMF shall be capable of downloading keying information to a secure key loader using standard dial-up modems or by a local connection.

C6.10.1.9 Programmed Schedule

The KMF shall be able to automatically send re-key and index commands to radio groups based on a programmed schedule.

C6.10.1.10 Response to Requests

The KMF shall be able to recognize the subscriber unit PTT and re-key request, and automatically respond to re-key requests.

C6.10.2 Interfaces

C6.10.2.1 General Purpose Serial Interface

The KMF shall have a general-purpose serial interface with 16 or more asynchronous RS232 ports.

C6.10.2.2 Keyloader

The KMF shall be able to interface with a hand-held keyloader to transfer keys to and from the unit.



#### C6.10.2.3 Interstructure

The KMF shall be able to interface with a radio's system interstructure to provide the ability to change secure keys over the air.

#### C6.10.2.4 LAN

The KMF shall be able to interface with other key management systems to provide a LAN interface.

#### C6.10.3 Features

The following key management services shall be provided over-the-air by the KMF:

- Group re-keys
- Individual re-keys
- Key indexing
- Modifying keys at subscriber units
- Commanding keyset changeovers at subscriber units
- Modifying keyset attributes at subscriber units
- Updating keys held by subscriber units
- Setting date and time at subscriber units
- Inventorying key management related items at subscriber units
- Generation and use of internal secure keys
- Radio check
- Radio disable
- Disable radio keys
- Erase all radio keys from a subscriber unit
- Zeroize keys for individual subscriber units

### **C6.11 Remote Desktop Console**

The console must be compatible with tone remote keying commands. The following is a specification for a remote desktop console. The console shall be compatible with tone remote

keying commands, and have MDC-1200 signaling capability as well as either single-tone or no-tone signaling capability. The console shall have parallel console connectivity.

#### C6.11.1 General Specifications

- Size: Footprint shall be no greater than 144 square inches
- Display: LCD with, at a minimum, a built in clock (12/24 hour), VU meter, volume indicator and PC configurable menu system
- Station control: Must be able to control, at a minimum four base stations with parallel status to enable each remote to display the actual radio mode for all base stations
- Audio speakers: Select (main) speaker and one un-select speaker
- Functional controls: At a minimum, the following is required: separate volume control for select, un-select, and handset/headset audio programmable keypad control, transmit LED, receive LED, and parallel indication function
- Tone control:
  - Function Tone: Frequency Range: 550 – 2050 Hz
  - Guard Tone: Frequency Range: 1500 – 3000 Hz
- Filters: The remote control unit shall be adequately filtered or protected against interference caused by high ambient radio frequency fields from nearby transmitters or from static atmospheric discharges
- Control functions: Control functions such as PTT, and frequency selection shall be provided by control tones
- Remote control: Tone control shall provide all base station and repeater operation controls such as PTT, frequency selection, etc., by audio frequency tones; no DC operation controls are acceptable. There shall be no false operation of the tone controls due to normal voice operation; channel selection and station activation shall not require more than 300 ms to accomplish
- Channel selection: Channel selection shall be performed with industry standard tones

#### C6.11.2 Transmit Features

The standards listed above for analog and digital transmitters shall apply.

- Microphone and Headset: External inputs for a low impedance microphone, a built in condenser microphone, and an adjustable microphone sensitivity, as well as an external input for a headset with audio volume control
- Compression: Level output (within 3 dB) with varying audio inputs, up to 30 dB variation from beginning of compression
- Audio output: Adjustable from -20 dBm to +10 dBm (minimum), into a 600 ohm load
- Multiple frequencies: 8 minimum, F1 – F8

#### C6.11.3 Receiver Features

The standards listed above for analog and digital receivers shall apply.

- Audio Output: Built-in select and un-select speakers with adjustable volume control of up to 3 watts, with no more than 5 percent distortion and 30 dB of compression

### C6.12 Batteries – Rechargeable

#### C6.12.1 General

Batteries shall be capable of delivering the power level and quality required to enable the portable radio to operate under the required technical, environmental, and operational standards. In addition, batteries shall meet the following conditions:

##### C6.12.1.1 Rating

Battery life shall be no less than 8 hours based on a 5-5-90 duty cycle comprised of 3 seconds receive at the stated portable audio output power, 3 seconds transmit at the stated portable RF output power, and 54 seconds at standby. Battery life shall conform to all requirements specified under TIA TSB-102.CAAB.

