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APPENDIX A
UNIQUE DEPLOYED (TACTICAL)

A.1 INTRODUCTION

This appendix identifies and develops Tactical interoperability requirements as certification criteria for joint networked-communications systems. In pursuing acquisition initiatives, Combatant Commands (COCOMs), military services, and defense agencies shall use this appendix as a guideline for the purchase of commercial off-the-shelf (COTS) equipment as well as for the development of systems that need to interoperate in tactical network environments. The Tactical networked communications community of the Department of Defense (DoD) shall adhere to this appendix in compliance with DoD Instruction (DoDI) 8100.04.

This appendix defines unique Deployed (Tactical) requirements for Deployed products and systems. Detailed information and guidance on Requirements Categories, Language, specific terminology, principles, and procedures are provided in the Unified Capabilities (UC) Framework 2013 document.

A.1.1 Purpose

This appendix defines the unique requirements for Deployed products and systems. These are requirements that are not contained in other sections of the Unified Capabilities Requirements (UCR), and define requirements that are modified to support unique tactical users.

This appendix consolidates interoperability certification requirements to the maximum extent possible and incorporates them as part of requirements for the overarching Global Information Grid (GIG) in support of network-centric warfare. This appendix provides guidance for satisfying the certification requirements for Deployed voice systems used as part of an Operational Area Network (OAN), which is the deployed extension of the GIG. This appendix also defines other UCR elements applicable to the Deployed community, and serves as a ready reference to be used by the Joint Interoperability Test Command (JITC) when writing the Deployed annex to the UC Test Plan (UTP).

A.1.2 Applicability

The requirements described in this appendix apply to Network Elements (NEs), Local Area Networks (LANs) when used in Deployed (Tactical) environments, Deployed Cellular Voice Exchange (DCVX) Systems, and Session Controllers (SCs).

A.1.3 Definitions

Definitions and acronyms are provided in UC Framework 2013, Appendix C, Definitions, Abbreviations and Acronyms, and References.

A.2 CIRCUIT-SWITCHED-BASED DEPLOYABLE NETWORK DESIGNS AND COMPONENTS

Circuit-switched-based deployable requirements defined by previous editions of the UCR remain in effect during the remaining lifecycle of deployed circuit-switched products.

A.3 DEPLOYED VOICE QUALITY

The desired objective for Deployed voice quality is a Mean Opinion Score (MOS) of 4.0 or greater, but it is realized that the network may operate under less than ideal conditions. UC Framework Appendix A contains additional information on Deployed Voice Quality.

A.4 DEPLOYED NE GENERAL

Section 11, Network Elements, contains the Deployed NE general requirements.

A.5 DCVX SYSTEM

A.5.1 Introduction and Purpose

The following sections describe the requirements that shall be met by all deployed DCVX systems to be certified and used in the OAN tier of the GIG. Requirements are defined at the system level as well as for the various components that make up the cellular system, including protocol requirements. The DCVX is a cellular system with military-unique features (MUFs), and, therefore, is not the same as commercially deployed cellular systems.

It is recognized that not all components are needed for a specific application. The requirements discussed in this appendix are similar to those for a Deployed Voice Exchange-Commercial (DVX-C) and/or SC, and are dependent on the network configuration as well as the specific authorized gateway connection.

A.5.2 Applicability

The requirements within this appendix are applicable to the following:

- All DCVX systems that connect directly or indirectly to the Defense Information Systems Network (DISN) voice systems, including the UC Services Network, Defense Switched Network (DSN), Defense RED Switch Network (DRSN) Secure Phone Gateways, and/or commercial Public Switched Telephone Network (PSTN).

- Procured or leased commercial cellular systems that connect to any DISN service gateway. Commercial cellular services are not currently allowed to be directly connected to DISN service gateways unless the connection is Time Division Multiplexing (TDM) based (e.g., Analog, Primary Rate Interface [PRI], or Integrated Services Digital Network [ISDN]), excluding the use of Signaling System No. 7 (SS7). Future commercial cellular services' Internet protocol (IP)-based connections will be allowed once the Information Assurance policy and Security Technical Implementation Guidelines (STIGs) are established. In both instances, the DISN service gateway may or may not be protected by a separate or built-in encrypted gateway on the commercial cellular services connection. Encrypted gateway requirements are excluded from the DCVX section.
- Procured or leased cellular systems using leased commercial cellular frequencies that connect to any DISN service gateway.

Terminal devices procured and/or leased, whose primary carrier service is owned and operated solely by a commercial carrier service (e.g., Verizon, Sprint) are not considered elements of a DCVX and are exempt from this appendix. The current version of the UCR is the governing requirements document that takes precedence over the explicit or implicit requirements of subsidiary or reference documents, standards, and specifications. In the event of a conflict, the explicit requirements of the UCR take precedence over the explicit or implicit requirements of any other requirements document except for those requirements specified in the documents listed in Section A.5.3, Policy and Reference Documents.

A.5.3 Policy and Reference Documents

The following policy and instruction documents, in conjunction with the current version of the UCR, will be used as the basis for Approved Products List (APL) certification:

1. Policy for the use of commercial wireless devices, services, and technologies in the DoD GIG, as outlined in DoD Directive (DoDD) 8100.2. This directive further promotes joint interoperability using open standards throughout DoD for commercial wireless services, devices, and technological implementations.
2. "Wireless Priority Service (WPS) Industry Requirements for the Full Operating Capability (FOC) for CDMA-Based Systems – Home Location Register (HLR)" or current edition.
3. "Wireless Priority Service (WPS) Industry Requirements for the Full Operating Capability (FOC) for GSM-Based Systems" or current edition.
4. 3G TS 24.067 V3.0.0 (1999-05), 3rd Generation Partnership Project; Technical Specification Group Core Network; enhanced Multilevel Precedence and Preemption (MLPP) (eMLPP) – Stage 3 or current edition.

A.5.4 DCVX General

A.5.4.1 Coverage and Signaling Strength

TAC-000010 [**Required**] The signal strength shall not be less than the current Global System for Mobile (GSM) [Second Generation (2G), Third Generation (3G), Pre-Fourth Generation (4G)], Code Division Multiple Access (CDMA), Mobile Worldwide Interoperability for Microwave Access (WiMAX), and 4G authorized international standards and specifications. The GSM (2G, 3G, Pre-4G), CDMA, Mobile WiMAX, and 4G technology are spectrum based; therefore, GSM (2G, 3G, Pre-4G), CDMA, Mobile WiMAX, and 4G band, coverage, signal strength, and power are the basis for a planned "area of support." Environment, weather, geography, topography, and adjacent spectrums are elements that must be considered when applying the basis for an area of support. For testing purposes, the generic set of parameters presented in Table A.5-1, Current Cellular Systems Parameters, shall be used for JITC certification either by testing and/or as determined by JITC.

Table A.5-1. Current Cellular Systems Parameters

DCVX GSM/GPRS (2G, 3G, PRE-4G)	
Bands	As provided by standards and/or DoD GSM Cellular Band (e.g., 450 MHz, 850MHz, 900MHz, and 1900 MHz)
Specification on Coverage	As provided by standards (e.g., ITU-R 2G. 2.5G, 3G, 3GSM, UMTS, GSM Edge) (www.itu.int/publications)
Distance Transmit/ Receive	Up to 25 miles depending on topology/manmade structures, and frequencies also determine coverage parameters.
DCVX CDMA	
Bands	As provided by standards (e.g., 450 MHz, 700 MHz, 800 MHz, 850 MHz, 900 MHz, 1700 MHz, 1800 MHz, 1900 MHz, and 2100 MHz)
Specification on coverage	As provided by standards (e.g., TIA, IS-95, 3GPP2, IMT-2000, CDMA 1XRTT, CDMA2000) (www.tiaonline.org)
Distance Transmit/ Receive	Up to 32 miles depending on topology/manmade structures and frequencies also determine coverage parameters.
DCVX (4G IMT-ADVANCED)	
Bands	As provided by standards (e.g., GSM: 700 MHz, 850 MHz, 900 MHz, 1700 MHz, 1800 MHz, 1900 MHz, 2100 MHz and 2600 MHz, Mobile WiMAX: 500 MHz to 3.5 GHz)
Specification on Coverage	As provided by standards (e.g., GSM: 4G-Advanced, Mobile WiMAX, 802.16m, Pre-4G: 802.16-2009)
DCVX (4G IMT-ADVANCED)	
Distance Transmit/ Receive	Up to 25 and 30 miles for 4G-Advanced and WiMAX respectively depending on topology/manmade structures and frequencies also determine coverage parameters

TERMINAL DEVICE	
Bands	As provided by standards (CDMA/GSM/4G-Advanced) and/or DoD GSM Cellular (e.g., 450 MHz, 700 MHz, 800 MHz, 850 MHz, 900 MHz, 1700 MHz, 1800 MHz, 1900 MHz, 2100 MHz, and 2600 MHz, Mobile WiMAX, 500 MHz to 3.5 GHz)
CDMA Specification	As provided by standards (e.g., CDMA (IS95), CDMA2000, CDMA 1XRTT and CDMA 1xEVDO)
GSM Specification	As provided by standards (e.g., GSM (GSM 02.07 Tech. Spec.(ver.7.1.0 Rel. 1998), 2.5G, 3G, 3GSM, GSM Edge)
4G Specifications	As provided by standards (e.g., GSM: 4G-Advanced; Mobile WiMAX; 802.16m, Pre-4G: 802.16-2009)
Distance Transmit/ Receive	Up to 8 miles depending on topology/manmade structures and frequencies also determine coverage parameters.

LEGEND

1xEVDO: One Times EVDO	CDMA2000: Code Division Multiple Access 2000	IS-95: Interim Standard 95
1XRTT: One Times Radio Transmission Technology	DCVX: Deployed Cellular Voice Exchange	ITU-R: International Telecommunications Union – Radiocommunication Sector
3G: Third Generation	DMSC: Deployed Mobile Switching Center	MHz: Megahertz
3GPP2: Third Generation Partnership Project 2	DoD: Department of Defense	TIA: Telecommunications Industry Association
3GSM: Third Global System for Mobile	EVDO: Evolution-Data Optimized	WCDMA: Wideband CDMA
4G: Fourth Generation	GPRS: General Packet Radio Service	WiMAX: Worldwide Interoperability for Microwave Access
BSS: Base Station Subsystem	GSM: Global System for Mobile	
CDMA: Code Division Multiple Access	IMT-2000: International Mobile Telecommunications 2000	

A.5.4.2 Protocol/Format

TAC-000020 [**Required**] The DCVX shall support at least one or more of the following protocols:

a. GSM/General Packet Radio Service (GPRS) GPRS [2G, 2.5G, Third Generation (3G), Third Global System for Mobile (3GSM), GSM Edge].

b. Wideband CDMA (WCDMA).

c. CDMA2000.

d. CDMA One Times Radio Transmission Technology (1XRTT).

e. Universal Mobile Telecommunications System (UMTS).

f. Evolution-Data Optimized (EVDO) (or EV-DO).

g. Mobile WiMAX (802.16-2009).

h. Fourth Generation IMT-Advanced.

i. 4G-Advanced.

j. Mobile WiMAX Series (802.16m and beyond).

A.5.4.3 MOS and Measuring Methodology

TAC-000030 [**Required**] The DCVX shall support the minimum MOS scores as defined in Section 6, Network Infrastructure End-to-End Performance, or better as measured in any 5-minute interval using International Telecommunications Union – Telecommunication (ITU-T) Recommendation P.862 testing standard. The baseline test environment shall be operated in an open air, clear of obstruction, line-of-sight environment, with the specific requirements as outlined in Table A.5-1. Based on the results, the estimated MOS performance range will be extrapolated and provided in the vendor Letter of Compliance (LOC) based on the Access Network operating at or near full power mode and, at a minimum, operating at a height of 80 feet. The values provided in the vendor LOC will be included in the APL report.

A.5.4.4 Availability

TAC-000040 [**Required**] The DCVX shall have an availability of 99.97 percent, which includes scheduled maintenance.

A.5.4.5 Encryption

TAC-000050 [**Conditional**] Depending upon which of the following encryption types a terminal device provides to support secure calls: Secure Communications Interoperability Protocol (SCIP), other National Security Agency (NSA)-accredited encryption scheme(s), and/or other required accredited encryption schemes as defined in appropriate cellular STIGs, the DCVX must provide appropriate radio and network transport bandwidth to support the terminal device encryption requirements contained in Section A.5.5.4, Terminal Device Encryption.

TAC-000060 [**Conditional**] If a secure call capability is provided in the terminal device(s), then the DCVX shall support SCIP, other NSA-accredited encryption scheme(s), and/or required accredited encryption schemes as defined in the appropriate cellular STIGs. The DCVX that supports SCIP (also known as terminal device) will be required to go secure E2E with another SCIP Phone and/or via a SCIP Gateway if the Assured Services (AS) Session Initiation Protocol (SIP) (AS-SIP) is used while the DCVX supports the establishment and maintenance of the secure call.

TAC-000070 [**Optional**] The DCVX may have the capability to provide secure SCIP Gateway functions.

A.5.4.6 Calling Features

A.5.4.6.1 Call Waiting Feature Requirement

The Call Waiting (CW) feature interacts with MLPP and Assured Service for TDM and IP, respectively. If a precedence and preemption capability is available in the DCVX, then the preemption interactions must meet the requirements described in Section A.5.4.10.1, Precedence Call Waiting. Call Waiting is a feature where a line in the talking state is alerted by a CW tone when another call is attempting to complete to that line. A CW tone is only audible to the line with the CW feature activated.

TAC-000080 [**Required**] The CW feature shall generate a CW tone only audible to the line with the CW feature activated.

TAC-000090 [**Required**] The Cancel CW feature is required when CW is active. The user must be able to cancel the CW service. Cancel CW is a feature that allows the user with CW service to inhibit the operation of CW for one call. The user dials the Cancel CW code, obtains recall dial tone, and places a call normally. During this call, the CW service shall be inactive so that anyone calling the CW user shall receive the normal busy treatment, and no CW tones shall interrupt the user's call.

A.5.4.6.2 Three-Way Calling Requirement

The Three-Way Calling (TWC) feature interacts with MLPP and Assured Service for TDM and IP, respectively. If a precedence and preemption capability is provided in the DCVX, then the MLPP interactions must meet the requirements described in Section A.5.4.10.2, Precedence Three-Way Calling (TWC).

TAC-000100 [**Optional**] The TWC feature allows a station in the talking state to add a third party to the call without operator assistance. To add a third party to the call, the TWC customer places the other party on hold, receives recall dial tone, dials the third party's telephone number, and then takes the first line off hold to establish the TWC connection. This may occur at any time after the completion of dialing the second number joining the TWC. After the TWC connection has been established, the customer with the service activated may disconnect the last party added. The customer with the service activated may terminate the TWC call by disconnecting. If either of the other two parties hangs up while the service-activating customer remains off-hook, then the TWC is returned to a two-party connection between the remaining parties.

TAC-000110 [**Optional**] The terminal device may support signaling to allow TWC.

A.5.4.6.3 Conference Calling

The Conference Calling feature is Conditional because it interacts with MLPP and Assured Service for TDM and IP, respectively. If precedence and preemption and conference calling capabilities are provided in the DCVX, then the preemption interactions must meet the requirements described in Section A.5.4.10.3, Precedence Conference Calling.

TAC-000120 [**Optional**] The Conference Calling feature allows the user to establish a conference call involving up to six conferees (including the user). This feature is requested via an access code.

TAC-000130 [**Optional**] The terminal device may support signaling to allow conference calling.

A.5.4.7 Roaming

TAC-000140 [**Optional**] The DCVX system may only support roaming to one or more DCVXs. The DCVX roaming numbering capability shall support the following:

a. Tactical Global Block Numbering Plan (GBNP).

b. Tactical Routing and Numbering: The DCVX shall be equipped and operationally capable of the dialing format for User Dialing Format to Coalition Forces as defined in North Atlantic Treaty Organization (NATO) Standardization Agreement (STANAG) 4214, "International Rating and Directory for Tactical Communications Systems," Edition 3, Version T, 7 January 2005, or current edition.

Direct network connections from the DCVX to commercial cellular provider systems in support of terminal device roaming on the commercial cellular provider network(s) are not allowed.

A.5.4.8 Precedence and Preemption

The DCVX may support preemption and precedence under the following conditions:

TAC-000150 [**Optional**] The DCVX may support the cellular version of precedence and preemption, called eMLPP, and/or a proprietary methodology. When precedence and preemption are available, the interface to the DSN/UC Networks and/or the supporting DVX-C shall support one or more of the interfaces.

