**No Changes to UCR 2008, Change 3, Section 5.9, Network Element Requirements**

**This Errata sheet will be used as a placeholder for future changes made to this section.**

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# 5.9 NETWORK ELEMENT REQUIREMENTS

## 5.9.1 Introduction

This section describes the requirements that must be met by DISN 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 DISN.

### *5.9.1.2 Applicability*

This requirement applies to all NEs procured or leased for installation in the DISN. All services, features, and functions (both unique military and standard commercial) identified in this section are to be implemented in DISN assets including DSN 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 other sections of the UCR.

### *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.

Network Elements using DLoS transport have no intervening bridge, relay, or switch device between the actual transport devices. An NE using DLoS transport may be comprised of a single transmitter or 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 transmitters or 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. 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). However, an NE having an IP interface and using a DLoS transport comprised of 802.11 and/or 802.16 series standards shall instead, meet the requirements for a Wireless Access Bridge in Section 5.3.1.7.2, Wireless.

In terms of network arrangements, the DLoS can be used for direct Point-to-Point Link, Point-to-MultiPoint Link, and/or Mesh/Semi-Mesh Link arrangement. A Point-to-Point Link consists of two connection endpoints (CEs) with no intervening CEs in between. A Point-to-Multipoint Link is a specific type of multipoint link providing network traffic multiple paths from a single location to multiple locations. Such a link consists of a central CE that is connected to multiple peripheral CEs. Any transmission of data that originates from the central CE can be received by all of the peripheral CEs, a.k.a. multicast like, while any transmission of data that originates from any of the peripheral CEs is only received by the central CE. Wherein a Mesh/Semi-Mesh network arrangement implies a peer-to-peer type relationship between two or more multiple CEs

Given the three link architectures defined above, the NEs may operate in three defined architectural configurations: Point-to Point (P2P), Point-to Multipoint (P2MP) and Mesh/Semi-Mesh (M/SM). In P2P architecture, the two NEs have a single connection and traffic flow association; thus, the two NEs operate as a matched set only. The ingress traffic to the NE is the egress traffic of the other, and vice versa.

The P2MP and M/SM architectures behave somewhat the same; thus, they can be referred to as Point-to-Network (P2N) for NEs. In a P2N configuration, this is not the case. The P2N architecture defines all the physical route connections between the various NEs comprising the P2N. Wherein the P2N Association Path (AP) defines what ingress traffic types and bandwidth amount is routed via a specific NEs route path within that P2N architecture. The ingress traffic to one of the NEs in the P2N AP may fully or partially egress one or more of the other NEs. However, the aggregate egress from all NEs in the P2N architecture must be identical to the aggregate ingress of all of the NEs in the same P2N architecture. However, if operating in a P2MP mode that is applying multicast from a central NE to the peripheral NEs, the aggregate of the additional multicast traffic must be accounted for in the egress sum total.

A P2N architecture can be a star, full-mesh, semi-mesh, or other architecture configuration. Since P2N architectures can result in multiple serial NE hops from where the associated ingress and egress traffic enters and exits the P2N architecture, the Special Interoperability Test Certification Report will state the maximum latency for a P2N AP. This maximum AP latency will be the limiting design criteria for establishing the P2N deployment architecture.

Figure 5.9.2-1, Network Element Diagram, shows the typical P2P architecture where an NE can operate as a standalone device or integrated into the transmission interfaces of switches or other network devices. The same stand-alone or integrated capability also applies to NEs in a P2N architecture approach wherein the only difference in Figure 5.9.2-1 is that there are three or more NEs connected to the "Transport Bandwidth" interoperating. 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.