##### C6.12.1.2 Charge Rate

Batteries shall be capable of being charged to full rated capacity with 1.5 hours.

##### C6.12.1.3 Battery Life

Batteries shall be capable of being fully charged and discharged at least 1000 times.

**C6.12.2 Memoryless**

Batteries shall be rechargeable, dual rate, ultra-high capacity Nickel-Metal Halide (NiMH), and shall be immune from the memory effect common to many rechargeable batteries used for portable wireless communications. The memory effect is a reduction in the apparent life capacity caused by shallow cycling.

**C6.12.3 Disposable**

Disposable batteries shall contain alkaline battery cells enclosed in a lightweight metal or plastic housing.

**C6.13 Single Unit Battery Charger**

**C6.13.1 General**

The unit shall be capable of charging a single rechargeable battery in the maximum time of 1.5 hours. The charger shall be capable of charging NiCd, or NiMH batteries. A “tri-chemistry” charger is not desired.

**C6.13.2 Input Voltage**

The input voltage shall be 110 VAC or 220/240 VAC.

**C6.13.3 Indications**

The unit shall have an indicator LED for the status of the battery, such as charging, charged, and conditioning indicators.

**C6.14 Six Unit Battery Charger**

The unit shall be capable of charging six rechargeable batteries in the maximum time of 1.5 hours. The charger shall have the same performance as the single battery charger unit specified above, and shall have an LED indicator for each battery.

## **C6.15 Battery Management Kit**

The following is a specification for a battery management system capable of recharging as well as curing “memorized” NiCd batteries.

### **C6.15.1 Functional Buttons/Displays**

The unit shall have several function buttons per battery station to perform charging and recycling operations, and one LCD display showing battery status.

### **C6.15.2 Capacity**

The unit shall be able to service 6 batteries simultaneously.

### **C6.15.3 Electrical**

- Input voltage: 110VAC +/- 10 percent 50/60 Hz or 230 VAC +/- 10 percent 50/60 Hz
- Maximum mAh battery: 7000 mAh
- Operating temperature: 0 to +50 degrees Celsius
- Charge and discharge rate: 600ma +/- 5 percent
- Battery voltage: 4.8 VDC – 14.4 VDC

## **C6.16 Radio Accessories**

### **C6.16.1 Radio Programming Equipment and Cables**

Include all software, equipment and cabling necessary to program standard features, as well as software upgrades, from computer to radio.

### **C6.16.2 Hirose Connector**

A 6-pin Hirose connector capable of connecting to the accessory slot/connector of the portable radio for attaching compatible accessories and programming devices

### **C6.16.3 Radio Keying Cable**

Cable shall connect between the portable and the encryption key loading equipment to provide a path for loading encryption keys.

C6.16.4        Radio Cloning Cable

Cable shall be capable of connecting from the programmed radio to the copy radio and delivering the cloned programming parameters.

C6.16.5        Mobile Radio Control Cabling

All associated cabling necessary for the control from the control head to the transceiver of the mobile radio.

C.6.16.6       Mobile Radio Power Cabling

All associated cabling necessary for powering the transceiver and control head of the mobile radio.

C6.16.7        Mobile Radio Mounting Bracket

Mounting bracket for remote mount

C6.16.8        Carry Case - Portable

High-activity swivel leather case designed to fit the radio shape. Include a swivel belt loop and T-strap.

C6.16.9        Two-Piece Surveillance Kit - Portable

Earpiece assembly with standard earphone and urethane earloop and two-wire PTT palm microphone or Voice Activated (VOX) interface module combined. Connects to portable radio.

C6.16.10       Three-Wire Surveillance Kit - Portable

Earpiece assembly with standard earphone and urethane earloop and three-wire mini lapel microphone kit with PTT or VOX interface module combined. Connects to portable radio.

