Changes to UCR 2008, Change 1, Section 5.9, Network Elements

NOTE: Section 5.9 was added as a new Section to UCR 2008, Change 1. The requirements now appearing in Section 5.9 were moved from Section 5.2.12.5 of the original UCR 2008. The changes listed below therefore reflect the original requirements from UCR 2008.

SECTION	CORRECTION	EFFECTIVE DATE
5.9.2	Added the definition of Direct Line of Sight (DLoS) Transport as new capability and applicability	Must Be Implemented Immediately if DLoS Transport used
5.9.2.1.1	Added DLoS Transport to Alarms	Must Be Implemented Immediately if DLoS Transport used
5.9.2.1.2.1	Revised latency to reflect actual deployment conditions (Increased delay parameters) for TDM congestion control	Must Be Implemented Immediately
5.9.2.1.2.2	Added that IP interface parameters in section 5.9.2.3.9 shall be meet by the IP Congestion Control for IP Transport	Must Be Implemented Immediately
5.9.2.1.2.3	Added a new requirements section for congestion control for DLoS Transport for both TDM, IP or combination thereof	Must Be Implemented Immediately if DLoS Transport used
5.9.2.3.9	Revised IP Interface for DLoS transport applicability in reference to Section 5.3.1.7.2 Wireless LAN	Must Be Implemented Immediately if DLoS Transport used is comprised of 802.11 a/b/g and/or 802.16
5.9.2.3.9	Revised latency to reflect actual deployment conditions (Increased delay parameters) for IP Interfaces for both secure and non-secure calls.	Must Be Implemented Immediately
5.9.2.4.5	Added new section on DLoS Transport on Mean Opnion Score, Maximum Transmission Range, and Measuring Methodology	Must Be Implemented Immediately if DLoS Transport used
5.9.2.5.1	Added new section on DLoS Transport Deployment Guidance for Maximum Deployment Range, Maximum Operational Range, and Weather Days calculation	Must Be Implemented Immediately if DLoS Transport used
5.9.2.5.2	Added new section on a Network Element utilizing DLoS Transport can operate as a Wireless Access Bridge connecting two LANs together	18 Month Rule Applies
5.9.2.5.3	Added new section on Submission of DLoS transport to UCCO for DSN Connection Request	Must Be Implemented Immediately if DLoS Transport used

SECTION	CORRECTION	EFFECTIVE DATE
5.9.2.6	Added general security requirements for all Network Elements	Must Be Implemented Immediately
5.9.2.6	Added new requirement for DLoS Transport Wireless Intrusion Detection System	Must Be Implemented Immediately if DLoS Transport used
5.9.3	Replace previous Random Burst Error testing environment with Satellite Burst Error testing environment	Must Be Implemented Immediately
5.9.3.1	Revised the digital error rate and application of error correction in the General Requirements	18 Month Rule Applies
5.9.3.1	Deleted the modem and facsimile requirements since redundant with Strategic Network Element since T-NE takes it requirements from S-NE unless otherwise noted.	Must Be Implemented Immediately

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5.9 NETWORK ELEMENT REQUIREMENTS

5.9.1 Introduction

This section describes the requirements that must be met by DSN Fixed network element (F-NE) and Deployed network element (D-NE) devices.

5.9.1.1 Purpose

The purpose of this section is to specify the NE requirements so they can be certified for use in the DSN.

5.9.1.2 Applicability

This requirement applies to all NEs procured or leased for installation in the DSN. All services, features, and functions (both unique military and standard commercial) identified in this section are to be implemented in DSN assets including switches, trunks, and ancillary equipment. This requirement also applies to upgrades and new software loads for existing equipment. This section is not applicable to those NEs that are covered explicitly in the UCR or by other sections.

5.9.1.3 Definitions

Definitions of terms can be found in Appendix A, Section A2, Glossary and Terminology Description.

5.9.2 DSN F-NE Generic Requirements

This section describes the requirements that must be met by DSN F-NE devices. The F-NE is referred to as NEs throughout Section 5.9.2 and its subparagraphs.

An NE is any component of a network through which the DSN bearer and signaling traffic transits. This may include either TDM or IP bearer and signaling traffic or both. The transport between NEs may be TDM, IP, or Direct Line of Sight (DLoS). For IP transport, the IP connection may transit a LAN, MAN, CAN, or WAN dependent on its deployment. It can interconnect LSC, MFSS, and SS VVoIP bearer and signaling traffic as well as transport all other IP traffic. For DLoS transport, this would include technologies such as Free Space Optics, millimeter wave or other RF formats, proprietary or standards-based, such as IP-based protocols (e.g., the 802.11 and 802.16 series). The DLoS is primarily used for point-to-point wireless network bridging between NEs. This means NEs using DLoS transport have no intervening bridge/relay/switch device between the actual transport devices. An NE using DLoS transport

may be comprised of a single transmitter/receiver device or operate with a separate receiver and transmitter elements, but still operate on the whole as a single NE. Additionally, the NE using DLoS transport may have redundant transmitter/receivers to increase reliability and to meet other stated requirements. The NEs may include multiplexers, routers, CSU/DSUs, compression devices, circuit emulation, channel banks, and/or any network device that could have an effect on the performance of the associated network traffic. Figure 5.9.2-1, Network Element Diagram, shows the typical NE as a standalone device or integrated into the transmission interfaces of switches or other network devices. Network Elements could be anything and everything in the route or path that connects DSN Switches, Non-DSN Switches, and/or IP devices not categorized elsewhere in this document (e.g., Multiplexers, Routers, CSU/DSUs, D-Channel Compression Devices, and/or Trunk Encryption). The use of NEs shall not provide the means to bypass the DSN as the first choice for all switched voice and dial-up video telecommunications between DoD user locations.

