



AM TR-NIS-000133

AMERITECH OC-3, OC-12 AND OC-48 DEDICATED RING SERVICE INTERFACE SPECIFICATIONS

A technical description of the User/Network Interface for Ameritech OC-3 Dedicated Ring Service, Ameritech OC-12 Dedicated Ring Service and Ameritech OC-48 Dedicated Ring Service.

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Points of Contact:

Brian Baldwin, Technical Regulatory, (847) 248-5324
George Young, SONET Technology Planning, (847) 248-5486

Author(s):

Brian Baldwin

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TECHNICAL REFERENCE NOTICE

This Technical Reference is published by Ameritech to provide a technical description of the User/Network Interface for Ameritech's OC-3 Dedicated Ring, OC-12 Dedicated Ring and OC-48 Dedicated Ring (SONET) Services. It provides interface specifications and operating requirements as a guide for system users and vendors.

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For further information, contact:

Ameritech Procurement Services

Information Management

Location 3A71D

2000 West Ameritech Center Drive

Hoffman Estates, IL 60196-1025

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GENERAL

This document describes the User/Network Interface specifications for Ameritech OC-3 Dedicated Ring, Ameritech OC-12 Dedicated Ring and Ameritech OC-48 Dedicated Ring (SONET) services. The term OC-N Dedicated Ring Service, as used here, shall refer to any of these Services, collectively and individually.

Ameritech OC-3 Dedicated Ring Service, Ameritech OC-12 Dedicated Ring Service and Ameritech OC-48 Dedicated Ring Service provide high-speed (155.52 Mb/s, 622.08 Mb/s and 2488.32 Mb/s respectively), optical fiber-based full duplex data transmission capabilities based upon the Synchronous Digital Hierarchy (SDH) and Synchronous Optical Network (SONET) standards approved by the International Telecommunication Union - Telecommunication Standardization Sector (ITU-TS, formerly CCITT) and the American National Standards Institute (ANSI), respectively.

Ameritech Dedicated Ring Services are provided in the form of a ring topology between one or more Ameritech network locations and one or more customer premises locations. A ring is defined as a set of nodes at these locations and interconnecting fibers to form a closed loop. Protection switching functions are employed across the ring which, taken together with the ring topology, provide for the delivery of transport services with the highest availability, survivability and reliability. **Ameritech OC-N Dedicated Ring Services operate only in conformance with SONET Unidirectional Path Switched Ring (UPSR) criteria for ring protection switching operations.**

1. PURPOSE

This document describes the User/Network Interface specifications for Ameritech OC-3 Dedicated Ring, Ameritech OC-12 Dedicated Ring and Ameritech OC-48 Dedicated Ring (SONET) services. The term OC-N Dedicated Ring Service, as used here, shall refer to any of these Services, collectively and individually.

2. CHANGE AND REISSUE

This is the first issue of this document. This section will show future changes and modifications.

3. GENERAL

Ameritech OC-3 Dedicated Ring Service, Ameritech OC-12 Dedicated Ring Service and Ameritech OC-48 Dedicated Ring Service provide high-speed (155.52 Mb/s, 622.08 Mb/s and 2488.32 Mb/s respectively), optical fiber-based full duplex data transmission capabilities based upon the Synchronous Digital Hierarchy (SDH) and Synchronous Optical Network (SONET) standards approved by the International Telecommunication Union - Telecommunication Stan-

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standardization Sector (ITU-TS, formerly CCITT) and the American National Standards Institute (ANSI), respectively.

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4. OVERVIEW

SONET is a set of international standards for fiber-based transmission systems that uses a synchronous multiplexing scheme. SONET provides standard transmission rates based on a basic modular Synchronous Transport Signal level 1 (STS-1) rate of 51.84 Mb/s. Byte interleaving of multiple STS-1 signals creates a standard STS-N ($N \times 51.84$ Mb/s) signal. Other higher rate services require N multiples of the STS-1 rate which are known as concatenated rates, STS-Nc, and carriers by an STS-N line signal. The optical counterpart of an STS-N signal is the Optical Carrier-level N signal (OC-N), which is the result of a direct optical conversion of the STS-N after frame synchronous scrambling.

SONET-based facilities provide for the flexible transport of various different service signals contained in the payload portion of the STS-N format. SONET-based facilities have the capability to accept non-SONET formats for transport in the SONET payload structure. This makes them backward compatible with existing data rates, i.e., DS1 and DS3 as well as future rates and formats, i.e., Asynchronous Transfer Mode (ATM). SONET provides for the transport of all services below the existing DS3 rate in sub-STS-1 payloads, referred to as Virtual Tributaries (VTs). Transport of services at the DS3 level and above occupy the payload portion of one or more entire STS-1 signals.

Ameritech OC-N Dedicated Ring Services (OC-3, OC-12 and OC-48) currently allow those payload mappings which support the transport of:

1. DS1 services within a VT1.5 Virtual Tributary structure; and
2. DS3 services within an STS-1 structure.

Transport of STS-1 channels without constraint to payload mapping is supported by Ameritech OC-N Dedicated Ring Services when the STS-1 channels do not terminate inside the Ameritech network.