C6.16.11       Handheld Speaker/Microphone for Portable

The handheld speaker/microphone shall, at a minimum, include a large Push-To-Talk switch, a swivel clip, and a minimum 12" (retracted) coiled cord. It shall comply with the following:

- Audio output: 1.0 watts at 8 ohms
- Microphone sensitivity: -64 +/- 4 dB at 74 dBSPL, measured at 1 kHz
- Earphone Jack: The microphone shall have an input jack to accept a standard earphone connection
- Environmental: The handheld speaker/microphone shall be capable of operation within the temperature range of -30 to +60 degrees Centigrade; it shall comply with MIL-STD-810E standards for: driven rain, humidity, salt, fog, blowing dust, and shock

#### C6.16.12 Handheld Microphone for Mobile

The radio shall include a handheld microphone shall, at a minimum, include a large Push-To-Talk switch, a swivel clip, and a minimum 12" (retracted) coiled cord. It shall comply with the following:

- Audio output: 1.0 watts at 8 ohms.
- Microphone sensitivity: -64 +/- 4 dB at 74 dBSPL, measured at 1 kHz

#### C6.16.13 External Speaker

12W power output, including wiring and adapter necessary for connection to the mobile unit.

#### C6.16.14 Remote Mount Conversion Kit

The kit shall enable the mobile radio to be securely mounted in a location remote from the dash of the vehicle.

#### C6.16.15 Test Accessories

An interface box and necessary interface cables necessary to provide a centralized control point for performing radio equipment testing and performance evaluation.

C6.16.16      Antenna - Portable

Heliflex, non-adjustable antenna covered with injection molded rubber. Standard antenna optimized for use in the applicable frequency band.

C6.16.17      Antenna - Mobile

Unity gain. Roof, trunk, or magnet mount. Maximum power input shall be 150W. Optimized for use in the applicable frequency band.

**C6.17            Software Upgrades**

C6.17.1          Standard Software

A standard software upgrade shall, at a minimum, enable the radio to operate all standard features, as well as the following:

- TIA-102 compliant Common Air Interface (CAI) protocol, per TIA TSB-102.BAAA, BAAB-A, BAAC-A, and BAAD.
- Vocoder: Improved Multi-Band Excitation (IMBE), per TIA TSB-102.BABA, BABB-A, BABC, and BABD.

C6.17.2          Software and Hardware Training

*Duration:        One 4-hour course*

*Class Size:     1 class of 4 students*

*Location:       Contractor Facility or MPD Facility of MPD's choice*

This training shall instruct the students on how to install CAI, IMBE, DES and OTAR software into portable and mobile radios. It shall also detail the methods of programming functionality and features into the portable and mobile radios from both the keypad and a personal computer.

The training shall include a live demonstration using portable radios.

**C7                DOCUMENTATION**

The following is a summary of the required documentation for each contract.

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## **C7.1 UHF Radio System Contract**

The UHF Radio System contract involves the design and installation of a functional wide-area coverage radio system.

### **C7.1.1 Documentation**

#### **C7.1.1.1 Offerors**

Potential Offerors shall submit three copies of the following documentation to be considered for award:

- Bid Proposal
- Design Proposal
- Coverage Study
- Intermodulation Study and proposal to eliminate single-point-of-failure problems
- Evidence of past performance and experience
- Coverage Testing Plan
- Description of Maintenance Facilities and Training Plan Report

#### **C7.1.1.2 Awarded Contractor**

The awarded Contractor shall submit documentation as depicted in Table C-16.

## **C7.2 IDIQ Equipment Contract**

The IDIQ Equipment contract will be used by the MPD for future equipment purchases.

### **C7.2.1 Documentation**

#### **C7.2.1.1 Offerors**

To allow for a thorough and fair evaluation of the bids, the potential Offerors shall submit the following documentation to be considered for award:

Equipment specification sheets and product guides for all equipment to be considered for award.

#### **C7.2.1.2 Awarded Vendor**

The awarded Vendor shall provide the following documentation with purchased equipment:

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- Equipment manuals
- Installation manuals, as required
- Y2K Compliance Statement
- Warranty Statement

**Table C-16. Documentation Deliverables**

<b>Equipment</b>	<b>Section</b>	<b>Delivery Time</b>
Contract Requests for use of District-owned space	C4	60 days after award
Installation Schedule (3 Copies)	C4	60 days prior to installation
Design documentation and diagrams (3 Copies)	C3	60 days prior to installation
Blueprint drawings of intended equipment locations (3 Copies)	C3	60 days prior to installation
Wiring Diagrams for Equipment Connections	C3	60 days prior to installation
Phasing Plan (3 Copies)	C3	60 days prior to installation
Test Plan/Schedule (3 Copies)	C3, E4	60 days prior to installation
Copy of Modification to FCC Licenses (3 Copies)	C3	30 days prior to installation
Preventive Maintenance Schedule	C5	60 days after award
Spare Parts List	C5	90 days after award
Test and Support Equipment List	C5	30 days prior to acceptance
Coverage Testing report (Three copies)	C3, E4	Upon Final Acceptance
As-built drawings and system diagrams (Three copies)	C4	Upon Final Acceptance
Warranty Statement for Entire Radio System	C5	Upon Final Acceptance
User Reference Manual for Transmit Sites	C5	Upon Final Acceptance
Equipment manuals	C6	Upon Final Acceptance
Installation manuals	C6	Upon Final Acceptance
Y2K Compliance Statement	C6	Upon Final Acceptance
Proof of Proper and Compliant System Performance (Physical Acceptance Test Results)	E4	Upon Final Acceptance



