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AM-TR-NIS-000130

Ameritech Multichannel Video Service (AMVS) Interface Specifications

A technical description of the User/Network Interface for Ameritech Multichannel Video Service (AMVS).

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1. PURPOSE

This document describes the User/Network Interface specifications for Ameritech Multichannel Video Service (AMVS).

2. CHANGE AND REISSUE

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

3. GENERAL

AMVS interfaces offer:

A. Access for one-way, multiple video and audio signal transport to/from Ameritech's Video Interactive Services (VIS) Network or other Video Hubs.

B. Analog or digital transport formats.

C. Point-to-point or shared Unidirectional Ring Topology (on a point-to-point service basis).

4. SERVICE DESCRIPTION

The Multichannel Video Service (AMVS) provides for the one-way transmission of multiple high quality National Television Standards Committee (NTSC) System-M analog and MPEG-2 System Compressed digital video and audio channels between a Video Information Provider (VIP) and Ameritech's VIS Network or Video Hub. Employing fiber optic technology, the service has a high degree of reliability and maintainability. AMVS provides for the delivery of video/audio signals from the originating premises of Ameritech's VIS Network or Video Hub (see Figures 1 and 2). AMVS can also be configures to transport these signals from Ameritech's VIS Network or Video Hub to the VIP (see Figures 2 and 3).

AMVS is a single mode fiber based service, with electrical-to-optical conversion and multiplexing functions, provided by equipment placed at the originating and terminating premises. For each video channel, up to two, or optionally four, audio channels are available for providing Stereo, Second Audio Program (SAP), Broadcast Television Steering Committee (BTSC) or Professional (PRO) aural transport. The network interface (except for Shared Ring Topology transport) at the customer premises, is a 2.38 Gbs optical signal handed off with a single SC optical connector for Basis service, or two SC connectors when Protection is provided. Transmission from source to destination is digital, with a bit rate of 2.38 Gbs. Each AMVS channel may accommodate a single uncompressed, analog video signal (with its associated audios) or a digital content stream, composed of digitally multiplexed MPEG-2 System compliant encoded

video and audio streams, up to a maximum payload of approximately 36 Mbs, as described in MPEG-2 Systems International Standard, ISO/IEC 1-13818 IS [Ref. 4.1]. The approximately 36 Mbs of digital content is encapsulated in a one-way 44.736 Mbs channel. Due to technical considerations, as described in greater detail in Ameritech publication AM TR-NIS-000126 [Ref. 4.2], transmission is limited to termination at Ameritech's VIS Network or a Video Hub.

Various Service Protection Options are available as follows:

- Option #1: High Speed Optical equipment protection with fibers in common sheath. Figure 1 (b) or Figure 2 (b).
- Option #2: High Speed Optical equipment protection with co-routed fibers in different sheaths. Figure 1 (c) or Figure 2 (c).
- Option #3: High Speed Optical equipment protection with fiber cut protection via diversely routed fiber cables. Figure 1 (d) or Figure 2 (d).
- Option #4: Individual encoder card protection in addition to Option #3 above. Figure 1 (e).
- Option #5: Shared Unidirectional ring Topology (on a point-to-point service basis) with reverse direction secondary ring. Figure 4.

AMVS will follow the standard rate structure for Special Access Services, and includes Local Distribution Channel (LDC), Channel Mileage Termination (CMT) and Channel Mileage (CM) rate elements. This service will be offered on a monthly, with a minimum order period of 12 months, and contract basis (i.e., 12, 36, and 60 month options). This service will be offered in increments of 4 channels.

Transmission interfaces are specified by AMVS service type as listed in the following table.

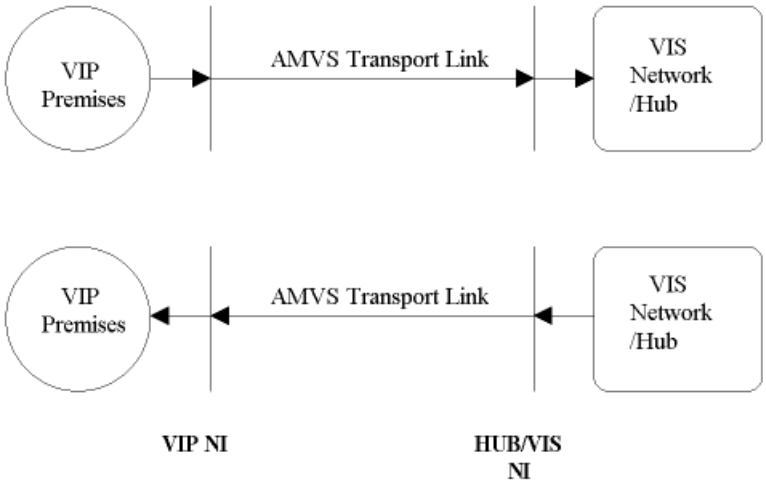
AMVS Interface Specifications	**AMVS Service Types (where applicable or optional)**	
Interfaces	**Analog**	**Digital**
NTSSC Video with 2-Channel Audio	"	
MTSC Video with 4-Channel Audio	Optional	
2.38 Gbs Optical	"	"
One-Way Digital Content Stream		"