TAC-000160 [**Conditional**] The DCVX will support a preemption and precedence capability under one or more of the following conditions:

a. The DCVX supports GSM in the DoD GSM cellular band.

b. The DCVX supports the use of leased cellular frequency in one of the bands and protocol(s) listed in Table A.5-1, Current Cellular Systems Parameters.

c. The DCVX supports one or more of the cellular bands and protocol(s), as described in Table A.5-1, Current Cellular Systems Parameters, in an environment that is outside the

continental United States (OCONUS), where the local Forces-Status Agreement allows eMLPP/proprietary version operation.

d. The DCVX supports one or more of the cellular bands and protocol(s), as described in Table A.5-1, Current Cellular Systems Parameters, dependent on the operational environment and usage of cellular frequencies allowed by local and/or U.S. National Civilian Authorities.

A.5.4.9 Precedence Capability Terminal Device Activation/Deactivation

TAC-000170 [**Conditional**] If a precedence and preemption capability is provided in the DCVX, then the DCVX may be capable of providing on any supported terminal device the user's Precedence Class Table Assigned features. These features are provided to the terminal device based on the user entering a specified personal identification number (PIN) on the same terminal device. The DCVX will assign to the terminal device the entire user's precedence capability as defined in the DCVX's class features table(s). This will allow the user to make precedence calls from terminal devices other than the one assigned or provided to the user. Additionally, the precedence features assigned to that active terminal device can be turned off by reentering the same or different PIN on the terminal device. The precedence capability user's activation or deactivation PIN may be stored in the DCVX or in another database accessible by the DCVX to validate the user's PIN(s) associated with the user's precedence capability. The user's precedence activation or deactivation PIN may be assigned and/or user settable after an initial assigned PIN has been provided.

A.5.4.10 Precedence and Preemption Calling Features

TAC-000180 [**Conditional**] If a precedence and preemption capability is provided in the DCVX, then the following applies under the following calling features:

a. If no active call is in progress, then the terminal device will receive precedence notification per Section 2, Table 2.9-1, UC Ringing Tones and Cadences.

b. If a ROUTINE or lower precedence call is in progress to the terminal device, and a calling party calls at a higher precedence level, then the current call will be preempted.

   If a precedence call has been connected to the terminal device and is in progress, then the calling party of equal or lower precedence will receive a notification that the lower precedence call was rejected. The following provides the precedence interactions for calls in progress to terminal devices.

A.5.4.10.1 Precedence Call Waiting

TAC-000190 [**Conditional**] The following Precedence CW treatments shall apply to precedence levels of PRIORITY and above if the precedence and preemption capability is provided in the DCVX.

A.5.4.10.1.1 Busy With Higher Precedence Call

TAC-000200 [**Required**] If the precedence level of the incoming call is lower than the existing precedence call, then precedence CW shall be invoked. In an active call, if the incoming call is PRIORITY precedence or above, the precedence CW tone shall be applied to the called party per AS-SIP 2013, Section 6, Table 6.1-4, UC Information Signals.

A.5.4.10.1.2 Busy With Equal Precedence Call

TAC-000210 [**Required**] The DCVX shall provide the precedence CW signal to the called station per AS-SIP 2013, Section 6, Table 6.1-4, UC Information Signals. The DCVX shall apply this signal regardless of other programmed features, such as call forwarding on busy or caller ID. The called station shall be able to place the current active call on hold, or disconnect the current active call and answer the incoming call.

A.5.4.10.1.3 Busy With Lower Precedence Call

TAC-000220 [**Required**] The DCVX shall preempt the active call. The active busy station shall receive continuous preemption tone until an on-hook signal is received and the other party shall receive preemption tone for a minimum of 3 seconds. After the current call is terminated and the terminal device is idle, the station to which the precedence call is directed shall be provided precedence notification ring per Section 2, Table 2.9-1, UC Ringing Tones and Cadences, or comparable vibration cadence. The station shall be connected to the preempting call after going off-hook.

A.5.4.10.1.4 No Answer

TAC-000230 [**Required**] If, after receiving the precedence CW signal, the busy called station does not answer the incoming DSN call within the maximum programmed time interval, the switch shall treat the call IAW Section 2.2.10, Precedence Call Diversion.

A.5.4.10.2 Precedence Three-Way Calling (TWC)

TAC-000240 [**Conditional**] If precedence and preemption and TWC are provided in the DCVX, then the following TWC requirements apply:

> **TAC-000240.a** [**Required**] In TWC, each call shall have its own precedence level. When a TWC is established, each connection shall maintain its assigned precedence level. Each connection of a call resulting from a split operation shall maintain the precedence level that it was assigned upon being added to the TWC.
>
> **TAC-000240.b** [**Required**] The DCVX shall class mark the originator of the TWC at the highest precedence level of the two segments of the call. Incoming calls to lines participating in the TWC that have a higher precedence than the higher of the two segments shall preempt unless the call is marked non-preemptable.

TAC-000240.c [**Required**] When a higher precedence call is placed to any one of the TWC participants, that participant receives the preemption tone per AS-SIP 2013, Section 6, Table 6.1-4, UC Information Signals. The other two parties shall receive a conference disconnect tone. This tone indicates to the other parties that one of the other TWC participants is being preempted.

TAC-000240.d [**Required**] In a TWC call where each connection is established at a different precedence level, the precedence level of the participant who initiated the TWC call shall be assigned the highest precedence of the two connections.

A.5.4.10.3 Precedence Conference Calling

TAC-000250 [**Conditional**] If precedence and preemption and conference calling are provided in the DCVX, then the following precedence conference calling requirement is required:

TAC-000250.a [**Required**] All addresses shall be processed at a precedence level equal to that precedence level dialed by the conference originator.

(1) If all conference bridges are busy, then ROUTINE precedence conference call attempts shall be connected to a "line busy" tone, and call attempts at precedence levels above the ROUTINE precedence shall re-examine all conference bridges on a preemptive basis.

(2) A conference bridge that is busy at the lowest level of precedence stored for all units shall be preempted for a higher precedence conference call.

(3) When a conference bridge is preempted, a 2-second burst of preemption tone per AS-SIP 2013, Section 6, Table 6.1-4, UC Information Signals, shall be provided to the conferees on the existing conference. The existing connections to the bridge shall be dropped, and the bridge shall send an on-hook signal automatically to the associated switch ports to permit the new connections to be established.

(4) Where the requesting precedence level is equal to or lower than the existing conference, the connection shall be denied, and the caller shall be provided a Blocked Precedence Announcement (BPA) per Section 2.9.1.2.2, Announcements.

A.5.4.10.4 Voice Mail

The Voice Mail feature interacts with precedence and preemption. If precedence and preemption capability and voice mail are provided in the DCVX or voice mail added externally, then the precedence and preemption interactions must meet the requirements described in Section 2.25.2.3, Precedence Call Diversion.

TAC-000260 [**Optional**] The DCVX may provide ROUTINE calls only voice mail capability for users. Additional features, such as message forwarding, may be provided in addition to a

basic voice mail capability provided they do not interfere with precedence and preemption if the capability is provided in the switch.

A.5.4.10.4.1 Precedence and Preemption Interaction With Voice Mail

TAC-000270 [**Conditional**] If precedence and preemption are provided in the DCVX and voice mail capability is provided internally to the DCVX or connected externally to the DCVX as an adjunct, then the following requirement applies:

> **TAC-000270.a** [**Required**] The DCVX shall divert all precedence calls above ROUTINE that are destined for voice mail IAW Section 2.25.2.3, Precedence Call Diversion.

A.5.4.11 Management Capabilities for Terminal Devices

TAC-000280 [**Required**] The DCVX shall have the capability to manage its supported terminal devices as published in its users' database [e.g., HLR or Mobility Management Entity (MME)] so it can assign, transfer, or terminate services, features, and calling capability to include telephone numbers for its terminal devices.

A.5.4.12 Security

TAC-000290 [**Required**] All components of the DCVX shall meet security requirements as outlined in DoDI 8510.01 and the applicable STIG(s).

A.5.5 Terminal Device-Specific

Cellular handsets, often referred to as mobile subscribers, handsets, PDAs, Smartphones, BlackBerrys, and any other end user cellular devices, commercial- or Government-developed, are herein referred to as terminal devices. The terminal device is the interface between the user and the cell network. The terminal device can be a handheld unit, a mounted mobile device, or a fixed location device.

A.5.5.1 Terminal Device

TAC-000300 [**Required**] The terminal device shall provide the following status information to the network:

a. Powered on.

b. Moved to a new location.

c. Alerting.

d. Dialing.

TAC-000310 [**Required**] The terminal device shall display the following status information to the end user:

a. Signal strength.

b. Battery capacity.

c. Roaming status.

d. Service not available.

e. Call progress status.

TAC-000320 [**Required**] If no STIG exists for the terminal device, then the terminal device shall have the ability to provide key-locking ability to lock the terminal device's keypad and unlock the keypad after providing the appropriate key sequence or PIN entries as provided by the vendor in the terminal device. The lock and unlock key sequence or PIN shall be set by the user. If the user PIN is unavailable or not supplied, then an administrator method, which can be vendor proprietary, shall unlock the terminal device.

TAC-000330 [**Optional**] The terminal device may have the capability to support WPS on commercial networks and/or DoD networks where provided when not connected to and functioning on a DoD precedence and preemption network.

TAC-000340 [**Conditional**] Removable and Exchangeable Subscriber Identity Module (SIM): If a SIM card is utilized, then the SIM card in commercially available terminal devices shall be removable and exchangeable into other similar commercially available terminal devices that are compatible with the DCVX system (applicable to a GSM-based system). This excludes secure terminal devices and other terminal devices not readily commercially available.

A.5.5.2 Terminal Device Signaling

TAC-000350 [**Required**] The terminal device shall provide information to allow the DCVX to identify the terminal device when the terminal device is powered up, successfully registered, and in active call status.

A.5.5.3 Terminal Device Frequency Band Support

A terminal device that supports more than one frequency band has a high connection and reliability capacity.

TAC-000360 [**Optional**] A terminal device may support multiple (e.g., five) frequency bands as specified in Table A.5-1, Current Cellular Systems Parameters, for each protocol supported in Section A.5.4.2, Protocol/Format.

TAC-000370 [**Optional**] The terminal device may also support roaming and interconnecting with commercial cellular networks when operating outside the transmission range of the home

based DCVX and other supporting DCVXs interconnected in support of roaming within the Tactical OAN.

A.5.5.4 Terminal Device Encryption

TAC-000380 [**Conditional**] If SCIP and/or other NSA-accredited encryption are implemented in the terminal device, then the SCIP and/or other NSA-accredited encryption-capable terminal device shall have the capability to go secure to provide E2E encryption to another secure cellular-capable terminal device, and via the DCVX, to a non-cellular NSA encryption-capable device per the requirements specified in Section 3.8, DoD Secure Communications Devices (DSCD). The SCIP and/or other NSA-accredited encryption device shall provide E2E encryption within the DCVX, from DCVX to DCVX (roaming) and from DCVX to external networks such as DSN, UC Network, and/or PSTN.

TAC-000390 [**Optional**] The terminal device may support other non-NSA encryption schemas, such as Advanced Encryption Standard (AES) encryption as used by the Government Emergency Telecommunications Service (GETS) system.

A.5.5.5 Device Battery

TAC-000400 [**Required**] The commercially available nonsecure terminal device that is readily available must have a battery that shall provide as a minimum 6 days standby time in total and 3 hours nonsecure talk time in total but not both requirements sequentially on the same battery charge. The NSA encryption secure terminal devices (e.g., PDA Secure Mobile Environment Portable Electronic Device [SME PED]) must provide their specified battery and secure or nonsecure talk time. All other terminal devices must provide their specified battery and nonsecure talk time and/or secure talk time, if applicable.

TAC-000410 [**Required**] The terminal device shall have the capability, when the primary battery is removed or drained, to retain primary network and user settings on the device before another primary battery is installed or recharged. This is required to ensure the terminal device is able to reconnect to the DCVX upon power-up.

A.5.5.6 Terminal Device Secure Call Handling

TAC-000420 [**Conditional**] If the terminal device supports SCIP or other NSA-accredited encryption scheme(s), then the terminal device and/or DCVX system will provide classified secure call handling features, as defined in Section 11.3.8, Secure Call Handling, if conversion is made from TDM to IP Network boundaries.

A.5.5.7 Terminal Device Display and Alerting Features

The terminal device shall have the following display and alerting features:

TAC-000430 [**Required**] Power-On Status. When the terminal device is powered on, the display shall indicate:

a. Signal strength.

b. Remaining battery capacity.

c. Active call status.

d. Registration results (either success or failure).

TAC-000440 [**Required**] ROUTINE Call Alerting. The idle, registered terminal device shall provide or be provided with an auditory and/or visual display alert for incoming ROUTINE calls.

TAC-000450 [**Optional**] Precedence Call Alerting. The DCVX may be required to meet the eMLPP functionalities specified in Section A.5.4.8, Precedence and Preemption. The eMLPP references or uses a proprietary methodology. If precedence and preemption capability is provided, then, upon receiving a precedence call, the idle, registered terminal device will provide or be provided with a precedence alert and/or tone notification. Whether using eMLPP or a proprietary version, the terminal device shall issue the same alerting tone(s) for precedence calls IAW eMLPP requirements. Upon notification, the user will have the capability to select or reject the call of higher precedence.

A.5.6 Access Network-Specific

Specific Access Network capability is as follows.

A.5.6.1 Signaling

TAC-000460 [**Required**] The Access Network will determine which channel to use for call setup IAW the appropriate supported protocols listed in Section A.5.4.2, Protocol/Format, as outlined in Table A.5-1, Current Cellular Systems Parameters.

A.5.6.2 Strength

TAC-000470 [**Required**] The Access Network will monitor the terminal device for signal strength and transfer the terminal device to the stronger cell when necessary IAW the appropriate supported protocols listed in Section A.5.4.2, Protocol/Format.

A.5.6.3 Protocol/Format

TAC-000480 [**Required**] The Access Network shall support one or more of the protocols listed in the DCVX general requirements, in Section A.5.4.2, Protocol/Format, and as outlined in Table A.5-1, Current Cellular Systems Parameters.

A.5.6.4 Coverage

TAC-000490 [**Required**] The Access Network will assign the strongest cell to the terminal device per the standards. The coverage area this system will provide shall be IAW the GSM (2G, 3G, Pre-4G), CDMA, Mobile WiMAX and/or 4G standards and specifications IAW Table A.5-1, Current Cellular Systems Parameters, and in Section A.5.4.2, Protocol/Format. Actual coverage will depend on topology and/or manmade structures and frequencies.

A.5.6.5 Preemption

TAC-000500 [**Conditional**] If precedence and preemption capability is provided in the DCVX, then, in the event of a preemption for reuse, the Access Network and/or Core Network must disable the old call and maintain the current channel assignment to the terminal device in order to allow the set up of the new call. In the event where there are no idle channels available and preemption for reuse does not occur, then when a precedence call is received, the DCVX will find the lowest precedence channel and preempt that channel to allow for the higher-level precedence call to be completed.

A.5.7 Core Network-Specific

Because of the differences between the various cellular generations (2G, 3G, Pre-4G, 4G), it is not feasible to identify specific component requirements. Thus, this appendix refers to Core Network functionality instead. Additionally, the HLR functionality is not required to be a local component part of the Core Network, but it will be necessary for the Core Network to access a home location register at some location to determine the attributes of its supported terminal device. Whether the home location registry functionality is local with the Core Network or it is remotely queried, the home location registry functionality is a component of the DCVX under test.

A.5.7.1 Visitor Location Register Functionality

TAC-000510 [**Required**] The Core Network shall maintain a Visitor Location Register Functionality to allow service to any authorized active terminal device within its domain per in Section A.5.4.2, Protocol/Format. Visitor Location Register (VLR) functionality may be updated by the DCVX resident HLR functionality, a shared HLR functionality with another DCVX, and/or via roaming between DCVXs.

A.5.7.2 Home Location Register Functionality

TAC-000520 [**Required**] The Core Network shall connect to an HLR functionality to determine the attributes of the terminal device currently being served by the DCVX. The HLR Functionality can be co-located with the Core Network or accessed remotely. Access to the remote HLR Functionality may be by one or more of the following connection types:

a. ISDN PRI (T1/E1).

b. MLPP ISDN PRI (T1/E1).

c. IP AS-SIP (signaling and associated bearer channel).

d. Signaling Transport (SIGTRAN) (CCS7 over IP).

e. 2G, 3G, and/or 4G Standards interconnection protocols transported across DoD Networks.

TAC-000530 [**Required**] HLR Storage. The HLR Functionality must store and support information on each terminal device registered to the network that the HLR Functionality serves.

TAC-000540 [**Required**] HLR Change and Propagation. The HLR Functionality must support changes to the terminal device information. Once the HLR receives the supported change information, the HLR, whether local or remote from the Core Network, has 3 minutes to propagate the change information to the VLR Functionality. If the DCVX supports roaming, then the HLR change must also propagate to the querying VLRs.