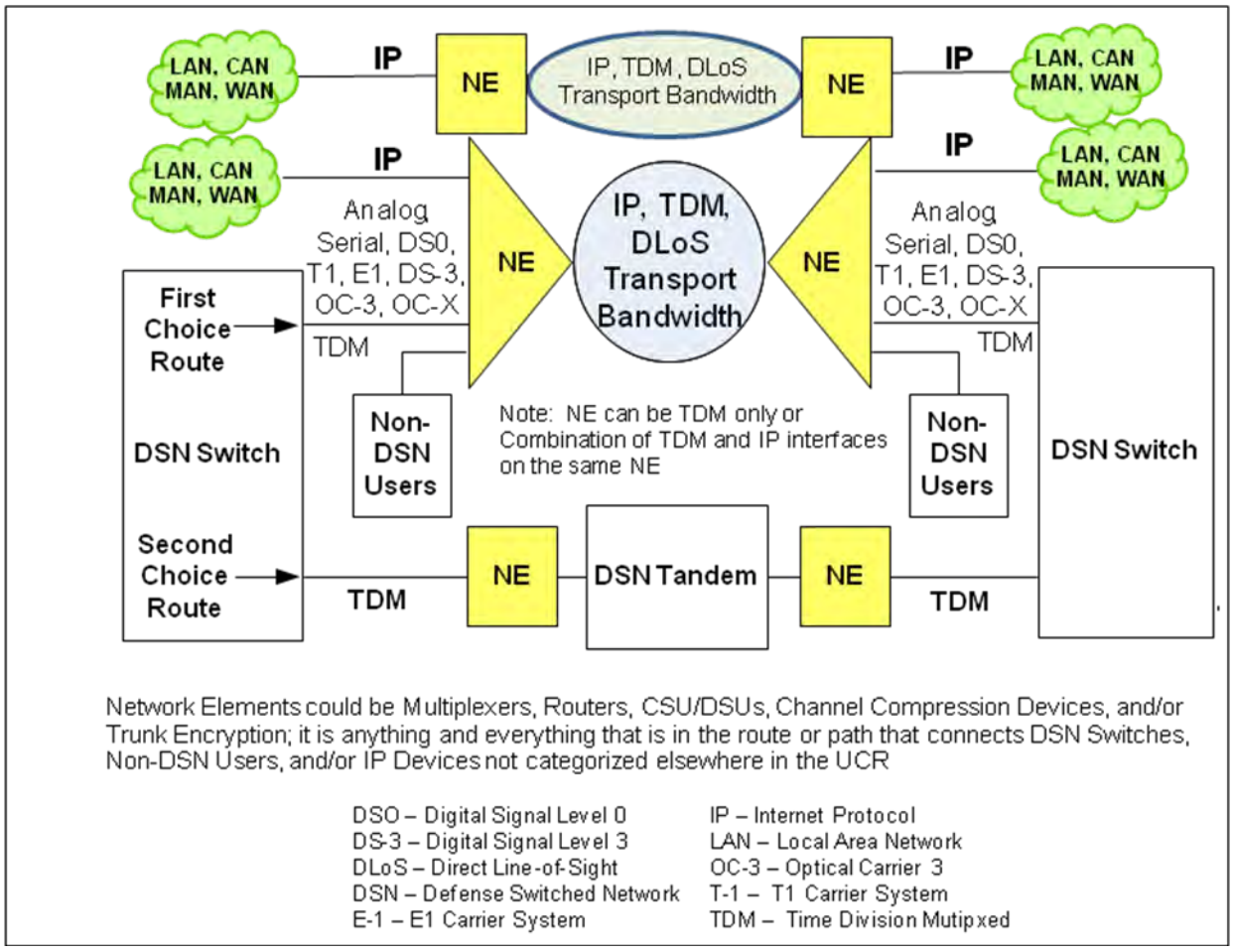

Figure 5.9.2-1. Network Element Diagram

As a minimum, the requirements in Section 5.9.2.1 include the features and capabilities considered necessary for a particular switch type to support warfighter missions in DoD. In addition to the compliance requirements of the main body of this UCR, all NEs are to be compliant with the following requirements and conditions.

5.9.2.1 General Requirements

[Required] All NEs shall meet the following general requirements and conditions:

1. The introduction of an NE(s) shall not cause the E2E average MOS to fall below 4.0 as measured over any 5-minute time interval.

2. The introduction of an NE(s) shall not degrade the E2E measured BER to no more than .03 percent from the baseline minimum E2E digital BER requirement which is not more than one error in $1x10^9$ bits (averaged over a 9-hour period).

3. The introduction of an NE(s) shall not degrade secure transmission for secure end devices as defined by UCR 2008, Section 5.2.12.6, DoD Secure Communications Devices.