### **TIA 102-SERIES STANDARDS SUMMARY**

TSB 102-A	APCO Project 25 System and Standards Definition	Nov 1995
IS 102.AAAA-A	APCO Project 25 DES Encryption Protocol	Feb 1997
TSB 102.AAAB	APCO Project 25 Security Services Overview	Jan 1996
IS 102.AAAC	Conformance Test for Project 25 DES Encryption Protocol	Feb 1997
TSB 102.AABA	APCO Project 25 Trunking Overview	Apr 1995
TSB 102.AABB	APCO Project 25 Trunking Control Channel Formats	Nov 96
IS 102.AABC	Project 25 Trunking Control Channel Messages	Mar 1998
TSB 102.AABD	Project 25 Trunking Procedures	Oct 1997
TSB 102.AABF	APCO Project 25 Link Control Word Formats and Messages	May 1996
TSB 102.AABG	APCO Project 25 Conventional Control Messages	July 1996
TSB 102.AACA	APCO Project 25 Over-The-Air-Rekeying (OTAR) Protocol	Jan 1996
TSB 102.AACB	OTAR Operational Description	Jan 1997
TSB 102.AACC	Conformance Tests for the Project 25 OTAR Protocol	Feb 1997
TIA 102.BAAA	Project 25 FDMA Common Air Interface (CAI)	May 1998
TSB 102.BAAB-A	APCO Project 25 CAI Conformance Test	Aug 1995
TSB 102.BAAC-A	APCO Project 25 CAI Reserved Values	Dec 1995
TSB 102.BAAD	APCO Project 25 CAI Operational Description for Conventional Channels	Oct 1994
TIA 102.BABA	Project 25 Vocoder Description	May 1998
IS 102.BABB-A	Project 25 Vocoder Mean Opinion Score (MOS) Test	Jan 1997
IS 102.BABC	APCO Project 25 Vocoder Reference Test	Jun 1996
TSB 102.BACA	Inter-RF Sub-System Interface (ISSI) Messages Definition	Dec 96
TSB 102.BACC	Inter-RF Sub-System Interface (ISSI) Overview	Dec 96
IS 102.BADA	Telephone Interface Requirements and Definitions (Voice Service)	May 1996
IS 102.BAEA	Project 25 Data Overview	Jan 1998
IS 102.BAEB	Project 25 Packet Data Specification	Apr 1998
IS 102.BAEC	Project 25 Circuit Data Specification	Jan 1998
IS 102.BAEE	Radio Control Protocol	Jan 1998
TSB 102.BAFA	APCO Project 25 Network Management Interface	Dec 94
IS 102.CAAA	Digital C4FM/CQPSK Transceiver Measurement Methods	May 1997
TSB 102.CAAB	Digital C4FM/CQPSK Transceiver Performance Recommendations	Aug 1994



**SECTION D - PACKAGING AND MARKING**

This section is not used in this solicitation

## **SECTION E – INSPECTION, TESTING AND ACCEPTANCE**

### **E1 ACCEPTANCE TESTING**

Final acceptance of the UHF radio system by the DC MPD shall be given upon successful completion of the following tests:

- Physical Acceptance Test
- Functional Acceptance Test
- Coverage Acceptance Test
- Owner Acceptance Test

A test plan for each of the above tests, with the exception of the Owner Acceptance Test, shall be submitted to the MPD for approval at least 30 days prior to the test start date. Each test shall be monitored by the MPD.

Note that the above testing may be performed channel by channel.

### **E2 PHYSICAL ACCEPTANCE TEST**

The Physical Acceptance Test is performed to ensure that the proper equipment is installed and operating in compliance with the specifications.