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Non-channelized Super Rate service with concatenated STS-3c transport is also supported by Ameritech OC-12 Dedicated Ring Service, without constraint to payload mapping. Non-channelized Super Rate service with concatenated STS-3c and STS-12c transport is also supported by Ameritech OC-48 Dedicated Ring Service, without constraint to payload mapping as they do not determine within the Ameritech network.

SONET technology has led to the development of new Network Element (NE) capabilities, i.e., add/drop multiplexing and integrated optical terminations. These capabilities have been the catalyst for the continuing development of new architectures, such as self-healing rings with integrated protection switching, while at the same time remaining compatible with existing architectures, such as point-to-point. They allow for transport between intermediate locations without the need to demultiplex and convert the entire high-speed signal to lower-speed electrical signals.

SONET's overhead and transport functions are divided into layers that increase in complexity. Each layer communicates to other terminal equipment within the same layer and processes certain information and passes it to equipment in other layers. The layers are referred to as Path, Line, Section and Physical. The Path layer adds non-SONET to SONET mapping overhead to the input DS1, DS3, etc., electrical signals for passage to the Line layer. The Line layer provides synchronization and multiplexing of a number of payload envelopes, plus the addition of maintenance and protection overhead to the Path layer for transfer to the Section layer. The functions of the Section layer include framing, scrambling, section error monitoring and adding communications overhead (i.e., order wire) from the Line layer before passing the frame down to the Physical level. Finally, the OC-N Physical layer cares for electrical to optical signal conversion and transport of bits as optical pulses across the physical fiber-optic medium.

5. SERVICE DESCRIPTION

Ameritech OC-N Dedicated Ring (OC-3, OC-12 and OC-48) Services will provide full duplex transmission between Ameritech-owned network ring nodes and customer-owned premises ring nodes across optical User/Network Interfaces which are the subject of specifications contained in this AM TR-NIS-000133 document. Ameritech-owned network ring nodes may be located at Ameritech wire centers or customer premises locations. Customer-owned ring nodes will be located at customer premises locations.

The Ameritech OC-N Dedicated Ring Service User/Network Interface specifications defined here for Ameritech OC-N Dedicated Ring Services are characterized by a dual optical interface configuration between the Ameritech network portion of the ring and the customer ring node installation as shown in Figure 1.

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The customer ring node installation shall meet the optical interface requirements described in Section 6 OPTICAL INTERFACE REQUIREMENTS identically for both sides of the customer ring node dual optical interface. The customer ring node installation shall meet the architectural feature requirements described in Section 7. ARCHITECTURAL FEATURE REQUIREMENTS The customer ring node installation shall meet the Undirectional Path Switched Ring functional requirements described in Section 8 SONET UNIDIRECTIONAL PATH SWITCHED RING AUTOMATIC PROTECTION SWITCHING.

As shown in Figure 1, User/Network Interfaces for lower rate point-to-point Ameritech OC-N Services provided from ports dropping from Ameritech OC-N Dedicated Ring Services are not addressed by this specification but are covered by AM TR-NIS-000111, "Ameritech OC-3, OC-12 and OC-48 Service Interface Specifications."

Ameritech OC-3 Dedicated Ring Service provides transport of the optical signal that results from the optical conversion of an electrical STS-3 signal, which is comprised of either:

three interleaved STS-1 channels which each contain:

- (a) one DS3 that is STS-1 mapped; or
- (b) up to 28 DS1s that are VT-mapped; or
- (c) an STS-1 channel without constraint to payload mapping when the STS-1 channel does not terminate via an add/drop function to DS1 or DS3 services within the Ameritech network.

Ameritech OC-12 Dedicated Ring Service provides transport of the optical signal that results from the optical conversion of an electrical STS-12 signal, which is comprised of either:

- 1. twelve interleaved STS-1 channels which each contain:
 - (a) one DS3 that is STS-1 mapped; or
 - (b) up to 28 DS1s that are VT-mapped; or
 - (c) an STS-1 channel without constraint to payload mapping when the STS-1 channel does not terminate via an add/drop function to DS1 or DS3 services within the Ameritech network; or
- 2. four interleaved concatenated STS-3c channels; or
- 3. from one to three interleaved concatenated STS-3c channels, mixed with from three to nine STS-1 channels as in 1 above, subject to utilization of the total STS-12 capacity.

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Ameritech OC-48 Dedicated Ring Service provides transport of the optical signal that results from the optical conversion of an electrical STS-48 signal which is comprised of either:

1. forty-eight interleaved STS-1 channels which each contain:
 - (a) one DS3 that is STS-1 mapped; or
 - (b) up to 28 DS1s that are VT-mapped; or
 - (c) an STS-1 channel without constraint to payload mapping when STS-1 channel does not terminate via an add/drop function to DS1 or DS3 services within the Ameritech network;
2. or sixteen interleaved concatenated STS-3c channels; or
3. from 1 to 15 interleaved concatenated STS-3c channels, mixed with from 3 to 45 STS-1 channels as in 1 above, subject to utilization of the total STS-48 capacity; or
4. four interleaved concatenated STS-12c channels; or
5. from one to three interleaved concatenated STS-12c channels, mixed with from 12 to 36 concatenated STS-1 channels as in 1 above, subject to utilization of the total STS-48 capacity; or
6. from one to three interleaved concatenated STS-12c channels, mixed with from 4 to 12 concatenated STS-3C channels, subject to utilization of the total STS-48 capacity; or
7. from one to three interleaved concatenated STS-12c channels, mixed with from 1 to 11 concatenated STS-3c channels, also mixed with from 3 to 33 STS-1 channels as in 1 above, subject to utilization of the total STS-48 capacity.