4. The NE(s) shall support a minimum modem transmission speed of 9.6 kbps across the associated NE(s).

5. The NE(s) shall support a minimum facsimile transmission speed of 9.6 kbps across the associated NE(s).

6. The NE shall transport all call control signals transparently on an E2E basis.

5.9.2.1.1 Alarms

[Required] The NE shall be able to propagate Carrier Group Alarms (CGAs) in accordance with UCR 2008, Section 5.2.1.5.7, Carrier Group Alarm, upon physical loss of the TDM interface. Voice switching systems utilizing a TDM connection to a NE shall receive the proper CGAs from the NE upon loss of the transport link between NEs, regardless of whether the transport link is TDM, IP, or DLoS between the NEs. NEs that support IP ingress/egress traffic either as inbound or outbound NE traffic and/or transport between NE(s) shall support one or more of the following routing protocols: Link-State and/or Distance-Vector, such that the NE can notify the IP network (e.g., LAN, MAN), using one of the above routing protocols, the condition of its link state for transporting ingress IP traffic, namely operational or down.

5.9.2.1.2 Congestion Control

The NE shall assure that congestion between paired NEs does not affect DSN calls in progress or subsequent calls. Call congestion handling shall be met in one or more of the following ways.

5.9.2.1.2.1 For TDM Transport

[Conditional] The NE shall implement TDM congestion control via one of the following methods:

1. A dynamic load control signal (e.g., contact closure) shall be provided to the DSN switch in accordance with UCR 2008.

2. Congestion is not possible in the NE by nature of its functioning (e.g., a TDM multiplexer or transcoder).

3. A software capability in limiting the provisioning the ingress and egress interfaces making congestion impossible even under the worst congestion scenario. This can be done by limiting the bearer or aggregate provisioning.

[Conditional] The addition of NEs with TDM transports shall not increase the one-way latency per NE pair when measured from end to end over any 5-minute period specified as follows:

1. TDM ingress G.711 (non-secure calls) to non-transcoding G.711 TDM egress shall not increase delay more than 10 ms per NE pair as measured end-to-end.

2. TDM ingress G.711 (non-secure calls) to transcoding TDM egress with compression codecs (Section 5.9.2.2, Compression) shall not increase delay by more than 100 ms per NE pair as measured end-to-end.

3. TDM ingress G.711 (secure calls) to non-transcoding TDM egress G.711 shall not increase delay by more than 50 ms per NE pair as measured end-to-end.

4. TDM ingress G.711 (secure calls) to transcoding TDM egress with compression codecs (Section 5.9.2.2, Compression) shall not increase delay by more than 250 ms per NE pair as measured end-to-end.

5.9.2.1.2.2 For IP Transport

[Conditional] The NE(s) utilizing IP transport shall implement IP congestion control. Congestion may be controlled by using Differentiated Services, which shall be capable of providing preferential treatment for call congestion over other media types in accordance with

Section 5.3.3, Network Infrastructure E2E Requirements, and a capability to limit the provisioning of input, and output interfaces so congestion is impossible under the worst transport congestion scenario. The IP interface parameters subject to ingress/egress requirements shall be met IAW Section 5.9.2.3.9, IP Interface.

5.9.2.1.2.3 For DLoS Transport

The NE shall implement DLoS congestion control based on the DSN Traffic and signaling type to be transported.

[Conditional] The NE transporting only TDM bearer and signaling traffic shall implement DLoS congestion control via one or more of the following methods:

1. A dynamic load control signal (e.g., contact closure) shall be provided to the DSN switch in accordance with UCR 2008.

2. Congestion is not possible in the NE such that the maximum ingress throughput into the NE is configured such that it does not exceed the DLoS link maximum egress transport capability to include all DLoS overhead control traffic between the transport devices.

3. A software capability in limiting the provisioning of the ingress and egress interfaces making congestion impossible even under the worst congestion scenario. This can be done by limiting the bearer or aggregate provisioning.

[Conditional] The NE transporting only ingress IP traffic, and not using DLoS transport comprised of 802.11 a/b/g, 802.16-2004 (formerly 802.16d), or 802.16e-2005, shall implement DLoS IP congestion control per Section 5.9.2.1.2.2, For IP Transport. Additionally, IP congestion control may include a standards based or proprietary protocol between the NEs that will adjust the Quality of Service of the NE based on DLoS transport monitoring feedback to the NE to accommodate for changing environmental link conditions.

[Conditional] The NE transporting both TDM and IP ingress traffic simultaneously over the same DLoS transport link shall meet the following requirements:

1. **[Required]** The NE shall provide congestion control so it provides the same level of capability, respectively, for the appropriate traffic type, TDM and IP, per the requirements for single traffic type ingress/egress to the NE. Additionally, the congestion control may include a standards based or proprietary protocol between the NEs that will adjust the Quality of Service of the NE based on DLoS transport monitoring feedback to the NE to accommodate for changing environmental link conditions.

2. **[Conditional]** The use of DLoS transport shall not increase the one-way latency or packet delay per the requirements for TDM ingress and TDM or IP egress interfaces per the appropriate Section 5.9.2.1.2.1, For TDM Transport, and Section 5.9.2.3.9, IP Interface, respectively.

5.9.2.2 Compression

[Conditional] The NE used for voice compression shall support at least one of the following standards:

- ITU-T Recommendation G.726
- ITU-T Recommendation G.728
- ITU-T Recommendation G.729

5.9.2.3 Interface Requirements

5.9.2.3.1 Analog

[Conditional] The NE for an analog 2-wire or 4-wire trunk interface shall be in accordance with UCR 2008, Section 5.2.6.4, Analog Trunk Interface.

5.9.2.3.2 Serial

[Conditional] The NE used for serial interface connections shall be in accordance with one of the following standards:

- ITU-T Recommendation V.35
- TIA-232-F
- EIA-449-1
- TIA-530-A

5.9.2.3.3 BRI ISDN

[Conditional] The ISDN BRIe interface shall meet the requirements and conditions in accordance with UCR 2008, Section 5.2.1.3.3, National ISDN 1/2 Basic Access.