TAC-000550 [**Conditional**] Intra-DCVX Queries. If a roaming capability is supported in the DCVX, then the HLR Functionality must support queries from other DCVXs using specified protocol methods for obtaining terminal device information [e.g., GSM (2G, 3G, Pre-4G), CDMA, Mobile WiMAX, and/or 4G standards] based queries.

A.5.7.3 Equipment Identity Register Functionality

TAC-000560 [**Required**] To validate terminal devices to prevent a compromised terminal device from connecting to the cellular switch and obtain services, an Equipment Identity Register (EIR) functionality must be provided and integrated to work in conjunction with the Terminal Device Authentication Center functionality as stated in Section A.5.7.4, Terminal Device Authentication Center Functionality, to prevent compromising the DCVX.

A.5.7.4 Terminal Device Authentication Center Functionality

TAC-000570 [**Required**] To authenticate terminal devices as valid terminal devices associated with the DCVX, the cellular switch will use standard cellular techniques, industry best practices, and/or vendor proprietary processes integrated into the switch.

TAC-000580 [**Optional**] Terminal devices not assigned to the supporting Deployed Mobile Switching Center (DMSC) HLR (e.g., roaming terminal devices) may be supported for authentication via the industry standard(s) and/or industry best practices for roaming authentication.

A.5.7.5 Core Network External Network Trunks and Interfaces

TAC-000590 [**Required**] The Core Network shall support one or more of the following TDM and/or IP trunks and interfaces. The Core Network can support simultaneous interface connections to the DSN and UC VVoIP/Data networks using TDM and IP respectively, but not use TDM and AS-SIP protocol simultaneously in support of voice and/or video calls.

A.5.7.5.1 TDM Support

TAC-000600 [**Conditional**] If TDM trunks are supported, then the following requirements apply as directed:

> **TAC-000600.a** [**Required**] The Core Network will support ISDN PRI (T1/E1) as defined in Section 2.25.1, National ISDN 1/2 Basic Access for trunks that connect to the DSN/PSTN without MLPP capability.
>
> **TAC-000600.b** [**Conditional**] If a precedence and preemption capability is provided in the DCVX, then the Core Network will support MLPP PRI (American National Standards Institute [ANSI] T1.619a, ITU Q.955.3 and/or Q.735.3) per Section 2.25.2.7, ISDN MLPP PRI.
>
> **TAC-000600.c** [**Conditional**] The Core Network may support a DS1 Interface (e.g., PCM-24, PCM-30) per Section 11.2.3.4, DS1 Interface.

A.5.7.5.2 AS-SIP IP Trunking Support

TAC-000610 [**Conditional**] If AS-SIP IP trunks are supported, then the DCVX shall comply with the stated requirements of an SC, and if required, act as a SIP Back-to-Back User Agent (B2BUA). The Core Network and terminal devices supporting UC VVoIP Services are required to meet the conditions as stated in Section 8, Information Security.

A.5.7.5.3 DCVX Interconnection (Roaming)

Including the connections provided in Section A.5.7.5.1, TDM Support, and Section A.5.7.5.2, AS-SIP IP Trunking Support, one or more of the following connections can be used for connecting DCVXs together on DoD networks within the Tactical OAN in support of roaming capability and/or querying the local or remote HLR Functionality. Neither connection type below shall connect to the PSTN and/or other non-Government networks.

TAC-000620 [**Optional**] SIGTRAN: The Core Network may support CCS7 over IP using SIGTRAN IAW Internet Engineering Task Force (IETF) Request for Comments (RFC) 2719, and other associated supporting RFCs.

TAC-000630 [**Optional**] 2G, 3G, and/or 4G Standards: The interconnection portion of the protocols contained within the 2G, 3G, Pre-4G, Wideband WiMAX, and/or 4G Standards, as

delineated in Section A.5.4.2, Protocol/Format, may be used to interconnect DCVX systems when said protocols are transported over DoD operated and/or controlled networks.

A.5.7.5.4 Non-MLPP Networks Support

TAC-000640 [**Optional**] The Core Network may support an ISDN PRI (T1/E1) non-MLPP trunk for connecting to the PSTN and/or other non-Government networks. ISDN PRI (T1/E1) requirements are contained within Section 2.25.1, National ISDN 1/2 Basic Access.

A.5.7.6 Call Handling

TAC-000650 [**Required**] The Core Network shall handle both intraswitch calls and calls to and from the DSN, PSTN, and/or UC Services Network, while recognizing a powered-on terminal device that comes into its operational area.

A.5.8 Security

TAC-000660 [**Required**] All components of the DCVX shall meet security requirements as outlined in DoDI 8510.01 and the applicable STIG.

A.5.9 DCVX Network Management

TAC-000670 [**Required**] The DCVX is to be managed by at least one or more of the following:

TAC-000670.a [**Optional**] A front or back panel and/or external console control capability shall be provided for local management.

TAC-000670.b [**Optional**] Remote monitoring and management by the Advanced DSN Integrated Management Support System (ADIMSS) or similar Network Management (NM) systems developed by DoD Components. The following requirements apply:

TAC-000670.b.1 [**Required**] Data Interface: The NE shall provide NM data/monitoring via one or more of the following physical interfaces:

(a) Ethernet/Transmission Control Protocol (TCP)/IP (IEEE 802.3).

(b) Serial (RS-232)/Asynchronous.

(c) Serial/Synchronous (X.25 and/or BX.25 variant).

All data that is collected shall be accessible through these interfaces. For NM purposes, the NE must provide no less than two separate data channels. They may be physically separate (e.g., two distinct physical interface points) or logically separate (e.g., two user sessions through a single Ethernet interface). The data may be sent in ASCII, binary, or hexadecimal data or ASCII text designed for screen/printer display.

The data channels shall be used for and, as such, must be capable of providing:

i. Alarm/Log Data.

ii. Accounting data (e.g., Call Detail Record [CDR]).

iii. Performance Data (e.g., traffic data).

iv. DCVX access (to perform DCVX data fill administration and network controls).

TAC-000670.b.2 [**Required**] Fault Management: The DCVX shall detect fault (alarm) conditions and generate alarm notifications. The alarm messages must be sent to the assigned NM Alarm channel in near-real time. No alarm restriction/filtering is necessary. In addition to the data formats in Section 11.2.4, Device Management, alarms may be sent as Simple Network Management Protocol (SNMP) traps. If this channel is also used to output switch administrative log information, then the alarm messages must be distinguishable from an administrative log message.

TAC-000670.b.3 [**Required**] Configuration Management: Requirements for this feature shall be in accordance with Telcordia Technologies GR-472-CORE, Section 4.

A.6 DEPLOYED (TACTICAL) MASTER SC AND SUBTENDED SC REQUIREMENTS AND DASAC REQUIREMENTS IN SUPPORT OF BANDWIDTH CONSTRAINED LINKS

Since these requirements are applicable to the Fixed (Strategic Enterprise), as well as to the Deployed (Tactical) environment, these requirements are defined in Section 2.24, MSC and SSC. Many of these requirements, which are mandatory for the Deployed environment, are conditional for the Fixed environment.

A.7 DEPLOYED WIDE AREA NETWORK OPTIMIZATION CONTROLLER

A.7.1 Introduction

This product category defines the functions and requirements specific to a Deployed Wide Area Network (WAN) Optimization Controller (WOC).

A.7.2 WOC Functional Description

WAN optimization appliances provide efficiencies in WAN data transmission in the deployed environment over all RF or wired connections where deployed. Data efficiency are determined by measurable values and related to the function of the WAN Optimization Appliance type.

A.7.3 Throughput Acceleration Requirements

TAC-000680 [**Required: WOC**] The optimization appliance shall have proxies or strategies for accelerating Hyper Text Transfer Protocol (HTTP) and HTTP Secure (HTTPS) traffic.

TAC-000690 [**Required: WOC**] The optimization appliance shall have proxies or strategies for accelerating File Transfer Protocol (FTP), Secure Copy Protocol (SCP) and Secure File Transfer Protocol (SFTP) traffic.

TAC-000700 [**Required: WOC**] The optimization appliance shall have proxies or strategies for accelerating Common Internet File System (CIFS) and Microsoft SharePoint traffic.

TAC-000710 [**Required: WOC**] The optimization appliance shall have proxies or strategies for accelerating Citrix traffic and Windows Remote Desktop connections.

TAC-000720 [**Required: WOC**] The optimization appliance shall provide a service that allows proactive pre-positioning of files at peering appliances across a WAN segment.

TAC-000730 [**Required: WOC**] The optimization appliance shall have proxies or strategies for accelerating email interfaces. Examples of email interfaces include but are not limited to the IETF standard Simple Mail Transport Protocol (SMTP) and the Microsoft proprietary Messaging Application Programming Interface (MAPI).

TAC-000740 [**Required: WOC**] The optimization appliance shall increase the throughput of all TCP connections. Data Efficiency is measured by: WAN Data Reduction = (LAN [Kbytes] - WAN [Kbytes]) / LAN (Kbytes) %.

TAC-000750 [**Required: WOC**] The optimization appliance, when conducting TCP transfers with Transport Layer Security (TLS), shall at least match the throughput performance of the standard Space Communications Protocol Specification-Transport Protocol (SCPS-TP) protocol.

A.7.4 Data Reduction Requirements

TAC-000760 [**Required: WOC**] The optimization appliance shall have the ability to perform transparent, lossless, data compression on individual TCP connections.

TAC-000770 [**Required: WOC**] The optimization appliance shall be capable of compression and data reduction of TCP traffic. Data Efficiency is measured by: WAN Data Reduction = (LAN [Kbytes] - WAN [Kbytes]) / LAN (Kbytes) %.

TAC-000780 [**Required: WOC**] The optimization appliance shall be capable of compression and data reduction of User Datagram Protocol (UDP) traffic (objective).

TAC-000790 [**Required: WOC**] The optimization appliance shall be capable of compression and data reduction of Generic Routing Encapsulation (GRE) tunnel traffic (objective).

A.7.5 Quality of Service Requirements

TAC-000800 [**Required: WOC**] The optimization appliance shall have the capability to provide the quality-of-service functions such as: packet identification and marking, traffic shaping, and traffic policing.

TAC-000810 [**Required: WOC**] The optimization appliance shall have features to assign minimum and maximum bandwidth to particular traffic flows, as identified by any combination of source and destination addresses, TCP/UDP port, Differentiated Services Code Point (DSCP), or application protocol. Data Efficiency is measured by: High Priority traffic flow (Kbps) on Non-congested WAN = High Priority traffic flow (Kbps) on Congested WAN.

TAC-000820 [**Required: WOC**] The optimization appliance shall be capable of applying DSCP markings according to user-configurable rules.

A.7.6 Real-Time Traffic Requirements

TAC-000830 [**Required: WOC**] The appliance shall be capable of performing Robust Header Compression (ROHC) for all voice over IP packets, per IETF RFC 3095.

TAC-000840 [**Required: WOC**] The appliance shall be capable of concatenating small UDP packets together while minimizing jitter; the capture window size (in msec) shall be user adjustable, and provide multiple queues for different DSCP values.

TAC-000850 [**Required: WOC**] The optimization appliance shall allow bypassing specific IP UDP, and TCP flows from the processing requirements defined in prior sections. The flows will be identified by IP protocol number, source and destination pair, {address, port} tuples, UDP/TCP ports, or DSCP. The appliance shall not degrade performance (i.e., packet loss, delay and jitter) for such flows.

A.7.7 Network Monitoring Requirements

TAC-000860 [**Required: WOC**] The optimization appliance shall be capable of capturing at least 1 GB of complete packets (headers and payloads), and exporting them in a standard packet capture formatted files (such as PCAP) to network accessible storage.

TAC-000870 [**Required: WOC**] The optimization appliance shall collect and present real-time traffic statistics and graphs, including: (a) a listing of the concurrent TCP and UDP flows; (b) percentage of traffic by protocol; (c) the top-ten flows by bandwidth; and (d) the top-ten flows by duration. The statistics and graphs shall cover scales from 5 minutes to 1 week. The data used to

draw the graphs shall be transferable to network accessible storage in comma-separated values (csv) or Microsoft Excel (xls) format.

A.7.8 IPv6 Requirements

TAC-000880 [**Required: WOC**] The appliance shall process IP version 6 (IPv6) traffic with performance at least equal to IP version 4 (IPv4).

TAC-000890 [**Required: WOC**] The WAN optimization appliance shall be capable of supporting IPv4 and IPv6 simultaneously.

TAC-000900 [**Required: WOC**] The WOC shall meet the IPv6 requirements specified in Section 5, IPv6 Requirements, identified for Network Appliance/Simple Server (NA/SS).

A.7.9 Appliance Management Requirements

TAC-000910 [**Required: WOC**] The optimization appliance shall automatically discover its peers, without manual configuration.

TAC-000920 [**Required: WOC**] The optimization appliance shall be able to discover the conditions of the WAN connection and adjust to changes in operating characteristics (e.g., bandwidth, delay, and packet loss rates), without manual configuration or foreknowledge of the characteristics of the WAN connection.

TAC-000930 [**Optional: WOC**] The optimization appliance shall present a Management Information Base (MIB) accessible via the SNMP protocol, using Federal Information Processing Standards (FIPS) 140-2 compliant algorithms (Protocol Data Unit [PDU]).

TAC-000940 [**Optional: WOC**] The optimization appliance shall provide a device manager via a HTTP/HTTPS Graphical User Interface (GUI).

TAC-000950 [**Optional: WOC**] The optimization appliance shall provide a full featured Command Line Interface (CLI).

TAC-000960 [**Optional: WOC**] The optimization appliance shall support SNMPv3 Authentication and Encryption.

A.7.10 Packet Loss Mitigation Requirements

TAC-000970 [**Required: WOC**] The optimization appliance shall have methods to mitigate IP packet loss through the application of forward error correction and packet order correction.

A.7.11 Deployed Link Requirements

TAC-000980 [**Required: WOC**] The optimization appliance shall remain fully operational when the connection bandwidth is as low as 56 kbps bidirectional.

TAC-000990 [**Required: WOC**] The optimization appliance shall remain fully operational when the packet loss rate on a connection is as high as 5 percent.

TAC-001000 [**Required: WOC**] The optimization appliance shall remain fully operational when the WAN connection has up to 3 seconds of one-way delay.

TAC-001010 [**Required: WOC**] The optimization appliance shall remain fully operational with 0.5-second delays in the forward direction and up to 2.5 seconds in the return direction.

TAC-001020 [**Required: WOC**] The optimization appliance shall remain fully operational with bandwidth asymmetries of up to 75:1 (forward TCP: return ACK).

A.7.12 Fail-Over Requirements

TAC-001030 [**Required: WOC**] The optimization appliance shall have a fail-to-wire capability that engages during power outages, during system reboot, and when the accelerator is powered off.

TAC-001040 [**Required: WOC**] The optimization appliance shall be resilient to loss of power. The appliance must self-restore to the last configured state before loss of power without intervention when power is restored.

A.7.13 Security Requirements

TAC-001050 [**Required: WOC**] The optimization appliance's CLI shall be accessed in-band only via secure login and shall be restricted to authorized users with individual user-identification and password.

TAC-001060 [**Required: WOC**] The optimization appliance will limit the number of sequential unsuccessful Secure Shell (SSH) login attempts per account to three, and shall lock out access to that account after that many failed attempts.

TAC-001070 [**Required: WOC**] The optimization appliance must log all management and configuration accesses.

TAC-001080 [**Required: WOC**] The optimization appliance's local serial-port access shall be restricted to authorized users with individual user-identification and password.

TAC-001090 [**Required: WOC**] The traffic from the remote management console to the management sub-system and vice-versa shall be encrypted, via TLS/SSL or IPSec encapsulation.

TAC-001100 [**Required: WOC**] The optimization appliance shall maintain security of any sensitive cached data by providing the appropriate encryption for any non-volatile storage media.

TAC-001110 [**Required: WOC**] The optimization appliance shall include data-erase capability such that the appliance returns to a sanitized state when the power is removed.

A.7.14 Interface Requirements

TAC-001120 [**Required: WOC**] WAN and LAN network interfaces shall be 10/100 (10/100/1000) speed and duplex auto-sensing wired Ethernet, in accordance with applicable Institute of Electrical and Electronics Engineers (IEEE) Std 802.3 standards.

A.7.15 Interoperability Requirements

TAC-001130 [**Required: WOC**] The optimization appliance shall support a mode of operation that uses the standard SCPS-TP.

TAC-001140 [**Optional: WOC**] The optimization appliance shall support a mode of operation that uses the standard SCPS-SP.

TAC-001150 [**Required: WOC**] The optimization appliance shall produce "routable" traffic, i.e., traffic that is proper IPv4 or IPv6 traffic. Traffic between two optimizers must be standard IPv4 (or IPv6) packets.

A.7.16 Physical Characteristics

TAC-001160 [**Required: WOC**] The system shall not incur damage when stored without power, heat, and air conditioning for 30 days, subject to the environmental conditions contained in this specification.