The one-way analog video and audio, and digital content stream interfaces terminate on industry standard electrical and mechanical equipment. Digital interfaces provide transmission

facilities that can carry multiple content streams in a single video Radio Frequency (RF) channel equivalent of 6 MHz bandwidth; e.g., up to twelve 3 Mbs MPEG-2 encoded videos in a 36 Mbs multiplex stream encapsulated in a one-way 44.736 Mbs channel for 256 Quadrature Amplitude Modulation (QAM) processing.

5. INTERFACES

The signal interface specification defines the analog and digital signal interfaces for message and content to which the VIP will attach for access to the VIS Network or Video Hub. This is a one-way interface.



The VIS NI is part of the separately tariffed VIS Network access interface, and is described in Ameritech publication AM TR-NIS-000126.

Transport interfaces which will be initially offered are:

- Optical Interface (VIP side, Non-Ring applications only): This interface can be associated with AMC and DMC services, allowing transport of up to 16 Analog Content channels, 32 Digital Content channels, or mixes of both (up to 16 card slots). Each card slot can accommodate one Analog or two Digital Content channels. Because the 2.38 Gbs optical bit rate includes proprietary overhead and bit mapping, the customer's equipment beyond this optical interface must be an ADC DV6000 terminal to ensure compatible operation with Ameritech's terminal.

- Analog Content Interface (VIS Network/Hub side or Shared Ring): Analog Content services are associated with VIS Analog Multicast (AMC) services and consist of unscrambled Analog NTSC Baseband Video with up to two, or optionally four, as-

sociated 50 Hz to 15 kHz Audio channels. The audios will be input separately from the video; i.e., not in a combined format. Ameritech reserves the right to remove and/or recode the Vertical Blanking Interval (VBI) at the VIS Network access location, except for FCC Compliant Closed Caption data found in line 21 of field 2, which will be transported without modification.

- Digital Content Interface (VIS Network/Hub side or Shared Ring): Digital Content services are associated with VIS Digital Multicast (DMC) services. The digital content stream delivered to the interface must be composed of digitally multiplexed MPEG-2 System encoded video and audio streams, up to a maximum payload of approximately 36 Mbs for 256 QAM processing, as described in MPEG-2 Systems International Standard, ISO/IEC 1-13818 IS. This payload must be encapsulated in a 44.736 Mbs signal.

5.1. Analog Content

These specifications describe the input and output signal requirements.

5.1.1. NTSC Analog Video Interface (VIS Ntwk./Hub Side or Shared Ring)

Interface Connector	Locking LCC (note 1)
Channels and Channel Designations	One NTSC Baseband Video Input Channel, with separately carried Audio (i.e., not combined with the video signal).
Nominal Operating Level	1 Volt peak-to-peak (140 IRE units) Sync Tip to Reference White
Level and Synchronizaton Reference	Bellcore TR-TSV-000338 [Ref. 5.1] 525 Line/ 60 Field
Impedance	75 Ohms, Unbalanced to Ground

NOTE: ADC standard connector. Hybrid cables, BNC to LCC, are available from ADC.

5.1.2. Analog Audio Interface (VIS Ntwk./Hub Side or Shared Ring)

Interface Connector	Wire Punch down, QCP connector (XLR Female for Special Applications)
Channels and Channel Designations	Two independent (i.e., not combined with the Video signal) Audio Input Channels, Stereo Left and Right. Monaural uses only one of these channels. Optionally, two additional independent Audio Input Channels, Second Audio Program (SAP) and Professional (PRO).
Specification Reference	Bellcore TR-NPL-000337, AP4 service [Ref. 5.2]
Impedance	600 Ohms, Balanced to Ground

The fourth audio signal, commonly referred to as the Professional (PRO) Channel, is normally used as an one-way order wire. Currently, it does not have application at the VDT or end user Television set; i.e., it is not transported by Ameritech's VIS Network.