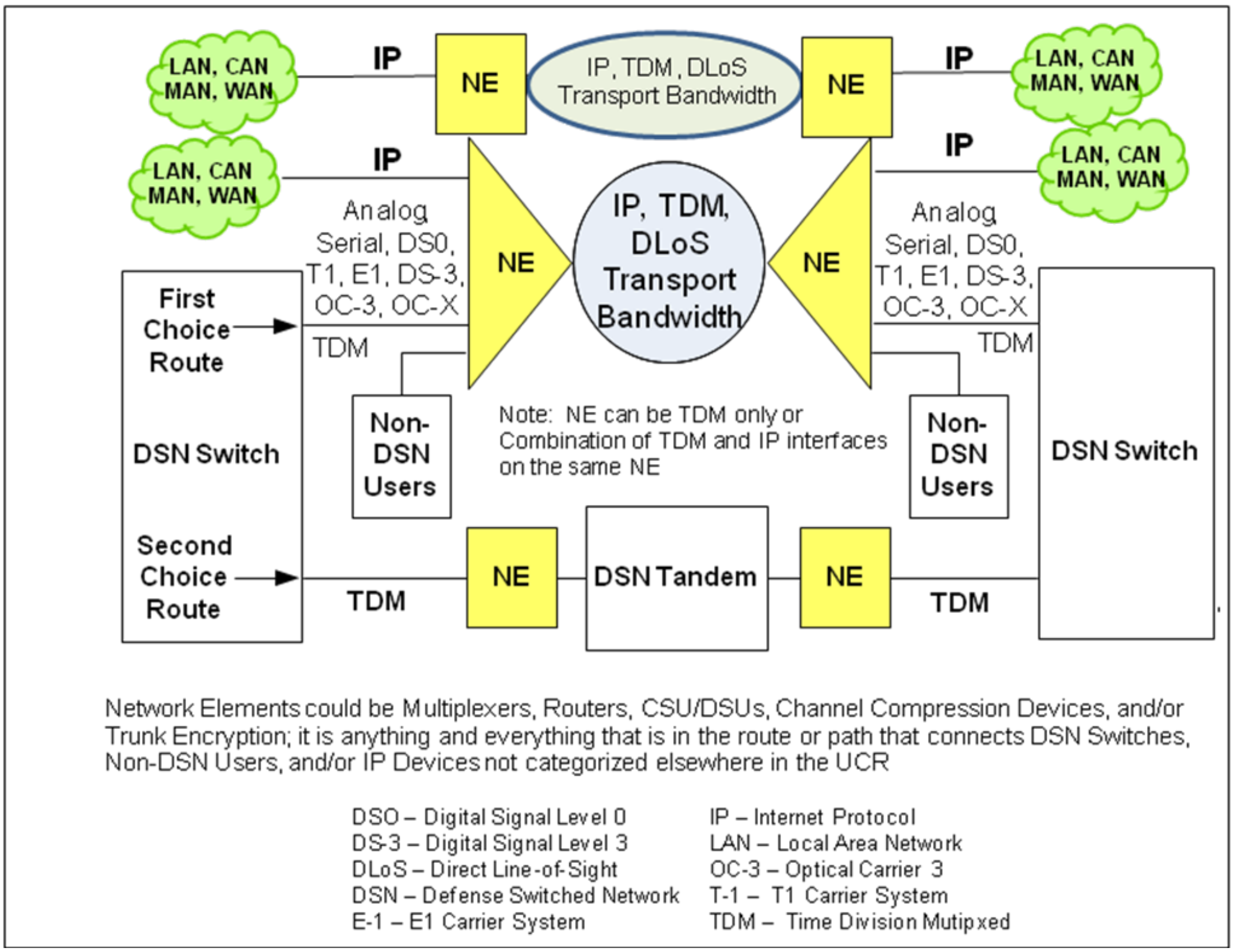


**Figure 5.9.2-1. Network Element Diagram**

As a minimum, the requirements in Section 5.9.2.1, General Requirements, 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*

The following are NE general requirements and conditions:

1. **[Required]** 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. **[Required]** 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. **[Required]** The introduction of an NE(s) shall not degrade secure transmission for secure end devices as defined in Section 5.2.2, DoD Secure Communications Devices.

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

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

6. **[Required]** The NE shall transport all call control signals transparently on an E2E basis.

7. **[Conditional]** The NEs that support a P2N capability shall meet the following additional requirements when deployed in a P2N architectural configuration:

   a. **[Required]** The aggregate egress from all NEs in the P2NP architecture must be identical to the aggregate ingress of all NEs in the same P2N architecture. However, if all or part of the P2N is operating in a P2MP mode that is applying multicast from a centrally designated NE to one or more of the associated peripheral NEs, the aggregate of the additional multicast traffic must be accounted for in the egress sum total

   b. **[Required]** Excluding latency, the P2N AP shall be measured as though it is a P2P architecture at the P2N AP NE endpoints ingress and egress points. As such, the P2N AP must meet all the other stated requirements of a P2P.

   c. **[Required]** For a given P2N AP, the maximum latency allowed E2E, as measured over any 5-minute period at the P2N AP NE ingress and egress points, shall be 5 ms or less, when added in addition to the expected P2P latency. Hence, as an example, if the expected P2P latency requirement for a P2N AP is 50 ms, then P2N AP maximum latency, regardless of the number of NE hops between the ingress and egress NEs, the measured value shall not exceed 55 ms.

## *5.9.2.1.1 Alarms*

**[Required]** The NE shall be able to propagate Carrier Group Alarms (CGAs) upon physical loss of the TDM interface. The NE shall provide the capability of detecting a carrier group alarm (CGA). When this alarm is detected, all associated outgoing trunks shall be made busy automatically to subsequent customer call attempts. Call attempts on associated incoming trunks shall not be processed. When possible, the Reverse Make Busy feature shall be exercised on incoming trunks. Voice switching systems using a TDM connection to an 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. The NEs that support IP ingress or 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, so the NE can notify the IP network (e.g., LAN, MAN), using one of these 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

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

   a. A dynamic load control signal (e.g., contact closure) shall be provided to the DSN switch per the following requirements:

      (1) The NE shall provide the capability to handle Carrier Group Alarm (CGA) indications from the carrier systems/equipment using the E-telemetry interface (scan points) for the TDM interfaces provided (e.g., DS0, DS1, and/or OC-X), and, comply to the Telcordia Technologies GR-303-CORE, System Generic Requirements, Objectives, and Interface, December 2000, Issue 4 and Telcordia Technologies TR-NWT-000057 that specifies the use of an COT-generated DC contact closure alarm to indicate an “all-accessible-channels-busy“ condition.

      (2) The NE when interfaced to the network that provides an E-telemetry interface type (scan points) for alarm management shall be capable of CGA management that is used to minimize the effects of carrier failures on switching systems and on service. CGA scan point (binary condition, i.e., “closed” contact for active and “opened” for inactive states) when “closed”

should busy out the failed circuits, release customers from the failed circuits, and prevent the failed circuits from seizing the DSN trunk equipment and prevent the NE from seizing the failed circuits.

(3) The DSN CGA System Operation can be divided into three parts, i.e., detection of the carrier failure, conditioning the failed trunk, and reaction of the switching equipment to the processing of the failure. Requirements for scan point CGA are:

(a) Sense Point Interface: The switching system shall provide sense points to which external CGAs can be interfaced to, so that failure of the carrier equipment shall cause the trunks to be removed from service.

(b) Call Processing Actions: Receipt of a CGA shall cause call processing to be aborted on associated trunks that are not in the talking state.

(c) Trunk Conditioning: Receipt of a CGA shall cause the following actions on the affected trunks:

(i) Idle trunks shall be removed from the idle list. Subsequent calls for service must be ignored for the duration of the CGA. Busy-back shall be returned on those incoming trunks, which are optioned for busy-back while in the out-of-service state and proper MLPP treatment shall be applied.