TAC-001170 [**Required: WOC**] All rack-mountable system equipment shall be installed in EIA-standard 19 inch (48.31 centimeters) electronic equipment rack(s), in accordance with EIA-RS310D. A depth of no more than 24" should be considered in cases where the system or its components may be installed in Transit Cased systems.

A.7.17 Power

TAC-001180 [**Required: WOC**] The system and its components shall be capable of operation with voltage ranges from 110–240VA, 50/60 Hertz (Hz).

TAC-001190 [**Conditional: WOC**] If auto-sensing input power supplies are not utilized then the system shall utilize manual switch setting for different voltage ranges.

TAC-001200 [**Required: WOC**] The system shall have dual power supplies acting in redundant mode.

TAC-001210 [**Required: WOC**] The WAN Optimization appliance shall be capable of continued operations in the event of a power supply failure.

TAC-001220 [**Required: WOC**] The system shall comply with best commercial practices and standards, including National Fire Protection Association (NFPA) 70 (National Electrical Code) and UL 60950 (Safety of Information Technology Equipment) for the electrical design of system

components. The system shall not present uncontrolled hazards during operation, maintenance, or disposal of equipment.

A.7.18 Safety

TAC-001230 [**Required: WOC**] A means shall be provided for disconnecting AC and DC power to each item of rack-mounted electronic equipment.

TAC-001240 [**Required: WOC**] Personnel shall be protected from accidental exposure to sharp projections and corners, as specified in MIL-HDBK-454, Guideline No. 1.

TAC-001250 [**Required: WOC**] Components of the system utilizing LASER or Fiber Optic interfaces shall be appropriately labeled in accordance with ANSI Z136.2—January 1988: American National Standard for Safe Use of Optical Fiber Communications Systems Utilizing Laser Diode and Light Emitting Diode (LED) Sources.

A.7.19 Environment

TAC-001260 [**Required: WOC**] The system and its components shall operate normally within the threshold temperature range of 0 to 40 degrees C (+32 to +104 degrees F) with an objective temperature range of -30 degrees C to +49 degrees C (-22 to +120 degrees F). The system shall withstand storage and transportation in temperature extremes from –30 to +50 degrees C (-22 to 122 degrees F).

TAC-001270 [**Required: WOC**] In the operating mode, the system and its components shall operate when exposed to relative humidity up to 95 percent non-condensing.

TAC-001280 [**Required: WOC**] The system and its components shall, in its operational configuration, withstand exposure to settling dust and shall sustain no dust penetration that affects operational service requirements. Use of filters is acceptable.

TAC-001290 [**Required: WOC**] The system and its components shall, during operation and while in storage/transport conditions, withstand exposure to environments such as those found in coastal areas or aboard ships.

TAC-001300 [**Required: WOC**] No element of the system and its components shall operate at an acoustic noise level in excess of 65 dB(A). The acoustic noise level during temporary noise conditions, such as equipment alarms, shall not be considered part of the normal operational state.

A.7.20 Corrosion Control

TAC-001310 [**Required: WOC**] Connective components of the system (bolts, washers, nuts, etc.) shall be manufactured from corrosion-resistant or non-corrosive materials.

TAC-001320 [**Required: WOC**] All external parts and materials subject to corrosion shall be coated with anti-corrosion compounds and/or fabricated from non-corrosive materials.

A.7.21 Nuclear, Biological, and Chemical (NBC) Survivability

TAC-001330 [**Required: WOC**] The system and its components shall be capable of operation and maintenance by personnel wearing full NBC-contaminant protective clothing (Mission Oriented Protective Posture [MOPP] IV level).

TAC-001340 [**Required: WOC**] The external portion of the system and its components shall be capable of decontamination using NBC-decontamination procedures and equipment. MIL-HDBK-783 and MIL-STD-810F, Test Method 504 may be used as guidance on contamination avoidance and decontamination procedures.

A.8 RADIO GATEWAY REQUIREMENTS

A.8.1 Introduction

This section establishes the requirements for the components that are used in a Radio Gateway (RG).

A.8.1.1 Purpose

The UCR Radio Gateway (RG) Requirements product category is specific to the functionality of the RG. The functionality is available to support UC APL products and products that may not require UC APL certification. For example, DoD radio equipment, Radio End Instruments (REIs), and Voice Net Access Radios (VNARs) are not on the Unified Capability APL but are the critical communication asset that the RG MUST interface to. In addition to the radio assets, an IP End Instrument (EI) or its application may not be part of the UC APL. This is due to the new support capabilities of the RG's Stream Function. This function is capable of receiving and transmitting Real-Time Transport Protocol (RTP) voice traffic over multicast. While this category defines the RG's multicast requirements, the IP EI must also meet specific multicast requirements—similar to the requirements defined under the Stream Function.

A.8.1.2 General

The RG's primary function is to connect a VNAR with interested but dissimilar DISN End Instruments (EI)s. The RG can be one physical device, performing all of the necessary functions, or be a host of components and functions that are separated by the technologies that make up a portion of the DISN architecture. Figure A.8-1, Radio Gateway Components, provides a high-level overview of the core RG components.

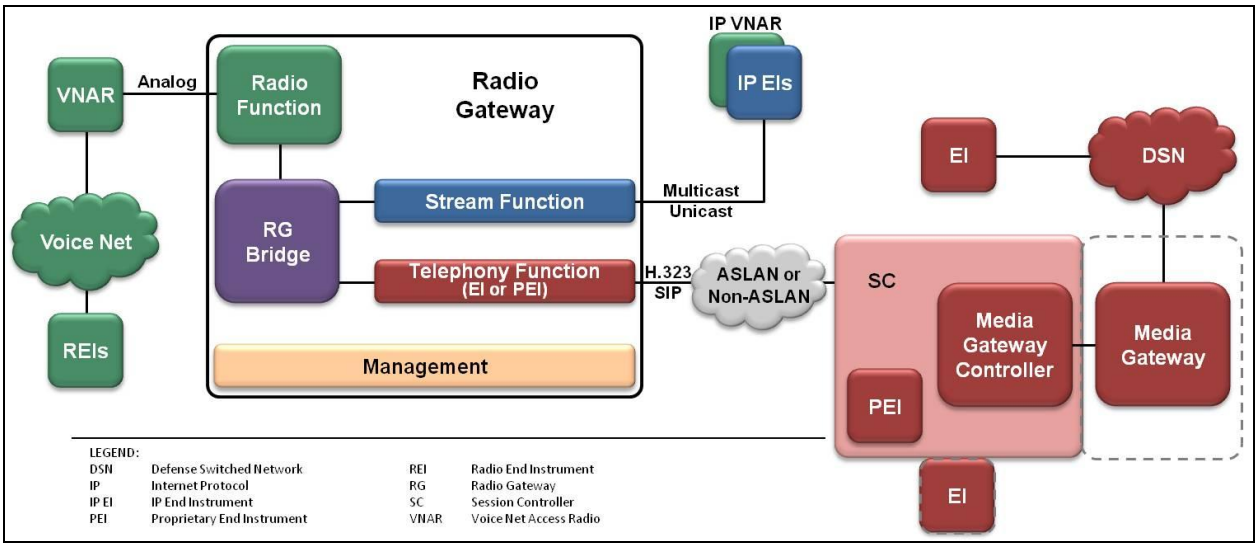


Figure A.8-1. Radio Gateway Components

A.8.2 Interfaces

The interfaces that the RG supports can be divided into three categories – Analog, Network, and Serial. Each of these performs a specific role to provide external access to various EIs. Figure A.8-2, Radio Gateway Interfaces, provides a high-level overview of the RG interfaces. These functions and the interface requirements are listed in the following text.

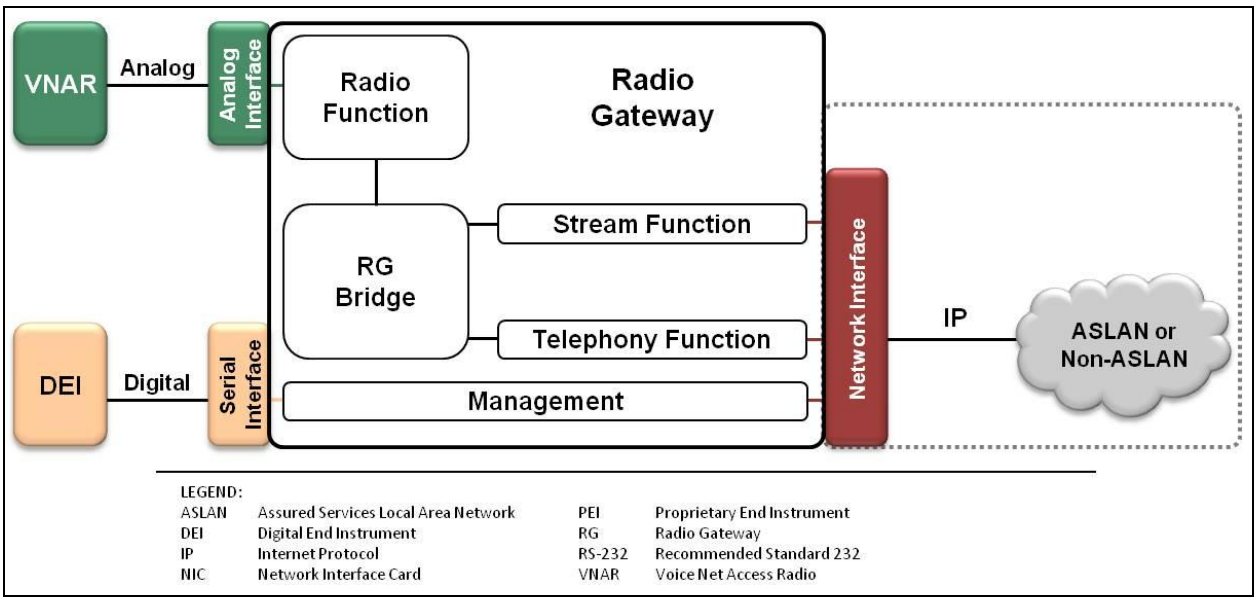


Figure A.8-2. Radio Gateway Interfaces

A.8.2.1 Analog Interface (Radio Function)

TAC-001350 [**Required: RG**] The RG shall contain an Analog Interface.

TAC-001360 [**Required: RG**] The RG Analog Interface shall support 4 and 2 wire configurations.

TAC-001370 [**Required: RG**] The RG's analog interface shall support an impedance of 600Ω balanced or unbalanced.

TAC-001380 [**Required: RG**] The RG's analog interface shall support an impedance of 47kΩ.

TAC-001390 [**Optional: RG**] The RG's analog interface may support high impedances dictated by the radio being connected to the RG.

A.8.2.2 Network Interface (Telephony and Stream Functions)

TAC-001400 [**Required: RG**] Ethernet interfaces shall be in accordance with IEEE 802.3-2002.

TAC-001410 [**Required: RG**] The RG shall support the following Ethernet types:

a. 10 Base-x.

b. 100 Base-x.

c. 1000 Base-x.

A.8.2.3 Network & Serial Interface (Management Functions)

TAC-001420 [**Required: RG**] The RG's Management interface shall be provided by one or more of the following serial or Ethernet interfaces.

TAC-001430 [**Optional: RG**] The RG's Management interface may support Serial or Ethernet interfaces: Ethernet interfaces shall be in accordance with IEEE 802.3-2002. Serial interfaces shall be in accordance with one of the following standards:

a. ITU-T Recommendation V.35.

b. TIA-232-F.

c. EIA-449-1.

d. TIA-530-A.

A.8.3 Functional Requirements

This section defines the functional requirements that the RG performs in order to support voice flow between EIs and VNARs. Figure A.8-3, Bearer and Signal Paths, provides an overview of the bearer channels and Push To Talk (PTT) signaling links necessary to provide connectivity between the different EIs and a VNAR. PTT signaling is required for all RG deployments. This signal instructs the VNAR to accept remote VNAR and/or EI bearer traffic and relay it to the associated radio voice net. Without this instruction, bearer traffic could be sent to the VNAR but no audio would pass to the REIs that share the same voice net.

The flow shown in Figure A.8-3, Bearer and Signal Paths, illustrates a number of different PTT signaling methods. The PTT signaling method/s used will be determined by the VNAR, EIs, and the RG.

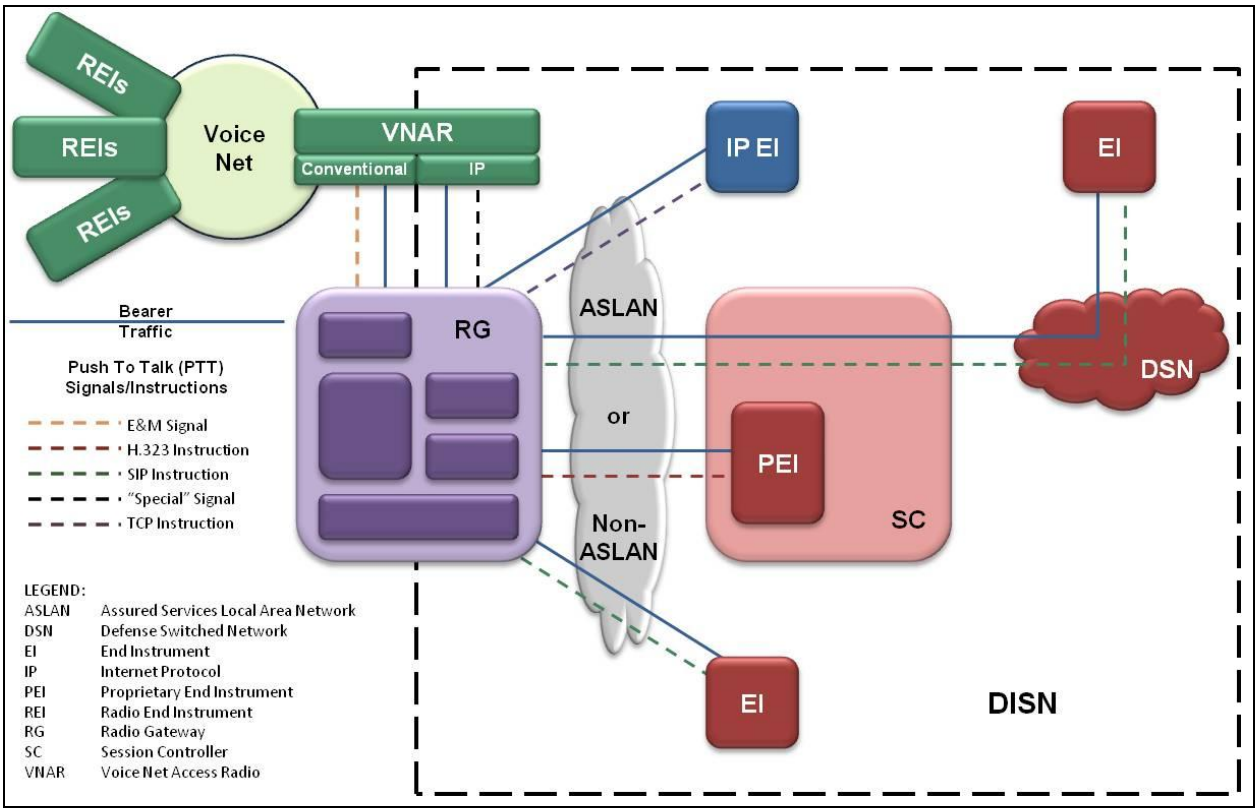


Figure A.8-3. Bearer and Signal Paths

A.8.3.1 VNAR OTT

When an EI wants to send audio to the radio, a PTT instruction is sent to the RG using the EI's connection protocols and technologies. The RG interprets these instructions and then sends the PTT signal in the VNAR's proper format.

TAC-001440 [**Required: RG**] The RG shall support Ear and Mouth (E&M) PTT signaling in accordance with "MILSTD 188.141C" for connecting to the VNAR.

TAC-001450 [**Required: RG**] The RG shall support in-ban PTT signaling for connecting to the VNAR.

TAC-001460 [**Required: RG**] The RG shall support Pass-through. Pass-through is an RG method that, when bearer traffic is received from a remote EI, the traffic is passed to the VNAR with no special RG PTT signaling. The PTT mechanisms are all internal to the radio (i.e., VOX).

TAC-001470 [**Required: RG**] when configured to support VOX the RG shall not clip the beginning of the audio received.

TAC-001480 [**Required: RG**] The RG shall support configurable Tone Signaling.

TAC-001490 [**Optional: RG**] The RG may support tone signaling configurable between the 0Hz and 3201Hz frequency range.

TAC-001500 [Optional: RG] The RG may support a dB Level or Amplitude tone signal configurable at or between -50 and 3dB.

TAC-001510 [**Required**: RG] The RG may support tone duration configurable at or between 10 and 2000ms.

TAC-001520 [**Required**: RG] The RG shall support Guard Tones configurable for an infinite duration.

TAC-001530 [**Required**: RG] The RG shall support sequential order tone patterns.

