

TR 73593

May 1996



Interface Performance Specification
for Broadcast User Television Signals
Delivered Over
Uncompressed Digital Transport Systems

Technical
Reference

NOTICE

This Technical Reference is published by BellSouth Telecommunications, Inc., and provides information required for interconnecting with the BellSouth company networks.

BellSouth Telecommunications, Inc., reserves the right to revise this document for any reason, including but not limited to, conformity with standards promulgated by various governmental or regulatory agencies, utilization of advances in the state of the technical arts, or the reflection of changes in the design of any equipment, techniques, or procedures described or referred to herein. Liability to anyone arising out of use or reliance upon any information set forth herein is expressly disclaimed, and no representations or warranties, expressed or implied, are made with respect to the accuracy or utility of any information set forth herein.

This document is not to be construed as a suggestion to any manufacturer to modify or change any of its products, nor does this document represent any commitment by BellSouth Telecommunications, Inc., to purchase any product whether or not it provides the described characteristics.

Nothing contained herein shall be construed as conferring by implication, estoppel or otherwise, any license or right under any patent, whether or not the use of any information herein necessarily employs an invention of any existing or later issued patent.

If further information is required, please contact:

Advanced Network Architecture
Director – Science and Technology
BellSouth Telecommunications, Inc.
Room 40F82
675 W. Peachtree
Atlanta, GA 30375

**Interface and Performance Specifications
for Broadcast Television Signals Delivered over
Uncompressed Digital Transport Systems**

CONTENTS

1.	Introduction	1
1.1	General	1
1.2	Purpose	1
1.3	Applicability of Technical Specifications	1
2.	Service Description	2
2.1	General	2
2.2	Service Type	2
2.3	Network Interface (At the Customer Premises)	2
3.	Video Coding Overview	3
4.	Video Signal Specifications	3
5.	Audio Signal Specifications	3
6.	Network Specifications	4
7.	Network Channel (NC) Code and Network Channel Interface (NCI) Code	4
7.1	General	4
7.2	Network Channel (NC) Code	4
7.2.1	Network Channel (NC) Code Example	5
7.3	Network Channel Interface (NCI) Code	6
7.3.1	Network Channel Interface (NCI) Code Example	8
7.4	Compatible Interface Combinations for This Service	8
8.	Technical Specifications	9
8.1	General	9
9.	Interface Illustrations:	13
9.1	Interface Type 04TV6.8-0	13
9.2	Interface Type 04TV6.8-0	14
9.3	Interface Type 04TV6.8-0	15
9.4	Interface Type 04TV6.8-0	16
9.5	Interface Type 04TV6.8-0	17
9.6	Interface Type 04TV6.8-0	18
10.	Appendix	19
10.1	Glossary of Terms	19

10.1.1	General	19
10.1.2	Common Definitions, Descriptions and Terminology	19
11.	References	25

Interface and Performance Specifications

for Broadcast Television Signals Delivered over Uncompressed Digital Transport Systems

1. Introduction

1.1 General

This document provides interface and performance specifications for broadcast television signals delivered by BellSouth over uncompressed digital transport systems to Interexchange Carriers (ICs) and End Users (EUs) for both interLATA access and for IntraLATA Service. For interLata access, BellSouth provides the digital facilities from the EU's Network Interface (NI) within the LATA to the IC's point of termination (POT). For intraLATA service, BellSouth provides facilities end-to-end.

The delivered video signal is expected to meet or exceed the television technical specifications for broadcast quality television (TV1) stipulated in Bellcore Technical Reference TR-TSV-000338, Issue 2, August 1993.

This BellSouth Technical Reference supplements Bellcore Generic Requirements Document GR-338-CORE, Issue 1, December 1995 and Technical Reference TR-TSV-000338, Issue 2, August 1993.

