

PROJECT 25

**NEW TECHNOLOGY STANDARDS PROJECT
DIGITAL RADIO TECHNICAL STANDARDS**

**STATEMENT
OF
REQUIREMENTS**

November 10, 1999

NEW TECHNOLOGY STANDARDS PROJECT

DIGITAL RADIO TECHNICAL STANDARDS

STATEMENT OF REQUIREMENTS

11/10/99

Foreword

This statement of requirements document includes *Phase I Frequency Division Multiple Access (FDMA)*, Phase II *FDMA* and *Time Division Multiple Access (TDMA)* Project 25 requirements. *Phase II requirements include both Phase I requirements and requirements which are specific to Phase II.* Phase II requirements are *italicized* for ease in differentiating Phase I and Phase II Items. Items with **bold**, strike thru, underline and paragraph side bars show changes from previous versions. *Requirements are for both FDMA and TDMA except for requirements specific to TDMA which are denoted by an asterik*.*

A. Introduction

The objectives of this effort to establish a standards profile for the operations and functionality of new digital Public Safety radio systems are as follows.

1. Obtain maximum radio spectrum efficiency.
2. Ensure competition in system life cycle procurements.
3. Allow effective, efficient and reliable intraagency and interagency communications.
4. Provide "user friendly" equipment, "user friendly" being defined as the least amount of mental and physical interaction by the operator.
5. Provide a graceful path from present analog technologies through all phases of Project 25.

B. General Requirements List

In order to meet the stated objectives, it is felt that a general list of requirements is needed that defines the necessary system characteristics. This general list of requirements serves as a guideline for the more comprehensive list of detailed requirements which follows. To support this, the following statements are set forth as provided by Public Safety users with some modification.

1. The system shall offer channel utilization that immediately improves spectrum efficiency by at least two (2) times¹ over current analog systems, with a goal of an increase in improvement to at least four (4) times as technology continues to develop.
 - a. *Phase II shall provide for 6.25 kHz bandwidth channels or equivalent.*
 - *b. *TDMA transmitters and receivers shall be capable of operating in either a 12.5 kHz or a 25 kHz channel bandwidth with a minimum spectrum efficiency of 6.25 kHz per time slot.*
2. Subscriber units shall communicate in either a conventional or trunked environment using clear (unencrypted digital), digitally encrypted voice, or data modes regardless of the manufacturer of the equipment.
3. The system shall provide up to four levels of encryption with compatible modes of operation and shall provide the same functions associated with clear (unencrypted digital) operation. Subscriber units shall be capable of zero, one or *multiple* types of encryption, as required.

Type 1 is for classified national government communication.

Type 2 is for unclassified national security-related communications.

Type 3 is for unclassified sensitive government communications
(e.g., Public Safety).

Type 4 is for other purposes, (e.g., exportable).
4. Multiple radio subsystems must be interconnectable into larger systems. Further, subscriber unit units must be able to roam between different radio subsystems. Up to 64,000 different radio subsystems shall be uniquely identifiable. Further, each radio subsystem shall provide for up to 2,000 uniquely identifiable functional talk-groups or vertical partitions for distinct and separate organizations, and at least 48,000 individually identifiable subscriber units. Through hierarchical numbering, individual subscriber units and talk-groups from any radio subsystem are uniquely identifiable in any radio subsystem in concert with their home subsystem identification (similar to hierarchical telephone numbers and area codes).

¹Public Safety Frequencies 821-824/866-869 MHz presently use enhanced 25 kHz channel equipment together with a 12.5 kHz / 25 kHz regional coordination plan tied to minimum spacing between base stations. In this instance, the improvement in spectrum efficiency with 12.5 kHz digital channels will be approximately 1.3 times.

Project 25 STATEMENT OF REQUIREMENTS

5. The system shall be designed around a suite of operational standards so that field systems manufactured by different vendors can operate together and offer unit-to-unit communications based on predefined activation procedures.
6. Data transmission between a public or private switched telephone network access point, standard SNA, X.25, or TCP/IP networks and mobile (or portable) Data Terminal Equipment (DTE), over the RF link, are required. Data transmission shall operate at a speed of at least 9600 bps (including overhead) with minimal error retransmissions. All host applications on SNA, X.25, or TCP/IP networks shall have the ability to identify, and transparently communicate with any subscriber unit linked DTE device.
7. All subsystems and associated subscriber units which comprise a radio system must be under control of a single network management scheme, regardless of manufacturer. The scope of the single network management scheme includes the five basic elements of network management:
 - a. Configuration Management
 - b. Fault Management
 - c. Security Management
 - d. Performance Management
 - e. Accounting Management

Implicit in the ability to manage these elements is the transfer of relevant managed object attributes which can be used for example to generate; Managed information reports, alarms, reconfigurations, etc.