#### **E2.1 General Compliance**

The proper and compliant installation and programming of all fixed-end equipment, control equipment, and fixed encryption equipment shall constitute physical acceptance. The MPD shall be allowed to witness all installation and programming procedures.

The Contractor shall conduct on-site inspection of all system facilities with the MPD prior to formal acceptance by the MPD. This inspection shall demonstrate detailed compliance with the design and equipment requirements of this specification. It shall also show that all aspects of the system are completely operational and debugged. All specified system functions shall be demonstrated to be operational.

The Contractor shall supply documentary proof of proper and compliant system performance.

## **E2.2 Physical Tests**

The Contractor shall test all fixed station antennas and transmission lines with a time domain reflectometer or swept return loss devices. A chart recording of the test results shall be made and retained in the site log. VSWR in excess of 1.5:1 shall not be permitted at any fixed station.

All hardware supplied shall be tested to comply with manufacturer specifications. Base station/repeater power output, frequency, and deviation shall be tested before approval from the MPD.

## **E3 FUNCTIONAL ACCEPTANCE TEST**

The Functional Acceptance Test is used to determine that the installed and operating, physically acceptable system performs the functions and features in the manner and level that is required.

The MPD shall be allowed to witness all testing procedures.

### **E3.1 Communication with Subscriber Units**

This test is not intended to determine coverage. The Coverage Acceptance Test is responsible for coverage testing.

The Contractor shall prove adherence with all technical specifications during a live test demonstration. The live test demonstration shall show the Contractor's capability to support the subscriber unit requirements as defined in the Equipment section. The test shall be performed with MPD-owned portable and mobile units, or with Contractor-owned units approved by the MPD.

The MPD will provide a list of requirements to be demonstrated during the test. The Contractor shall make a request for this list 30 days after contract award, and should expect to receive the list 60 days after contract award.

The live test shall include communications with encryption, if the tested channel is required to have such capabilities.

The Contractor shall also test to ensure that the VHF Citywide-1 channel broadcasts the same transmissions that the UHF Citywide-1 channel broadcasts.



### **E3.2 Alarms and Control**

Control equipment features shall be tested to ensure that the functionality is in compliance with the specifications. The equipment shall also be tested for proper repeater access and control of the remote stations. The remote desktop controllers to be installed at the three ROCs shall also be tested for functionality as well.

The Contractor shall also test patching the DC Fire Department's frequencies to the MPD, and vice versa through the main consoles.

The automatic station identification feature of the base station and repeater transmitters shall also be tested for proper signaling and timing intervals

### **E3.3 Encryption and OTAR**

Encryption and OTAR features and functionality shall be tested during a live test on the SOD channel to ensure compliance with the specifications. The test shall be performed with MPD-owned portable and mobile units, or with Contractor-owned units approved by the MPD, that are equipped with the appropriate TIA-102 DES software.

MPD personnel shall be allowed to witness the test. The test shall be a voice encrypt test as detailed in the TIA-102 document, TIA/EIA IS-102.AAAC, entitled *Conformance Test for the Project 25 DES Encryption Protocol*.

Also, the key loading and enable/disable functionality of the OTAR shall be tested per TIA-102 document TIA/EIA TSB-102.AACC entitled *Conformance Tests for the Project 25 Over-The-Air-Rekeying (OTAR) Protocol*. The OTAR test shall confirm the proper functionality of all typical KMF operations, as listed and described in Section 5.2 of the TIA-102 document TIA/EIA TSB-102.AACB, entitled *Over-The-Air-Rekeying (OTAR) Operational Description*.

The encryption test shall test both receiver and transmitter performance, for both portable and mobile radios.

In addition, the Key Management Facility (KMF) shall be tested to determine that the key loading and storage features as well as all other features are compliant with the specifications.

## **E4 COVERAGE ACCEPTANCE TEST**

Coverage Acceptance Testing is performed to determine that the functions and features of the functionally acceptable system are available for use by the mobile user in the coverage ranges defined in the Design Requirements section of this specification.

Coverage acceptance shall be given upon successful completion of the Coverage Acceptance Test, as described in the Design Requirements section of this specification.

### **E4.1 Test Types and Environments**

Coverage testing shall consist of a Bit Error Rate (BER) test. The procedure for this test is explained below. Each test shall be performed in three separate environments: out-of-building, underground/Metro tunnels, and in-building.