5.1.3. One-Way Digital Content Interface (VIS Ntwk./Hub Side or Shared Ring)

Interface Connector	BNC Female
Channels and Channel Designations	One Digital Content Channel
Impedance	75 Ohms
Transmission Rate (note 1)	44.736 Mbs ± 20 ppm
Specification Reference	Bellcore TR-NIS-000342 [Ref. 6.3] Section 7
Line Code	Bipolar with Three Zero Substitution (B3ZS)
Framing Format	M13

NOTE: Downstream RF processing requires that the maximum payload be limited to approximately 36 Mbs for 256 QAM processing, with MPEG Null packets employed to bring the bit rate to a full 44.736 Mbs payload rate as described in Section 5.1.3.1.

5.1.3.1. MPEG Packet Rate

Each M-Frame of the Digital Content Channel, which has a frame repetition rate of 106.4 microseconds (μsec), is subdivided into seven subframes. Each subframe consists of 8 data

blocks, with each block organized as one Overhead bit followed by 84 Payload bits. Overhead bit usage must conform to TR-NIS-000342 requirements with a C-bit parity application. M23 framing is not supported and the Alarm Channel, since this is a unidirectional transport application, is inactive (i.e., X-bits = 1). Although a C-bit parity application is employed, P-bit and CP-bit parity (i.e. P-bits set for parity remainder) will not be monitored across the network, but will be used for maintenance and trouble analysis.

C-bits are currently set as follow:

C-bit	Value	Description
Subframe	1	
C1	1	Application Identifier=C-bit parity application.
C2	1	Reserved.
C3	1	Unidirectional traffic, no Far End Alarm & Control (FEAC) codewords are being transmitted.
Subframes	2, 6 and 7	
C1	1	Unused.
C2	1	Unused.
C3	1	Unused.
Subframe 3		
C1	P1	CP-bit parity value.
C2	P1	CP-bit parity value.
C3	P1	CP-bit parity value.
Subframe 4		
C1	1	Unidirectional traffic, Far End Block Error (FEBE) not used.
C2	1	Unidirectional traffic, Far End Block Error (FEBE) not used.
C3	1	Unidirectional traffic, Far End Block Error (FEBE) not used.
Subframe 5		
C1	1	Terminal-to-terminal data link is not implemented.
C2	1	Terminal-to-terminal data link is not implemented
C3	1	Terminal-to-terminal data link is not implemented

Within the 4704 payload bits of each M-Frame (7 subframes times a 8 payload block repetitions/subframe times 84 bits/block), the Digital Content plus Forward Error Correction (FEC) will be transported. Each 188 bytes (1504 bits) of Digital Content will be concatenated with 8 bytes (64 bits) of FEC, utilizing a Reed-Solomon T=4 code, resulting in a 196 byte (1568 bits) packet. More detail can be found in “Tutorial on Reed-Solomon Error Correction Coding”, Geisel, W.A., NASA Technical Memo 102162, 1990. Hence, a maximum of three such packets can be trans-

ported within the M-Frame payload (2 packets times 1568 bits/packet = 4704 bits). The concatenated packets are mapped into the M-Frame with the Most Significant Bit (MSB) of the first byte of the first packet being the first bit after the X1 Overhead bit. the MSB of each byte is transmitted first. Within each M-Frame, 4512 bits (3 packets times 188 bytes/packet times 8 bits/byte) can contain actual Digital Content, with the other 192 bits (3 packets times 8 bytes/ packet times 8 bits/byte) used for FEC. This equates to a maximum Digital Content bit rate of approximately 42,405 Mbs [(44.736 Mbs ± 20 ppm) times (84/85 Payload bits per subframe data block bits) times (188/196 Digital Content bytes per packet bytes)] within the 44.736 Mbs Digital Content Channel.

Buffering in the 256 QAM modulator limits its throughput to a maximum of 36.138583 Mbs, necessitating that the Digital Content bit rate be reduced from the 42,405 Mbs maximum payload capacity of the 44,736 Mbs Digital Content Channel. MPEG “Null” packets, as defined in document ISO/IEC 1-13818 IS, must be inserted to pad the Digital Content Transport stream. These Null packets, marked with a unique 13 bit Packet Identifier (PID) defined as 1FFF (Hexadecimal), are recognized by the QAM modulator and deleted from the transport stream at the QAM input. To limit the chance of buffer underflow/overflow and maintain MPEG-2 System timing, Null packets must be inserted uniformly across the payload; i.e., as opposed to being lumped at the beginning or end of multiple M-Frames. Null packets must also be uniformly inserted for transport cases not requiring even the QAM throughput maximum rate (e.g., a single 6 Mbs MPEG channel alone in the 44.736 Mbs Digital Content Channel).