TAC-001540 [**Required**: RG] The RG shall support a minimum of 8 signaling tones.

TAC-001550 [Optional: RG] The RG analog interface may support 2/4-wire Type III E&M signaling.

TAC-001560 [Optional: RG] The RG analog interface may support 2/4-wire Type V E&M signaling.

A.8.3.2 COR, COS, and VAD

TAC-001570 [**Required: RG**] The RG shall support Carrier Operated Relay (COR) or Carrier Operated Switch (COS) Signaling.

TAC-001580 [**Required: RG**] The RG shall be capable of inspecting the incoming VNAR RF audio stream to determine if it is valid audio traffic or refuse the propagation of noise.

A.8.3.3 Audio Manipulation

To gain optimal stream behavior between the RG and VNAR, several processes are used by the radio function.

TAC-001590 [**Required: RG**] The RG shall support the capability of performing both half-duplex and full-duplex signaling.

TAC-001600 [**Required: RG**] The RG shall support the ability to lower or raise the amplitude of the transmitted or received audio stream within the minimum range of 0 and 10dB.

TAC-001610 [**Required: RG**] The RG shall support the ability to configure from 0ms - 2000ms. Receive Audio Timeout after transmitted audio to the VNAR has ceased.

TAC-001620 [**Required: RG**] The RG shall support relay of audio signals that are above a configurable dB threshold.

A.8.4 Telephony Functions

A.8.4.1 Telephony EI PTT Instruction Functionality

TAC-001630 [**Conditional: RG**] If the RG supports SIP Instructions from the EI, then the RG shall support the following:

a. In-Band PTT instructions (‘start’ and ‘stop’) by receiving EI generated Dual-Tone Multifrequency (DTMF) tones over the RTP audio bearer per RFC 4733, RTP Payload for DTMF Digits, Telephony Tones, and Telephony Signals.

   OR

b. Out-of-Band EI PTT instructions (‘start’ and ‘stop’) by receiving Key Press Stimulus Protocol (KPML) DTMF events as defined by RFC 4730, A Session Initiation Protocol (SIP) Event Package for Key Press Stimulus (KPML).

TAC-001640 [**Conditional: RG**] If the RG supports H.323 instructions from the EI, then the RG shall support the following:

a. In-Band EI PTT instructions (‘start’ and ‘stop’) by receiving the DTMF tones over the RTP audio bearer per RFC 4733 RTP Payload for DTMF Digits, Telephony Tones, and Telephony Signals.

   OR

b. Out-of-Band alphanumeric user input messages as defined by the ITU H.245 Standard.

A.8.4.2 Audio Manipulations

TAC-001650 [**Required: RG**] The RG shall support a buffer that can withstand a variable delay of received voice segments of at least 1500ms.

TAC-001660 [**Required: RG**] The RG shall support the ability to provide a unique telephone number or Dial-in Number (DN) for each telephony function.

TAC-001670 [**Conditional: RG**] If the RG supports more than one telephony function; then, the RG shall support the following:

a. Direct-Inward-Dial (DID). This method connects the caller directly to a Telephony Function with no voice prompt requesting the user for selection.

   OR

b. The RG may support Interactive Voice Response (IVR). This method uses voice prompts to request that the caller select a Telephony Function by entering the Dial-in Number (DN) or extension of the Telephony Function.

   OR

c. Operator/Attendant Routing. This method allows an authorized operator/attendant to route a caller to the appropriate Telephony Function. This routing may be accomplished locally (e.g., using direct RG controls) or remotely (e.g., using an RG administrative network connection).

A.8.5 Authentication

TAC-001680 [**Required: RG**] The RG shall support authentication of inbound callers before allowing access to each connected Radio Bridge.

TAC-001690 [**Optional: RG**] The RG may support a Participant Code function. This code is required, before allowing a caller access to the connected Radio Bridge.

TAC-001700 [**Optional: RG**] The RG may support Operator/Attendant Authentication. – Each Telephony Function may be configured to allow a live operator/attendant to authenticate a caller by offline means before allowing access to the connected Radio Bridge.

TAC-001710 [**Required: RG**] The RG shall support an audible tone or IVR voice message to the caller if the authentication process determines that the caller is unauthorized.

TAC-001720 [**Required: RG**] The RG shall support a configurable parameter-determined period; in which the system will terminate the call if the unauthorized caller does not hang up.

TAC-001730 [**Required: RG**] The RG shall support an audible tone or IVR voice message to the caller acknowledging successful entry into the Radio Bridge.

A.8.6 Dial Plan and Routing Requirements

(Reference UCR Section 2.18, Worldwide Numbering and Dialing Plan, and UC Framework [UCF] Appendix A Section A.9.9, GBNP).

TAC-001740 [**Required: RG**] Each Telephony Function shall be assigned a routable user identity, which can be one of the following: DSN number, Tel- Uniform Resource Identifier (URI), SIP-URI, Fully Qualified Domain Name (FQDN), or internal ID.

A.8.7 Streaming Functions

A.8.7.1 IP VNAR PTT Functionality

IP VNARs can be directly connected to the DISN network using its own internal TCP/IP stack.

TAC-001750 [**Conditional: RG**] If the RG supports an IP VNAR, then the RG shall support the following:

a. Pass-Through. Pass-through is an RG method that, when bearer traffic is received from a remote EI, the traffic is passed to the VNAR with no special RG PTT signaling. The PTT mechanisms are all internal to the radio.

OR

b. DTMF Signaling the IP VNAR will accept the bearer traffic.

TAC-001760 [**Conditional: RG**] If the IP VNAR accepts SIP DTMF tones, then the RG shall support the following:

a. In-Band PTT signaling by transmitting the DTMF tone over the RTP audio bearer per RFC 4733, RTP Payload for DTMF Digits, Telephony Tones, and Telephony Signals.

   OR

b. Out-of-Band PTT signaling by transmitting KPML DTMF events to the IP VNAR as defined by RFC 4730, A Session Initiation Protocol (SIP) Event Package for Key Press Stimulus (KPML).

TAC-001770 [**Conditional: RG**] If the IP VNAR accepts H323 signaling, then the RG shall support the following:

a. In-Band PTT signaling by transmitting the DTMF tone over the RTP audio bearer per RFC 4733 RTP Payload for DTMF Digits, Telephony Tones, and Telephony Signals.

   OR

b. Out-of-Band alphanumeric user input messages, as defined by the ITU H.245 Standard.

A.8.7.2 IP EI PTT Instruction Functionality

For an RG to act on an IP EI's request to pass traffic through a connected VNAR, the RG has to be instructed to do so.

TAC-001780 [**Optional: RG**] The RG may support the capability of inspecting the incoming EI audio to determine if it is valid audio traffic or refuse the propagation of noise.

TAC-001790 [**Optional: RG**] The RG may support the capability of sending IP EI In-band Generated Tones to the VNAR with no voice inspection.

TAC-001800 [**Optional: RG**] The RG may support the capability of generating and mixing with the incoming Bearer traffic to the VNAR the necessary tones upon the detection of an IP EI voice stream.

A.8.7.3 Audio Manipulation

TAC-001810 [**Required: RG**] The RG shall support a Jitter Buffer capable of withstanding a variable delay of received voice segments of at least 1500ms.

A.8.7.4 Multicast

The RG's Stream Function can accept bearer traffic using strictly unicast point-to-point communications or multicast.

TAC-001820 [**Conditional: RG**] If the RG supports streaming RTP traffic between the Stream Function and a remotely connected EI, via multicast, then the RG shall support the following:

a. The RG shall support the Internet Group Management Protocol, Version 3 (IGMPv3) for IPv4 multicast management and multicast group membership reporting to neighboring multicast NE as defined by RFC 3376.

b. The RG shall support Multicast Listener (MLD), Version 2 for IPv6 multicast NEs to discover the presence of multicast listeners as defined by RFC 4604.

c. The RG shall support administratively scoped addresses (239/8) and multicast administrative boundaries as described in RFC 2365.

A.8.8 Bridge Functions

Once suitable audio is received by the RG from one of its functions, the RG MUST transcode the traffic and bridge it to the protocol and technology that the destination understands. The RG is responsible for bridging the functions and the connected endpoints together.

TAC-001830 [**Required: RG**] The RG shall support the capability of at a minimum, bridging a connected VNAR or IP VNAR in one of the following configurations:

a. Local Configuration. A local configuration connects more than one conventional VNAR together through the RG's backplane or internal processes (see Figure A.8-4). Note that this only applies to RGs containing more than one Radio Function.

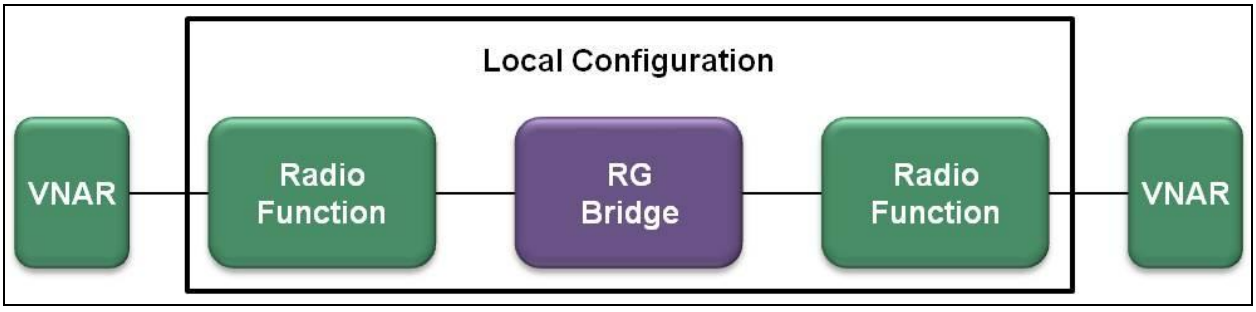


Figure A.8-4. RG Bridge Local Configuration

b. Telephony Configuration. The telephony configuration connects a VNAR or IP VNAR to a SIP/H.323 EI, remote IP VNAR, or trunk (see Figure A.8-5).

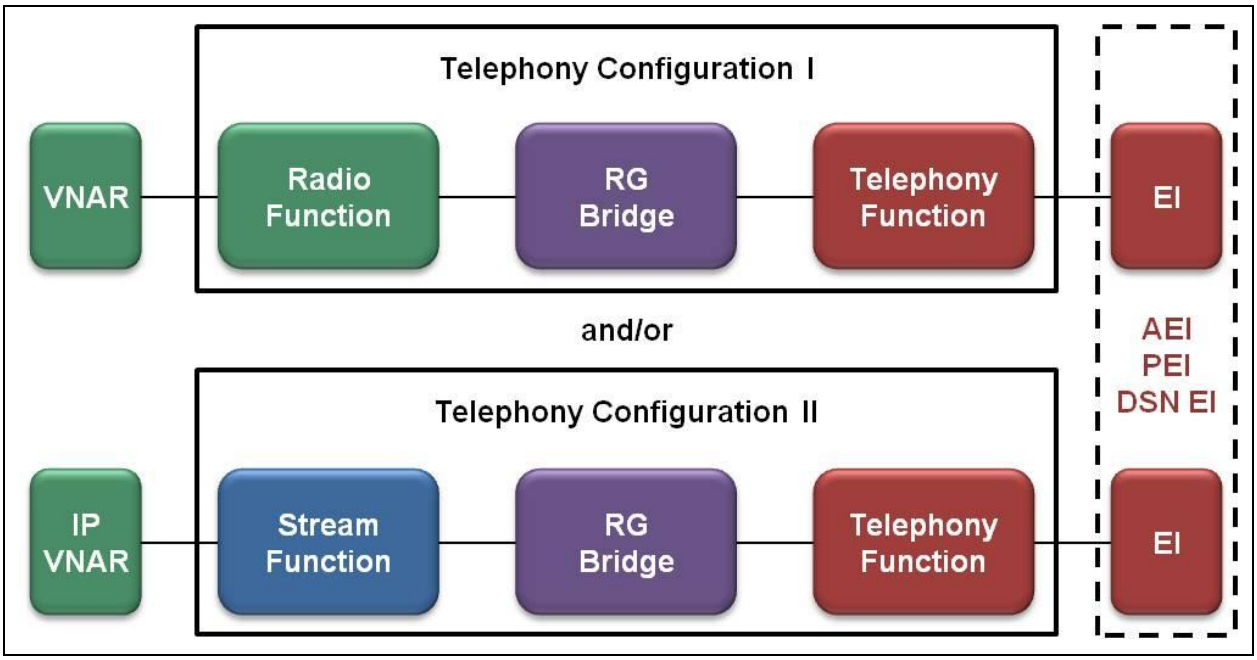


Figure A.8-5. RG Bridge Telephony Configuration

c. Stream Configuration. The stream configuration connects a VNAR or IP VNAR to a unicast or multicast voice EI or remote IP VNAR (see Figure A.8-6).

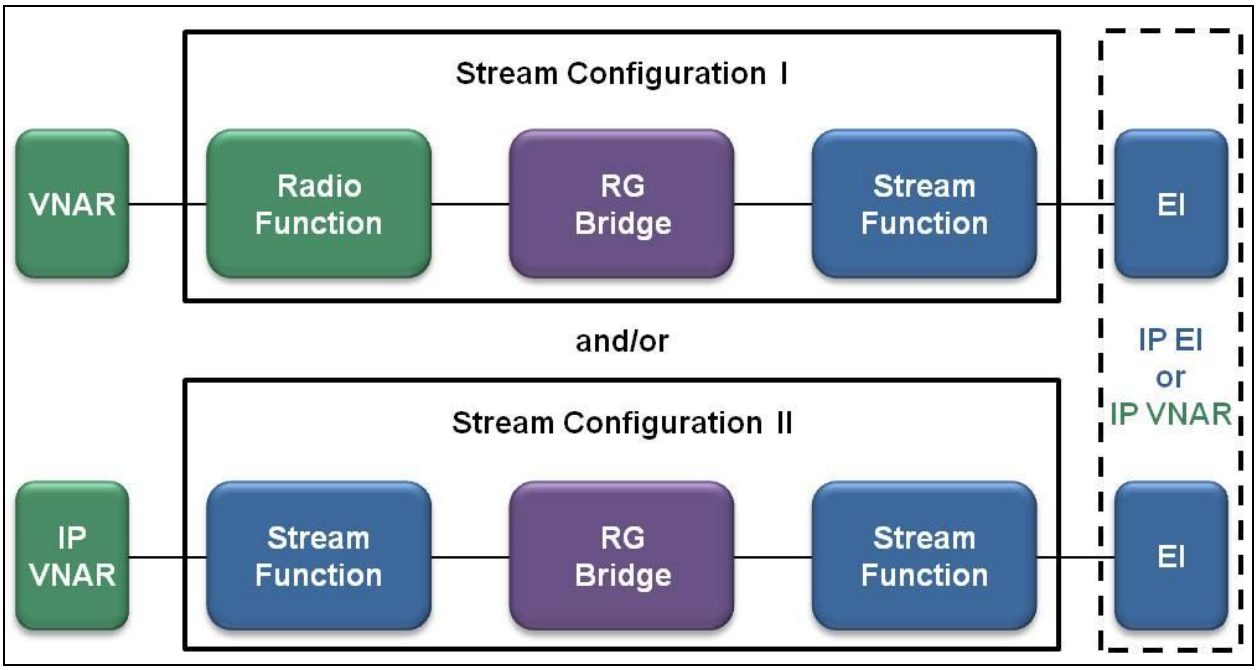


Figure A.8-6. RG Bridge Stream Configuration

TAC-001840 [**Required: RG**] The RG shall support the capability of decoding RTP traffic.

TAC-001850 [**Required: RG**] The RG shall support the capability of receiving multiple RTP streams, mixing these streams, and sending the single mixed RTP stream to an EI or VNAR (conventional or IP).

A.8.9 Bearer Traffic

In addition to acting as a PTT signaling and instruction interpreter, the RG MUST be able to receive and send audio traffic between the different endpoints (VNARs and EIs) using protocols and technologies that the RG and endpoints both support.

TAC-001860 [**Required: RG**] The RG shall support the following DSN Approved Codecs:

a. G.711 (μ law or a law).

b. G.729 or G.729A.

TAC-001870 [**Optional: RG**] IP EI Stream Codecs: In addition to the DSN Approved Codecs, the IP EI may support additional codecs.

a. G.711 (μlaw or a law).

b. G.723.1.

c. G.721.

d. G.726 (16, 24, or 32 kbps).

e. G.729 or G.729A.

f. GSM Full rate.

g. MELPe.

h. PCM 16 bit @ 128 kbps.

i. Ramalho G.711 Lossless (RGL) (μlaw or alaw).

j. Speex (2.15, 5.95, 8, 11, 15, 18.2, or 24.6 kbps).

k. G.722.1.

A.8.10 Quality of Service

TAC-001880 [**Required: RG**] The RG shall support Differentiated Services (DiffServ) per hop behaviors (PHBs) and traffic conditioning IAW RFCs 2474, 2597, 2598, 3140, and 3246.