1.2 Purpose

The purpose of this document is to describe the interface and performance specifications for composite System M-NTSC broadcast television signals delivered over uncompressed digital transport systems. This document is not intended to be used as an ordering guide, however the customer may consult this document for access codes. **The BellSouth Tariffs should be consulted for ordering information.**

1.3 Applicability of Technical Specifications

The technical interface and performance specifications listed in this reference were developed based on compilation of data obtained from tests of uncompressed digital transport systems representative of the industry. These tests determined that video transmitted over most uncompressed digital transport systems can meet the specifications of ANSI Standard T1.502-1988 and Bellcore Generic Requirements Document GR-338-CORE for broadcast television.. When standards are developed for uncompressed digital transport systems, this document will be revised to incorporate those standards.

2. Service Description

2.1 General

Television Special Access and Local Channel Services (TV1) are full or part time channels used exclusively for transmission of standard format video and associated audio signals within a LATA. The service described herein accommodates commercial broadcast television System M–NTSC video signals and up to four 15/20 kHz associated audio signals per video signal. Transport will be via uncompressed digital techniques over fiber optics or a mix of basic facilities. These services may be provided between an Interexchange Carrier (IC) and an End User (EU) or between two End Users (EU) within the same LATA.

This service provides digital transport of television special access services (TV1) at bit rates 135 – 270 Mb/s. If bit rates are compatible with existing transmission services (e.g., SONET), these digital video transport services may use existing digital transport services to realize economies of scale. While analog System M–NTSC television signals are provided by the customer at the interface, this service cannot be mixed with analog television service. Two one–way services may be combined to provide two–way, fully interactive video services.

The interface for the video will accommodate an analog baseband video signal on a 75 ohm unbalanced cable terminated in a BNC Connector. The interface for the audio will accommodate an analog baseband audio signal on a 600 ohm balanced cable. With an analog interface, video coding and/or decoding will be performed by BellSouth.

2.2 Service Type

This service will provide video quality whose performance specifications will meet or exceed the analog video specifications described for short haul transmission in ANSI Standard T1.502–1988. This service will be designated as TVU for uncompressed digital video service. BellSouth will design and provide a network solution using the appropriate technology to meet the customer’s needs for this service.

2.3 Network Interface (At the Customer Premises)

A baseband–to–baseband analog signal will be the network interface component.

3. Video Coding Overview

Hardware used to convert an analog video signal into a recoverable digital equivalent are known as video coders. The simplest such devices sample the analog video signal at a rate high enough to recover the highest frequency information it is designed to transmit, and directly encode each sample according to an agreed upon plan. Most of today's digital systems use pulse code modulation (PCM). There are several methods which PCM sampling may be accomplished by a typical coder (e.g., the method described in SMPTE Standard 244M) and achieve the same high quality video signal at the output of the decoder. However, it is not the purpose of this Technical Reference to specify any unique algorithm for PCM sampling but to describe the interface and performance specifications these signals must meet to comply with BellSouth's customer expectations for video quality.

4. Video Signal Specifications

Since this service requires BellSouth to provide the video coders and decoders, the interface will be analog video conforming to EIA RS-170-A "Electrical Performance Standards – Color Television Studio Facilities". The coders and decoders should operate such that they not only overcome channel degradations but also inherent noise and distortion the algorithm introduces in the signal. The in-service quality of the video signal at the output of the decoder must conform to the specifications shown in Table 8.1.

The analog video signal input for this service is System M-NTSC composite television signals, 75 ohms, unbalanced impedance with input return loss greater than 30 dB. The input signal level of a transmission service channel is the difference in voltage between sync tip (-40 IRE) and reference white (+100 IRE) of a composite picture signal presented to the video baseband input terminals and usually expressed in volts. The values shall be a nominal 1 volt peak-to-peak difference between sync tip and reference white (140 IRE units).

The output signal level of a transmission service channel is that level presented by the transmission channel output terminals. The output signal shall be a faithful reproduction of the input signal, subject to parametric variations permitted by the performance characteristics set forth in this technical reference.