Each M-Frame can be thought to contain three slots for MPEG transport packets, with each of the packets always being a Data MPEG transport packet or a Null MPEG transport packet. MPEG-2 Data packets should be made available to the VIP’s ’MPEG to 44.736 Mbs framer’ at a packet rate which exactly produces the desired data rate. The framer must map the MPEG packets into the 44.736 Mbs frame. At the beginning of an MPEG packet within the 44.736 Mbs frame, the framer should insert an MPEG Data packet if it is available. If a complete Data packet is not available, an MPEG Null packet should be inserted. This will provide a proper distribution of Data and Null packets.

For example, A Digital Content channel is to carry the full throughput capacity of a 256 QAM modulator.

The Digital Content channel carries three MPEG packets/frame; hence, the Packet Insertion Interval (PII) = [(7 subframes/frame) times (8 data blocks/subframe) times (85 bits/data block)] divided by [(4473600 bits/sec) times (3 packets/frame)] = 35.467334 μsec/packet.

Given the QAM throughput rate of 36138583 bits/sec, the Packet Arrival Interval (PAI) = [(188 MPEG Data bytes/packet) times (8 bits/byte)] divided by (36138583 bits/sec) = 41.617569 μsec/MPEG Data packet. Note: Lower MPEG Data rates would increase the PAI by decreasing

the 36138583 bits/sec value in the equation; e.g., an MPEG Data rate of 27 Mbs would result in a PAI of 55.703703 μsec/MPEG Data packet.

If MPEG Data packets start arriving at the framer at the beginning of the Digital Content channel frame, the framer should insert the first Data packet into the frame. Because the PII is approximately 7 μsec shorter than the PAI, a full Data packet will not have arrived within the PII, and the second packet to be inserted will be a Null packet. By the time that the framer is ready to insert a third packet, a Data packet has been waiting approximately 29 μsec. Another Data packet can be inserted, and the framer will have Data packets available for frame insertion for the next four packets. At this point the framer will have gotten ahead of the Data packet source, and a Null packet will have to be inserted. This pattern repeats with the number of Data packets between Null packets varying between four and five.

The VIP must perform time stamp correction on the MPEG transport stream, such that the Program Clock Reference (PCR) is adjusted prior to insertion into the M-Frame. Ameritech's VIS Network will not compensate for inaccurate PCRs at the input NI, nor will it dejitterize the Digital Content stream. The Null packets will be filtered out at the QAM modulator to re-establish the original MPEG transport data rate. More information on QAM modulating an MPEG transport stream can be found in Scientific Atlanta publication # V0001Z95 [Ref. 5.4].

5.1.4. One-Way Optical Interface (VIP Side, Non-Ring Applications Only)

For compatibility with the VIS network/Hub side terminal equipment, for Analog Content interfacing, a DV6000 shelf (which provides the 2.38 Gbs optical signal) with one of the channel cards specified below, will be required per video channel:

- DV-6101-VE-N2 [single video plus up to 2 associated audios transmit/encoder card]
- DV-6101-VE-N4 [single video plus up to 4 associated audios transmit/encoder card]
- DV-6102-VD-N2 [single video plus up to 2 associated audios receive/decoder card]
- DV-6102-VD-N4 [single video plus up to 4 associated audios receive/decoder card]

A maximum of 16 such cards can be provisioned in single shelf. Use of this equipment will provide the baseband video Performance Objectives listed in Section 5.4 and Section 5.5 following.

For compatibility with the VIS network/Hub side terminal equipment, for Digital Content interfacing, a DV6000 self (which provides the 2.38 Gbs optical signal) with one of the channel cards specified below, will be required per two 44.736 Mbs channels.

- DV-6101-DE [dual digital channel transmit/encoder card]
- DV-6101-DD [dual digital channel receive/decoder card]

A maximum of 16 such cards can be provisioned in a single shelf. These cards also provide termination for up to two additional DS1 signals, which will not be supported across the Network Interface (NI).

Optical Connector:	Single SC as described in "Ameritech SC Connector Specification V.02" [Ref. 5.5]. Two connectors for protection options.
Laser Type:	Doped Fabray-Perot (DFB)
Wavelength:	1310 nm ± 10 nm or 1550 nm ± 20 nm
Output Power:	0 dBm
Receiver Type:	InGaAs Avalanche Photo Detector (APD) Minimum Receiver Level for BER Less Than 1E-9: -30 dBm

5.2. Network Channel Code

The Network Channel (NC) code, as described in Bellcore Documents SR-STS-000307 [5.6] and SR-STS-000323 [5.7], is a four character representation of the channel parameters. It consists of two data elements: (1) two-character positions that specify the type and quality of the channel, and (2) two-character positions that specify an available option code for this channel type.