TAC-001890 [**Required: RG**] The RG shall support a configurable mechanism to mark DSCPs in the header of IP packets. The default marking shall be as defined in UCR Section 6, Network Infrastructure End-to-End Performance Requirements.

TAC-001900 [**Required: RG**] The RG shall support a configurable fail-safe mechanism to prevent a VoIP EI from streaming continuous voice traffic to a PTT-based Voice Net.

TAC-001910 [**Required: RG**] The RG fail-safe mechanism shall only reinstate transmissions based on completion of a configurable specific, positive action by the EI.

A.8.11 Internet Protocol Version 6

TAC-001920 [**Required: RG**] The RG shall support the IPv6 requirements as defined for NA/SS in UCR Section 5, IPv6.

A.8.12 NMFCAPS

TAC-001930 [**Required: RG**] The RG shall support General Network Management requirements as specified in UCR Section 15, Enterprise and Network Management Systems.

A.8.13 Information Assurance

TAC-001940 [**Required: RG**] The RG shall support the Information Assurance (IA) requirements for a LAN Switch as defined in UCR Section 4, Information Assurance.

TAC-001950 [**Required: RG**] The RG shall apply the appropriate STIGs for an NA/SS.

A.9 IP MODEM

A.9.1 Overview

This specification establishes the performance requirements for an IP Modem that will be used for transmissions over DoD and commercial satellite systems. COTS technology, products, standards, documentation, and methods usage are recommended to the greatest extent possible.

A.9.2 IP Modem Functions

The underlying source of user requirements for an IP Modem is the Functional Capabilities Description (FCD), TIA-157. Section 3 of the FCD refers only to the Baseline IP Modem features associated with the Hub-Spoke network topology.

The following FCD sections are not applicable to or not required of an IP Modem:

1. Requirements identified in the FCD for the Mesh network topology are optional.
2. Requirements identified in the FCD for the Point-to-Point network topology are not applicable to an IP Modem. These capabilities will be provided by the MD-1366 Enhanced Bandwidth Efficient Modem (EBEM) being procured separately.
3. An IP Modem is not required to adhere to the Software Communications Architecture described in the FCD.

A.9.3 Requirements

A.9.3.1 Precedence

The commercial and DoD standards are applicable to the IP Modem to the extent specified herein. This specification shall take precedence in the event of a conflict between provisions of this document and corresponding provisions of the standards cited.

A.9.3.2 Digital Video Broadcasting – Return Channel via Satellite

The IP Modem shall implement the following standards-based air interface:

TAC-001960 [**Required**] The IP Modem shall use a return channel air interface that employs Multifrequency – Time Division Multiple Access (MF-TDMA) in a manner broadly similar to EN 301 790. The air interface shall, however, be substantially more capable of performing than EN 301 790, including the use of a better turbo code as well as additional modulation schemes (BPSK, 8PSK, spread-spectrum BPSK). The forward channel shall be compliant with DVB-S2 (EN 302 307).

TAC-001970 [**Required**] The IP Modem system shall be equipped with necessary timing and frequency generation functions sufficiently stable and accurate to support network requirements.

TAC-001980 [**Required**] The IP Modem shall accept reference timing and frequency signals available from its associated satellite terminal and use these signals as sources for generating internal operating frequencies and clocks.

TAC-001990 [**Required**] The IP Modem shall not transmit over the air any modem position and/or location information relative to any of the modems within the network.

TAC-002000 [**Required**] The IP Modem shall utilize a startup mechanism whereby it performs acquisition and logon without operator intervention using only information stored within the modem or obtained from the forward link carrier.

TAC-002010 [**Required**] Operator input of the Transmission Security (TRANSEC) passphrase shall be required at each startup. The IP Modem may also use an over-the-air authentication mechanism based on exchange of X.509 certificates over a PKI infrastructure. The IP modem should be certified according to FIPS 140-2.

A.9.3.2.1 Compliance With ETSI EN 301 790

TAC-002020 [**Required**] The IP Modem may support several burst payload size options, including choices that are identical or similar to the MPEG profile of DVB-RCS (EN 301 790). Aside from modulation and coding advantages addressed elsewhere, the IP Modem may offer features not included in the DVB-RCS MPEG profile. This includes in-band capacity requests for rapid reaction to changes in capacity demand. The IP Modem may use HDLC for IP packet encapsulation; this method has very low overhead.

A.9.3.2.2 Compliance With ETSI EN 302 307

TAC-002030 [**Required**] The IP Modem shall comply with the non-optional requirements of ETSI EN 302 307. The IP Modem shall comply with all "Professional Services" normative requirements of ETSI EN 302 307. Implementation of 32APSK is not required in the IP Modem. The use of "normal" frames is not required. Support for Transport Streams is not required if support for generic streams is provided.

A.9.3.3 Satellite Network Modem System (ISNMP)

TAC-002040 [**Required**] Network Management Interfaces: IP Modem products shall provide at least the following interface rates (other rates and IEEE standards may be provided as conditional interfaces):

a. 10 Mbps IAW IEEE 802.3i.

b. 100 Mbps IAW IEEE 802.3u.

TAC-002050 [**Required**] The IP Modem shall comply with the following sections and subsections of TIA/EIA 1073-000, 1, Section 4.1: Hub Spoke Topology.

A.9.3.4 Logon and Synchronization

TAC-002060 [**Required**] After failure, an IP Modem shall be able to logon to the satellite network in less than ninety (90) seconds.

TAC-002070 [**Required**] The IP Modem shall achieve synchronization and the ability to pass IP traffic bi-directionally within five (5) seconds after login.

TAC-002080 [**Required**] The IP modem shall automatically synchronize to the network timing reference after initial power-on and after loss of time synchronization.

TAC-002090 [**Required**] The IP Modem shall be able to self-correct timing to compensate for changes in satellite locations. This shall be accomplished without the input of satellite ephemeris data.

TAC-002100 [**Required**] The IP Modem shall synchronize its clock with the Network Timing Reference received on the forward link.

A.9.3.5 Network Requirements

A.9.3.5.1 LAN Interface

TAC-002110 [**Required**] IP Modem products shall provide a multiport managed Ethernet switch with a minimum of 8 10/100 Ethernet ports.

TAC-002120 [**Required**] The switch shall provide a high-speed switch fabric with support for 2048 MAC address entries with automatic learning and aging.

TAC-002130 [**Required**]The switch shall provide port-based VLAN (IEEE 802.1q) assignment and configuration.

TAC-002140 [**Required**] The switch shall support IEEE 802.1p.

TAC-002150 [**Required**] Each switch port shall be full duplex and shall support auto-negotiation (IEEE 802.3) and flow control (IEEE 802.3x).

TAC-002160 [**Required**] Spanning Tree IAW IEEE 802.1D.

TAC-002170 [**Required**] The IP Modem shall support all packet sizes from 64 to 1500 bytes on all interfaces.

A.9.3.5.1.1 IP Header and Payload Compression

TAC-002180 [**Required**] The IP Modem shall provide IP Header and Payload Compression [Transmission Control Protocol (TCP)/IP and Real Time Protocol (RTP)/User Datagram Protocol (UDP)/IP] for efficient bandwidth utilization in accordance with RFC 3759, RFC 4362, RFC 3173, and the IETF Draft document "draft-ietf-rohc-rfc4995."

A.9.3.5.1.2 IP Encapsulation

TAC-002190 IM019 [**Required**] The IP Modem shall provide Generic Stream Encapsulation (GSE) on the forward link. The IP Modem may alternatively provide other encapsulation, provided the functionality and performance is at least equivalent to GSE.

A.9.3.5.1.3 IP Packet Routing

TAC-002200 [**Required**] The IP Modem shall support the following IP dynamic routing protocols for IPv4 Unicast and multicast traffic:

a. Open Shortest Path First (OSPF), version 2 (OSPF v2) per RFC 2328.
b. Border Gateway Protocol (BGP), version 4 per RFC 4271.
c. Routing Information Protocol, version 2 (RIPv2) per RFC 2453.

TAC-002210 [**Required**] The IP Modem shall support DHCP.

TAC-002220 [**Required**] The IP Modem shall support a local DNS cache for IPv4 addresses.

TAC-002230 [**Required**] The IP Modem shall be capable of static routing of IPv4 and IPv6 multicast packets.

a. The IP Modem shall support local configuration of static IGMP joins and leaves to include IGMP v3 capability to filter by source address. This capability is intended to provide the IP Modem with the flexibility to manually add and delete individual multicast streams.

b. The IP Modem shall comply with standard IPv4 multicast routing protocols as defined by RFC 1112 and RFC 3376 (IGMPv3).

TAC-002240 [**Required**] The IP Modem shall support IPv4 Unicast static routing.

TAC-002250 [**Required**] The IP Modem shall be capable of distributing all static and dynamic routes, including changes.

TAC-002260 [**Required**] The metrics for the routing protocols shall be configurable to enable a routing policy such that the satellite link can act as the primary link, or a backup link, or possibly the primary in one direction and a backup in another direction.

A.9.3.5.1.4 IP Packet Forwarding

TAC-002270 [**Required**] The IP Modem shall support IP connectivity, be capable of extracting information from IP packet headers, and support transparent IPv4 packet forwarding for unicast and multicast services in accordance with Paragraph 7 of TIA-1073-001, SNMS Network Layer Standard.

A.9.3.5.1.5 IP Encapsulation

TAC-002280 [**Required**] The IP Modem shall support the following IP characteristics:

a. The IP Modem shall provide a Single Transport Stream or a single generic stream for the forward link carrier.

b. The IP Modem shall provide encapsulation of IP packets on the forward link that is compliant with MPE (EN 301 192), GSE (TS 102 606) or equivalent.

A.9.3.5.1.6 IPv6

TAC-002290 [**Required**] The IP Modem shall support the mandatory requirements of DoD IPv6 Standard Profiles for IPv6 Capable Products published in the DISR for the applicable equipment categories.

TAC-002300 [**Required**] The IP Modem shall support simultaneous, dual-stack, IPv4, and IPv6 packet processing.

TAC-002310 [**Required**] The IP Modem shall extract information from IPv6 packet headers and support transparent IPv6 packet forwarding for unicast and multicast services.

TAC-002320 [**Required**] The IP Modem shall support the following IP dynamic routing protocols for IPv6 unicast and multicast traffic:

a. OSPF, version 2 (OSPF v2) per RFC 2328.

b. BGP, version 4 (BGP-4), per RFC 4271.

c. Routing Information Protocol, next generation(ng) (IPv6) (RIPng), per RFC 2080.

TAC-002330 [**Required**] The IP Modem shall support DHCPv6 and DHCPv6 relay.

TAC-002340 [**Required**] The IP Modem shall support a local DNS cache for IPv6 addresses.

TAC-002350 [**Required**] The IP Modem shall support IPv6 Neighbor Discovery (ND).

A.9.3.5.2 Satellite Interface Requirements

TAC-002360 [**Required**] The IP Modem shall support Constant Coding and Modulation (CCM) and Adaptive Coding and Modulation (ACM) techniques compliant with EN 302 307.

TAC-002370 [**Required**] The IP Modem shall support Binary, Quadrature and Binary Phase Shift Keying (BPSK, QPSK, and 8PSK) modulation in the return channels. In addition, the IP Modem shall support Turbo Coding with a performance at least equivalent to that defined in EN 301 790. Implementation of Reed Solomon, Convolutional, and CRC Channel Coding is not required. The constellation for QPSK shall be as defined in ETSI EN 301 790 [2].

TAC-002380 [**Required**] The outbound/broadcast transmission rate shall be configurable for a minimum of 1 Mbps up to 45 Mbps.

TAC-002390 [**Required**] The IP Modem shall operate with earth terminals over one or any combination of C-, X-, Ku-, or Ka-band geosynchronous transponder satellite systems.

TAC-002400 [**Required**] The IP Modem shall accommodate Doppler effects of C-, X-, Ku-, or Ka-band geosynchronous satellites with orbital inclinations of up to seven (7) degrees.

TAC-002410 [**Required**] An IP Modem network shall operate on only one satellite at a time.

TAC-002420 [**Required**] An IP Modem network shall operate in X- and Ka-band simultaneously.

TAC-002430 [**Required**] The IP Modem shall support operation in a receive-only mode. In this mode of operation, the IP Modem shall operate without any communications to the distant end in both TRANSEC enabled or disabled modes. This mode shall require no transmission by the IP Modem nor any type of network log-on or authentication.

TAC-002440 [**Required**] The IP Modem shall use a dynamic MF-TDMA technique and shall support frequency hopping between carriers with different symbol rate, coding rate and modulation scheme. The burst payload size of all traffic time slots accessed by an IP modem in a logon session shall be the same.

A.9.3.5.2.1 Forward Link Modulation and Coding Rates

TAC-002450 [**Required**] The modulation and forward error correction (FEC) coding formats implemented in the forward channel shall be compliant with the requirements of EN 302 307 including the following:

a. QPSK modulation with FEC rates of 1/4, 1/3, 2/5, 1/2, 3/5, 2/3, 3/4, 4/5, 5/6, and 8/9.

b. 8PSK modulation with FEC rates of 3/5, 2/3, 3/4, 5/6, and 8/9.

c. 16APSK modulation with FEC rates of 2/3, 3/4, 4/5, 5/6, and 8/9.

A.9.3.5.2.2 DVB Compliance

TAC-002460 [**Required**] The IP Modem shall provide functionality and performance at least equivalent to the Minimum Compliance Requirements under the "MPEG2 DVB-S2" profile of ETSI EN 301 790, with the exception of specific exclusions as specified in the present document.

A.9.3.5.2.3 Transmission

TAC-002470 [**Required**] The outbound/broadcast transmission rate shall be configurable for a minimum of 1 Msps.

TAC-002480 [**Required**] The IP Modem forward link error performance shall be compliant with EN 302 307, Paragraph 6 with 0.5 dB of degradation for QPSK and 0.9 dB of degradation for higher order modes (in IF loop back mode, FECFRAME (16, 200 bits) and with 0.20 roll-off. This includes allowance for the difference in FECFRAME size.

TAC-002490 [**Required**] The IP Modem return link error performance shall be compliant with Table A.9-1, Turbo Code Es/No Performance (170-byte packet) at Quasi Error Free PER = 10-5 (IF loop, AWGN channel), in IF loopback mode and with 0.20 roll-off. This table provides a threshold Es/No specification for a range of spectral efficiencies, expressed as FEC payload bits per data-carrying symbol. Recognizing that each proposed Turbo codec may have configurable FEC rate options that vary slightly, each vendor shall support an FEC rate with a threshold Es/No matched with the appropriate range. A minimum of three configurable FEC rate options shall be supported that offer flexibility in the tradeoff between power and bandwidth.

Table A.9-1. Turbo Code Es/No Performance (170-byte packet) at Quasi Error Free PER = 10-5 (IF loop, AWGN channel)]

SPECTRAL EFFICIENCY (BITS/SYMBOL)	THRESHOLD ES/N0 (DB)
< 0.500	0.4
0.501 to 0.600	1.5
0.601 to 0.700	2.0
0.701 to 0.800	2.3

SPECTRAL EFFICIENCY (BITS/SYMBOL)	THRESHOLD ES/N0 (DB)
0.801 to 0.800	2.8
0.901 to 1.000	3.5
1.001 to 1.100	4.1
1.101 to 1.200	4.8
1.201 to 1.300	5.4
1.301 to 1.400	6.0
1.401 to 1.500	6.8
1.501 to 1.600	8.4
1.601 to 1.700	8.7
1.701 to 1.800	9.3
1.801 to 1.900	10.0
1.901 to 2.000	10.6
2.001 to 2.100	11.5
2.101 to 2.200	12.7

A.9.3.5.2.4 Variable Coding and Modulation (VCM)

The IP Modem control and management system shall provide Variable Coding and Modulation (VCM) techniques compliant with EN 302 307. For the Forward Link TDM broadcast, the DVB-S2 Modulator shall support Frame-to-Frame dynamic switching between Mod Codes to accommodate different size broadcast receivers on the same broadcast. The control interface for this switching shall provide for a means of traffic differentiation (such as by destination IP/multicast address) to allow external selection of modulation and code rate, and shall be open and documented.

TAC-002500 [**Required**] The IP Modem shall comply with the IF interface and frequency requirements specified in Table A.9-2, IF Interface Requirements, and Table A.9-3, IP Intermittent Frequency Requirements.