5. Audio Signal Specifications

The analog audio interface to the service shall have 600 ohm, balanced with capability for up to four audio channels. Each audio channel shall be independent with a bandwidth of 15 or 20 kHz. The audio bandwidth is technology specific and is contingent upon customer requirements.

6. Network Specifications

Video signals will be sampled and digitized for transport through the network. Disturbances that are inherent in the network that cause digital errors and ultimately video impairments are of considerable concern. More specifically, these disturbances consist of transients, discontinuities in switching, jitter and wander of the digital signal. Since most disturbances could be described as either jitter or wander, these two components will be the only components specified in this document. The effect of jitter and wander on video signals are cumulative from the input to the encoder through the network to the output of the decoder. The decoder must accurately replicate the clocking information of the encoder in frequency and phase so that the original analog video signal may be recreated. The network perturbations can disturb this clocking through phase and frequency shifts which can cause degradations in video performance including failure of signal.

Threshold levels for jitter and wander that will allow video signals to be transported through the network and provide high quality video signals that meet the requirements of this document to the end-user are under study. Jitter threshold levels specified for SONET are found in ANSI Standard T1.105.03 and wander specifications for SONET have been determined by ANSI Standard T1.101. In absence of performance specifications for jitter and wander applied to uncompressed video signals transported over a digital path through the network, the above specifications for SONET have been determined to be BellSouth's requirements for Uncompressed Digital Video Service.

7. Network Channel (NC) Code and Network Channel Interface (NCI) Code

7.1 General

This section provides the NC and NCI codes for Broadcast Television Services delivered by uncompressed digital transmission systems in the BellSouth Network.

7.2 Network Channel (NC) Code

The Network Channel code is an encoded representation used to identify both switched and nonswitched channel services. It is a four character code that consists of two (2) data elements: (1) Channel Service Code and (2) Optional Feature Code. The NC code describes the channel parameters. Table 7.1 shows the format of the NC structure.

Table 7.1: Network Channel Code Format

Field Identity	Network Channel Service Code		Optional Feature Code	
	1	2	3	4
Character Position	1	2	3	4
Code	A	A	A	A

- (1) **The Network Channel Service Code** is a two character alpha code (A) that describes the channel service in an abbreviated form. The Channel Service Code will typically be specified as the service code of the service. This code is always filled in.
- (2) **The Optional Feature Code** is a two character alpha code for video service that represents service quality and C. O. option codes available for each channel service code. The Service Quality is an alpha code shown in the third position that describes the quality of the service channel. The C. O. option is an alpha code in the fourth position that describe various combinations of the type of C. O. service requested (i.e., CO Bridging & Switching). The NC optional feature code field is always filled in. A hyphen (–) is used in the fourth position of the NC Code to indicate the absence of features or options.

Allowable Network Channel (NC) Codes and combinations for this service are shown in the following Tables 7.2 – 7.4:

Table 7.2: Network Channel Service Code for Television Channel Service TVU

Network Channel Service Code	LATA Service	Description
TV	Access	Television Special Access and Local Channel Services

Table 7.3: Service Quality

Position	Character	Description
3	U	Composite System M–NTSC analog broadcast television signals complying with the analog performance specifications of ANSI Standard T1.502–1988 sampled and digitized for transport at bit rates greater than 135 Mb/s but less than 270 Mb/s.

Table 7.4: Central Office Option

Position	Character	Option(s)
4	–	None
	B	C.O. Bridged
	S	C.O. Switched
	C	B + S
	Z	Nonstandard

7.2.1 Network Channel (NC) Code Example

The NC code “TVUS” contains the following components:

- (1) **TV** – This two character Network Service Code indicates that this television channel service is Broadcast Television Special Access and Local Channel Services.

- (2) **U** – This character position indicates the composite NTSC broadcast television signal has been sampled and digitized into a bit rate greater than 135 Mb/s but less than 270 Mb/s.
- (3) **S** – This character position indicates C.O. options. “S” indicates that this service is equipped for central office switching.