The NC Codes currently available for AMVS are shown in the table below.

Table 5.
NC CODES

NC CODE	Option CODE Character 3	Option CODE Character 4
ANALOG CONTENT		
TX	B (Quality #2)	C (MultiChannel)

DIGITAL CONTENT		
TV	D	C (MultiChannel)

5.3. Network Channel Interface Code

The electrical/optical interface of the Ameritech owned facilities are described by a Network Channel Interface (NCI) code. The NCI code, also described in Bellcore Documents SR-STS-000307 and SR-STS-000323, is comprised of five elements that are specified by the customer for each Point of Termination when ordering the service. These elements are:

A. The 'number of conductor' code, characters 1 and 2, can be of six options:

01 - for an unprotected Optical Interface

02 - for a Digital Content Interface or Protected Optical

04 - for 1 Video and 1 Channel Audio

06 - for 1 Video and 2 Channel Audio

08 - for 1 Video and 3 Channel Audio

10 - for 1 Video and 4 Channel Audio

B. The protocol code, characters 3 and 4, can be one of three options:

TV - Television Interface

DS - Digital Hierarchy Interface

WV - Multiple Channels within an Optical Interface

C. The impedance code, character 5, is one of two options:

6 - 75 Ohms for Electrical Interfaces

F - Fiber for Optical Interfaces

D. The protocol option can be one of four options:

15 - for Analog Video plus one or two 15 kHz Audio Signal

15A - for Analog Video plus three or four 15 kHz Audio Signal

44A - for one Electrical 44.736 Mbs Transmission Bit Rate

L - for one Optical 2.38 Gbs Transmission Bit Rate

E. The direction of service can be one of two options:

0- for Transmit End

-0 for Receive End

Table 6.
ALLOWED COMBINATIONS

Character 1&2	Character 3&4	Character 5	Protocol	Direction
04	TV	6	15	0- (or -0)
06	TV	6	15	0- (or -0)
08	TV	6	15A	0- (or -0)
10	TV	6	15A	0- (or -0)
02	DS	6	44A	0- (or -0)
01	WV	F	L	0- (or -0)
02 (note)	WV	F	L	0- (or -0)

NOTE: Applies when a protection option is to be provided.

5.4. Analog Video Performance Objectives

The following table provides the performance objectives for AMVS with Analog Content transport equipment.

Video Parameter	**AMVS Performance Objective** (note 1)
Amplitude Response vs. Frequency (50 IRE unit sinusold) (note 2)	
.5 MHz	+0.7/-0.7 IRE
1.0 MHz	+0.9/-0.9 IRE
2.0 MHz	+1.0/-1.0 IRE
3.0 MHz	+1.2/-1.1 IRE
3.58 MHz	+0.6/-0.6 IRE
4.2 MHz	+1.2/-1.1 IRE
Chrominance-Luminance Gain Inequality	+/- 2 IRE
Chrominance-Luminance Delay Inequality	+/- 20 Nanosecond
Field-Time Waveform Distortion	≤3 IRE peak-to-peak
Line-Time Waveform Distortion	≤.5 IRE peak-to-peak
Short-Time Waveform Distortion	≤2.0%
Long-Time Waveform Distortion	≤8.0 IRE units peak, 3 second setting time
Insertion Gain	+5.9/-5.5 IRE
Luminance Nonlinearity	≤2 IRE
Differential Gain	≤2 IRE or 2 %
Differential Phase	≤0.7 degrees
Chrominance-Luminance Intermodulation	≤1 IRE
Chrominance Nonlinear Gain (20 or 80 IRE unit Chroma signal)	+/-1 IRE
Chrominance Nonlinear Phase	≤1 degree
Signal-to-Weighted-Random-Noise Ratio (10 kHz – 4.2 MHz)	≥63 dB

Note 1: Values shown are in general compliance with TR-TSV-000338, ≤20 Route-Miles (referred to as Short Haul in other standards) performance levels.

Note 2: For 100 IRE unit test signals, the IRE limits are doubled. Conversion to decibel notation can be accomplished via the following equation. Value (in dB)=20 times the base 10 Log of [Vmeas (in IRE) divided by Vref (in IRE)] where Vref is the reference voltage (50 or 100 IRE) and Vmeas is the measured voltage for which the dB value is desired.