5.9.2.3.4 DS1 Interface Requirements

[Conditional] The T1 interface shall meet the requirements and conditions in accordance with UCR 2008, Section 5.2.6.1, PCM-24 Digital Trunk Interface.

5.9.2.3.5 E1 Interface Requirements

[Conditional] The E1 interface shall meet the requirements and conditions in accordance with UCR 2008, Section 5.2.6.2, PCM-30 Digital Trunk Interface.

5.9.2.3.6 DS3 Interface Requirements

[Conditional] The DS3 interface shall meet the following requirements and conditions.

5.9.2.3.6.1 Framing

[Required] Frame structure shall include M13 framing in accordance with ANSI T1.107-2002.

[Conditional] Frame structure may include C-bit parity application in accordance with ANSI T1.107-2002.

5.9.1.5.3.6.2 Line Coding

[Required] The line coding shall be bipolar 3 zero substitution (B3ZS) in accordance with ANSI T1.102-1993.

5.9.2.3.7 Timing

[Required] The NE shall be able to derive timing signal from an internal source, an incoming digital signal, or an external source in accordance with UCR 2008, Section 5.2.10.1, Timing Modes.

5.9.2.3.8 OC-X Interface Requirements

[Conditional] OC-X interface shall be in accordance with UCR 2008, Section 5.2.12.2, DSN Switch SONET Digital Trunk Interface, and/or appropriate SONET commercial standards. (NOTE: X stands for the capacity (e.g., 3, 48, 192 and higher).

5.9.2.3.9 IP Interface

[Conditional] The NE having an IP interface and using DLoS transport comprised of 802.11 a/b/g, 802.16-2004 (formerly 802.16d), and/or 802.16e-2005 instead shall meet the requirements for a Wireless Access Bridge in Section 5.3.1.7.2, Wireless. All other IP configurations shall meet the following:

1. Delay. The addition of NEs with IP transports shall not increase the one-way latency per NE pair when measured from end to end over any 5-minute period as specified below:

   a. TDM ingress G.711 (non-secure calls) to non-transcoding G.711 IP Egress shall not increase delay more than 50 ms per NE pair as measured end-to-end.

   b. TDM ingress G.711 (non-secure calls) to transcoding IP egress with compression codecs (Section 5.9.2.2, Compression) shall not increase delay by more than 100 ms per NE pair as measured end-to-end.

   c. TDM ingress G.711 (secure calls) to non-transcoding G.711 IP egress shall not increase delay by more than 50 ms per NE pair as measured end-to-end.

   d. TDM ingress G.711 (secure calls) to transcoding IP egress with compression codecs (Section 5.9.2.2, Compression) shall not increase delay by more than 250 ms per NE pair as measured end-to-end.

2. Jitter. The addition of an NE shall not cause jitter measured from ingress to egress to increase by more than 5 ms averaged over any 5-minute period:

3. Packet Loss. The addition of an NE shall not cause packet loss measured from ingress to egress to increase by more than 0.05 percent averaged over any 5-minute period.

4. **[Required: F-NE, D-NE]** For VVoIP systems, if the system decrypts the VVoIP traffic and applies a proprietary encryption approach prior to transmittal between the two components of the single vendor system, then the system proprietary encryption approach shall be one of the encryption and integrity approved approaches defined in Section 5.4, Information Assurance Requirements.

   NOTE: For example, if the NE decrypts the AS-SIP with TLS packets between the NEs and re-encrypts using NE proprietary encryption methods, then the proprietary method must be one of the cryptographic methods defined in Section 5.4, Information Assurance Requirements, (e.g., IPSec with AES 128 bit encryption, HMAC-SHA1 for integrity, and DoD PKI for authentication). All Section 5.4, Information Assurance Requirements, approved encryption and integrity approaches use FIPS 140-2 cryptographic modules (or have been granted a formal waiver by NIST). It is also important to note that proprietary only refers to the lack of interoperability with a different vendor's NE and all cryptographic approaches used in Section 5.4, Information Assurance Requirements, are standards based.

   [Required: F-NE, D-NE] VVoIP systems that utilize proprietary encryption approaches within the system shall restore the VVoIP packets to their original format (e.g., AS-SIP with TLS and SRTP) upon exiting from the system to ensure the VVoIP session can complete successfully.

[Conditional] The IP interface shall meet the IP requirements detailed in the DISR and Section 5.3, IP-Based Capabilities and Features, inclusive.

5.9.2.4 Device Management

5.9.2.4.1 Management Options

[Required] The NE devices are to be managed by at least one of the following:

1. **[Conditional]** A front or back panel and/or external console control capability shall be provided for local management.

2. **[Conditional]** Remote monitoring and management by the ADIMSS as described in the UCR 2008, Section 5.2.8, Network Management, Section 5.2.8.3, Fault Management, and Section 5.2.8.4, Configuration Management.

5.9.2.4.2 Fault Management

[Conditional] Shall report any failure of self-test diagnostic function on non-active and active channels on a noninterference basis to the assigned NMS.

5.9.2.4.3 Loop-Back Capability

[Conditional] The NE shall provide loop-back capability on each of the trunk side interfaces in accordance with ITU-T Recommendation V.54.

5.9.2.4.4 Operational Configuration Restoral

[Required] Loss of power should not remove configuration settings. Unit should be restored to the last customer-configured state before the power loss, without intervention when power is restored.