Table A.9-2. IF Interface Requirements

PARAMETER	REQUIREMENT
Input and output independence	Input and output parameters shall be independently settable
IF Frequency	L-Band.
IF Output Frequency Setability	1 kHz steps
Hub IF Output Frequency Stability (internal reference)	1 x 10E-8 per day
Hub IF Output Frequency Accuracy	1 x 10E-7 at 1 hr after internal reference startup
IP Modem IF Output Frequency Stability	6 x 1E-8 after achieving downstream NCR lock
IF Output Spectral Shape	As specified in Figure X.X.3.5-1

PARAMETER	REQUIREMENT
Spectral Inversion	Modulator output spectrum shall not be inverted
IF Output Power Level	At minimum, 0 to -25 dBm in <0.5dB increments
IF Output Impedance	50 ohms or 75 Ohms
IF Input Desired Carrier Power	-55 to -10 dBm
IF Input Impedance	50 ohms
IF Input Doppler Mitigation	As specified in Paragraph X.X.3.5.2.5
IF Output Spurious Emissions	IF Output Spurious Emissions shall be –less than -50 dBc for information rates >2048 kbps and less than -40 dBc for information rates ≤2048 kbps
IF Output Harmonics	IF Output Harmonics shall be less than or equal to -50 dBc
LEGEND:	
dB decibel	IF Intermediate Frequency
dBc decibel (referenced to carrier)	kHz Kilohertz
dBm decibel (referenced to milliwatts)	

Table A.9-3. IP Intermittent Frequency Requirements

CARRIER DEVICE	INTERMEDIATE FREQUENCY
Satellite	70 MHz, 950-2050
Terrestrial Microwave	250 MHz, 70 MHz or 75 MHz
FM Radio	262 kHz, 455 kHz, 1.6 MHz, 5.5 MHz, 10.7 MHz, 10.8 MHz, 11.2 MHz, 11.7 MHz, 11.8 MHz, 21.4 MHz, 75 MHz and 98 MHz
LEGEND:	
FM Frequency Modulation	kHz Kilohertz
IP Internet Protocol	MHz Megahertz

A.9.3.5.2.5 Doppler Performance

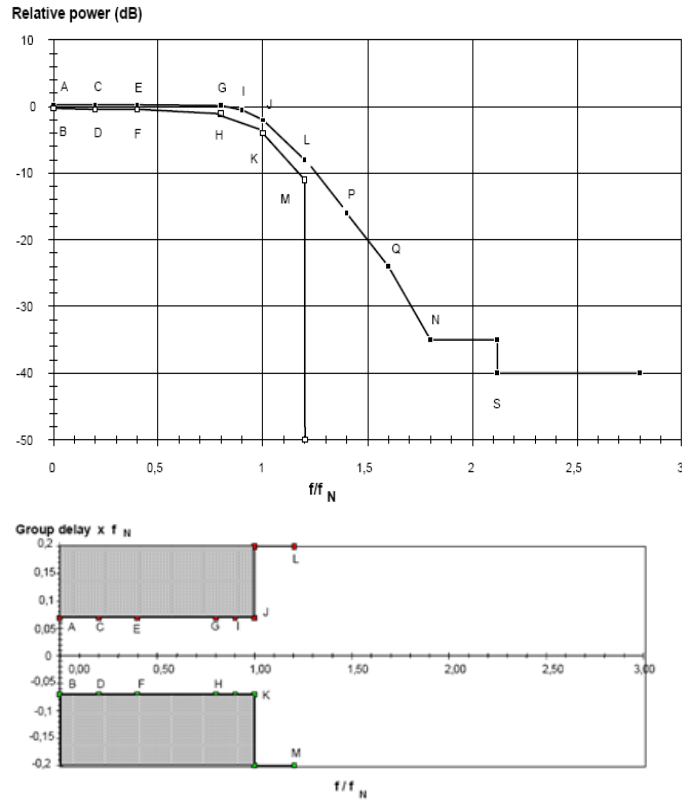
TAC-002510 [**Required**] The IP modem shall maintain its specified performance under all of the satellite Doppler conditions listed in Table A.9-4, Satellite Doppler Conditions, up to seven (7) degrees of orbital inclination:

Table A.9-4. Satellite Doppler Conditions

PARAMETER	C-BAND	X-BAND	KU-BAND	KA-BAND
Doppler Shift in Hz	± 2,475	± 3,535	± 6,045	± 11,810
Doppler Rate of Change in Hz/sec	± 226	± 270	± 490	± 1,046
Doppler Acceleration in Hz/sec^2	± 243	± 290	± 526	± 1,124
LEGEND:				
Hz Hertz		sec second		

A.9.3.5.2.6 Spectral Confinement

TAC-002520 [**Required**] The IP Modem modulator output signal spectral confinement, group delay, and demodulator input filter mask shall be as specified in the spectral density limit mask and group delay chart shown in Figure A.9-1, Modulator Signal Spectral Density Limit Mask and Group Delay.



POINT	FREQUENCY FOR □ = 0.35	RELATIVE POWER (DB)	GROUP DELAY
A	0.0 f_N	+0.25	+0.07 / f_N
B	0.0 f_N	-0.25	-0.07 / f_N
C	0.2 f_N	+0.25	+0.07 / f_N
D	0.2 f_N	-0.40	-0.07 / f_N
E	0.4 f_N	+0.25	+0.07 / f_N
F	0.4 f_N	-0.40	-0.07 / f_N
G	0.8 f_N	+ .15	+0.07 / f_N
H	0.8 f_N	-1.10	-0.07 / f_N
I	0.9 f_N	-0.50	+0.07 / f_N
J	1.0 f_N	-2.00	+0.07 / f_N
K	1.0 f_N	-4.00	-0.07 / f_N
L	1.2 f_N	-8.00	-
M	1.2 f_N	-11.00	-
N	1.8 f_N	-35.00	-
P	1.4 f_N	-16.00	-
Q	1.6 f_N	-24.00	-
S	2.12 f_N	-40.00	-

Legend:
dB decibel FN Frequency

Figure A.9-1. Modulator Signal Spectral Density Limit Mask and Group Delay

TAC-002530 [**Required**] IP Modem products shall transmit in a single or range of frequencies as listed in Figure A.9-1, Modulator Signal Spectral Density Limit Mask and Group Delay.

A.9.3.5.2.7 IP Encapsulation

TAC-002540 [**Required**] The IP Modem shall support the following IP characteristics:

a. The IP Modem shall provide a Single Transport Stream or a single generic stream for the forward link carrier.

b. The IP Modem shall provide encapsulation of IP packets on the forward link that is compliant with MPE (EN 301 192), GSE (TS 102 606) or equivalent.

A.9.3.5.2.8 IPv6

TAC-002550 [**Required**] The IP Modem shall support the mandatory requirements of DoD IPv6 Standard Profiles for IPv6 Capable Products published in the DISR for the applicable equipment categories.

TAC-002560 [**Required**] The IP Modem shall support simultaneous, dual-stack, IPv4 and IPv6 packet processing

TAC-002570 [**Required**] The IP Modem shall extract information from IPv6 packet headers and support transparent IPv6 packet forwarding for unicast and multicast services.

TAC-002580 [**Required**] The IP Modem shall support the following IP dynamic routing protocols for IPv6 unicast and multicast traffic.

a. Open Shortest Path First, Version 2 (OSPF v2) per RFC 2328.
b. Border Gateway Protocol version 4 (BGP-4), per RFC 4271.
c. Routing Information Protocol, next generation(ng) (IPv6) (RIPng) per RFC 2080.

TAC-002590 [**Required**] The IP Modem shall support DHCPv6 and DHCPv6 relay.

TAC-002600 [**Required**] The IP Modem shall support a local DNS cache for IPv6 addresses.

TAC-002610 [**Required**] The IP Modem shall support IPv6 Neighbor Discovery (ND).

A.9.3.6 Assured Service Requirements

A.9.3.6.1 Class of Service

The IP Modem shall manage communications resources to satisfy its traffic and QoS requirements. Resources shall be allocated using a per network QoS strategy. Higher priority traffic classes shall be allocated before lower priority traffic classes within the defined QoS policy.

TAC-002620 [**Required**] The IP Modem shall support Mechanism Message Authentication Code (MAC) Messages or equivalent as required by the non-optional requirements of EN 301 790.

TAC-002630 [**Conditional**] The IP Modem may comply with non-optional MAC Message requirements of EN 301 790 including the following methods:

- Mini-slot Method.
- Data Unit Labeling Method.

TAC-002640 [**Required**] The IP Modem shall be capable configuring VLAN IDs (VIDs). VIDs on an ingress port shall be configurable to any of the 4094 values (except 0 and 4095 are reserved). Each VLAN shall support independently routable IP address spaces.

TAC-002650 [**Required**] The IP modem shall be able to support up to 7 VLANs simultaneously.

TAC-002660 [**Required**] The IP Modem shall be capable supporting port-based VLANs, and VLANs using 802.1q tagged packets at the modem Ethernet interface.

A.9.3.6.2 QoS

IP Modem products shall support configurable traffic classification and QoS as follows:

TAC-002670 [**Required**] The IP Modem shall support traffic classification for the purpose of QoS assignment based on DSCP as defined in RFC 2474/2475, source IP address, destination IP address, destination port, and VLAN.

TAC-002680 [**Required**] For each traffic classification, the IP Modem shall support priority levels and weighted fair queuing with configurable parameters.

TAC-002690 [**Required**] The IP Modem shall be capable of accepting any packet tagged with a DSCP (0-63) on an ingress port and reassign that packet to any new DSCP value (0-63). Default DSCPs are provided in Table A.9-5.

Table A.9-5. Default DSCPs

	AGGREGATE SERVICE CLASS	GRANULAR SERVICE CLASS	DEFAULT DSCPS		
			BASE 2	BASE 10	BASE 16[3]
1	Control	Network Control	110 000-111 000	48-56	0xC0 – 0E0
2	Inelastic/Real Time	User Signaling[1]	101 000-101 111	40-47	0xA0 – 0xBC
		Circuit Emulation[1]			
		Short Messages[1]			
		Voice[2]			
		Video/VTC	100 000-100 111	32-39	0x80 – 0x9C
		Streaming	011 000-011 111	24-31	0x60 – 0x7C
3	Preferred Elastic	Interactive Transactions	010 000-010 111	16-32	0x40 – 0x5C
		File Transfers	001 000-001 111	8-15	0x20 – 0x3C
4	Elastic	Default	000 000-000 111	0-7	0x0 – 0x1C

Notes:
1. All user signaling (voice and video) may be grouped into this granular service class. User signaling, circuit emulation, and short messages may use the same DSCP.
2. Voice traffic must be differentiated with a different DSCP from user signaling, circuit emulation, and short messages.
3. DSCP Hexadecimal (Base 16) values assume last two bits of the 8 bit field to be 00.

Specific DSCPs for each precedence level are contained in UCR Section 6, Network Infrastructure End-to-End Performance Requirements.

Definitions of granular service classes are provided in UCR Section 6, Network infrastructure End-to-End Performance Requirements.

	AGGREGATE SERVICE CLASS	GRANULAR SERVICE CLASS	DEFAULT DSCPS		
			BASE 2	BASE 10	BASE 16[3]

LEGEND:

DSCP	Differentiated Services Code Point	VTC	Video Teleconferencing
UCR	Unified Capabilities Requirements		

TAC-002700 [**Required**] The QoS mechanism shall support at least four traffic classes: Control & Signaling; Real-time Streaming; Preferred Data; Best Effort.

TAC-002710 [**Required**] The IP Modem shall be capable of accepting any packet tagged with a DSCP (0-63) on an ingress port and assign that packet to a QoS behavior listed in UCR 2008, Section 5.3.1.3.6, Quality of Service Features.

TAC-002720 [**Required**] The IP Modem shall allow configuration and mapping of user traffic DSCPs to traffic classes for each network based on Per Hop Behavior (PHB).

TAC-002730 [**Required**] The modem shall be configurable so that the Control and Real Time traffic shall be treated as Priority Traffic and have a PHB served through a Priority Queuing mechanism.

TAC-002740 [**Required**] The Streaming and Preferred Data traffic shall be treated as higher service classes than Best Effort with a PHB serviced through a queuing mechanism that can guarantee delivery of this traffic up to a configured maximum.

TAC-002750 [**Required**] The IP Modem shall be configurable to allocate for each of the service classes:

a. A percent of the configured network information rate of the air interface or a percent of the minimum/maximum user information rate per remote.

b. To prevent starvation of the Best Effort and other class traffic queues, the IP Modem shall police Priority traffic and Preferred traffic such that it is not permitted to exceed its allocated rate.

TAC-002760 [**Required**] The IP Modem shall ensure that the DSCP values of IP datagrams appear the same on the terrestrial interface at the egress of the IP Modem network as they were at the ingress of the datagrams on the terrestrial interface of the IP Modem network.

TAC-002770 [**Required**] The Forward Link encapsulators shall have the capability to provide guaranteed bandwidth on the FL TDM per IP Input (Multicast destination Address, IP Unicast destination range, etc).

TAC-002780 [**Required**] The IP Modem shall support the following (as a minimum) Capacity Request categories, as defined by EN 301 790 for Return Channel via Satellite:

a. Absolute Volume Based Dynamic Capacity (AVBDC).

b. Free Capacity Assignment (FCA).

TAC-002790 [**Required**] The IP Modem may optionally support the following Capacity Request categories, as defined by EN 301 790 for Return Channel via Satellite:

a. Rate Based Dynamic Capacity (RBDC).

b. Committed Rate Assignment (CRA).

TAC-002800 [**Required**] The IP Modem shall provide configuration support to map resources at the Media Access Control (MAC) layer (capacity categories) from Layer 3 (PHBs, service classes or IP 5-tuple).

TAC-002810 [**Required**] The IP Modem must be able to support the prioritization of aggregate service classes described in Table A.9-6, Traffic Prioritizations. Traffic Prioritizations Prioritized service classes shall be queued according to UCR 2008, Section 7.2.1.6, Quality of Service Features.

Table A.9-6. Traffic Prioritizations

AGGREGATE SERVICE CLASS		GRANULAR SERVICE CLASS	PRIORITY
1	Control	Network Control	1
2	Inelastic/ Real-Time	User Signaling	2
		Circuit Emulation	2
		Short Messages	2
		Voice	3
		Video/VTC	4
		Streaming	5
3	Preferred Elastic	Interactive Transactions and OA&M	6
		File Transfers and OA&M	7
4	Elastic	Default	Best Effort

LEGEND:
OA&M Operations, Administration, and Management VTC Video Teleconferencing

TAC-002820 [**Conditional**] If provided, then the following CoS requirements apply:

a. The IP Modem shall be capable of accepting any frame tagged with a user priority (0-7) on an ingress port and assign that frame to a QoS behavior listed in UCR 2013, Section 7.2.1.6, Quality of Service Features.

b. The IP Modem shall be capable of accepting any frame tagged with a user priority (0-7) on an ingress port and reassign that frame to any new user priority value (0-7).

TAC-002830 [**Required**] IP Modem products may support the 3-bit user priority field of the IEEE 802.1Q 2-byte Tag Control Information (TCI) field (see Figure UCR 7.2-1, IEEE 802.1Q Tagged Frame for Ethernet, and UCR Figure 7.2-2, TCI Field Description). The default values are provided in Table 7.2-1 of the 802.1Q Default Values.

a. Provide a minimum of four (4) queues (see Figure 7.2-6).

b. Assign any "tagged" session to any of the queues.

c. Support Differentiated Services (DiffServ) per hop behaviors (PHBs) per RFCs 2474, 2494, 2597, 2598, and 3246 as listed in Figure 7.2-6

d. Support the following requirements:

(1) Weighted Fair Queuing (WFQ) IAW RFC 3662.

(2) Priority Queuing (PQ) IAW RFC 1046.

(3) Class-Based WFQ IAW RFC 3366.

e. All queues shall be capable of having a bandwidth (BW) assigned (i.e., queue 1: 200 kbps, queue 2: 500 kbps, etc.) or percentage of traffic (queue 1: 25 percent, queue 2: -25 percent, etc.).

A.9.3.6.3 QoS Performance and Delay

TAC-002840 [**Required**] The IP Total Delay (IPTD), Inter-Packet Delay Variation (IPDV) and IP Packet Loss Ratio (IPLR) for the IP Modem shall meet the performance parameters as specified in Table A.9-. These numbers are inclusive of encryption enabled and satellite link best case round-trip propagation delay of 472 ms. The system loading shall be configured such that the outbound channel is at least 50% utilized, and the inbound channel is at least 50% utilized. The measurements shall be taken while the system is in steady state. The IPTD is a combination of modem processing delay plus propagation delay. The IPTD is measured from the IP stream entering the IP Modem from the LAN interface to the IP stream exiting the paired IP Modem. IPDV is measured one-way from IP Modem to IP Modem. Packet Loss Ratio is the ratio of packets received to packets sent from the IP Modem. Performance thresholds are listed in Table A.9-7, Performance Thresholds for IP Modem Satellite Networks.