6. OPTICAL INTERFACE REQUIREMENTS

The physical interconnections for the dual customer ring node optical interface will each be at a telephone company-provided optical cross-connect panel, using customer-provided 1310/1550 nm single mode fiber patch cords meeting EIA Class IVa requirements and equipped with single-position SC connectors (SCFOC/2.5), as specified in the Ameritech SC Connector Specification V.02.

Attenuation and dispersion limits across the optical interfaces are as follows:

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| Attenuation: | 0 to 12 dB | (OC-3 [Intermediate Reach]) |
| | 10 to 28 dB | (OC-3 [Long Reach] *) |
| | 10 to 24 dB | (OC-12 [Long Reach] *) |
| | 17 to 25.4 dB | (OC-48) [Long Reach] 1310 nm option) * |
| | 15 to 23.4 dB | (OC-48 [Long Reach 1550 nm option] *) |

* Ameritech OC-N Dedicated Ring Services shall provide for the minimum attenuation losses across the optical interface, as required.

| | | |
|-------------|--------------------|--|
| Dispersion: | 96 ps/nm maximum | (OC-3 [Intermediate Reach]) |
| | 210 ps/nm maximum | (OC-3 [Long Reach], OC-12 [Long Reach], OC-48 [Long Reach] 1310 nm option) |
| | 1220 ps/nm maximum | (OC-48 [Long Reach] 1550 nm option) |

6.1. OPTICAL LINE CODING

For all SONET interfaces, binary Non-Return-to Zero (NRZ) optical line coding shall be used after scrambling.

6.2. PAYLOAD MAPPING

Two types of payload mapping are available with Ameritech OC-N Dedicated Ring Services: STS-1 and sub-STS-1. Transport of concatenated STS-3c and STS-12c channels by Ameritech OC-12 Dedicated Ring Service and Ameritech OC-48 Dedicated Ring Service is also provided without constraint to payload mapping as they do not terminate within the Ameritech network.

Only asynchronous mapping DS3, as described in Section 3.4.2.1 of Bellcore Document GR-253-CORE shall be supported for the STS-1 level. STS-1 channel transport without constraint to payload mapping is supported when the channels do not terminate inside the Ameritech network (i.e., customer premises-to-customer premises).

Only asynchronous mapping into a floating VT1.5 SPE for clear channel DS1, as described in Section 3.4.1.2 of Bellcore Document GR-253-CORE, "SONET Common Generic Criteria" will be supported for the sub-STS-1 level.

STS-1 and concatenated STS-Nc signals accepted for non-channelized transport by Ameritech OC-N Dedicated Ring Services shall conform to the STS-1 requirements of Section 3.5.1.4 and Section 5.1.2 of Bellcore technical reference GR-253-CORE.

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6.3. LINE RATE

For Ameritech OC-3 Dedicated Ring Service, the bit rate at the physical layer is 155.520 Mb/s +/- 20 ppm.

For Ameritech OC-12 Dedicated Ring Service, the bit rate at the physical layer is 622.080 Mb/s +/- 20 ppm.

For Ameritech OC-48 Dedicated Ring Service, the bit rate at the physical layer is 2488.32 Mb/s +/- 20 ppm.

All the above 20 ppm bit rate tolerances apply to free running modes. The normal operating mode, however, is the synchronized mode (see Section 7.5 SYNCHRONIZATION).

6.4. TRANSMITTER AND RECEIVER REQUIREMENTS

SLM or MLM laser-equipped transmitters with the following parameters are utilized:

| | | |
|-----------------------|----------------------|--|
| Center Wavelength: | 1260 - 1360 nm | (OC-3 [Intermediate Reach]) |
| | 1275 - 1340 nm | (OC-3 [Long Reach]) |
| | 1285 - 1330 nm | (OC-12 [Long Reach], OC-48 [Long Reach] 1310 nm option) |
| | 1525- 1575 nm | (OC-48 [Long Reach] 1550 nm option) |
| Spectral Width (MLM): | Max. 4.0 nm RMS * | (OC-3 [Intermediate Reach]) |
| | Max. 4.0 nm RMS * | (OC-3 [Long Reach]) |
| | Max. 2.0 nm RMS * | (OC-12 [Long Reach]) |
| Spectral Width (SLM): | Max. 1 nm ** | (OC-12 [Long Reach], OC-48 [Long Reach]) |

* Measured out to and including 20 dB down from the peak mode.

** Measured 20 dB down from the maximum amplitude of the central wavelength.

Also, the minimum side-mode suppression ratio is 30 dB.