Note 3: Test methodologies can be found in document ANSI T1.502-1988 [5.8].

5.5. Analog Audio Performance Objectives

The following table provides the performance objectives for AMVS with Analog Content transport equipment.

Audio Parameter	**AMVS Performance Objective** (note 1)
Amplitude Response vs. Frequency (Ref. 1 kHz @ 0 dBm0) 50 to 100 Hz .1 to 10 kHz 10 to 15 kHz	 +1.0/-1.4 dB +/- 1.0 dB + 1.0/-2.0 dB
Signal-to-Noise Ratio (note 2) (15 kHz Flat Weighting)	≥63 dB
THD + Noise (note 3) (4 seconds/404 Hz/ + 18 dBm0)	≤1 %
Maximum Instantaneous Peak Level (Clip Level)	+ 18 dBm0
Maximum Steady Tones (averaged over one second) 50 Hz to 404 Hz 404 Hz to 15 kHz	 +8 dBm0 0 dBm0

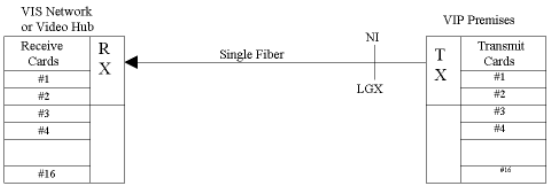
Note 1: Values shown are in general compliance with TR-NPL-000337, AP4 Service, Performance levels.

Note 2: Referenced to + 18 dBm0 instantaneous peak level.

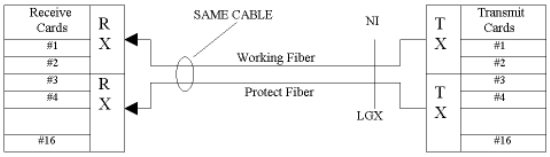
Note 3: This "test only" level may not be continuously applied to the audio channel.

Note 4: Test Methodologies can be found in document ANSI T1.505.-1989 [5.9].

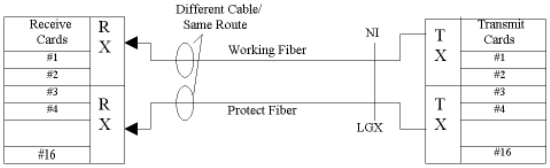
Figure 1. VIP ACCESS TO VIS Network/Hub (Non-Ring Application)



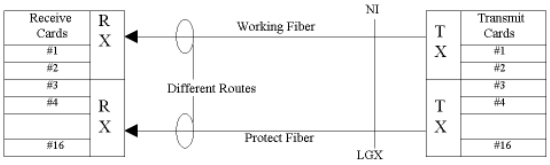
(a) AMVS Basic Service
(Card Interfaces follow)



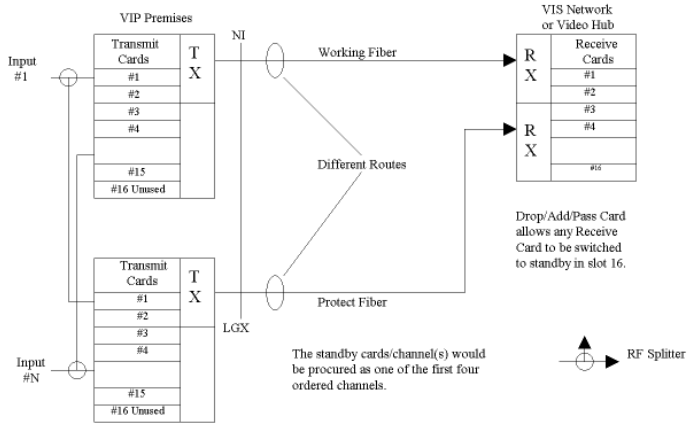
(b) Protection Option #1
(Card Interfaces follow)



(c) Protection Option #2
(Card Interfaces follow)



(d) Protection Option #3
(Card Interfaces follow)



(e) Protection Option #4
(Card Interfaces follow)

Figure 3. TRANSMIT and RECEIVE Cards: Input and Output Electrical Interfaces (VIS Network/Hub side or Shared Ring)