8. Management of system components and software levels shall be able to be performed from a single point. *This shall be accomplished in such a manner that an entry change to one database will automatically change all other associated databases without further user action.*
9. Overall system management shall be able to delegate vertical partitioning management to the organization responsible for the operation of the partition.
10. Voice quality for both clear and encrypted communication shall be equal to or superior to current clear voice analog systems and the measure of quality shall include both male and female voices.
11. System range performance for both clear and encrypted communication shall be equal to or superior to current clear voice analog systems and shall include simulcast without the need for additional site development.

Project 25 STATEMENT OF REQUIREMENTS

Phase II simulcast systems shall not require more sites than current clear voice analog or Phase I, multi-site/multi-cast or simulcast systems meeting the same coverage area requirements. For example, if simulcast sites are spaced 25 miles apart for mobile subscriber coverage in a current analog or Phase I, multi-site/multi-cast simulcast system, then Phase II equipment can be placed at the same sites without system performance degradation or the need to add more closer sites.

12. The system shall meet all the mandatory requirements and shall offer as options the same desirable features as APCO Project 16A. In all instances where Project 25 Statement of Requirements conflicts with those of APCO Project 16A, the Project 25 Requirements shall supercede.
13. Equipment size shall be comparable to existing analog systems. Portable subscriber units shall be offered for covert and uniformed users (covert portable being smaller) with batteries that shall power these portables for at least 8 hours (5,5,90 duty cycle) with minimal size and weight.
14. Interconnection to public switched telephone network shall be equal to or superior to current analog systems.
15. Each manufacturers system shall provide for backward compatibility with that manufacturers existing analog systems to facilitate a graceful and gradual migration from the old analog to the new digital. As a minimum, this shall include mobile and portable subscriber units. In addition, subscriber units shall include the ability to select and operate on available analog mutual aid channels for communications with the fixed network equipment as well as direct unit-to-unit.

As a Standard Option, the console interface shall provide for backward compatibility with that manufacturers existing analog systems.

16. The system shall be able to co-exist with *Phase I and* with older analog systems, share the same segments of allocated RF spectrum and provide little interference to existing adjacent-channel systems as well as work properly.
17. The system shall be technically flexible to allow for single and multiple site systems, voting and simulcast designs, with variable numbers of stations per site. The system shall allow for single station sites without loss of control, voice, or text capability. The maximum number of stations at a site shall not be limited for future growth.

Project 25 STATEMENT OF REQUIREMENTS

18. The system shall allow for continued enhancement of standardized functions and features so that the system can grow with user needs. Further, a standard method shall be specified for segmenting nonstandard (or potentially future-standard), value-added features between manufacturers to safeguard from unintentional interaction between subscriber units of different manufacturers subsystems.
19. The system shall minimally be equally adaptive to all Public Safety mobile radio frequency bands and blocks of spectrum, without precluding its adapting to other land mobile bands.
20. The mobile and portable equipment shall meet the applicable sections of MIL-STD-810E "Environmental Test Methods and Engineering Guidelines" as follows.

Method 506.3	Rain	Procedure I - Blowing Rain
Method 509.3	Salt Fog	Procedure I - Aggravated Screening
Method 510.3	Sand and Dust	Procedure I - Blowing Dust
Method 514.4	Vibration	Procedure I, Category 10 - Minimum Integrity Test (3 axes)
Method 516.4	Shock	Procedure I - Functional Shock

Also, all radio equipment shall meet the requirements of TIA/EIA-603 "Land Mobile FM or PM Communications Equipment Measurement and Performance Standards" when operated in the analog mode.

21. Throughput delay shall be as follows:
 - a. Less than 250 msec in direct radio-to-radio communications.
 - b. Less than 350 msec in radio-to-radio communications through a single conventional repeater.
 - c. Less than 500 msec in radio-to-radio communications within an RF subsystem.
22. The system shall be designed to be resistant to interference from co-channel, adjacent-channel, and intermodulation effects, in a manner similar to Continuous Tone-Controlled Squelch System (CTCSS) used today.
23. The system shall allow direct mobile to mobile communication at any time without degrading normal system performance. Direct communication while in range of the fixed equipment shall do no more than temporarily capture receivers from possible outbound messages. Direct communication shall be

possible at any time while out of range of the fixed equipment with no degradation in system performance or capacity.