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| Output Power: | -5.4 to -15 dBm | (OC-3 [Intermediate Reach]) |
| | +4.6 to -5 dBm | (OC-3 [Long Reach]) |
| | +2 to -3 dBm | (OC-12 [Long Reach]) |
| | +6 to -3 dBm | (OC-48 [Long Reach] 1310 nm option) |
| | +4 to -2.6 dBm | (OC-48 [Long Reach] 1550 nm option) |
| Extinction Ratio: | 8.2 dB minimum | (OC-3 [Intermediate Reach], OC-48 [Long Reach]) |
| | 10 dB minimum | (OC-3 [Long Reach], OC-12 [Long Reach]) |
| Eye Pattern Mask: | See Section 4.2.4.4 of Bellcore Document GR-253-CORE | |
| Receiver Sensitivity: | -28 dBm minimum | (OC-3 [Intermediate Reach]) |
| | -33 dBm minimum | (OC-3 [Long Reach]) |
| | -27 dBm minimum | (OC-12 [Long Reach]) |
| | -26 dBm minimum | (OC-48 [Long Reach]) |
| Receiver Overload: | -8 dBm maximum | (OC-13 [Intermediate Reach], OC-12 [Long Reach]) |
| | -10 dBm maximum | (OC-3 [Long Reach]) |
| | -11 dBm maximum | (OC-48 [Long Reach]) |

Also, the receiver must tolerate an optical path-power penalty not exceeding 1 dB.

7. ARCHITECTURAL FEATURE REQUIREMENTS

7.1. INTERLEAVING

The STS-1 frame (Figure 2) consists of 90 columns and nine rows of 8-bit bytes, for a total of 810 bytes (6480 bits). The first three columns make up the Transport Overhead. Nine bytes are used as Section Overhead and 18 bytes as Line Overhead. The remaining 87 columns make up the Synchronous Payload Envelope (SPE), which contains one column of Path Overhead and 86 columns of actual payload.

An STS-3 signal shall be formed by interleaving three STS-1 signals, one byte at a time, sequentially starting with the A1 framing byte from STS-1 number 1, followed sequentially by the

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A1 byte from STS-1 number 2 and so on. The first bit to be transmitted in the STS-3 signal shall be the most significant bit (leftmost bit) of the A1 framing byte from STS-1 number 1.

An STS-12 signal shall be formed either by interleaving four STS-3 or STS-3c signals, one byte at a time sequentially starting with STS-3(c) number 1, or by byte interleaving 12 STS-1 signals in an order that simulates four STS-3 signals (i.e., byte one from STS-1 number 1 followed by byte one from STS-1 number 4 and so on).

An STS-48 signal shall be formed either by interleaving four STS-12 or STS-12c signals, four bytes at a time sequentially starting with four bytes from STS-12(c) number 1 followed by four bytes from STS-12(c) number 2 or by byte interleaving 16 STS-3 or STS-3c signals in an order that simulates four STS-12 signals (i.e., byte 1 from each of STS-3c numbers 1 through 4 followed by byte 1 from each of STS-3(c) numbers 13 through 16 and so on).

Before byte interleaving to form an STS-3, STS-12 or STS-48 signal, the transport overhead of all constituent STS-1, STS-3 or STS-12 signals shall be frame aligned. This is accomplished by adjusting the payload pointers of the lower rate signals to reflect the new relative position of the SPEs.

7.2. SCRAMBLING

STS-N line signals shall be scrambled using a frame synchronous scrambler of sequence length 127, operating at the line rate. The generating polynomial shall be $1+x^6+x^7$. The scrambler shall be reset to "1111111" on the most significant bit of the byte following the STS-1 number N C1 (STS-1 ID) byte. This bit and all subsequent bits to be scrambled, shall be added, modulo 2, to the output of the x7 position of the scrambler. The scrambler shall run continuously throughout the complete STS-N frame. The frame bytes (A1 and A2) and the STS-1 identification byte (C1) from STS-1 number 1 through STS-1 number N shall not be scrambled.

7.3. GENERATING AND PROCESSING OVERHEAD

The overhead bytes referenced in Section 3.3 and Section 5.2 of Bellcore's technical reference, GR-253-CORE shall be active across the dual customer ring node optical interface, except for the following:

| | |
|----------------------------------|------------|
| Line Data Communications Channel | (D4 - D12) |
| Section Trace | (J0) |
| Section Growth | (Z0) |
| Section Local Orderwire | (E1) |
| Section User Channel | (F1) |

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| | |
|------------------------|------|
| Line Express Orderwire | (E2) |
| Path User Channel | (F2) |
| Synchronization Status | (S1) |
| Path Growth | (Z3) |
| Tandem Connection | (Z5) |

Concerning the overhead bytes listed directly above, Ameritech OC-N Dedicated Ring Services will not process or recognize information transmitted by the customer installation. Ameritech OC-N Dedicated Ring Services will also not transmit information intended for use by the customer installation in the overhead bytes listed directly above. The customer ring node installation shall also neither process or recognize information in the overhead bytes listed directly above which are received from Ameritech OC-N Dedicated Ring Services.