(ii) Trunks in the talking state shall be monitored for disconnect, after which they are to be placed in the same state as described above for idle trunks.

(4) Restoration of Service: All trunks affected shall be returned to their previous state after the CGA is removed.

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

c. 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.

2. **[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:

    a. Time Division Multiplexing ingress G.711 (nonsecure calls) to nontranscoding G.711 TDM egress shall not increase delay more than 10 ms per NE pair as measured end-to-end.

    b. Time Division Multiplexing ingress G.711 (nonsecure 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.

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

    d. Time Division Multiplexing 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) using IP transport shall implement IP congestion control. Congestion may be controlled by using DiffServ, which shall be capable of providing preferential treatment for call congestion over other media types IAW Section 5.3.3, Network Infrastructure End-to-End Performance 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 or 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.

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

    a. A dynamic load control signal (e.g., contact closure).

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

c. 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.

2. **[Conditional]** The NE transporting only ingress IP traffic, and using a DLoS transport, excluding 802.11, and/or 802.16 series standards, -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 QoS of the NE based on DLoS transport monitoring feedback to the NE to accommodate for changing environmental link conditions.

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

   a. **[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 or egress to the NE. Additionally, the congestion control may include a standards-based or proprietary protocol between the NEs that will adjust the QoS of the NE based on DLoS transport monitoring feedback to the NE to accommodate for changing environmental link conditions.

   b. **[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]** If provided, the NE shall provide for a 2-wire and/or 4-wire analog trunk circuit(s) interface that interfaces using industry standard signaling and facility arrangements per one or more of the following:

1. E&M Trunk Circuits: The NE shall interface with exchange carriers using industry standard E&M signaling. The switching system shall interface with Type I and Type II E&M signaling in accordance with paragraph 9 and subparagraphs of GR-506-CORE. The switching system shall interface with Type V E&M signaling as defined in Paragraphs 6.8.5, 6.8.6, 6.8.7.2, 6.8.8.2, and 6.8.8.3 of Telcordia Technologies Document SR-2275. The DSN switch analog trunk interface shall always originate on the M-lead.

2. Single Frequency Trunk Circuits: The NE will interface with external switching facility (SF) equipment using a 4-wire E&M trunk circuit, either Type I or II. The DSN in-band signaling equipment utilizing SF will place a 2600 Hz tone on the circuit to indicate the idle state (on-hook) and the tone will be removed from the circuit to indicate the busy state (off-hook). Signaling states will be conveyed via E and M leads (Type I or II) to the telephone equipment terminating the circuit on the equipment side of the interface. The SF trunk interface consists of only the voice path conductors (T, R, T1, R1), but at a point between this transmission facility interface and the switching function the SF signal will be translated back to the two-state dc signals.

3. Dual Frequency Trunk Circuits: The Dual Frequency Signaling Unit (DFSU) equipment used in the DSN operates in much the same way as an SF unit, except that whenever the 2600 Hz tone is removed from the circuit a 2800 Hz tone is applied for a short period (175 ms maximum). The 2800 Hz tone burst will serve as a confirmation tone; the receiving signaling unit will only transition from on-hook to off-hook if the loss of the 2600 Hz tone is followed by the 2800 Hz tone. This prevents false on-hook to off-hook transitions from occurring due to a break in the communications circuit. Like the SF trunk interface, the DF trunk interface will consist of only the voice path conductors (T, R, T1, R1). The NE shall interface an external DFSU using a 4-wire E&M trunk circuit with Type I or II E&M signaling. This connection is on the equipment-side of a DF trunk interface.

#### *5.9.2.3.2 Serial*

**[Conditional]** The NE used for serial interface connections shall be IAW 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 BRI interface shall meet the requirements and conditions IAW Section 5.3.2.31.2, National ISDN 1/2 Basic Access.

### *5.9.2.3.4 DS1 Interface Requirements*

**[Conditional]** If provided, the NE shall meet the following DS1 (T1) interface requirements and conditions of a PCM-24 Digital Trunk Interface:

PCM-24 Digital Trunk Interface: An NE shall provide a PCM-24 channel digital interface with a 1.544 Mbps T1 bit stream configured in either the D3/D4 (Superframe) framing format or the D5 Extended Superframe (ESF) framing format. D5 is also referred to as Extended Frame (EF). The same framing format shall be used in both directions of transmission. Voice signals shall be encoded in the 8-bit µ (255 quantized values) pulse code modulation (PCM) encoding law. Supervisory and dial pulse (DP) signals shall utilize the A and B bits of the D3/D4 format or the A, B, C, and D bits of the D5 format for pre-CCS7 configurations. Voice channel address in-band signaling shall be provided on individual channels. The D5 format shall be the preferred and system “goal” digital framing format and shall be provided in accordance with MIL-STD-187-700.

1. Interface Characteristics: The NE shall use the DS1 24 channel standard interface as specified in ANSI T1.102, “Digital Hierarchy – Electrical Interfaces.”

Table 5.9.2.3.4-1, PCM-24 Electrical Interface Characteristics, provides the electrical characteristics at the interface. Table 5.9.2.3.4-2 and Table 5.9.2.3.4-3 provide a listing of the framing characteristics.