5.9.2.4.5 DLoS Transport MOS, Maximum Transmission Range, and Measuring Methodology

[Conditional] The NEs using DLoS transport shall support the following:

1. **[Required]** Minimum MOS scores as defined in Section 5.9.2.1, General Requirements, performance requirement or better as measured in any 5-minute interval using P.862 testing standard.

2. **[Required]** The minimum acceptable Maximum Transmission Range (MTR) shall be 300 feet based on operating in an open air-minimal obstruction, clear line-of-sight environment with the DLoS transport device operating at or near full power mode. Based on the testing results, the estimated maximum performance range while still maintaining MOS requirements, as required in item 1, shall hereby be referred to as the NE DLoS transport MTR.

The MTR baseline-testing environment shall be while operating in an open air-minimal obstruction, clear line-of-sight environment with the DLoS transport device operating at or near full power mode. The NE shall be tested at a minimum operating height of 25 feet with a clear unobstructed line of sight between NEs at a minimum range of 150 feet. The NEs may be tested with attenuation inserted to simulate the actual NE DLoS transport capability from which the maximum MOS performance range MTR can be extrapolated.

The value determined shall be included in the APL report. Refer to Section 5.9.2.5.3, Submission of DLoS Transport NEs to UCCO for DSN Connection Request, concerning guidelines on submitting the DLoS transport NE engineering analysis package.

5.9.2.5 DLoS Deployment Guidance

5.9.2.5.1 DLoS Transport NE Maximum Deployment Range

DoD Components using DLoS transport NEs shall engineer the deployment of said transport devices to compensate for operational capacity usage and impairments. Local weather and clutter/reflections will affect the operational range of free space optics and RF DLoS transport NEs, respectively. Redundancy shall be factored in too. The following calculation will define the Maximum Deployment Range (MDR) for engineering purposes based on local conditions:

MDR=MOR(1-(WD/365))

The MDR between the DLoS transport transmit and receive devices compensated for redundancy, if used, capacity usage, weather, clutter and reflections which is to be submitted for engineering analysis per Section 5.9.2.5.3, Submission of DLoS Transport NEs to UCCO for DSN Connection Request. In mixed redundancy, DLoS transport environments, such as using free space optics and millimeter wave together, the furthest distance calculated will be the MDR value.

The maximum operational range (MOR) between the DLoS transport transmit and receive devices is based on the MTR as defined in Section 5.9.2.4.5, DLoS Transport MOS, Maximum Transmission Range, and Measuring Methodology, that is further compensated for local clutter and reflections per the line of sight the NEs are to be deployed. Also included in the calculation is the affecting performance factors for operational bandwidth utilization and required receive

power level to maintain MOS 4.0, versus baseband transport utilization requirement. The DLoS transport link redundancy, if used, shall also be factored into the analysis. This calculation is to be submitted as part of the engineering analysis per Section 5.9.2.5.3, Submission of DLoS Transport NEs to UCCO for DSN Connection Request.

Weather Days (WDs) is the best estimate of yearly average of weather impairment days as calculated over 2 consecutive years from the date of the submittal required per Section 5.9.2.5.3, Submission of DLoS Transport NEs to UCCO for DSN Connection Request. A WD is an operational weather impairment that is estimated to result in the MOS score to drop below 4.0 for more than 2 consecutive hours during a standard business day at the calculated MOR distance. More than 2 impairment hours constitutes as a single WD. Subsequent weather-related MOS impairments on the same calendar day do not constitute another WD. A summary of the WD data and yearly average calculation will be submitted as part of the engineering analysis per Section 5.9.2.5.3, Submission of DLoS Transport NEs to UCCO for DSN Connection Request.

5.9.2.5.2 TDM Only and IP over TDM Access

A NE with only TDM interfaces that uses a DLoS transport link can be used to transport TDM only or IP over TDM access traffic. Figure 5.9.2-2, TDM and IP over TDM Access via DLoS Transport NE, provides examples.