Project 25 STATEMENT OF REQUIREMENTS

24. A dispatcher shall have the ability to interrupt any call enabled by the system that an individual may be engaged in.
25. The mobile and portable equipment shall be able to *sequentially* scan both conventional channels (at least 8) and trunked talk-groups (at least 8) in both clear and encrypted voice. The scan to be completed in the minimum time. The scan shall be selectable priority which means that the transmitter channel or talk-group selected by the user is the priority channel or talk-group.
26. *As a standard option*, the system shall have over-the-air-re-keying (OTAR) of encryption keys.
27. The system shall allow mobiles and portables to roam over a wide coverage area with automatic connection as the unit enters a new site coverage area within any radio subsystem. The system must provide for registration and authorization control over subscriber units roaming between radio subsystems. Manual and automatic roaming capabilities shall be provided between radio subsystems.
28. The system shall allocate channels at sites based upon subscriber units present which need to receive a given message.
29. A manufacturer of a Project 25 software product should define the extent of the operating environment over which the product is known to work.
30. *The system shall have over-the-air programming to enable making software change to mobile and portable subscriber units. Specifically to include:*
 - a. *Programming the radio switches, scan list, phone list, etc.*
 - b. *Service programming the transmitter and receiver parameters and alignment*
 - c. *Upgrading new software versions of the radio operating system.*
 - d. *Cloning radios for duplicate programming of several radios*
31. *The system shall have an automated method of assigning radio identification (ID) numbers to consoles, control stations, and mobile and portable subscribers in ascending order as part of the system management network system database.*
32. *The system design shall not preclude full duplex operation as a Standard Option.*

Project 25 STATEMENT OF REQUIREMENTS

33. The system shall provide basic service communications capability despite failures such as communication/data link failures, local controller failures, or failures of base radios, until only one base radio is functioning, as a Standard Option.

34. *Fixed station and subscribers equipment transmitters and receivers shall be capable of being programmed to operate over the entire range of one or more land mobile radio service (LMRS) frequency bands. Operational performance is desired to be without degradation over the band.*

LMRS Frequency Bands

138 - 174 MHz

406 - 512 MHz

764 - 869 MHz

*35. *TDMA transmitter and receiver frequency synthesizers shall permit a minimum programmable carrier frequency increment of 3.125 kHz for aggregation of 6.25 kHz channel spacings, or 3.75 kHz for aggregation of 7.5 kHz channel spacings, as appropriate to the FCC/NTIA channel plan for a particular LMRS band or band segment.*

*36. *Fixed station and subscriber equipment shall be capable of operating in a TDMA access method, where the minimum number of communication time slots is either two (2) for a 12.5 kHz bandwidth channel, or four (4) for a 25 kHz bandwidth channel.*

*37. *For interoperability purposes, TDMA subscriber equipment shall be capable of operating in a conventional 12.5 kHz analog mode as a standard option and in a conventional 25 kHz analog mode where permitted by FCC/NTIA rules as a standard option. This is not intended to restrict any other modes of operation.*

*38. *For interoperability purposes, TDMA subscriber equipment shall be capable of operating in a conventional digital mode which shall be fully compliant with the project 25 Phase I (12.5kHz FDMA) Common Air Interface. This is not intended to restrict any other modes of operation.*

*39. *As a standard option, fixed station equipment shall be capable of operating in a duplex time slot mode on a single carrier frequency.*

Project 25 STATEMENT OF REQUIREMENTS

- *40. *Subscriber equipment shall be capable of at least the following modes of subscriber to subscriber communication - direct rather than through the TDMA fixed station infrastructure. A standard method shall be established to provide master timing and appropriate status. Each such operation shall allow a form of "talk group" identification that can permit inclusion/exclusion of subscriber units.*
- a. *Subscriber to subscriber or multiple subscribers, direct mode, independent of the TDMA infrastructure.*
 - b. *Subscriber to subscriber or multiple subscribers, where one subscriber operates in a time slot vehicular repeater mode so that a relatively wider coverage area may be obtained, independent of the TDMA infrastructure.*
- *41. *Subscriber equipment shall be capable of subscriber to subscriber or multiple subscribers, where one subscriber operates in a time slot vehicular repeater mode, linked to the TDMA infrastructure, so that infrastructure system coverage can be extended. The vehicular repeating subscriber shall be synchronized to the TDMA infrastructure system timing and serves as the master to the subscriber unit(s) communicating through it. Each such operation shall allow a form of "talk group" identification that can permit inclusion/exclusion of subscriber units.*
- *42. *Digital data shall be transmitted in either packet mode or circuit mode with a spectral efficiency of at least 1.536 bits per Hz **gross transmission rate**. Transmission of digital data may use dynamic allocation of channel bandwidth, up to the maximum possible for a particular channel width. Digital packet data may be statistically multiplexed over the available time slots of a radio channel. Appropriate status indication shall be established to identify the mode of digital data being transmitted.*

C. Detailed Requirements List

In order to meet the above stated general requirements list, it is felt that a detailed list of requirements is needed that defines the necessary system characteristics and services. The general rule for these detailed requirements is that they stem from one or more of the general requirements. To support this, the following requirements are recommended.