STS-1 and STS-Nc concatenated signals accepted for non-channelized transport by Ameritech OC-N Dedicated Ring Services shall conform to the overhead requirements of Section 3.3.2 of Bellcore reference GR-253-CORE.

The STS Path Trace function implemented in STS Path Overhead byte J1 shall contain a 62 ASCII character message terminated with a Carriage Return/Line Feed sequence [ASCII Hex "0D 0A"] as specified in Section 3.3.2.3 of Bellcore technical reference GR-253-CORE in order to be recognized by the Ameritech OC-N Dedicated Ring Service.

As an objective, the customer ring node installation should activate the STS-N Line Far End Block Error (FEBE) function to convey received line performance information to the Ameritech OC-N Dedicated Ring Service network. The STS-N Line FEBE function is implemented in the M1 byte of STS-1 number 3 as specified in Section 3.3.2.2 of Bellcore technical reference GR-253-CORE.

7.4. SELECTION DATA COMMUNICATIONS CHANNEL (DCC)

The SONET Section Data Communications Channel (DCC) may optionally be activated through the Ameritech OC-N Dedicated Ring network and the customer ring node installation across the dual optical interface shown in Figure 1. **Activation of the DCC described here pertains only to the OC-N Interfaces on the line side of the ring and does not provide for DCC activation on any OC-M drops from ports on Ameritech OC-N Dedicated Ring Services.**

The SONET DCC shall utilize a common set of OSI protocols for NE/NE communications between Ameritech network ring nodes and customer ring node installations for Ameritech OC-N Dedicated Ring Services. Specific implementations shall be based on the use of TL1 Applications Language over either a 3-Layer or 7-Layer protocol stack as determined by Ameritech.

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The customer ring node installation shall implement and conform to the following Section DCC protocol specifications:

Physical Layer 1 Section DCC shall be implemented in SONET Section overhead bytes D1-D3 according to the requirements of Section 8.3.1.3 of Bellcore Document GR-253-CORE, "SONET Common Generic Criteria."

Data Link Layer 2 protocol shall be implemented as LAPD according to the requirements of Section 8.3.2.3 and Appendix C of Bellcore technical reference GR-253-CORE.

Network Layer 3 protocol shall be implemented as CLNP (ISO 8473) according to the requirements of Section 8.3.3.2 and Appendix C of Bellcore technical reference GR-253-CORE.

For OSI 7-Layer implementations, the following DCC protocol specifications shall also apply:

Transport Layer 4 protocol shall be implemented as Class 4 of ISO 8073 according to the requirements of Section 8.3.4 and Appendix C of Bellcore technical reference GR-253-CORE.

Session Layer 5 protocol shall be implemented as Kernel/Full Duplex according to the requirements of Section 8.3.5 and Appendix D of Bellcore technical reference GR-253-CORE.

Presentation Layer 6 protocol shall be implemented as ASN.1 BER/Kernel according to the requirements of Section 8.3.6 and Appendix D of Bellcore technical reference GR-253-CORE.

Transaction-Oriented applications messaging over the DCC shall be based on TL1 Applications Language for Application Layer 7 as specified in the following documents:

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| <p>Ameritech OC-3 Dedicated Ring Service:</p> | <p>Fujitsu Practice FJTU-320-515-274 Transaction Language 1 (TL1)</p> <p>Messages for FLM 150 ADM</p> <p>Issue 4, July 1993</p> <p>Revision 3, November 1994</p> <p>or</p> |
| | <p>Alcatel Practice ALCL 363-203-201 Commands and Messages</p> <p>OC-3/OC-12 Add/Drop Multiplexer Alcatel Part No. 650205-823-022</p> <p>Issue 2, July 1994</p> <p>Change 1, November 1994</p> |
| <p>Ameritech OC-12 Dedicated Ring Service:</p> | <p>Fujitsu Practice FJTU-320-545-274 Transaction Language 1 (TL1)</p> <p>Messages for FLM 600 ADM</p> <p>Issue 5, September 1994</p> <p>or</p> |
| | <p>Alcatel Practice ALCL 363-203-201 Commands and Messages</p> <p>OC-3/OC-12 Add/Drop Multiplexer Alcatel Part No. 650205-823-022</p> <p>Issue 2, July 1994</p> <p>Change 1, November 1994</p> |

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| <p>Ameritech OC-48 Dedicated Ring Service:</p> | <p>Fujitsu Practice FJTU-320-560-274 Trans- action Language 1 (TL1)</p> <p>Messages for FLM 2400 ADM</p> <p>Issue 2, September 1993</p> <p>Revision 1, May 1994</p> <p>or</p> |
| | <p>Alcatel Practice ALCL 363-248-002</p> <p>Alcatel SONET Multiplexer 1648 SM</p> <p>Commands and Messages</p> <p>Alcatel Part No. 523-0608415</p> <p>Issue 2, July 1994</p> |

7.5. SYNCHRONIZATION

The OC-N Dedicated Ring Service customer ring node installation shall be synchronized to a source traceable to a Primary Reference Source (PRS) (i.e., Stratum 1 clock) meeting requirements specified in Bellcore's Generic Requirements GR-0436-CORE, "Digital Synchronization Network Plan" and TR-NWT-001244, "Clocks for the Synchronized Network: Common Generic Criteria."