7.3 Network Channel Interface (NCI) Code

The Network Channel Interface (NCI) Code is an encoded representation used to identify five (5) interface elements located at a point of termination (POT) or customer location. The interface elements are (1) Total Conductors, (2) Protocol, (3) Impedance, (4) Protocol Options, and (5) directionality of transmission. The delimiter in Table 7.5 is provided to separate different segments of the NCI Code. Table 7.5 shows the format of the NCI code structure.

Table 7.5: Network Channel Interface Code Format

Field Identifier	Total Conductors		Protocol		Imp	Del	Protocol Options			Del	Directionality	
	1	2	3	4	5	6	7	8	9	10	TX	RX
Character Position	1	2	3	4	5	6	7	8	9	10	11	12
Code	N	N	A	A	N		AN	AN	AN		N	N

Note: Imp = Impedance

Del = Delimiter – Required for overall code readability; generally a period (.) or a virgule (\,/)

- (1) **Total conductors (character positions 1 and 2)** is a two–character numeric code that represents the total number of physical conductors (i.e., wires) required at the interface. This field is always filled. Total conductors are described in Table 7.6.
- (2) **Protocol (character positions 3 and 4)** is a two–character alpha code that defines requirements for the interface regarding transmission. This field is always filled. The protocol combinations specified at the ends of a circuit need not be the same. However, only certain combinations are technically possible. Protocol codes are described in Table 7.7.
- (3) **Impedance (character position 5)** is a one–character numeric code representing the nominal reference impedance that will terminate the channel for the purpose of evaluating transmission performance. This field is always filled. The impedance code is described in table 7.8.
- (4) **Protocol Options (character positions 7, 8 and 9)** is a one–to–three character numeric or alphanumeric code that describes additional features of the protocol to be used. Protocol option codes are left justified when fewer than three characters are specified. Protocol option codes are described in Table 7.9.
- (5) **Directionality of transmission (character positions 11 and 12)** is a two character numeric code indicating the direction of transmission. This code is described in Table 7.10.

Table 7.6: Total Number of Conductors

Code	Number of Physical Conductors
04	video and one audio channel
06	video and two audio channels
10	video and four audio channels

Table 7.7: Protocol Codes

Code	Definition
TV	Analog Composite System M–NTSC Television Interface

Table 7.8: Impedance Code

Code	Impedance
6	75 Ohms for analog television signals

Table 7.9: Protocol Option

Option	Definition
8	Analog Composite System M–NTSC Television Signal equipped with up to four (4) associated 15/20 kHz audio signals sampled and digitized for transport at bit rates 135 – 270 Mb/s

Table 7.10: Direction of Service

Code	Description
–0	Transmit end
0–	Receive end

7.3.1 Network Channel Interface (NCI) Code Example

The NCI code “**6TV6.8-0**” contains the following components:

- (1) **6** – This numeric character is short for the “**06**” character as shown in Table 7.6 and indicate the total number of physical conductors connected to the Network Interface. Six conductors are shown.
- (2) **TV** – These two alpha characters indicate analog television and audio interface.
- (3) **6** – This single numeric character indicates the nominal reference impedance that will terminate the channel. As shown in Table 7.8, 75 ohms is the impedance.
- (4) **.”** – This single character is the delimiter.
- (5) **8** – This single numeric character is left justified in the three slots reserved for the protocol option code. As shown in Table 7.9, this character indicates analog Composite NTSC television signal equipped with associated signals sampled and digitized for transport at bit rates 135 – 270 Mb/s.
- (6) **“-0”** – This two character position indicates transmission directionality as shown in Table 7.11. The direction shown is transmit end.