1. System Requirements

- a. The system shall support existing 25 kHz and 12.5 kHz channelization where already established. Within 25 kHz channelization and where permitted, the system shall support operation on 2-for-1 12.5 kHz channelization. All protocols and procedures shall be adaptable to further channel splits as technology permits.

Project 25 STATEMENT OF REQUIREMENTS

- b. Systems or subsystems shall be configured in single site, multiple site non-simulcast, or multiple site simulcast. Multiple RF subsystems shall be combinable into larger wide-area systems. Wide-area systems shall be composed of individual RF subsystems which are independently capable of single site, multiple site, or multiple site simulcast. Any individual site need only deploy as many stations as necessary except in RF simulcast subsystems.
- c. Systems shall support authorized roamers from compatible digital systems for interagency assistance.
- d. All calls shall be digital except compatible analog voice calls.
- e. The site (or simulcast RF subsystem) location of all subscriber units, including authorized roamers, shall be maintained by the system.
- f. Calls shall not require resources at sites that do not contain addressed subscriber units (except simulcast RF subsystems).
- g. RF subsystems shall contain all the control intelligence to support call processing and track unit location and roamers within the RF subsystem. All RF subsystems shall support standard signaling and communications interfaces to be flexibly linked into wider-area networks via private or public networks.
- h. RF subsystems from any manufacturer (as described in C. I.g.) must be interconnectable into a wide-area system.
- i. Signaling format(s) must be compatible with standard transmission facilities in accordance with the North American transmission standards as defined by Bellcore TR-TSY-000333 for Switched and Special Access
- j. A Project 25 radio shall have the capability to digitally store functional characteristics, including, but not limited to, channel frequencies, minimum volume settings, and channel scanning patterns. The stored functional characteristics must be issued from an authorized field programming device.

Project 25 STATEMENT OF REQUIREMENTS

- k. *Phase I equipment², irrespective of the manufacturer, must have at least the capability to operate both as analog (11K0F3E and 20K0F3E/16K0F3E where permitted by FCC/NTIA rules)³, employing standard signaling (TIA-603), and the standardized digital mode defined in the TSB/IS 102 series. For example, trunking and encryption for current systems are not standardized and are not included in this minimum Phase I definition. However, manufacturers who presently provide analog or digital equipment with non-standard or proprietary capability must provide Phase I equipment which will operate in the analog mode and, as a standard option, in their own proprietary mode on a functional channel basis.*

Phase II equipment intended to replace Phase I equipment must have the capability to operate in both Phase I and Phase II modes on a functional channel basis. Analog capability (e.g., 11K0F3E and 20K0F3E/16K0F3E where permitted by FCC/NTIA rules)³ and proprietary modes for Phase II equipment shall be a Standard Option.

Phase II equipment intended to replace analog must have the capability to operate in both Phase I and Phase II modes on a functional channel basis. Analog capability (e.g., 11K0F3E and 20K0F3E/16K0F3E where permitted by FCC/NTIA rules)³ and proprietary modes for Phase II equipment shall be a standard

²As a Standard Option, that a fixed station be capable of dual mode operation (not simultaneously) for analog (Phase O) and digital (Phase I). This dual mode operation is required for all subscriber equipment and as a standard option for fixed equipment.

³16K0F3E is often licensed by the FCC as 20K0F3E.

option.

- l. Where it is operationally feasible, full duplex telephone interconnect operation may be supported between subscriber equipment and the RF Subsystem, as a Standard Option.

Project 25 STATEMENT OF REQUIREMENTS

- m. The fixed network equipment, as a Standard Option, may support functions of inquire and validation of radio unit ESN.
- n. Protected trunking control via encryption is to be a standard Option.