**Table 5.9.2.3.4-1. PCM-24 Electrical Interface Characteristics**

| | |
|---|---|
| Nominal Line Rate | 1.544 Megabits per second. |
| Line Rate Accuracy | In a self-timed, free running mode, the line rate accuracy shall be ± 50 bits/s (± 32 parts per million) or better. |
| Line Code | B8ZS (Bipolar with 8-Zero Substitution) Bipolar/Alternate Mark Inversion may be used until Clear Channel Capability is required. |
| Frame Structure | ESF (D5) or transitionally D3/D4. |
| Medium | One balanced twisted pair shall be used for each direction of transmission. |
| Pulse Amplitude | The amplitude of an isolated pulse shall be between 2.4 volts and 3.6 volts. |

**Table 5.9.2.3.4-1. PCM-24 Electrical Interface Characteristics (continued)**

| | |
|---|---|
| Pulse Shape | The shape of every pulse that approximates an isolated pulse (is preceded by four zeros and followed by one or more zeros) shall conform to the mask in figure F10/G703 of ITU- T Recommendation G.703. |
| Pulse Imbalance | In any window of seventeen consecutive bits, the maximum variation in pulse amplitudes shall be less than 200mV, and the maximum variation in pulse widths (half amplitude) shall be less than 20 ns. |
| Power Level | For an all-ones signal, the power in a 3 kHz band centered at 772 kHz shall be between 12.6 dBm and 17.9 dBm. The power in a 3 kHz ± 1 kHz band centered at 1544 kHz shall be at least 29 dB below that at 772 kHz. |
| Jitter | Where one Unit Interval (UI) is equal to 648 ns, the jitter of the signal shall not exceed the following limits, in both bands simultaneously: 1) Band 1 - 5.0 UIs, peak-to-peak, and 2) Band 2 - 0.1 UIs, peak-to-peak. Band 1 equals 10 Hz to 40 kHz. Band 2 equals 8 kHz to 40 kHz. |
| DC Power | There shall be no dc power applied to the interface. |

**Table 5.9.2.3.4-2. PCM-24 D3/D4 Interface Characteristics**

| | |
|---|---|
| Frame Organization | 24 8-bit PCM words, plus 1 framing bit, in 125 microseconds. |
| Channel PCM Word | Frames 1 through 5: 8-bit encoded voice sample. |
| | Frame 6: 7-bit encoded voice sample; least significant bit is the “A” signaling bit. |
| | Frames 7 through 11: 8-bit encoded voice sample. |
| | Frame 12: 7-bit encoded voice sample; least significant bit is the “B” signaling bit. |
| Channel Sampling Rate | 8000 times per second. |
| Channel Time Slot | 5.18 microseconds. |
| Bit Time Slot | 648 nanoseconds. |
| Framing Bit Pattern | Terminal Framing Bit: “101010” in odd-numbered frames (1, 3, 5, 7, 9, 11). |
| | Signaling Framing Bit: “001110” in even-numbered frames (2, 4, 6, 8, 10, 12). |
| Maximum Reframe Time | The DSN will reframe on the average within 50 milliseconds after an error free signal is restored. |

**Table 5.9.2.3.4-3. PCM-24 ESF Interface Characteristics**

| D5 EXTENDED SUPERFRAME FORMAT FRAMING CHARACTERISTICS | |
|---|---|
| Frame Organization | 24 8-bit PCM words, plus 1 framing bit, in 125 microseconds. |
| Channel PCM Word | Frames 1 through 5: 8-bit encoded voice sample. |
| | Frame 6: 7-bit encoded voice sample; least significant bit is the “A” signaling bit. |
| | Frames 7 through 11: 8-bit encoded voice sample. |
| | Frame 12: 7-bit encoded voice sample; least significant bit is the “B” signaling bit. |
| | Frames 13 through 17: 8-bit encoded voice sample. |
| | Frame 18: 7-bit encoded voice sample; least significant bit is the “C” signaling bit. |
| | Frames 19 through 23: 8-bit encoded voice sample. |
| | Frame 24: 7-bit encoded voice sample; least significant bit is the “D” signaling bit. |

**Table 5.9.2.3.4-3. PCM-24 ESF Interface Characteristics (continued)**

| | |
|---|---|
| Channel Sampling Rate | 8000 times per second. |
| Channel Time Slot | 5.18 microseconds. |
| Bit Time Slot | 648 nanoseconds. |
| Framing Bit Pattern | Frame and Superframe Synchronization Bit: 001011 (frames 4, 8, 12, 16, 20, 24). |
| | CRC Bit (frames 2, 6, 10, 14, 18, 22). |
| | Data Channel Link Bit (odd numbered frames 1, 3, 5, 7, 9, 11, 13, 15, 17, 19, 21, 23). |
| Maximum Reframe Time | The DSN will reframe on the average within 50 milliseconds after an error free signal is restored. |

2. Supervisory Channel Associated Signaling: On-hook and off-hook status of each channel is transmitted and derived from the coding of the “A” and “B” signaling bits. Trunk seizure, answer supervision, dial pulse digits (DPs), preemption signals, and all other trunk supervisory information shall be sent and received on a per-channel basis using this scheme. Per-trunk signaling in the DSN switching system shall control the value of the “A” and “B” bits to indicate an on-hook (“A” = 0, “B” = 0) or an off-hook (“A” = 1, “B” = 1) condition. When receiving supervisory status on digital trunks using the PCM-24 format, the DSN switching system shall interpret the combination of the “A” bit = 0 and the “B” bit = 0 as on-hook, and the combination bit = 1 and “B” bit = 1 as an off-hook indication. When signaling on Voice Frequency (VF) channels using the PCM-24 format, the least significant bit of each channel, every six frames, shall carry signaling information. Utilizing the four-state signaling option of the Superframe (D3) format, frame 6 shall contain the “A” channel signaling information and frame 12 shall contain the “B” channel signaling information. The switching system shall also interpret the combination of “A” bit = 1, “B” bit = 0, with bit position 2 in all 24 channels in the Superframe (D3) format equal to “0” as a channel alarm indication and shall also interpret the combination of “A” bit = 1, “B” bit = 0 as a remote make busy.