### **E4.2 Out-of-Building Testing**

The Contractor shall perform outside testing per a grid system. The required coverage area for each grid shall be divided into square grid “tiles” of equal area. Within each grid, a BER test shall be performed. Additionally, the Route 267 road to Dulles Airport shall be divided into test areas along the length of the roadway. The Contractor shall submit a map of the service areas divided into grids, showing the proposed locations to be tested in each grid.

All tests shall be performed from a moving vehicle, travelling at a minimum speed of 4 miles per hour.

### **E4.3 Underground/Metro Testing**

The Contractor shall notify the MPD 30 days in advance of the testing date so that the MPD may notify the Metro authorities and obtain access to the necessary stations and subway cars.

#### **E4.3.1 Metro (Subway) Tunnel Testing**

Testing within the tunnels shall be performed while traveling on a subway car. On subway lines that have more than one tunnel, each tunnel shall be tested. A BER test shall be performed every 1/4-mile of the tunnel.

If improper coverage is found, the Contractor shall determine and substantiate whether or not the lack of coverage is due to the repeaters or the leaky cabling or other propagation

equipment. If the problem is due to the repeaters, the Contractor shall solve the problem. If the problem is due to other equipment, the Contractor shall suggest a solution.

#### E4.3.2 Metro (Subway) Station Testing

All stations within the required underground/Metro coverage area shall be tested. The BER test shall be performed in 20 separate locations, spaced 20 feet apart, on each concourse of the station. Half of these tests must be a maximum of 3 feet from a building wall.

#### E4.3.3 I-95/I-395 Tunnel Testing

Each tunnel (north- and south-bound directions) shall be tested while traveling in a moving vehicle. A BER test shall be performed every 1/4-mile of the tunnel.

### E4.4 In-Building Testing

In-building testing shall be performed in all of the buildings listed in the coverage requirements of Section C3.4. Note that the MPD will provide a list of 6 buildings per district that will be required to be tested in addition to the buildings listed in C3. The Contractor shall notify the MPD 30 days in advance of the testing date so that the MPD may notify the building authorities and obtain access to the buildings.

If the minimum test spacing required below cannot be achieved due to the size of the room, the tests shall be spaced evenly throughout the room.

#### E4.4.1 Hospitals

Test measurements shall be performed in the emergency room. Ten tests spaced a minimum of five feet apart shall be taken, half of which must be a maximum of three feet from a building wall. At the DC General Hospital and the Washington Hospital Center, all patient areas shall be tested in the hallways with ten tests spaced a minimum of ten feet apart, half of which must be a maximum of 3 feet from a building wall.

#### E4.4.2 Police Stations/Offices

Test measurements shall be performed as follows:

- Lobby: Ten tests spaced a minimum of 5 feet apart, half of which must be a maximum of 3 feet from a building wall.
- Main hallway of each floor of the building: Ten tests spaced a minimum of 10 feet apart, half of which must be a maximum of 3 feet from a building wall.

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- Headquarters Basement: In addition to the above requirements for Police Stations, the main MPD Headquarters basement shall be tested for proper coverage. Test the main hallway of the basement with ten tests spaced a minimum of 10 feet apart, half of which must be a maximum of 3 feet from a building wall.

#### E4.4.3 MCI Center and RFK Stadium

Test measurements shall be performed as follows:

- All Concourse levels: Twenty tests, each concourse, equally spaced around the building, half of which must be a maximum of 3 feet from a building wall.
- Center of Arena (MCI Center only): Ten tests spaced a minimum of 10 feet apart.

#### E4.4.4 Miscellaneous Buildings

Test measurements shall be performed as follows:

- Lobby: Ten tests spaced a minimum of 5 feet apart, half of which must be a maximum of 3 feet from a building wall.
- Main hallway of the ground level: Ten tests spaced a minimum of 10 feet apart, half of which must be a maximum of 3 feet from a building wall.

### E4.5 BER Testing

The purpose of this coverage acceptance test is to determine the area for each frequency channel for which the BER for subscriber unit radios is equal to, or less than, 2.6 percent. The criterion for acceptance is that at least 95 percent (portable) or 98 percent (mobile) of the BER measurements made meet the 2.6 percent BER limit.

A minimum quantity of test tiles is required to have a 99 percent level of confidence that the 2.6 percent BER limit is met. Note that the 95 percent / 98 percent figure is the required *coverage*, while the 99 percent figure is the *confidence* level, or degree of certainty, that the testing is valid.