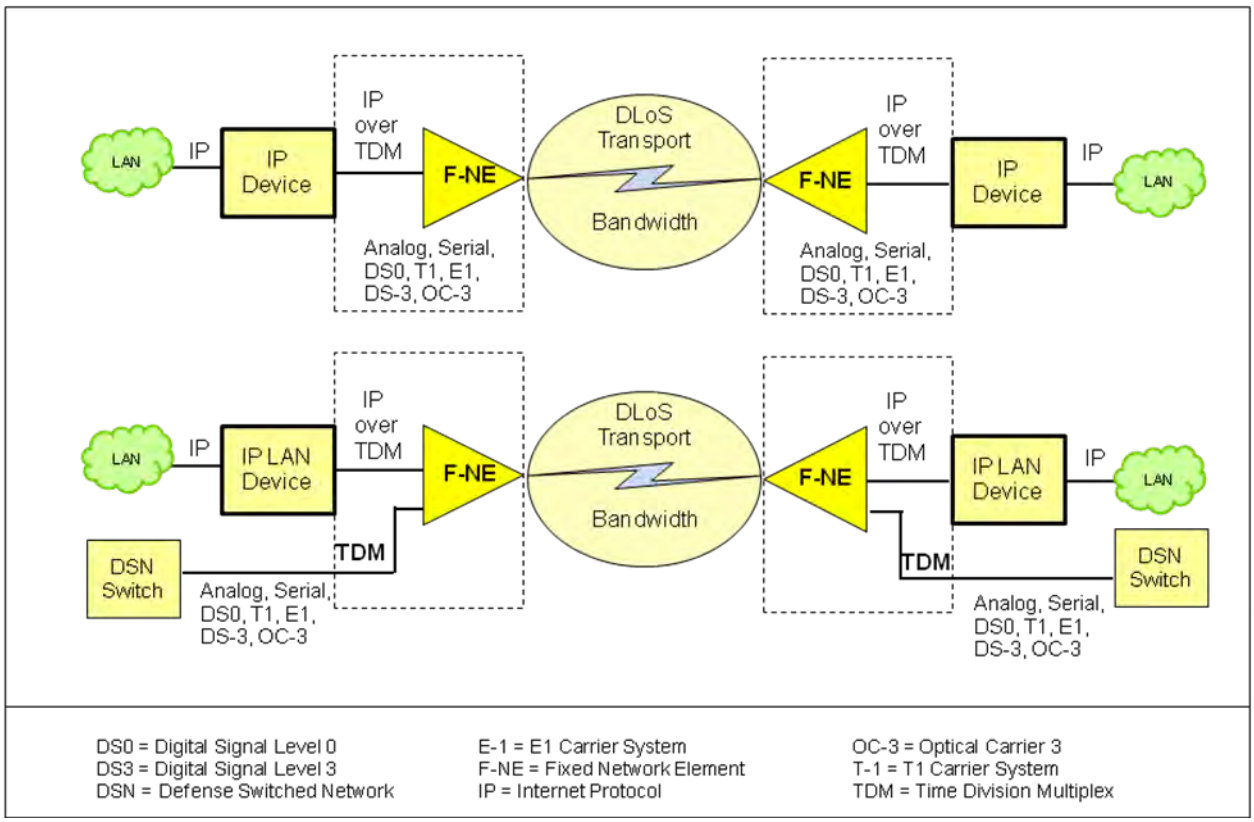

Figure 5.9.2-2. TDM and IP over TDM Access via DLoS Transport NE

The NE TDM only or IP over TDM Access interfaces can transport IP traffic provided it is deployed per the following conditions:

1. The IP device is listed on the APL either as a component of an ASLAN and/or CE Router.

2. The IP device meets the appropriate IP congestion controls for that IP device.

3. The connection from the IP device to the NE meets one or more of the NE interface requirements, other than IP, as described in Section 5.9.2.3, Interface Requirements.

4. The physical or configured capacity of the interface link (e.g., Section 5.9.2.3, Interface Requirements) from the IP device to the NE shall not exceed the transport capacity of the NE DLoS transport link, as determined in and modified per, or the portion thereof the transport link allocated to transport the IP traffic. The DLoS transport control traffic overhead will be included in traffic capacity determination.

5. Upon DLoS transport link loss in either direction between the NEs for IP over TDM connections, either the generated alarm from the NE shall be interpreted by the IP device as link failure and/or signaling packets, such as keep-alive packets or other standard routing

protocol/proprietary control means between the IP devices fails, will also be interpreted by the IP device as failure of the link connected to the NE.

5.9.2.5.3 Submission of DLoS Transport NEs to UCCO for DSN Connection Request

[Conditional] The DLoS transport NEs shall be engineered properly so that the DLoS transport transmitting/receiving devices achieve the required performance requirements in their specific deployed environment. The user shall submit a network design and engineering performance analysis with supporting calculations to meet minimum MOS performance with the request for DSN connection. Included is the calculation and data required for determining the MDR, as defined in Section 5.9.2.5.1, DLoS Transport NE Maximum Deployment Range. For certification procedures, the UCCO submittal shall also include wireless security compliancy as identified in Section 5.9.2.6, Security.

5.9.2.6 Security

[Required] All components of the NE shall meet security requirements, for each supported mode, as outlined in DODI 8510.01 and the applicable STIG.

5.9.2.7 DLoS Transport Wireless Intrusion Detection System

[Conditional] If a DoD-approved Wireless Intrusion Detection System (WIDS) exists for the DLoS transport technology used, the NE DLoS transport link shall be monitored. The system will have the following capabilities:

1. Continuous scanning. The WIDS will scan continuously around-the-clock to detect authorized and unauthorized activity.

2. Deployed systems shall be properly engineered so that the DLAB products achieve the required performance requirements in their specific structural environment. Users shall submit their network design with their request for DSN connection. The UCCO submittal shall include wireless security compliancy FIPS 140 and proposed accessibility as well as WIDS National Information Assurance Partnership (NIAP) Common Criteria validation for basic robustness. Medium robustness will be applied, as determined by the DAA, when the NIAP Common Criteria for that level is approved.

5.9.3 D-NE Requirements

[Required] The D-NEs shall meet all NE requirements specified in Section 5.9.2, DSN F-NE Generic Requirements, except as modified by the following paragraphs. The D-NEs shall be

tested under a simulated Deployed environment using the OAN architecture framework and the following parameters:

Inclusion of satellite-based transmission links. With respect to D-NE testing, the following parameters will be used when injecting burst errors into the network. The D-NE being tested shall continue to function as specified in Section 5.9.2.1, General Requirements, and Section 5.9.3.1, D-NE General Requirements, during such testing:

- Error Burst Density: The D-NE measured error burst density shall be $1x10^{-6}$.
- Error Burst Gap (gap between error bursts in ms): The measured D-NE error burst gap shall be 600 ms.
- Error Burst Length (length of error burst in ms): The measure D-NE error burst length shall be 500 ms.

5.9.3.1 D-NE General Requirements

[Conditional] The D-NEs may include voice compression, as specified in Section 5.9.2.2, Compression, to include the following additional compression standard: ITU-T Recommendation G.723.