7.4 Compatible Interface Combinations for This Service

Table 7.11: Compatible Interface Combinations

Service Code	NC Code	End-User Interface	Interexchange Carrier Interface
TV1	TVU	4TV6.8-0	4TV6.80-
		4TV6.80-	4TV6.8-0
		6TV6.8-0	6TV6.80-
		6TV6.80-	6TV6.8-0
		10TV6.8-0	10TV6.80-
		10TV6.80-	10TV6.8-0

8. Technical Specifications

8.1 General

The following performance specifications in Table 8.1 are presented to describe those parameters and threshold levels BellSouth will maintain in provisioning of this service to customers. As indicated earlier in this document, tests have been performed on digital video transport systems transporting video at bit rates 135 – 270 Mb/s to substantiate using the performance specifications of ANSI Standard T1.502–1988 for ascertaining the quality of the video. These tests proved that most analog short haul specifications are valid threshold levels to maintain for video transported over digital video transport systems at bit rates greater than 135 Mb/s.

The analog tests in the above ANSI Standard that were considered unreliable for measuring video quality transported over transmission systems at bit rates 135 – 270 Mb/s are the differential nonlinearity and signal-to-noise tests. The method recommended by BellSouth for measuring differential nonlinearity and signal-to-noise for ascertaining video quality transported over transmission systems at bit rates 135 – 270 Mb/s is performance of the same test with a shallow ramp (5 IRE) test signal.

During the differential gain and phase tests with the 5 IRE test signal, the gentle slope of the signal effectively extends the duration of the nonlinearity error. Hence, the spectral energy of the error is placed mostly in the lower frequencies allowing the error to pass through the output filters unattenuated where it is measured. Whereas the full 100 IRE ramp test signal places the spectral energy of the error across the low and high frequencies. Since the output filters attenuate the high frequencies, any error spectral energy placed in the high frequencies will be lost.

Table 8.1: Video Performance Specifications

Parameter	Requirements
Amplitude Response versus Frequency	
0.5 MHz	+0.12 to -0.12 dB
1.0 MHz	+0.15 to -0.16 dB
2.0 MHz	+0.17 to -0.19 dB
3.0 MHz	+0.21 to -0.19 dB
3.58 MHz	+0.10 to -0.10 dB
4.2 MHz	+0.21 to -0.19 dB
Chrominance-to-luminance gain inequality	+2% to -2%
Chrominance-to-luminance delay inequality	+20 to -20 ns
Field-Time waveform distortion	3% peak-to-peak
Line-Time waveform distortion	0.5% peak-to-peak
Short-Time waveform distortion	2%
Long-Time waveform distortion	3 second settling time, 8% peak
Insertion Gain	+5.9 to -5.5 IRE units
Insertion Gain Variation	
Hourly	±1.7 IRE units
Over one second	±1.2 IRE units
Luminance nonlinearity	2%
Differential gain	2%
Differential Phase	0.7 degrees
Chrominance-to-luminance intermodulation	1%
Chrominance nonlinear gain	
20 IRE Chroma signal	±2.5%
80 IRE Chroma signal	±2.5%
Chrominance nonlinear phase	1 degree
Dynamic gain of picture signal	2%
Dynamic gain of synchronizing signal	1.2%
Transient synchronizing signal nonlinearity	1%
Signal-to-noise Ratio 10 kHz to 4.2 Mhz, NTC weighing, 5 IRE ramp test signal	67 dB