2. RF Subsystem Interfaces

- a. An RF subsystem shall support either analog or ISDN standard fixed-network PSTN interfaces for telephone interconnect.
- b. An RF subsystem shall support a fixed-network host computer interface or an X.25, SNA, or TCP/IP network interface.
- c. An RF subsystem shall support standard network management interfaces to other RF subsystems of any manufacturer.
- d. An RF subsystem shall support standard service signaling and bearer channel interface for interconnection with other RF subsystems by a public or private wide-area network. The standard service set between RF subsystems shall be composed of the following.
 1. group calls setup
 2. private calls setup
 3. voice encryption control
 4. RF subsystem registration (roaming)
 5. analog bearer channel
 6. digital bearer channel
 7. access control and security

3. Common Air Interface Requirements

- a. One channel bit-rate, modulation, and link layer shall be utilized for all voice and data capabilities, excepted only for manufacturer-specific subsystems to provide backwards compatibility to existing manufacturer-specific systems.

1. For Phase II, the above paragraph is modified to read: One channel bit-rate, modulation, and link layer shall be utilized for all voice and data Capabilities, with backward compatibility as described in Section C.1.k.

- b. For single channel operation, control, voice, or data, features must be integrated into a common channel.
- c. A standard service set for all manufacturers composed of the following.

Project 25 STATEMENT OF REQUIREMENTS

- 1. group calls
- 2. private calls
- 3. interconnect calls
- 4. voice encryption control
- 5. data messages
- 6. site registration
- 7. RF subsystem registration (roaming)
- 8. dynamic subscriber unit talk-group regrouping
- 9. emergency alarm
- 10. User ID

4. *Open Console Interface Requirements*

A console is defined as a subsystem comprised of one or more elements from a single manufacturer that is the device(s) which allows a person(s) to effectively and efficiently use and control the capabilities and the functions of the radio system(s) to which it is attached. Specific console functions are described in Appendix A.

- a. *The Console Interface shall consist of one or more multiple access ports for connectivity between the RF Subsystem and one or more Console Subsystems. The Console Interface must support the Console Subsystem's capabilities to connect to one or more RF Subsystems*
- b. *The Console Interface shall support vocoded and encrypted audio.*

Encrypted audio shall be exchanged between the Console and RF Subsystems with no intermediate decryption and reencryption. This includes both single source and voted digital signal.
- c. *Data will go through the Ed interface (Data Host to RFSS) and not through the Console Subsystem to RFSS interface.*
- d. *The Console Interface is applicable to functions of telephone patching which can pass through the Console Subsystem to the RFSS.*
- e. *PSTN 9-1-1 signals are not to come through the Et (PSTN to RFSS)*

interface.

f. The Console Interface shall support the following:

1. Voter status and Control functions

a. Receive

b. Voted

Page 13

P25.920819.1.19

Project 25 STATEMENT OF REQUIREMENTS

c. Fail

d. Disable

e. Forced (Select)

2. Transmitter status and Control functions

a. Select

b. Failure

c. Frequency

g. The console shall accept synchronization from the network or RFSS where synchronization is required, as a standard option.

h. The console shall be capable of transmit, receive, and control of: analog, Phase I digital, and Phase II digital circuits, as a standard option.

*i. **Support audible signaling to and from subscriber units for functions as described in Appendix C.***

5. Mobile/Portable Subscriber unit Requirements

a. The existence of an ESN (Electronic Serial Number) in a radio (subscriber unit) is to be mandatory. The validation response to an ESN inquiry is to be mandatory.

b. Support all digital communications within this system.

c. Support analog communications within this system when involved in a call from an analog unit.

d. Support analog communications on a conventional channel.

e. Support a data port to an attached MDT (mobile data terminal), portable computer or other peripheral device.

- f. *Support a 12.5 kHz analog (11K0F3E) mode and a 25 kHz analog (20K03FE/16K0F3E mode where permitted by FCC/NTIA rules) for Phase I equipment. As a standard option, support a 12.5kHz analog (11K0F3E) mode and a 25kHz analog (20K0F3E/16K0F3E mode where permitted by FCC/NTIA rules) for Phase II equipment.*
- g. *Support a multi-point data port to multiple external peripherals.*

Project 25 STATEMENT OF REQUIREMENTS

- h. *Support an optional Subscriber Unit Transmitter Inhibit Mode. This is an optional mode on portable and mobile equipment which when selected by the user would inhibit the transmitter under all conditions until the mode was deselected by the user. While in the transmitter inhibited mode, the receiver would still be capable of receive operation.*
- ~~i. *Support an Optional Emergency Talkgroup Channel Marker mode. This feature would allow a trunked radio user to activate the emergency alarm and have all of the receiving radios on that talkgroup hear an audible "beep" or "tone" indicating the emergency alarm or cell. The audible indicator would periodically sound for the duration of the emergency. The audible indicator would cease when the initiating user of the emergency cleared the emergency status.*~~
- i. *Support audible signaling to and from subscriber units for functions as described in Appendix C.***
- j. *To adopt 4 rows by 3 columns matrix as the minimum key pad configuration with the first level and shifted functions to be software programmable and assignable. Label Configuration to conform to the North American telephone key pad standard numerical and symbol layout, as a Standard Option.*
- k. *As a standard option, mobile radio equipment shall include an interface to allow connection of an external audio and push-to-talk system. Audio appearing at this interface will be unencrypted.*
- l. *Provide as a standard option, a vehicular repeater capability as described in Appendix B.***

D. Standards Suite Proposed

In order to meet the stated objectives and requirements, it is felt that a comprehensive suite of standards is necessary that defines the interface characteristics and permits the interconnection of all system components. The necessary standards components are as follows.