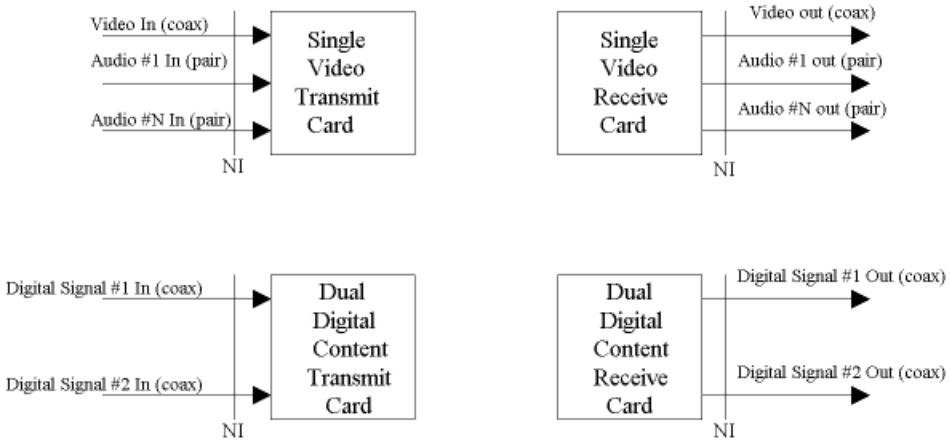


Figure 4. FEEDS FROM VIS Network/Hub (Non-Ring Application)