Table 8.2: 15 kHz Audio Performance Parameters

Parameter	Requirements
Amplitude response versus frequency	
Frequency Range	Response Limits
50 to 250 Hz	+0.3 to -1.0 dB
251 to 10,000 Hz	+0.3 to -0.3 dB
10,001 to 15,000 Hz	+0.3 to -1.0 dB
Total Distortion (< 4 sec / 400 Hz / +18 dBm)	0.3%
Band-Limited, Signal-to-idle-channel-noise ratio	72 dB
Insertion gain	0 ± 0.5 dB
Stereo gain difference between channels versus frequency	
Frequency Range	Gain Difference
50 to 250 Hz	+0.8 to -0.8 dB
251 to 10,000 Hz	+0.5 to -0.5 dB
10,001 to 15,000 Hz	+0.8 to -0.8 dB
Stereo phase difference between channels versus frequency	
Frequency Range	Phase Difference (degrees)
50 to 250 Hz	6 Degrees
251 to 10,000 Hz	3 Degrees
10,001 to 15,000 Hz	6 Degrees
Output Level tracking limits	± 0.2 dB
Quantizing error	
Low Level	6 dB Maximum Change
High Level (LF & HF)	-41 dBm
Intermodulation distortion	0.1%
Envelope delay	
Frequency Range	Envelope Delay
50 to 100 Hz	1.0 ms
101 to 200 Hz	0.5 ms
201 to 10,000 Hz	0.25 ms
10,001 to 14,000 Hz	0.5 ms
14,001 to 15,000 Hz	1.0 ms
Interruption of service	
S/N	< 30 dB
Gain	Degraded by 40 dB

Table 8.2: 20 kHz Audio Performance Parameters

Parameter	Requirements
Amplitude response versus frequency Frequency Range	Response Limits
50 to 250 Hz	+0.2 to -0.8 dB
251 to 10,000 Hz	+0.2 to -0.2 dB
10,001 to 15,000 Hz	+0.2 to -0.8 dB
Total Distortion (< 4 sec / 400 Hz / +18 dBm)	0.5%
Band-Limited, Signal-to-idle-channel-noise ratio	84 dB
Insertion gain	0 ± 0.5 dB
Stereo gain difference between channels versus frequency Frequency Range	Gain Difference
50 to 250 Hz	+0.5 to -0.5 dB
251 to 10,000 Hz	+0.5 to -0.5 dB
10,001 to 15,000 Hz	+0.5 to -0.5 dB
Stereo phase difference between channels versus frequency Frequency Range	Phase Difference (degrees)
50 to 250 Hz	6 degrees
251 to 10,000 Hz	3 degrees
10,001 to 15,000 Hz	6 degrees
Output Level tracking limits	± 0.2 dB
Quantizing error	
Low Level	3 dB Maximum Change
High Level LF	-51 dBm
High Level HF	-46 dBm
Intermodulation distortion	0.05%
Envelope delay Frequency Range	Envelope Delay
50 to 100 Hz	1.0 ms
101 to 200 Hz	0.5 ms
201 to 10,000 Hz	0.25 ms
10,001 to 14,000 Hz	0.5 ms
14,001 to 15,000 Hz	1.0 ms
Interruption of service S/N Gain	< 30 dB Degraded by 40 dB

9. Interface Illustrations:

This section illustrates each interface used to provide Television Special Access and Local Channel Services via uncompressed digital transport systems. Included is a summary of the technical information applicable to each interface.

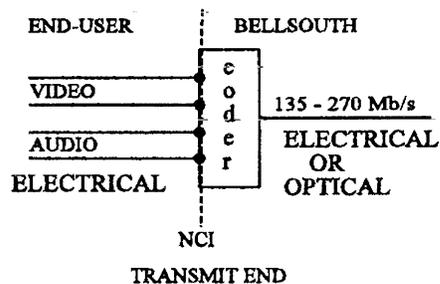
9.1 Interface Type 04TV6.8-0

<i>Application:</i>	Provides for a one-way transmission of a standard composite System M-NTSC video signal and one associated 15/20 kHz audio signal.
<i>Operating Mode:</i>	Full or part time video and associated audio
<i>Physical Description:</i>	Coaxial cable with BNC connector for video and two-wire (T,R) for audio
<i>Service:</i>	TV1

Electrical Features

	Video	Audio
<i>Impedance</i>	75 ohms unbalanced	600 ohms balanced
<i>Overload Point:</i>	1.2 V peak-to-peak (sync tip to reference white)	+18 dBm ¹ at 404 Hz
<i>Operating Levels</i>	1 V peak-to-peak (sync tip to reference white)	+8vu (max) program level
<i>Max Steady-State Levels (averaged over 1 second)</i>	NA	+8dBm, 50Hz-404 Hz 0 dBm, 404 Hz-15/20 kHz
<i>Frequency Range</i>	20 Hz - 4.2 MHz	50 Hz to 15 kHz 20 Hz to 20 kHz

Illustration:



¹This level may not be continuously applied to audio channels

9.2 Interface Type 04TV6.8-0

Application: Provides for a one-way reception of a standard composite System M-NTSC video signal and one associated 15/20 kHz audio signal.