[Conditional] Network element latency requirements for various codecs are defined in Section 5.9.2, DSN F-NE Generic Requirements. The D-NE allows for one additional codec, G.723.1. The latency introduced by a single D-NE using the G.723.1 codec shall be less than 90 ms. The latency introduced by a pair of D-NEs using the G.723.1 codec shall be less than 180 ms.

[Required] Voice calls placed through a set of D-NEs shall support a minimum MOS of 3.6 or better as measured in any 5-minute interval using the Perceptual Speech Quality Measure (PSQM) testing standard.

[Required] The introduction of a D-NE shall not cause the E2E digital BER to degrade the Tactical BER below $1x10^{-5}$ by more than 0.03 percent as measured over a 9-hour period. This value does not include the application of Forward Error Correction (FEC) but is the minimum acceptable value for Tactical transmission before FEC is applied.

[Required] The D-NE (when implemented in pairs) shall apply error correction to correct the errors interjected by the transport network between the two D-NEs such that the resulting BER of the external facing D-NE interface shall be better than $1x10^{-5}$ as measured over a 9-hour period.

[Required] The NE shall assure congestion within NEs does not affect DSN calls in progress or subsequent calls. Call congestion handling shall be met in one or more of the following ways:

1. A dynamic load control signal (e.g., contact closure) shall be provided to the DSN switch in accordance with Section 5.9.2.1.2, Congestion Control.

2. A software capability in limiting the provisioning the input and/or output interfaces such that makes congestion impossible even under the worst congestion scenario.

3. Congestion is not possible in the NE by nature of its functioning (e.g., a TDM multiplexer or transcoder).

5.9.3.2 D-NE TDM Requirements

[Conditional] The D-NE shall support at least one of the interfaces listed in Section 5.9.2, DSN F-NE Generic Requirements. To be certified for use, TDM interfaces shall meet the interface requirements for that specified interface. For interfaces provided, congestion control shall be provided as specified in Section 5.9.2.1.2, Congestion Control.

5.9.3.3 D-NE IP Requirements

Figure 5.9.3-1, D-NE Connectivity Using IP Transport, shows how IP can be used to provide transport for both D-NEs and Virtual Deployed Network Elements (VD-NEs). The D-NEs can also be used to pass data in addition to UC services (e.g., VVoIP).

[Conditional] The D-NEs may use IP as a means to transport voice communications between D-NEs. Interfaces supporting IP shall meet the appropriate specifications for that physical interface as stipulated in the latest DISR Baseline Release. The IP transport of voice services across D-NEs shall be accomplished through any one or more of the following methods: encapsulated TDM, long local, or PIPT.

[Required] For any IP transport methods used, D-NEs using IP interfaces shall meet the following parameters:

1. The addition of D-NEs shall meet the latency criteria specified in Section 5.9.3, D-NE General Requirements.

2. The addition of a D-NE shall not cause jitter measured from ingress to egress to increase by more than 5 ms averaged over any 5-minute period.