   In the ESF format ANSI defines a sixteen-state signaling option that labels the signaling bits “A” (frame 6), “B” (frame 12), “C” (frame 18), and “D” (frame 24). Because DSN does not require the “C” and “D” signaling channels the four-state option shall be used to allow changes in “A” and “B” signaling states to be transmitted twice as often. Utilizing Frames 6 and 18 in the 24-frame Extended Superframe shall contain the “A” channel signaling information; frames 12 and 24 shall contain the “B” channel signaling information.

3. Clear Channel Capability: The NE shall be capable of transmitting and receiving B8ZS line coding in accordance with MIL-STD-187-700.

4. Alarm and Restoral Requirements: The NE shall provide the alarm and restoral features on the digital interface unit (DIU) as defined in Table5.9.2.3.4-4, PCM-24 Alarm and Restoral Requirements.

**Table 5.9.2.3.4-4. PCM-24 Alarm and Restoral Requirements**

| | |
|---|---|
| Local Alarm Timing | The DSN PCM-24 DIU (digital interface unit) will enter the "LOCAL" or "RED" alarm state when it is unable to frame on the received PCM signal, or the received signal is lost, for 2.5 ± 0.5 seconds. |
| Reception Of Remote Alarm | The DSN PCM-24 DIU will detect a "REMOTE" or "YELLOW" alarm condition when bit 2 of all 24 channels of Superframe is set to a zero and when the "YELLOW" alarm is sent via the facility data link of Extended Superframe.<br><br>Within 35 to 1000 milliseconds after detecting the REMOTE alarm, the DSN switch will:<br><br>Release all connections on the affected DIU,<br>AND<br>Remove the affected circuits from service. |
| Transmission Of Remote Alarm | When the DSN PCM-24 DIU enters the LOCAL alarm state, it will send REMOTE alarm toward the connecting equipment by forcing bit 2 to a zero on all 24 channels of Superframe. |
| Restoral To Service From Local Alarm | Within 15 ± 5 seconds after a valid PCM signal is restored, the DSN DIU will:<br><br>Remove the REMOTE alarm being sent to the connecting equipment,<br>AND<br>Return the affected circuits to service. |
| Restoral To Service From Remote Alarm | Within 20 to 1000 milliseconds after the connecting equipment removes the REMOTE alarm, the DSN switch DIU will restore the affected circuits to service. |

### *5.9.2.3.5 E1 Interface Requirements*

**[Conditional]** If provided, the NE shall meet the following E1 interface requirements and conditions of a PCM-30 Digital Trunk Interface:

PCM-30 Digital Trunk Interface: The NE shall provide PCM-30 digital interfaces at a data rate of 2.048 Mbps. The PCM-30 interfaces shall meet the requirements of ITU-T Recommendation G.703 and ITU-T Recommendation G.732. Voice signals in the PCM-30 framing format shall utilize the A-law encoding technique in accordance with ITU-T Recommendation G.772 (REV), "Protected Monitoring Points on Digital Transmission Systems." The pertinent requirements for the PCM-30 interface are summarized in Table 5.9.2.3.5-1, PCM-30 Electrical Interface Characteristics.

**Table 5.9.2.3.5-1. PCM-30 Electrical Interface Characteristics**

| | |
|---|---|
| Nominal Line Rate | 2.048 megabits per second. |
| Line Rate Accuracy | In a self-timed, free running mode, the line rate accuracy shall be ± 102 bits/s (± 50 parts per million) or better. |
| Line Code | HDB3. |
| Frame Structure | Frame structure details appear in ITU-T Recommendation G.704. |
| Medium | One balanced twisted pair shall be used for each direction of transmission. |
| Pulse Amplitude | The amplitude of an isolated pulse shall be between 2.2 volts and 3.3 volts. |
| Pulse Shape | The shape of every pulse that approximates an isolated pulse (is preceded by three zeros and followed by one or more zeros) shall conform to the mask in Figure 1 5/G703 of ITU-T Recommendation G.703. |
| Pulse Imbalance | The ratio of amplitudes of positive and negative isolated pulses shall be between 0.95 and 1.05. |
| Power Level | For an all-ones signal, the power in a 3 kHz ± 1 kHz band centered at 1.024 MHz shall be between 13.7 dBm and 17.5 dBm. The power in a 3 kHz ± 1 kHz band centered at 2.048 MHz shall be at least 20 dB below that at 1.024 MHz. |
| Jitter | Where one Unit Interval (UI) is equal to 488 ns, the jitter of the signal shall not exceed the following limits, in both bands simultaneously: 1) Band 1 - 5.0 UIs, peak-to-peak, and 2) Band 2 - 0.1 UIs, peak-to-peak. Band 1 equals 10 Hz to 40 kHz. Band 2 equals 8 kHz to 40 kHz. |
| dc Power | There shall be no dc power applied to the interface. |
| Frame | 32 channels (numbered 0 to 31) with 8 bits (numbered 1 to 8) per channel. |
| Organization | PCM words. Frame alignment occupies bit positions 2 through 8 of channel 0, of every other frame. |
| Multiframe Organization | 16 consecutive frames, numbered from 0 to 15. |
| Channel Sampling Rate | 8000 times per second. |
| Channel PCM Word | Channel time slots 1 to 15, and 17 to 31, are assigned to telephone channels 1 to 30. |
| Channel Time Slot | 3.91 microseconds. |
| Tolerance | +50 ppm on line rate of 1.544 megabits per second. |
| Bit Time Slot | 488 nanoseconds. |
| Framing Bit Pattern | Bits 2 through 8 of channel 0, every other frame, contains the "0011011" frame alignment signal. To avoid falsely locking to the data contained in channel 0 for frames not containing the frame alignment signal, bit 2 of channel 0 is always a "1" in those frames. |
| Multiframe Alignment | The multiframe alignment signal is "0000" and occupies digit time slots 1 to 4 of channel time slot 16 in frame 0. |
| Framing Strategy | Frame alignment is assumed to be lost if 3 of 4 consecutive frame alignment signals are received with an error. |
| Reframing Algorithm | Frame alignment is assumed to be recovered if the next frame has a "1" in bit 2 of channel 0 and valid framing is present in the frame after that. |
| Multiframe Loss and Recovery | Multiframe alignment is assumed to be lost when two consecutive multiframe alignment signals are received in error. Multiframe alignment is assumed to be restored when the first correct multiframe alignment signal is detected. |

Table 5.9.2.3.5-2 shows the allocation of time slot 16 for channel associated signaling.