Operating Mode: Full or part time video and associated audio

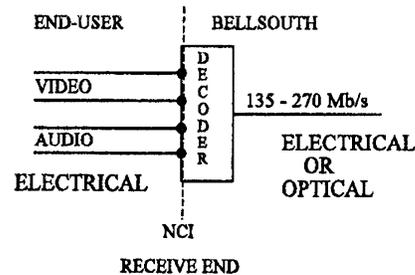
Physical Description: Coaxial cable with BNC connector for video and two-wire (T,R) for audio

Service: TV1

Electrical Features

	Video	Audio
<i>Impedance</i>	75 ohms unbalanced	600 ohms balanced
<i>Overload Point:</i>	1.2 V peak-to-peak (sync tip to reference white)	+18 dBm ¹ at 404 Hz
<i>Operating Levels</i>	1 V peak-to-peak (sync tip to reference white)	+8vu (max) program level
<i>Max Steady-State Levels (averaged over 1 second)</i>	NA	+8dBm, 50Hz-404 Hz 0 dBm, 404 Hz-15/20 kHz
<i>Frequency Range</i>	20 Hz - 4.2 MHz	50 Hz to 15 kHz 20 Hz to 20 kHz

Illustration:



¹This level may not be continuously applied to audio channels

9.3 Interface Type 04TV6.8-0

Application: Provides for a one-way transmission of a standard composite System M-NTSC video signal and two associated 15/20 kHz audio signals.

Operating Mode: Full or part time video and associated audio

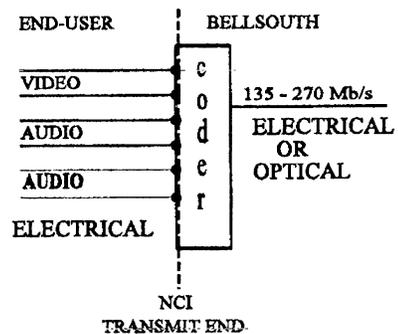
Physical Description: Coaxial cable with BNC connector for video and two-wire (T,R) for each audio signal

Service: TV1

Electrical Features

	Video	Audio
<i>Impedance</i>	75 ohms unbalanced	600 ohms balanced
<i>Overload Point:</i>	1.2 V peak-to-peak (sync tip to reference white)	+18 dBm ¹ at 404 Hz
<i>Operating Levels</i>	1 V peak-to-peak (sync tip to reference white)	+8vu (max) program level
<i>Max Steady-State Levels (averaged over 1 second)</i>	NA	+8dBm, 50Hz-404 Hz 0 dBm, 404 Hz-15/20 kHz
<i>Frequency Range</i>	20 Hz - 4.2 MHz	50 Hz to 15 kHz 20 Hz to 20 kHz

Illustration:



¹This level may not be continuously applied to audio channels

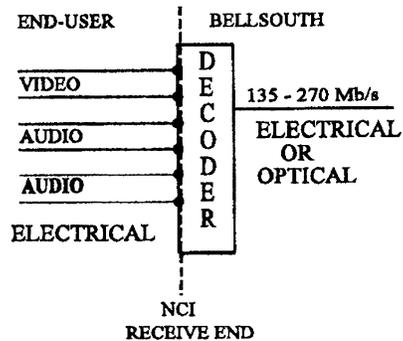
9.4 Interface Type 04TV6.8-0

<i>Application:</i>	Provides for a one-way reception of a standard composite System M-NTSC video signal and two associated 15/20 kHz audio signals.
<i>Operating Mode:</i>	Full or part time video and associated audio
<i>Physical Description:</i>	Coaxial cable with BNC connector for video and two-wire (T,R) for audio
<i>Service:</i>	TV1