1. Adopt 12.5 kHz bandwidth channels with future migration to 6.25 kHz bandwidth channels as technology allows. *Adopt 6.25 kHz bandwidth channels or equivalent.*
2. Interfaces

Project 25 STATEMENT OF REQUIREMENTS

- a. Establish a Common Air Interface all-digital trunking control standard, voice and data standard, and a control standard.
- b. Adopt an RF subsystem Interface Standard for the connections between all RF subsystems from international, national or industry standards as appropriate and available. Such standards sources as CCITT shall be consulted, among others.
- c. *Establish Open Console Interface(s) that support the functions identified in Appendix A, as applicable.*
- d. *Establish an Open Base Station/Repeater Interface*
- ~~e. *Establish a Vehicular Repeater Interface*~~
- f. e. *Establish an open Low Speed Data Interface as defined by the Common Air Interface.*

3. Host Interface Standard

The mobile data terminal (MDT) interface must be able to present an addressable MDT data stream to a host-attached port, physically over either an RS-232 or V.35 electrical interface, using either analog or digital transmission public switched telephone network (PSTN) facilities, or a computer network. When connected to a computer network, each MDT must be individually provided with its own network address, with such network presentation conforming to layers 1 through 3 of the OSI model according to the following specifications.

- a. 1984 CCITT Recommendation X.25. The physical layer must be capable of conforming with EIA RS-232-C for data rates under 19.2 kbps and CCITT V.35 for data rates above 19.2 kbps. The link layer must be compliant with High-level Data Link Control (HDLC) Link Access Procedure Balanced (LAPB).
 - b. IBM System Network Architecture (SNA) using Physical Unit (PU) 2 to PU 4 with Logical Unit (LU) 2 and LU 3. The physical layer is as specified in item D.1., above. The link layer must be compliant with Synchronous Data-Link Control (SDLC).
4. Encryption Standard
- a. Adopt FIPS 46-2 DES (Data Encryption Standard) and *FIPS 140-1* to ensure vendor competition and interoperability.

Page 16 P25.920819.1.19

Project 25 STATEMENT OF REQUIREMENTS

- b. *Adopt for Type-1 Encryption:*
 - 1. *The Type 1 encryption and key management standards for Phase I and II shall be as specified in NSA Specifications ON618551 and ON618536.**
*[*Qualified users, vendors, and others requiring the cited specifications may contact the National Security Agency, Attn: Secure Wired/Wireless Technologies Division, STE 6733, 9800 Savage Rd., Ft. George G. Meade, MD, 20755-6733.]*
 - 2. *The Type 1 encryption standard for backward compatibility with existing wideband analog systems shall be as specified in Federal Standard 1023.*

*APPENDIX A
CONSOLE FUNCTIONS*

1. *User Interface(s)*
 - (a) *Telephone Answerer/ Dispatcher*
 - (b) *Supervisor*
 - (c) *Other*
2. *911 Interface*
3. *Minimally, the console shall be capable of controlling the most basic conventional station. As standard options, the console shall provide control of advanced system capabilities, including conventional, trunking, simulcast, receiver comparators (voting), encryption, etc.*
4. Project 25 consoles at a minimum shall provide a standardized display of Unit I.D., status, and alias information, as a standard option.
5. *Project 25 consoles shall **support subscriber unit signaling as described in Appendix C.** ~~reproduce standard in channel marker~~*

~~and supervisory tones as identified in _____
irrespective of manufacturer of the subscriber units or
the manufacturer of the RFSS to which the console is attached,
as a standard option.~~

6. *For assurance of user access to a single clock source for event time stamping, the console shall interface to one of the following time synchronization code formats, as a standard option. This code will be furnished by a master clock system which is not necessarily a part of the console. Acceptable formats are:*
 - a. *ASCII time code via an RS-232 serial interface*
 - b. *Inter Range Instrumentation Group (IRIG) type B.*
 - c. *IRIG type E.*
7. *The console shall indicate channel status in a standard way irrespective of manufacturer of the RFSS, as a standard option.*
8. *The console shall have system manager configurable logging recorder ports which allow recording of each record designated talk group. These ports may also be used to distribute monitor system audio free of all in band audible signaling, as a standard option.*