**Table 5.9.2.3.5-2. Allocation of Time Slot 16**

| Channel time slot 16 of frame 0 | Channel time slot 16 of frame 1 | | Channel time slot 16 of frame 2 | | FR 3-14 18-29 | Channel time slot 16 of frame 15 | |
|---|---|---|---|---|---|---|---|
| 0000 xyxx | ABCD Channel 1 | ABCD Channel 16 | ABCD Channel 2 | ABCD Channel 17 | 3-14 18-29 | ABCD Channel 15 | ABCD Channel 30 |
| NOTES<br>When bits B, C, or D are not used they shall have the value: B = 1 C = 0 D = 1.<br>The combination 0000 of bits A, B, C, and D shall not be used for signaling purposes for channels 1-15. | | | | | | | |
| LEGEND<br>x = Spare bit to be made 1 if not used.<br>y = Bit used to indicate loss of multiframe alignment (REMOTE alarm). | | | | | | | |

1. Supervisory Channel Associated Signaling: When receiving supervisory status on digital trunks using the PCM-30 format, the DSN switching system shall interpret the combination of the “A” signaling channel bit = 1 and the “B” signaling channel bit = 1 as on-hook, and shall interpret the combination of the “A” signaling channel bit = 0 and the “B” signaling channel bit = 1 as an off-hook indication. The DSN switching system shall also interpret the combination of “A” bit = 1 and “B” bit = 0 as a channel alarm indication and a remote make busy. Bits “C” and “D” are not used in the DSN for signaling or control and therefore shall be set to the values “C” = 0 and “D” =1 in accordance with ITU-T Recommendation G.704.

2. Alarm and Restoral Requirements: The NE shall provide the alarm and restoral features on the DIU in order to be compatible with PCM-30 facilities and terminal equipment, as shown in Table 5.9.2.3.5-3, PCM-30 Alarm and Restoral Requirements.

**Table 5.9.2.3.5-3. PCM-30 Alarm and Restoral Requirements**

| | |
|---|---|
| Local Alarm Timing | The DSN PCM-30 DIU shall enter the “LOCAL” or “RED” alarm state when framing is lost, or the incoming signal is lost, for 4.5 ± 0.5 seconds. |
| Reception Of Remote Alarm | The DSN PCM-30 DIU shall detect a “REMOTE” or “YELLOW” alarm condition when bit 3 of channel time slot 0 in those frames not containing the frame alignment signal is set to a “1,” and will interpret this transition as a remote alarm from the connecting equipment. Within 35 to 1000 ms after detecting the REMOTE alarm, the DSN switch will:<br><br>Release all connections on the affected DIU,<br>AND<br>Remove the affected circuits from service. |

**Table 5.9.2.3.5-3. PCM-30 Alarm and Restoral Requirements (continued)**

| | |
|---|---|
| Transmission Of Remote Alarm | When the DSN PCM-30 DIU enters the LOCAL alarm state, it shall send within 2 ms a REMOTE alarm toward the connecting equipment by changing bit 3-channel time slot 0 from a "0" to a "1" in those frames not containing the frame alignment signal. |
| Restoral To Service From Local Alarm | Within 15 ± 5 seconds after a valid PCM signal is restored, the DSN switch shall:<br><br>Remove the REMOTE alarm being sent to the connecting equipment, AND<br>Return the affected circuits to service. |
| Restoral To Service From Remote Alarm | Within 20 to 1000 ms after the connecting equipment removes the REMOTE alarm, the DSN switch shall restore the affected circuits to service. |

### *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

1. **[Required]** Frame structure shall include M13 framing IAW ANSI T1.107-2002.

2. **[Conditional]** Frame structure may include C-bit parity application IAW ANSI T1.107-2002.

#### 5.9.2.3.6.2 Line Coding

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

### *5.9.2.3.7 Timing*

**[Required]** The NE shall be able to derive a timing signal from an internal source, an incoming digital signal, or an external source IAW Section 5.3.2.12.14.1.1, Timing Modes.

### *5.9.2.3.8 OC-X Interface Requirements*

**[Conditional]** The OC-X interface shall be IAW Section 5.5.3.2, Optical Transport System 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*

1. **[Conditional]** The NE having an IP interface and using DLoS transport comprised of 802.11 and/or 802.16 series standards shall instead meet the requirements for a WAB contained in Section 5.3.1.7.2, Wireless. All other IP configurations shall meet the following:

   a. 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 specified as follows:

      (1) Time Division Multiplexing ingress G.711 (nonsecure calls) to non-transcoding G.711 IP egress shall not increase delay more than 50 ms per NE pair as measured end-to-end.

      (2) Time Division Multiplexing ingress G.711 (nonsecure 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.

      (3) Time Division Multiplexing 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.