For this use of statistical methods to be valid, it is necessary for the actual locations at which the measurements are made to be truly representative of the range of receiving conditions that exist in the area under test. They must be representative as to the types of propagation environment conditions (e.g., in a valley or on a hill crest) and as to the percentage of the total area in which each propagation environment condition exists.

The Bidder shall submit a proposal for the test plan, which will be used by the MPD as part of the contract evaluation process. The test plan shall explain how the test routes will be chosen, how the route conditions will be representative of the propagation environment conditions of the roadways in the DC area, the type of equipment to be used, the method of testing to be used, and an estimate of the testing schedule.

The test plan shall consist of 8-1/2" x 11" three-hole punched paper, shall be bound in a 3-ring binder, and shall not exceed 100 pages. The plan shall also be delivered in electronic form in Microsoft Word and/or Excel format on 3 1/2" floppy disks.

The test plan shall be subject to MPD alterations.

#### E4.5.1 Testing Plan/Schedule

Within 60 days after contract signing, the Contractor shall provide a schedule to the MPD for review and approval that will define a schedule for the delivery of these pre-test requirements. Along with the schedule, a revised test plan shall be submitted that reviews the procedures that may have been altered at the discretion of the MPD.

The Contractor shall provide a map showing the proposed route for the test vehicle(s) that will pass through all tiles to which access is possible and shall indicate all tiles where a test sample is to be made. The total number of test samples shall be equal to or greater than the limit derived in the above section. The map shall be provided to the MPD's Project Administrator for review and approval.

#### E4.5.2 Number of Test Samples

The contractor shall determine the minimum number of locations at which the test samples will be measured for each coverage area in accordance with the following equation:

$$T_l = Z^2 * p * q / (e^2)$$

where:

$T_l$  = Number of Test Locations

$Z$  = 2.33 = Standard Deviate Unit, single tailed, for 99 percent confidence level

$p$  =  $r + e$  = True Service Area Reliability (decimal)

$q$  =  $1 - p$

$r$  = 0.980 = Service Area Reliability Criterion (decimal)

$e$  = Sampling Error Allowance (decimal) Specified by the Contractor

A greater number of locations may be used, if desired, and may be necessary to ensure that all types of path conditions are accurately represented in the total test samples.

#### E4.5.3 Parameters to be Measured

The Contractor shall measure the BER and the received signal strength at each test sample location. The received signal strength shall be provided as reference information for the MPD. Only the BER measurement shall be used to determine the coverage provided.

#### E4.5.4 Two-Receiver Coverage

The "out-of-building" radio system coverage requires that at least two receivers be able to successfully interpret the subscriber unit signal. The testing method shall account for this requirement. Therefore, in order for a test to be successful, at least two receivers must pass the minimum BER criteria for each BER test.

#### E4.5.5 Pass/Fail Criteria

Test Sample: The BER of the demodulated signal shall be equal to or less than 2.6 percent.

Coverage Area:  $(\text{number of test samples that pass})/(\text{total number of test samples}) \times 100$  shall be equal to, or greater than 95 percent for portables, or 98 percent for mobiles, depending on the coverage requirement for that specific area and radio channel.

#### E4.5.6 Test Configuration and Calibration

The Contractor shall provide a diagram of the receive test set-up showing all gains and losses, frequencies used, bandwidth, sensitivity, equipment manufacturer, and type numbers. The contractor shall provide copies of all calibration certificates as necessary to support the accuracy required above.

#### E4.5.7 Test Report

The Contractor shall submit a separate test report for each channel. Each test report shall contain all the test data measured for the applicable channel. The reports shall also include the date(s) and time(s) at which the testing was performed and the MPD and Contractor personnel involved. One MPD and one Contractor representative shall sign each report to attest to the authenticity of the data contained therein.

Each test report shall be a Microsoft Word file for text and one or more Excel spreadsheet files. Each report shall be provided to the State as two paper copies and one magnetic copy on an IBM formatted 3.5 inch diskette.

**E5                      OWNER ACCEPTANCE TEST**

The Owner Acceptance Test will be performed by the MPD for a period lasting 30 days after Physical, Functional, and Coverage Acceptance Testing has been successfully completed. During this test period, any malfunctions, improper operation of equipment, or intermittent problems will be announced to the Contractor. The Contractor shall then correct the problem within 48 hours. The testing period will then be extended by the length of time required for such corrections.

Upon successful completion of the Owner Acceptance Test by the MPD, the Contractor will be notified.