Page 18

P25.920819.1.19

APPENDIX A

CONSOLE FUNCTIONS (CONT'D)

9. *The console shall have an instant recall recorder port which allows balanced record of selected transmit and receive audio, and telephone line audio when interfaced through the console, as a standard option.*
10. *The console shall possess a means of making private and group calls, as a standard option.*
11. *The console shall allow duplication of memory elements so that software changes may be made to the console system off-line. Software updates are to be installed using generic language and inserted electronically rather than manually through chip replacements, as a standard option.*
12. *The console shall allow display of standardized status of voting system elements, as a standard option.*

APPENDIX B

Statement of Requirements for Project 25 Digital Vehicular Repeater Systems.

1. *Vehicular repeater system requirements shall be met in frequency division (FDMA) or time division (TDMA) channel access methods, according to infrastructure system requirements.*
2. *The vehicular repeater link channel shall provide two-way, full duplex operation to permit system control and handshake and to permit multiple associated subscriber units to operate on the same single link channel. A FDMA or two-slot TDMA vehicular repeater link will require two frequencies, one for each direction of communication. A four-slot TDMA vehicular repeater link will require a single frequency and employ alternate time slots, one for each direction of communication.*
3. *TDMA direct mode operation shall support at least the following three modes:*
 - a.) *unit-to-unit direct,*
 - b.) *unit-to-unit repeated, and*

c.) unit-to-unit repeated and linked to the infrastructure.

4. Repeater link channel operation is desired in the same frequency band as the infrastructure channels, so that subscriber units can be used either direct to the infrastructure or through the vehicular repeater. A single antenna and a duplexer that incorporates appropriate filtering is desired for the vehicular repeater control link, with a separate antenna for the system mobile.
5. Where a vehicular repeater system has multiple link channels available, the link channel to be used by a particular repeater may be selected manually or, as a standard option, may be selected automatically. Means shall be provided to “mark” an active repeater link channel as “in-use” on a first come, first served basis, so that other repeater units, within radio signal range, will not select that same channel.
6. The vehicular repeater unit shall provide the ability for a subscriber unit (typically a portable hand held unit) to operate with full feature capability in order to achieve extended signal coverage from/to the infrastructure or from/to other subscriber units. It shall be possible to repeat scanned channels of the system mobile receiver subject to personality programming.
7. The vehicular repeater unit may be a vehicle mounted mobile system or it could be a totally self-contained portable system. As a vehicle mounted mobile system, it is desired that it be an integrated vehicular repeater/mobile radio package.
8. The vehicular repeater unit shall be controlled by appropriate control words transmitted by the controlling subscriber unit. Such control words may include Network Access Codes, and source and destination IDs. System control functions may be operated manually from within the vehicle.

9. A single subscriber unit shall be able to operate exclusively through its companion vehicular repeater unit (“repeat unit”) and be able to remotely control the mobile operating channel in a conventional infrastructure, or the mobile system and talk group in a trunking infrastructure. Within the limitations of system implementation, all other subscriber unit functions shall operate transparently through the vehicular repeater system. Using digital signaling with handshaking for a positive acknowledgement, control functions shall be communicated over the link channel.
10. One or more portable radio units shall be able to operate through a single vehicular repeater unit. Subscriber unit access may be permitted by the use of Network Access Codes, including the receiver NAC \$F7F for multiple subscribers from different groups. Additional subscriber units arriving within range of this single vehicular repeater shall be capable of manually selecting the “in-use” link channel for this repeater (“repeat group”).

11. *As a standard option, **to the vehicular repeater requirement** it shall be possible to pair a vehicular repeater unit and its associated subscriber unit so that only control commands and functions from that subscriber unit are recognized by the associated vehicular repeater control system, except that any unit operating through this vehicular repeater in “repeat group” mode may transmit an emergency status. It shall be possible to pair a subscriber unit and a vehicular repeater in the field without special programming equipment. The command set for this option shall include the capability for the controlling subscriber unit to place the vehicular repeater unit into the “repeat unit” or “repeat group” modes.*
12. *Activation of vehicular repeater mode operation shall be provided by both front panel control and by remote activation (e.g. seat switch, vehicular charger socket insertion switch, etc). Remote activation shall be accomplished by contact closure, voltage sensing or current sensing, and be isolated from vehicle power and ground to permit implementation flexibility.*
13. *Vehicle control systems shall use a single control head, loudspeaker and microphone for all functions of the vehicular repeater/mobile radio system.*
14. *Control systems of portable and vehicular equipment shall provide simple, easy to understand and operate functions. Legends and status displays shall be easy to view in all lighting conditions likely to be encountered in public safety applications. Displays shall provide operational information (e.g. talk group/channel currently being received or selected for scan priority/transmit). When display of control functions is required, the display shall temporarily display necessary information and then after a programmable time delay revert back to normal operational information.*
15. *As an option, a full-function control and display ~~shall~~ **may** be offered in a remote speaker/microphone assembly that can be used with portable radio units, and with mobile units where a concealed installation is required.*