      (4) Time Division Multiplexing 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.

   b. 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.

   c. 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.

   d. **[Required: F-NE, D-NE]** For VVoIP systems, if the system decrypts the VVoIP traffic and applies a proprietary encryption approach before 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 it 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 PUB 140-2 cryptographic modules (or have been granted a formal waiver by National Institute of Standards and Technology (NIST)). Importantly, 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.

e. **[Required: F-NE, D-NE]** The VVoIP systems that use 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.

2. **[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*

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

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

b. **[Conditional]** 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:

(1) **[Required: Data Interface]** The NE shall provide network management (NM) data/monitoring via one or more of the following physical interfaces:

- Ethernet/TCP/IP (IEEE 802.3)
- Serial (RS-232)/Asynchronous
- 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:

- Alarm/Log Data
- Performance Data (e.g., traffic data)
- NE access (to perform NE data fill administration and network controls)

(2) **[Required: Fault Management]** The DSN telephone switching systems 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 are necessary. In addition to the data formats in Section 5.3.2.17, Management of Network Appliances, alarms may be sent as Simple Network Management Protocol (SNMP) traps. If this channel is also used to output switch administrative log information, the alarm messages must be distinguishable from an administrative log message.

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

### *5.9.2.4.2 Fault Management*

**[Conditional]** The NE shall report any failure of self-test diagnostic function on nonactive and active channels on a noninterference basis to the assigned NMS.

### *5.9.2.4.3 Loopback Capability*

**[Conditional]** The NE shall provide loopback capability on each of the trunk-side interfaces IAW 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*

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

   a. **[Required]** A minimum MOS score as defined in Section 5.9.2.1, General Requirements, performance requirement or better as measured in any 5-minute interval using ITU-T Recommendation P.862 testing standard.

   b. **[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 a, 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 or 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:

$$\mathbf{MDR=MOR(1-(WD/365))}$$

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) are 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.

### *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.

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.

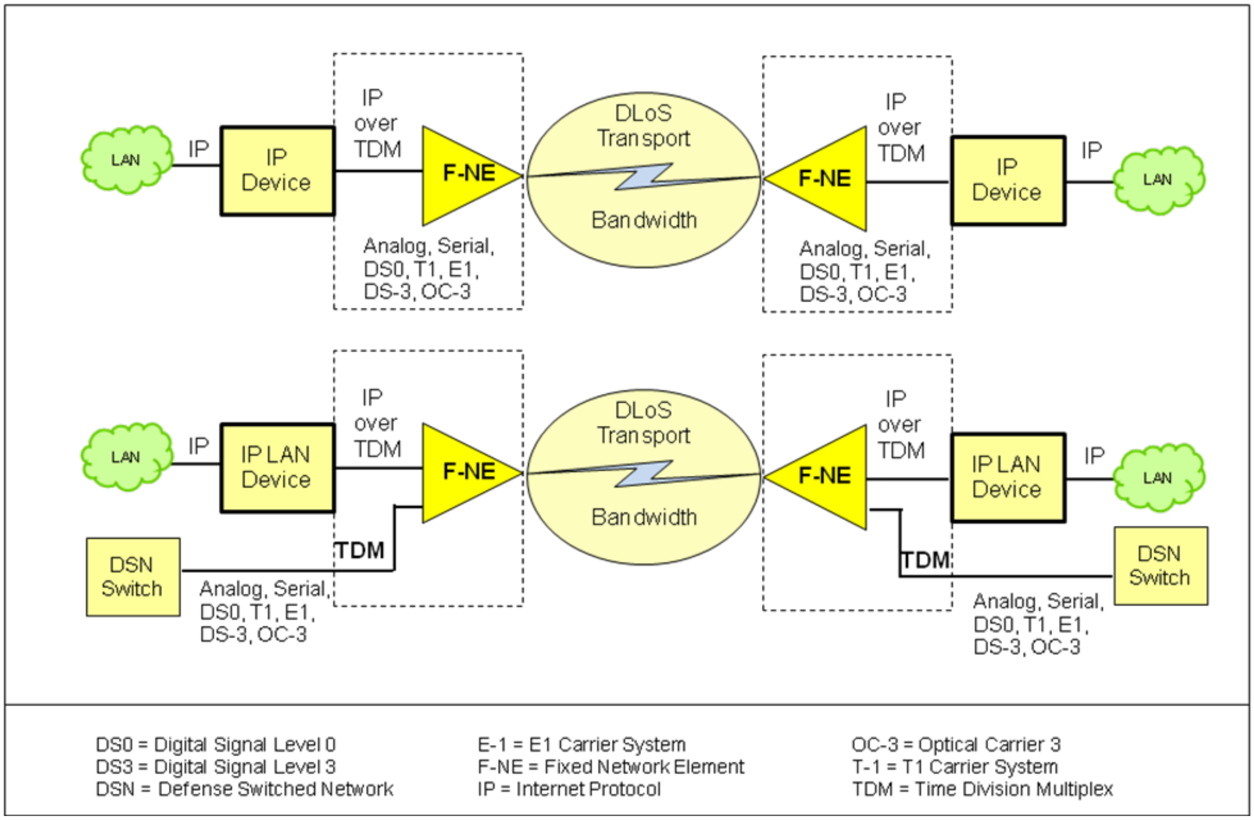


**Figure 5.9.2-2. TDM and IP over TDM Access via DLoS Transport NE**

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, or will be interpreted by the IP device as failure of the link connected to the NE also.

### *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 or 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(s).

### *5.9.2.7 DLoS Transport Wireless Intrusion Detection System*

1. **[Conditional]** If a DoD-approved WIDS exists for the DLoS transport technology used, the NE DLoS transport link(s) shall be monitored in according with the appropriate STIG(s).

## 5.9.3 D-NE Requirements

1. **[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 operational area network (OAN) architecture framework and the following parameters:

    a. 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:

        (1) Error Burst Density. The D-NE measured error burst density shall be $1x10^{-6}$.