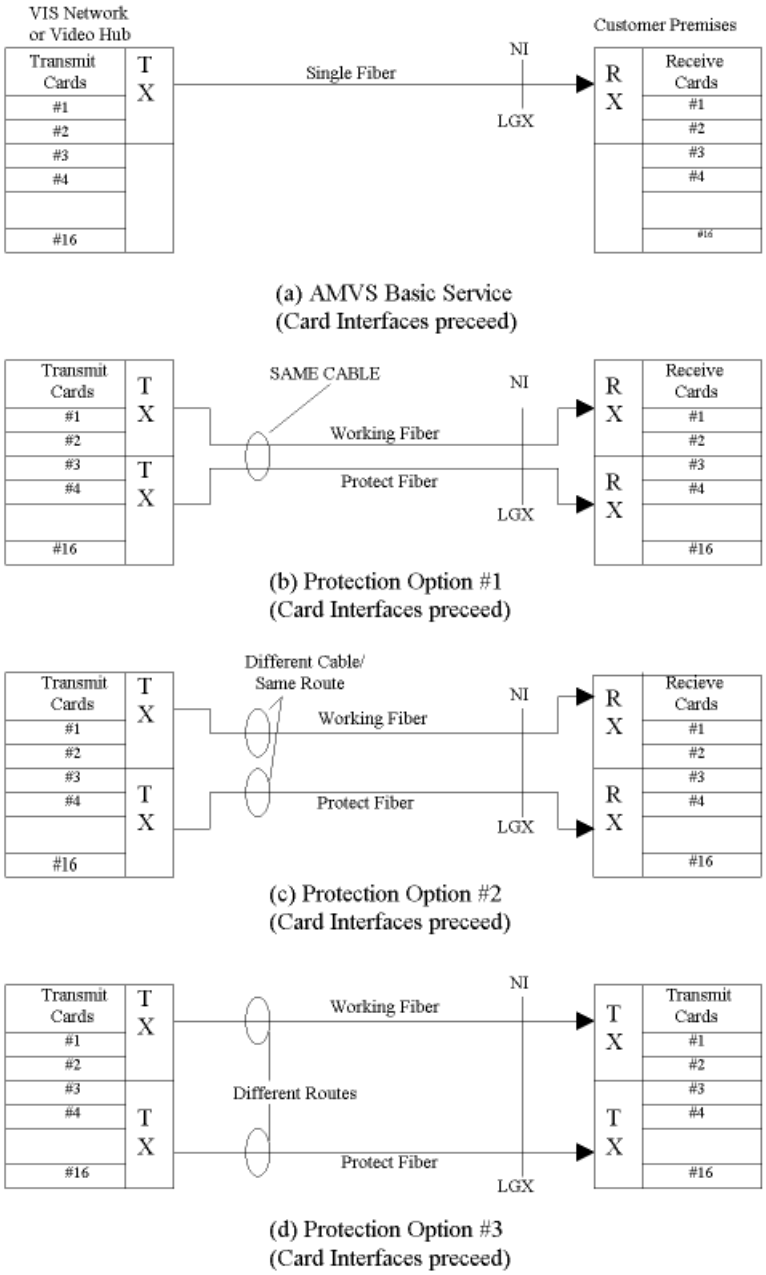
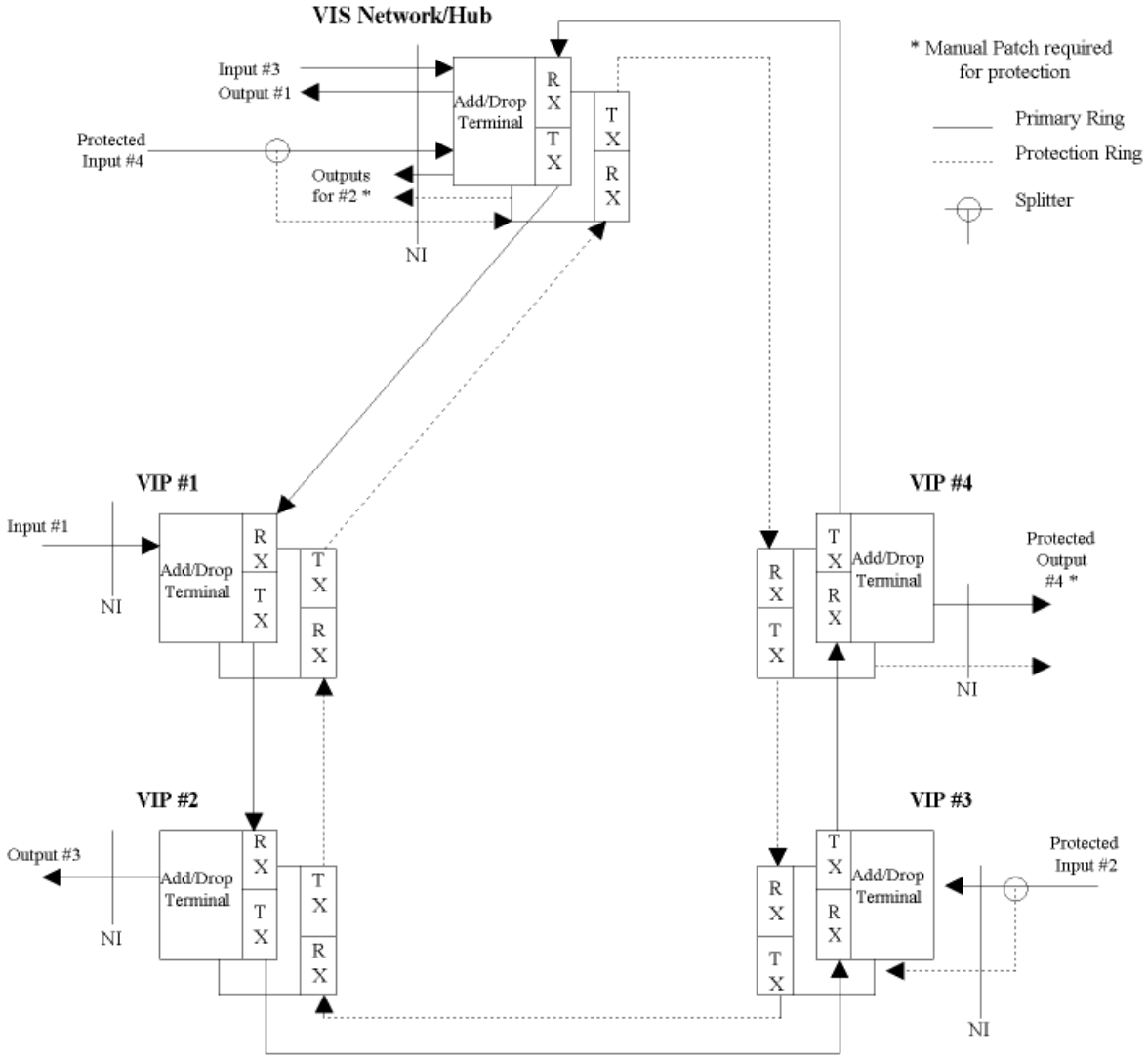


Figure 5. Shared Unidirectional Ring Topology (service is still point-to-point, VIP to/from VIS or Video Hub)



6. REFERENCES

Reference numbers, [x.y], apply to the Yth reference in Section X.

[4.1] - Generic Coding of Moving Pictures and Associated Audio: Systems Recommendation H.222.0, ISO/IEC 1-13818 IS November 1994.

[4.2] - Video and Interactive Service (VIS), Network Interface Specifications, AM TR-NIS-000126, Issue 1, March 1995.

[5.1] - Television Special Access and Local Channel Services - Transmission Parameter Limits and Interface Combinations, Telcordia (formerly Bellcore) TR-TSV-000338, Issue 2, August 1993.

[5.2] - Program Audio Special Access and Local Channel Services Telcordia (formerly Bellcore) TR-NPL-000337, Issue 1, July 1987.

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