The customer ring node installation shall obtain the required clock reference through the use of an external or line timing mode as defined in Section 5.4.3 of Bellcore's technical reference GR-253-CORE, "SONET Common Generic Criteria." Customers considering the choice of timing source should review EIA/TIA-594-91, "Private Digital Network Synchronization" and Bellcore SR-NWT-002224 "SONET Synchronization Planning Guidelines" prior to deciding which mode (external or line timing) to employ. Customer network synchronization and distribution plans may also be significantly affected by this decision and must be carefully considered for possible redesign upon application of a customer ring node installation. The through-timing mode as defined by Section 5.4.3.4 of GR-253-CORE shall **not** be employed by the customer ring node installation. DS1 mapped payload signals carried on Ameritech Dedicated Ring Services shall **not** be used for network synchronization from or by the customer ring node installation.

The OC-N Dedicated Ring Service customer ring node installation may obtain its required clock reference from an external timing source (Timing Signal Generator) provided by the customer separately at the customer premises location. Use of an external timing source is the preferred

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method of timing all ring nodes. The external source shall be a Stratum 3E Timing Signal Generator or better quality clock that is traceable to a Stratum 1 clock. Externally timed customer ring node equipment shall have the capability to switch automatically to an alternate timing reference when the active reference fails. If external timing is employed, it must conform to specifications contained in Section 5.4.3.1 of Bellcore's technical reference GR-253-CORE. In this case, the customer shall operate plesiochronously with traceability to a different Stratum 1 clock than in the Ameritech network.

The OC-N Dedicated Ring Service customer ring node installation may derive its required clock reference from the SONET OC-N signal received from the Ameritech network. In this case, terminating timing shall be accomplished using a line timing mode and the customer shall meet the line timing requirements specified in Section 5.4.3.2 of Bellcore technical reference GR-253-CORE. Ameritech will specify to the customer which of the two OC-N line signals entering a line-timed customer ring node will be used for reference. The internal clock provided in a line-timed customer ring node must meet Stratum 3 requirements for a minimum of 24 hours upon loss of the OC-N reference and shall also conform to the SONET Internal Clock requirements contained in Section 5.4.4.1 and Section 5.4.4.2.4 of GR-253-CORE, including the requirement to provide holdover. The line-timed customer ring node shall not be provisioned with a secondary reference in order to prevent timing loops from occurring on the ring during failures. The line-timed customer ring node shall be capable and provisioned for revertive operation from holdover to the designated OC-N line-timing source.

7.6. JITTER

The maximum permissible levels of output jitter at the OC-3, OC-12 and OC-48 interfaces are as follows:

| | B1 [Hz] | B2 [kHz] | B3 [MHz] | A1 [UIp-p] | A2 [UIp-p] |
|--------------|----------------|-----------------|-----------------|-------------------|-------------------|
| OC-3 | 500 | 65 | 1.3 | 1.5 | 0.15 |
| OC-12 | 1000 | 250 | 5 | 1.5 | 0.15 |
| OC-48 | 5000 | 1000 | 20 | 1.5 | 0.15 |

Timing jitter as measured over a 60-second interval with a bandpass filter with a lower cutoff frequency B1 and a minimum upper cutoff frequency B3 shall not exceed A1 Unit Intervals (UI) peak-to-peak. Timing jitter as measured over a 60-second interval with a bandpass filter with a lower cutoff frequency B2 and a minimum upper cutoff frequency B3 shall not exceed A2 UI peak-to-peak. The roll-off at lower cutoff frequency and upper cutoff frequency shall be 20 dB per decade.

For line-timed applications, reasonable jitter transfer characteristics are assumed to limit the jitter accumulation effect and to aid in the control of SONET pointer movements. When line tim-

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ing is utilized by the customer ring node installation, the jitter transfer function shall be under the curve shown in Figure 5-26 of Bellcore document GR-253-CORE, when input sinusoidal jitter up to the mask level in Figure 5-27 of that document is applied. Jitter generation shall not exceed .01 UI rms. A high-pass filter with a 12 kHz cutoff frequency shall be used.

A receiver's jitter tolerance is defined as the peak-to-peak amplitude of a sinusoidal jitter applied on the input signal that causes a 1 dB power penalty. Such a stress test will ensure that no additional penalty is incurred under operating conditions. The OC-N Dedicated Ring Service customer ring node installation shall tolerate, as a minimum, the input jitter applied according to the mask shown in Figure 5-27 of Bellcore Document GR-253-CORE, "SONET Common Generic Criteria."

8. SONET UNIDIRECTIONAL PATH SWITCHED RING AUTOMATIC PROTECTION SWITCHING

For Ameritech OC-N Dedicated Ring Services, Automatic Protection Switching (APS) functions operate only in conformance with SONET Unidirectional Path Switched Ring (UPSR) criteria for ring protection switching operations. SONET Bidirectional Line Switched Ring (BLSR) functionality is **not** supported by Ameritech OC-N Dedicated Ring Services.