        (2) Error Burst Gap (gap between error bursts in ms). The measured D-NE error burst gap shall be 600 ms.

        (3) 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*

1. **[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.

2. **[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.

3. **[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.

4. **[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.

5. **[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 so the resulting BER of the external facing D-NE interface shall be better than $1x10^{-5}$ as measured over a 9-hour period.

6. **[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:

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

    b. A software capability in limiting the provisioning of the input and/or output interfaces that make congestion impossible even under the worst congestion scenario.

    c. Congestion is not possible in the NE by the 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 also can be used to pass data in addition to UC services (e.g., VVoIP).

1. **[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 Proprietary Internet Protocol Trunk (PIPT).

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

   a. The addition of D-NEs shall meet the latency criteria specified in Section 5.9.3.1, D-NE General Requirements.

   b. 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.

   c. 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 DiffServ or integrated services to provide preferential treatment over IP transport.

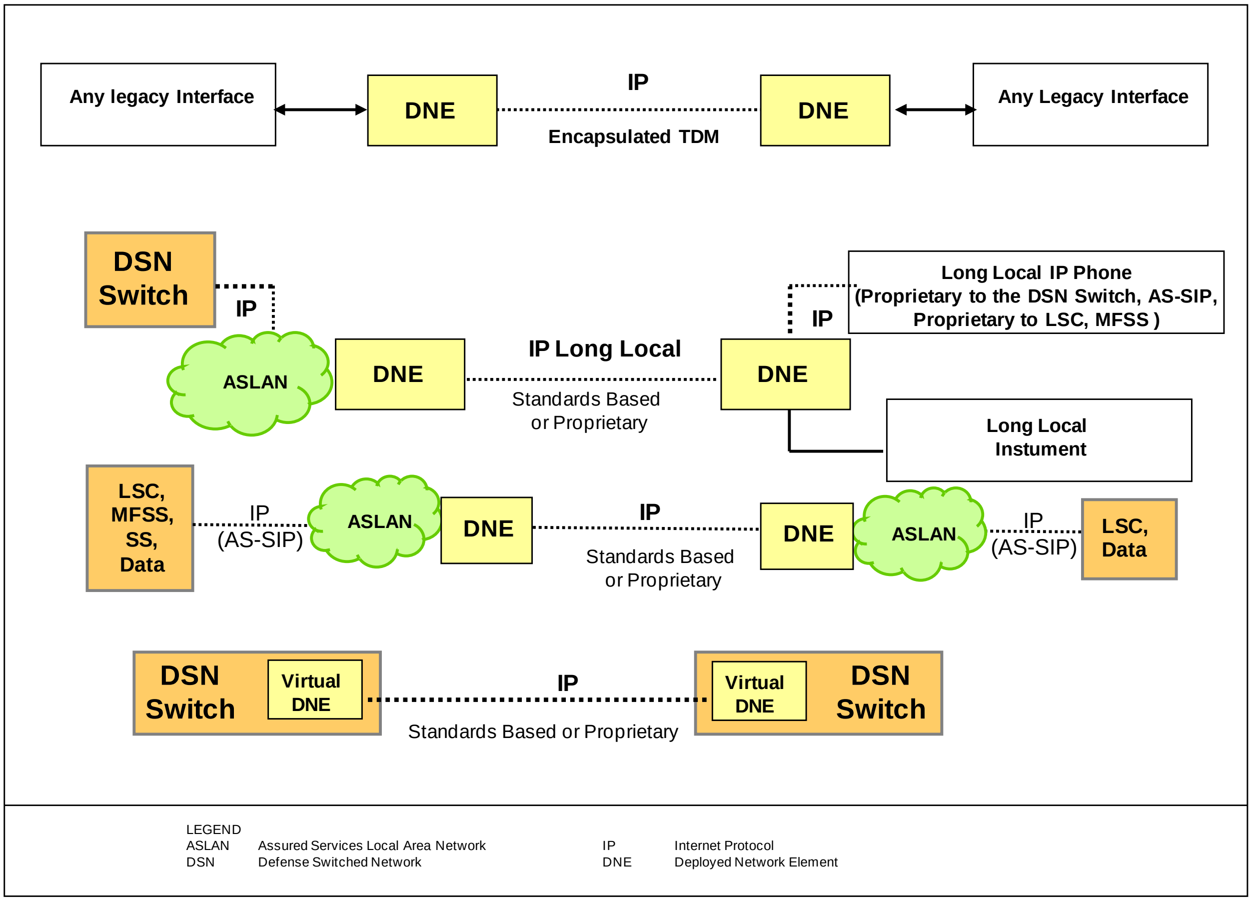


**Figure 5.9.3-1. D-NE Connectivity Using IP Transport**

2. **[Required]** The D-NE shall provide an IP bandwidth reservation or 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 DiffServ that shall be capable of providing preferential treatment for call congestion over other media types IAW Section 5.3.3, Network Infrastructure End-to-End Performance 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 IAW Section 5.9.2.1.1, Alarms, 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*

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

   a. **[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 Section 5.3.2.31.3.7, 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, Session Initiation Protocol, Version 2 (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, Section 5.3.2., is provided to the DSN IP telephony subscriber.

   b. **[Conditional]** For DVX VD-NE switches that do not support MLPP, this interface shall support end-to-end ISDN PRI National ISDN 1/2 (NI ½) 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*

1. **[Required]** In processing secure calls (SCIP) across conversion boundaries, such as TDM to IP and/or IP to TDM, the D-NE shall use the V.150.1 standards implementation IAW.NSA SCIP-215 and SCIP 216 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 also shall meet the requirements of Section 5.9.2.1, sub-requirement 3.

2. **[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.