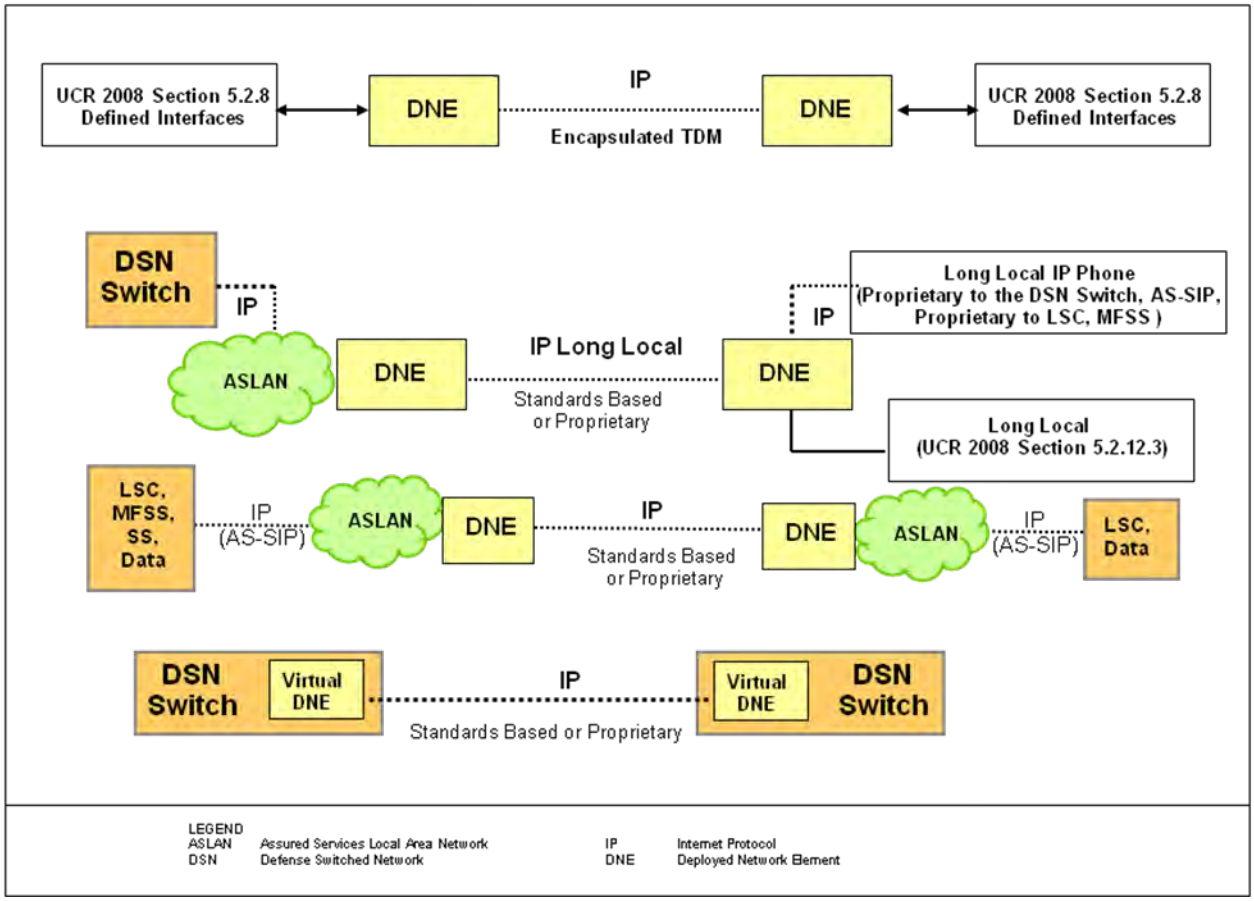

Figure 5.9.3-1. D-NE Connectivity Using IP Transport

3. The addition of a D-NE shall not cause packet loss measured from ingress to egress to increase by more than 0.05 percent averaged over any 5-minute period.

5.9.3.4 Encapsulated TDM Requirements

The D-NEs that use encapsulated TDM shall meet all the following requirements:

1. **[Required]** The D-NE shall use either differentiated services or integrated services to provide preferential treatment over IP transport.

2. **[Required]** The D-NE shall provide an IP bandwidth reservation/allocation mechanism to allow for the user-specified allocation of bandwidth to support the full nonblocking voice services requirement.

3. **[Required]** The D-NE shall implement IP congestion control. Congestion may be controlled by using differentiated services that shall be capable of providing preferential treatment for call congestion over other media types in accordance with Section 5.3.3,

Network Infrastructure E2E Requirements, and a capability to limit the provisioning of input and output interfaces, so congestion is impossible under the worst transport congestion scenario.

5.9.3.5 Carrier Group Alarms

[Required] The D-NE shall be able to propagate CGAs in accordance with UCR 2008, Section 5.2.6, System Interfaces, upon physical loss of the ingress TDM interface. Voice switching systems, DSN or DVX, shall receive the proper CGAs from the D-NE upon loss of the IP transport link between D-NEs.

5.9.3.6 Long-Local Requirements

The D-NEs that provide a long local shall meet all the following requirements:

1. **[Required: D-NE]** The D-NE shall provision features and functions to support the long-local device.

2. **[Required: D-NE]** The D-NE shall allocate enough bandwidth to support the long-local device to ensure assured services and nonblocking requirements are met.

5.9.3.7 Proprietary IP Trunk Requirements

[Conditional] Virtual D-NEs that use PIPT shall meet all the requirements specified in the following paragraphs:

1. **[Conditional]** The DVX VD-NE may use Proprietary IP signaling for this solution, and this interface shall support E2E ANSI T1.619a features and functions IAW UCR 2008, Section 5.2.2.7, ISDN MLPP PRI (i.e., Precedence, Preemption, MLPP Service Domain, Look Forward for Busy, Network Identifiers, and Coding Standard). The PIPT shall meet the appropriate specifications for IP voice signaling method protocols (i.e., H.323, SIPv2), as stipulated in the latest DISR Baseline Release to establish the virtual IP trunk session. Until a complete set of standards exists for MLPP over IP, initially vendors may implement proprietary protocols across the PIPT to ensure the complete MLPP functionality as detailed in UCR 2008, Section 5.2.2.7 is provided to the DSN IP telephony subscriber.

2. **[Conditional]** For DVX VD-NE switches that do not support MLPP, this interface shall support end-to-end ISDN PRI NI 1/2 features and functions (i.e., Bearer, Calling Number Delivery). The PIPT shall meet the appropriate specifications for IP voice signaling method protocols (i.e., H.323, SIPv2), as stipulated in the latest DISR Baseline Release to establish the virtual IP trunk session.

5.9.3.8 Secure Call Handling

[Required] In processing secure calls (SCIP) across conversion boundaries such as TDM to IP and/or IP to TDM, the D-NE shall utilize the V.150.1 standards implementation IAW.NSA SCIP-215 "U.S. Secure Communication Interoperability Protocol (SCIP) over IP Implementation Standard and Minimum Essential Requirements (MER) Publication" and SCIP 216 "Minimum Essential Requirements (MER) for V.150.1 Gateways Publication" for said ingress and egress conversions respectively. The D-NE shall support this NSA V.150.1 implementation capability on all D-NE interface ports where secure call conversion can occur. The secure call handling implementation on the D-NE shall also meet the requirements of Section 5.9.2.1, Sub-Requirement 3.

[Required] The secure call shall complete successfully as a minimum equal to or better than 85 percent of the time when used in the Deployed environment.

5.9.3.9 Voice Packet Multiplexing

[Conditional] A D-NE that is equipped with voice packet multiplexing, where individual small IP voice packets (from either the same or multiple sources) may be combined into a single larger IP packet. The D-NE shall be configurable to allow the operator to specify the maximum latency and/or packet size to provide flexibility in the actual implementation. The intent is to allow the system to trade off additional latency incurred by this process for the gain in packet processing efficiency.