APS employed across the dual optical interface of the customer ring node installation shall conform to UPSR STS/VT path switching criteria specified in Bellcore's technical reference GR-1400-CORE - "SONET Dual-Fed Unidirectional Path Switched Ring (UPSR) Equipment Generic Criteria."

The two OC-N Line side signals presented to the Ameritech OC-N Dedicated Ring Service by a customer ring node installation across the dual optical interface shown in Figure 1 must be identical in payload content within the STS-N or STS-Nc SPE. Customer traffic contained in any STS or VT-mapped timeslot across either of the OC-N Line interfaces must be duplicated by the customer ring node installation in the same timeslot across the other OC-N Line interface. The Ameritech OC-N Dedicated Ring Service will correspondingly present duplicated payload traffic content across the two OC-N Line interfaces to the customer ring node installation.

Configurations possible of STS level or VT level path switching for Ameritech OC-N Dedicated Ring Services are:

- For Ameritech OC-3 Dedicated Ring Service, either STS-1 or Vt1.5 level path switching may be implemented on a per STS-1 basis for any or all of the three STS-1 timeslots as specified by the customer.
- For Ameritech OC-12 Dedicated Ring Service, STS-3c or STS-1 level path switching may be implemented for any or all of the 12 STS-1 timeslots as specified by the customer. For STS-3c path switching, this must be implemented within speci-

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fied contiguous STS-1 timeslot boundaries. In addition, as an option, VT1.5 level path switching may be implemented in any three STS-1 timeslots per node within the total of 12 timeslots as specified by the customer.

- For Ameritech OC-48 Dedicated Ring Service, STS-12c, STS-3c or STS-1 path switching may be implemented for any or all of the 48 STS-1 timeslots as specified by the customer. For STS-12c or STS-3c path switching, this must be implemented within specified contiguous STS-1 timeslot boundaries. VT1.5 level path switching is not implemented with Ameritech OC-48 Dedicated Ring Service.

Ameritech OC-N Dedicated Ring customer ring node equipment shall provide STS/VT path protection equipment functions as specified in Section 5.1: (R) 5-1, (R) 5-2, (R) 5-9, (R) 5-10 and (R) 5-11 of GR-1400-CORE.

Customer ring node equipment shall operate APS according to STS/VT path protection switching required criteria contained in Sections 5.3.1, 5.3.2 and 5.3.3 of GR-1400-CORE. VT-level APS operation shall be required with this option for individual STS-1 channels which are VT-mapped. STS-level APS operation shall be required with this option for all other individual STS channels.

Customer ring node equipment shall meet STS/VT detection time requirements contained in Section 5.3.5 of GR-1400-CORE.

Customer ring node equipment shall transmit path FEBE values to Ameritech OC-N Dedicated Ring Services according to requirements (R) 6-11 and (R) 6-13 contained in Section 6.2 of GR-1400-CORE.

9. REFERENCES

[1] Bellcore Generic Requirements GR-1365-CORE - SONET Private Line Service Interface Generic Criteria for End Users, Issue 1, December 1994.

[2] Bellcore Generic Requirements GR-1374-CORE - SONET Inter-Carrier Interface Physical Layer Generic Criteria for Carriers, Issue 1, December 1994.

[3] Bellcore Generic Requirements GR-253-CORE - Synchronous Optical Network (SONET) Transport Systems: Common Generic Criteria, Issue 1, December 1994.

[4] Bellcore Generic Requirements GR-1400-CORE - SONET Dual-Fed Unidirectional Path Switching Ring (UPSR) Equipment Generic Criteria, Issue 1, March 1994.

[5] Bellcore TR-NWT-000499 - Transport Systems Generic Requirements (TSGR): Common Requirements, Issue 5, December 1993.

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[6] Bellcore Generic Requirements GR-0436-CORE - Digital Synchronization Network Plan, Issue 1, June 1994.

[7] Bellcore SR-NWT-002224 - SONET Synchronization Planning Guidelines, Issue 1, February 1992.

[8] Bellcore TR-NWT-001244 - Clocks for the Synchronized Network: Common Generic Criteria, Issue 1, June 1993.

[9] EIA/TIA-594-91 - Private Digital Network Synchronization

[10] Ameritech SC Connector Specification V.02

To order Ameritech reference documents, contact:

Ameritech Technical Information Resource Management

Location 3B72E

2000 West Ameritech Center Drive

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To order Bellcore reference documents, contact:

Bellcore Customer Relations

8 Corporate Place, PYA 3A-18A

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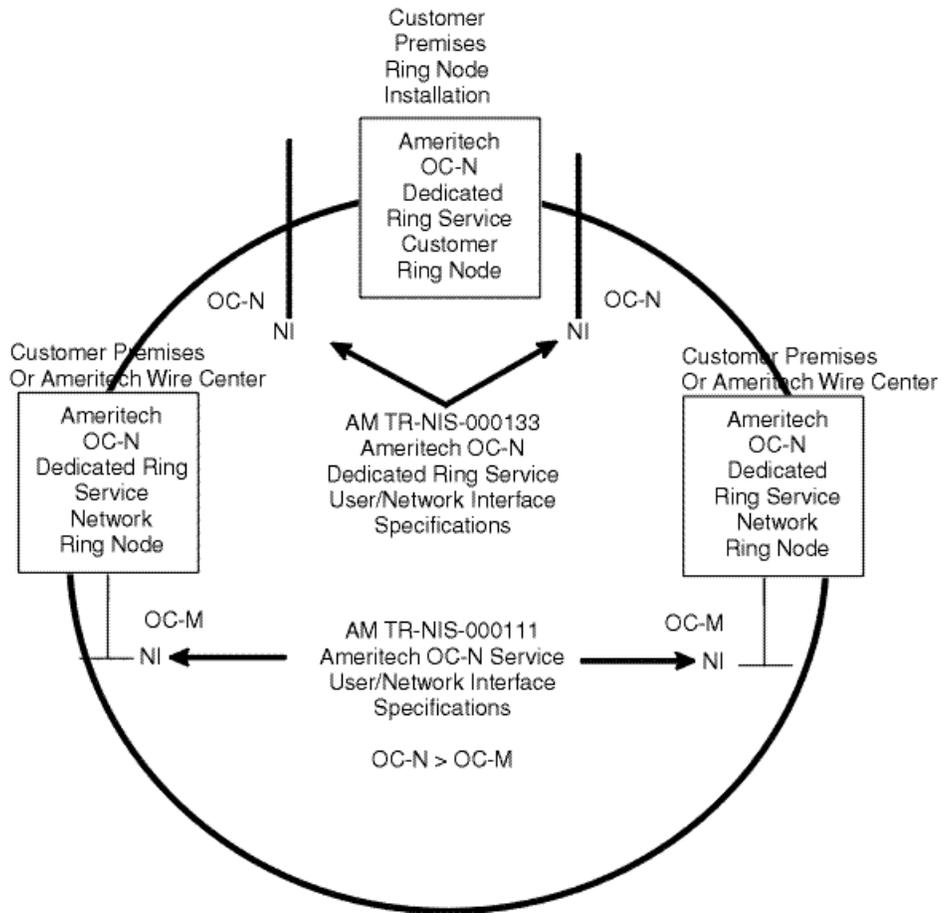
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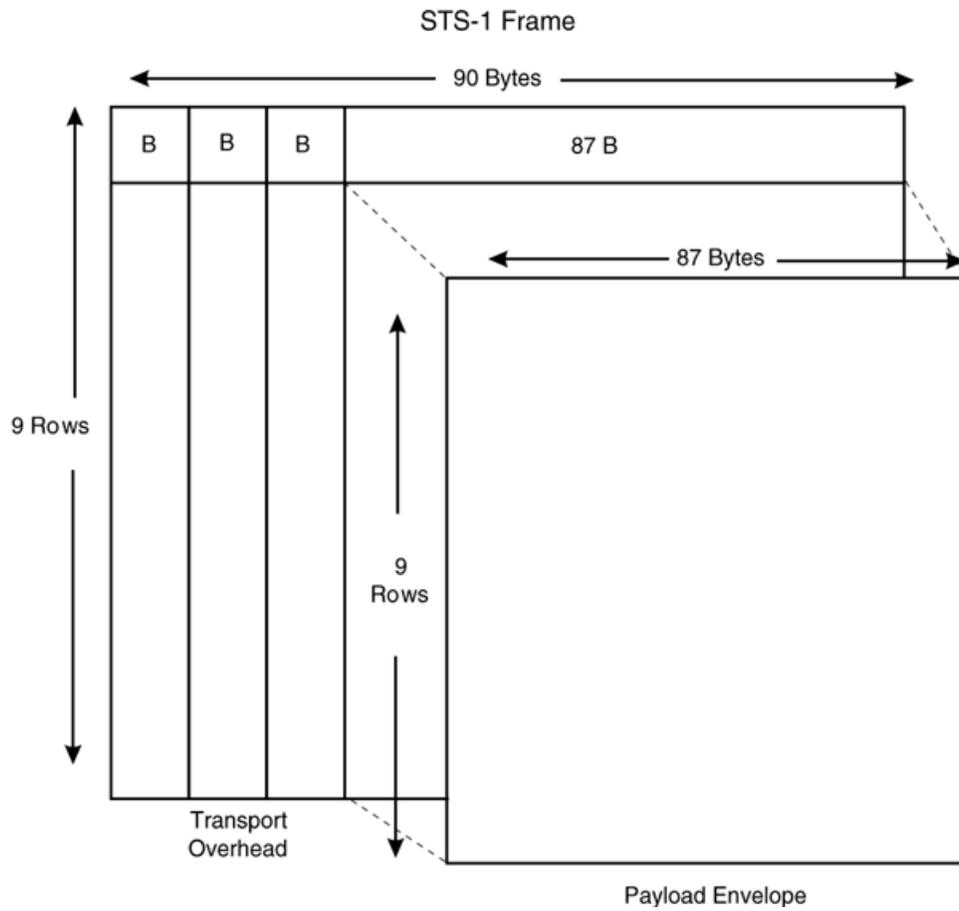
Figure 1.



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Figure 2.



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