Audible Signals

1. *Because of the inability to faithfully pass audio signaling through vocoders, audible signals must use data messages that cause the receiving unit to generate standardized tone signals. These standardized tone signals correspond to a specific signaling command. Audible signals use data messages in the system to initiate audible signals both in the subscriber units and also in the consoles.*
2. *It is a mandatory requirement that users shall be able to select no audible signaling, or any or all of the default types of signaling described below. As a standard option, users may require alternative signals which are subject to*

personality programming in the subscriber unit and/or in the console.

3. *Audible signals may be operational or system in nature.*

Operational Signals (Default)

4. *The mandatory, default audible signaling shall be limited to four standardized signals:*

A. *Emergency* – *indicates the highest level of a declared emergency.*

1. *The Emergency audible alert shall consist of a complex signal comprised of sequential pulsed 600 Hz and 1800 Hz sinusoidal tone signals.*
2. *The signal volume shall ramp from barely audible to maximum set equipment volume over a nominal two-second period.*
3. *The Emergency alert shall be initiated by the operation of a momentary switch at the subscriber unit **and may also be initiated by a console.** It shall terminate after sending for a nominal two seconds regardless of how long the operator holds the switch.*
4. *Receipt of an Emergency alert at a console shall cause a latch up output for operation of external alarms. The console operator shall be able to release this latch.*
5. *A receiving terminal unit shall continue to emit periodic Emergency signals until any digital control on the radio is operated.*

B. *Acknowledge* – *indicates an operator-designated affirmation of a request. This signal allows acknowledgment of a request without speaking.*

1. *The acknowledge audible alert shall consist of a single, nominal 250 msec pulse of 500 Hz sinusoidal tone signal followed immediately by a single, nominal 250 msec pulse of 1500 Hz sinusoidal tone signal.*
2. *This signal level shall ramp up from barely audible to maximum set equipment volume. The signal shall ramp upward in amplitude in*

a linear fashion across the total signal duration of nominally 500 msec.

3. *Acknowledge is initiated by the subscriber unit.*

C. **Message Alert** – *indicates that attention is needed to the message that follows.*

1. *A 1004 Hz sinusoidal tone pulsed on for 250 msec followed by 250 msec of no tone, followed by another pulse of 1004 Hz sinusoidal tone for 250 msec.*

2. *The console operator shall initiate the Message Alert by initiating a momentary function or switch. The Message Alert tone shall continue in a repeating cycle until the operator releases the momentary function or switch.*

D. **Channel Marker** – *an indication is placed periodically on a talk channel that indicates to new arrivals that the channel is in use. Allows someone coming onto the channel late to know that the channel is in use even when speech is not present. The Channel Marker audible signal shall consist of:*

1. *An 800 Hz sinusoidal signal pulsed signal held on for 250 msec followed by 10 msec of no signal followed by another pulse of 800 Hz sinusoidal signal for 250 msec.*

2. *The Channel Marker signal shall continue to be repeated at system-defined intervals until cancelled by the console operator.*

3. *The console operator shall initiate the Channel Marker*

4. *The Channel Marker signal shall be 10 dB below the volume control voice level.*

5. *In trunked applications, a new arrival on the talkgroup shall be immediately notified of channel priority use by the channel marker function whenever the receiving radio is capable of immediately transmitting on the marked talkgroup.*

Operational Signals (Personality Programmed)

- E. As a standard option, it shall be possible to program the Terminal Device personality to permit selection of the tone signaling patterns and tone frequencies and shall include the choices: "NONE" and "Default".*
- 1. Personality programmed signals shall be presented in a matrix of audible tone signal functions, tone patterns and tone frequencies which will be presented for selection of the terminal device's internally generated audible signals. A terminal device is any subscriber unit – mobile, portable, or control station and any console.*
 - 2. In the case of Emergency Alert, the choices shall include that the initiating terminal unit will either generate or not generate a local indication of the signal being transmitted.*

*audiblesignals.doc
10/14/99*