Table A.9-7. Performance Thresholds for IP Modem Satellite Networks

TRAFFIC CLASS	IP TOTAL DELAY	RMS JITTER	PACKET LOSS RATIO
Control & Signaling	300 ms	25 ms	<0.01%
Real Time	300 ms	25 ms	<0.015%
Preferred Data	375 ms	NS	<0.01%
Best Effort	NS	NS	NS
Note: Measured without congestion			

TRAFFIC CLASS	IP TOTAL DELAY	RMS JITTER	PACKET LOSS RATIO
LEGEND:			
ms Millisecond		VTC Video Teleconferencing	
NS Not Specified			

A.9.3.7 Transmission Security

TAC-002850 [**Conditional**] All information routed to the satellite (via the IF interface) must be protected with TRANSEC when interoperability compatibility exists with this standard.

A.9.3.8 Network Management

A.9.3.8.1 Network Management – IP Modem – Local Operator Functions and Interfaces

TAC-002860 [**Required**] At a minimum, the IP Modem shall provide means for a local (connecting from LAN interface) operator to execute the following:

- Provide an initial configuration when necessary.
- Upgrade the modem's software and firmware.
    a. Access a local web interface provided by the terminal to monitor performance parameters such as IP statistics, Tx/Rx signal power, latency, routing table information, faults, alarms and system logging information.
    b. Access a local web interface to provide TRANSEC initiation and management

The local web interface shall support operator functions using an external personal computer or laptop computer, hereafter termed the IP Modem Local Management Computer (LMC).

TAC-002870 [**Required**] The IP Modem shall connect to the LMC via an Ethernet or serial interface. The IP Modem shall be compatible with standard Secure Shell, Secure HTTP or SNMP and may also require the use of contractor-provided software.

TAC-002880 [**Required**] Front panel controls and indicators shall be provided, as necessary, to implement required TRANSEC Passphrase entry, loading of seed key and TRANSEC Bypass activation. Alternative solutions not requiring front panel controls to accomplish these same functions are acceptable.

A.9.3.9 Network Management – Remote Operator Functions and Interfaces

TAC-002890 [**Required**] The IP Modem shall provide a mechanism for the operator to execute all necessary NMS functions in a secure fashion utilizing the provided systems over-the-air (satellite link) interface as well as supporting the local operator as discussed in 9.3.8.1 above. As a minimum, IP Modem shall support the following network management functions:

TAC-002900 [**Required**] The IP Modem products shall support the following network control and monitoring features via a secure protocol:

a. Remote update of IP Modem configuration.

b. Remote update of IP Modem software and firmware.

c. Remote status monitoring of critical IP Modem parameters.

TAC-002910 [**Required**] The IP Modem shall provide a separate logical communications network for exchange of network management and control information between the IP Modem and a centralized network management system.

TAC-002920 [**Required**] The IP Modem will be capable of performance management, including the ability to measure, report, analyze, and adjust the IP Modem performance including but not limited to throughput, bandwidth utilization, network utilization, availability, latency, and packet error rate (PER).

TAC-002930 [**Required**] The IP Modem shall be capable of performance management functionality per network and per QoS traffic class.

TAC-002940 [**Required**] The IP Modem shall calculate and report the Information/Traffic Throughput Rate, which is the actual user traffic traversing the IP Modem network, for both outbound and inbound links by taking into consideration overhead factors.

TAC-002950 [**Required**] The IP Modem will provide fault management capabilities, including the ability to detect, log, isolate, and respond to fault conditions at the IP modem.

TAC-002960 [**Required**] The IP Modem will have the ability to perform security key distribution and to control access of the IP Modem to network resources and protect against hackers, unauthorized users, and physical or electronic sabotage.

TAC-002970 [**Required**] The IP Modem shall allow network administrators to control what each individual authorized user can (and cannot) do with the system.

TAC-002980 [**Required**] The IP Modem shall have the ability to control and monitor Network TRANSEC functions, including key management.

A.9.3.9.1 Demand Assigned Multiple Access (DAMA)

TAC-002990 [**Required**] The IP Modem shall support DAMA for MF-TDMA channel access.

TAC-003000 [**Required**] The IP Modem shall support a DAMA signaling protocol for communications between IP Modems. At a minimum, the DAMA signaling protocol shall provide efficient control and management information exchanges to enable the following functions:

a. IP Modem entry to the network.

b. Communications resource request and allocation, including priority and QoS traffic.

c. IP Modem exit from the network.

d. IP Modem status polling and reporting.

e. IP Modem remote configuration.

A.9.3.9.2 Network Management System Functions

TAC-003010 [**Required**] The IP Modem shall provide a mechanism for the operator to execute all necessary functions for the IP Modem at the terminal/site. As a minimum, IP Modem shall support the following network management functions:

a. Performance management, including the ability to measure, report, analyze, and adjust the IP Modem performance including but not limited to throughput, bandwidth utilization, network utilization, availability, and latency. Performance management functionality shall be available per network and per QoS traffic class. The IP Modem shall calculate and report the Information/Traffic Throughput Rate which is the actual user traffic traversing the IP Modem network for both outbound and inbound links by taking into consideration overhead factors.

b. Fault management, including the ability to detect, log, isolate, and respond to fault conditions at the IP Modem.

A.9.3.10 Remote Control and Network Management

TAC-003020 [**Required**] The IP Modem software and standard Microsoft Windows features (Secure HTTP and Secure Shell), Linux or Unix shall provide management functions necessary to remotely manage the IP Modem. The IP Modem shall support SNMPv1 and SNMPv2, at a minimum.

a. The IP Modem interface shall be used by the IP Modem to send aggregate performance notifications.

b. The IP Modem shall support SNMP network discovery by allowing IP Modem to collect status' of other IP Modems in the network.

A.9.3.11 Hardware Requirements

A.9.3.11.1 Hardware

TAC-003030 [**Required**] The IP Modem hardware components shall meet the requirements outlined in Table A.9-8, Hardware Requirements.

Table A.9-8. Hardware Requirements

PARAMETER		REQUIREMENT
a.	Packaging	Chassis-type components shall be mountable in a standard 19-inch rack
b.	Cooling	Shall not require external forced air cooling. The IP modem may provide its own forced air cooling.
c.	Electro-Magnetic Interference (EMI)	FCC Rules Part 15 (47CFR15, Sections 47CFR15.107 and 47CFR15.109 for Class B devices
d.	EMC Susceptibility	FCC Rules Part 15 for Class B devices
e.	Reliability	MTBF ≥ 40,000 hours in a Ground Fixed Environment using Telcordia SR-332 prediction
f.	Maintainability	MTTR ≤ 15 min at organizational level
g.	System Availability	0.9999
h.	AC Prime Power	Selectable 100-240V at 50-60Hz
i.	High Temperature, Operating (Sea Level)	60ºC (140ºF)
j.	High Temperature, Non-operating	60ºC (140ºF)
k.	Low Temperature, Operating	-30ºC (-22ºF)
l.	Low Temperature, Non-operating	-40ºC (-40ºF)
m.	Humidity, Operating	≤ 92 %, non-condensing
n.	Humidity, Transportation and Storage	100 %, non-condensing
o.	Internal Frequency Reference	Operable without external standard while meeting frequency stability requirements
p.	External Frequency Reference Input Interface	10 MHz from site frequency standard. Frequency reference should not be required for operation.
q.	10 MHz or 50 MHz (configurable) Frequency Reference Output Interface (-5 to +5 dBm at input port)	For associated VSAT block up converter and LNB
r.	24 VDC (4-5A max current) Power Output Interface	For associated VSAT block up converter
s.	13 and 18 VDC (-500mA max current) Power Output Interface, Switchable	For associated VSAT LNB
t.	Control Interface	Open AMIP v 1.7 for mobility
u.	Built In Diagnostics	As required to support MTTR

PARAMETER		REQUIREMENT	
LEGEND:			
A	Amp	mA	Milliamp
C	Celsius	MHz	Megahertz
dBM	Decibel (referenced in milliwatts)	MTBF	Mean Time Between Failures
EMI	Electromagnetic Interference	MTTR	Mean Time To Recover
F	Fahrenheit	SNMP	Simple Network Management Protocol
FCC	Federal Communications Commission	V	Volt
Hz	Hertz	VSAT	Very Small Aperture Terminal
LNB	Low-Noise Block Converter	VDC	Volts Direct Current

A.9.3.11.2 IP Modem Front Panel

The IP Modem shall allow the operator to execute the following functions using the front panel:

TAC-003040 [**Required**] The IP Modem front panel shall be equipped with a Key Fill Connector compatible with the AN/PYQ-10 Simple Key Loader (SKL) and capable of supporting the Seedkey loading functions specified in Paragraph C.5 of the Security Addendum. This Key Fill Connector interface shall be configured as specified in NSA Drawing ON241774. Alternatively, the IP modem may provide for secure over the air key distribution for TRANSEC without the need for an external key fill.

TAC-003050 [**Required**] The IP Modem front panel shall be equipped with the necessary controls and indicators to implement a TRANSEC Bypass, if the host network allows non TRANSEC terminals. Control of the TRANSEC bypass may alternatively be done through the front panel or through the Local Management Computer.

TAC-003060 [**Required**] If the IP modem requires a passphrase, the IP Modem front panel shall include a keypad and alphanumeric display for TRANSEC Passphrase entry. Alternately, passphrase entry may be done through the Local Management Computer.

TAC-003070 [**Required**] The IP Modem front panel shall be equipped with other controls and indicators for operation and maintenance functions required by the contractor's design including but not limited to power-on indicator, receive lock indicator, and logged on indicator.

A.9.3.11.3 Rear Panel

TAC-003080 [**Required**] The IP Modem chassis rear panel, as a minimum, shall include the following rear panel connectors and other features.

a. AC power.

b. Grounding stud.

c. IF input (if not included in the front panel).

d. IF output (if not included in the front panel).

e. Ethernet network interface for user traffic (if not included in the front panel).

f. Ethernet or serial interface compatible with standard personal/laptop computer (if not included in the front panel).

A.9.3.11.4 Human Engineering

TAC-003090 [**Required**] IP Modem equipment shall comply with the following Human Engineering requirements:

Front panel controls, displays, marking, coding, labeling, and arrangement schemes shall be uniform for common functions. The allocation of operational and maintenance functions to personnel and equipment shall be consistent with required safety, reliability, personnel skill levels, functional precision, and time constraints necessary for mission-effective IP Modem performance.

a. All front panel controls, displays, indicators, and associated labels shall be legible and easily visible in rooms with a general lighting level of 10 foot-candles without any aid over a ±30 degree viewing angle in the normal operating configuration.

b. The AC power on/off switches on the IP Modem rack(s) and chassis front panels shall be protected with a guard to prevent accidental activation.

A.9.3.11.5 Materials

1. Insofar as possible, nonflammable material shall be used.
2. Parts and materials that are not nutrients for fungus and are resistant to moisture shall be used in the IP Modem equipment whenever possible. Where use of fungi-nutrient materials is essential to the design, the materials shall be treated with fungicide agent.
3. The materials listed below shall not be used in the IP Modem equipment without written consent from the procuring agency:

   a. Asbestos: asbestos compounds and asbestos filled compounds.

   b. Cadmium.

   c. Carcinogens.

   d. Chlorofluorocarbons (CFCs), that is, Freon.

   e. Lithium and lithium compounds (except commercially-available batteries).

   f. Magnesium or magnesium alloys.

   g. Mercury or its compounds and amalgams.

   h. Polycarbonate Biphenyl (PCB).

i. Polyvinyl Chloride (PVC), except when used as component leads and cable insulation or jackets in NDIs.

j. Zinc or zinc alloys unless otherwise specified.

A.9.3.11.6 Nameplates and Product Marking

TAC-003100 [**Required**] A permanent nameplate that displays the information specified in the Statement of Work shall be affixed to the IP Modem equipment front panel(s).

TAC-003110 [**Required**] All IP Modem hardware components shall comply with the Unique Identification (UID) requirements of MIL-STD-130L.

A.9.3.11.7 Safety

TAC-003120 [**Required**] The IP Modem system shall be designed so that under all operating conditions specified herein (installation, operation, and maintenance) and under a likely fault condition (including human error), it protects against the risk of electric shock and other hazards.

a. Equipment shall meet the applicable requirements of the NFPA 70-93.

b. Equipment leakage current to ground shall not exceed 3.6 ma when tested in accordance with ANSI C101.1.

A.9.3.12 Software Requirements

A.9.3.12.1 Reprogrammability

TAC-003130 [**Required**] The IP Modem shall be able to receive software/firmware upgrades through unicast or multicast distribution over the air, or through a local Ethernet connection. The modem shall also be reconfigurable over the air.

A.9.3.12.2 IP Modem Options

TAC-003140 [**Required**] The IP Modem shall be equipped to enable optional capabilities to be implemented relying on software/firmware upgrades as much as possible.

A.9.3.12.3 Local Management Computer (LMC) Software

TAC-003150 [**Required**] The IP Modem application software necessary to provide functionality shall be supplied on a CD-ROM and be capable of operating on any commercial personal computer or laptop computer running Microsoft Windows or LINUX operating systems, unless the application is a standard web browser.

TAC-003160 [**Required**] Password authentication and connection encryption are required for the LMC to access the IP modem.

A.9.3.13 Information Assurance Requirements

TAC-003170 [**Required**] IP Modem products shall meet the security protocol requirements listed in UCR 2013, Section 4, Information Assurance Requirements, or FIPS 140-2.

TAC-003180 [**Required**] All user communications traffic routed to the IP Modem network interface will be either externally encrypted by HAIPE, or unencrypted SBU or lower traffic, and considered SBU.

A.9.3.14 Product Certification and Requirements Summary

TAC-003190 [**Required**] The contractor will be responsible for obtaining a series of certifications required by the Government prior to receiving a Unified Capabilities Interoperability certification. Certifications are required in the following areas.

a. Compliance with MILSATCOM criteria for operation on DSCS, GBS, and WGS.

b. Compliance with DVB-S2 standard (with TRANSEC bypassed).

c. NIST compliance with FIPS 140-2, Level 2 for TRANSEC.

d. Compliance with Information Assurance requirements specified in Section A.9.3.13, Information Assurance Requirements.

TAC-003200 [**Required**] Table A.9-9, is taken from Section7.2.3 of the UCR and summarizes product requirements and provides references to the governing documents.

Table A.9-9. Core, Distribution, and Access Product Requirements Summary

RQMTS	FEATURES	REFERENCES	APPLICABILITY
Physical Ports	Serial Port	EIA/TIA	R
	100Base T UTP	IEEE 802.3i	C
	100Base –FX	IEEE 802.3u	R
	1000Base-T UTP	IEEE 802.3u	C
	1000Base X Fiber	IEEE 802.3z	C
	10GBase-X	IEEE 802.3ae	C
Port Parameters	Auto-Negotiation	IEEE 802.3	R
	Force Mode	IEEE 802.3	R
	Flow Control	IEEE 802.3x	R
	Filtering	RFC 1812	R
	Link Aggregation	IEEE 802.3ad	C
	Spanning Tree Protocol	IEEE 802.1D	R
	Multiple Spanning Tree Protocol	IEEE 802.1s	C
	Rapid Reconfiguration of Spanning Tree	IEEE 802.1w	C
	Port Based Access Control	IEEE 802.1x 1	R

RQMTS	FEATURES	REFERENCES	APPLICABILITY
Traffic Prioritization	CoS Traffic Classes	IEEE 802.1D/Q	C
	DSCP	RFC 2474	R
VLANs	Port based	IEEE 802.1Q	R
	MAC based	IEEE 802.1Q	C
	Protocol based	IEEE 802.1Q	R
IPv4 Protocols	IPv4 requirements are contained within the DISR on-line RTS profiles for Core, Distribution, and Access products	DISR	R
IPv6 Protocols	See IPv6 profiles contained in the DISR	DISR	R
QoS	DiffServ PHBs	RFCs 3246, 2597	R
	Minimum 4 traffic queues	DoD CoS/QoS WG	R
	FIFO	RFC 3670	C
	WFQ	RFC 3662	R
	CQ	RFC 3670	C
	PQ	RFC 1046	C
	CB-WFQ	RFC 3366	C
Security	Security requirements are contained in the IA portion of the document		R

Notes:
1. Only between end-user and product; not trunks.
2. One of these queuing mechanisms is required to implement EF PHB.

LEGEND:

C	Conditional	IPv6	Internet Protocol version 6
CB-WFQ	Class-Based Weighted Fair Queuing	MAC	Media Access Control
CoS	Class of Service	PHB	Per-Hop Behavior
CQ	Custom Queuing	PQ	Priority Queuing
DiffServ	Differentiated Services	R	Required
DISR	DoD IT Standards Registry	RFC	Request for Comment
DoD	Department of Defense	RMON	Remote Monitoring
EF	Expedited Forwarding	RTS	Real-Time Services
EIA	Electronic Industries Alliance	TIA	Telecommunications Industry Association
FIFO	First-in First-out	UTP	Unshielded Twisted Pair
IEEE	Institute of Electrical and Electronics Engineers	VLAN	Virtual Local Area Network
IPv4	Internet Protocol version 4	WFQ	Weighted Fair Queuing