Electrical Features

	Video	Audio
<i>Impedance</i>	75 ohms unbalanced	600 ohms balanced
<i>Overload Point:</i>	1.2 V peak-to-peak (sync tip to reference white)	+18 dBm ¹ at 404 Hz
<i>Operating Levels</i>	1 V peak-to-peak (sync tip to reference white)	+8vu (max) program level
<i>Max Steady-State Levels (averaged over 1 second)</i>	NA	+8dBm, 50Hz-404 Hz 0 dBm, 404 Hz-15/20 kHz
<i>Frequency Range</i>	20 Hz - 4.2 MHz	50 Hz to 15 kHz 20 Hz to 20 kHz

Illustration:



¹This level may not be continuously applied to audio channels

9.5 Interface Type 04TV6.8-0

Application: Provides for a one-way transmission of a standard composite System M-NTSC video signal and four associated 15/20 kHz audio signals.

Operating Mode: Full or part time video and associated audio

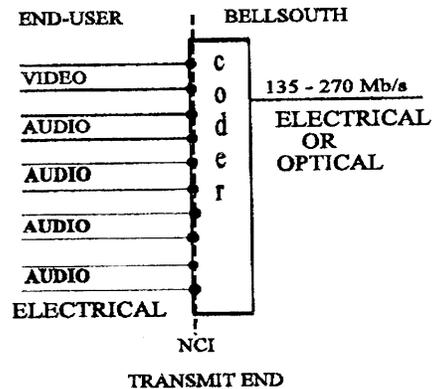
Physical Description: Coaxial cable with BNC connector for video and two-wire (T,R) for audio

Service: TV1

Electrical Features

	Video	Audio
<i>Impedance</i>	75 ohms unbalanced	600 ohms balanced
<i>Overload Point:</i>	1.2 V peak-to-peak (sync tip to reference white)	+18 dBm ¹ at 404 Hz
<i>Operating Levels</i>	1 V peak-to-peak (sync tip to reference white)	+8vu (max) program level
<i>Max Steady-State Levels (averaged over 1 second)</i>	NA	+8dBm, 50Hz-404 Hz 0 dBm, 404 Hz-15/20 kHz
<i>Frequency Range</i>	20 Hz - 4.2 MHz	50 Hz to 15 kHz 20 Hz to 20 kHz

Illustration:



¹This level may not be continuously applied to audio channels

9.6 Interface Type 04TV6.8-0

Application: Provides for a one-way reception of a standard composite System M-NTSC video signal and four associated 15/20 kHz audio signals.

Operating Mode: Full or part time video and associated audio

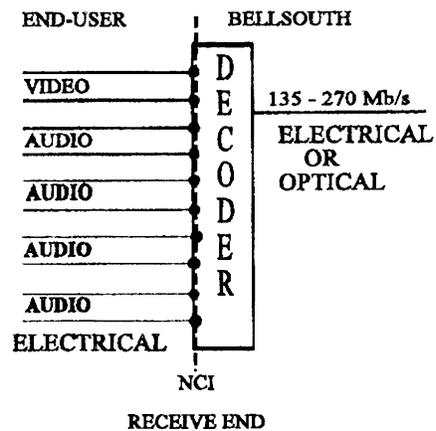
Physical Description: Coaxial cable with BNC connector for video and two-wire (T,R) for audio

Service: TV1

Electrical Features

	Video	Audio
<i>Impedance</i>	75 ohms unbalanced	600 ohms balanced
<i>Overload Point:</i>	1.2 V peak-to-peak (sync tip to reference white)	+18 dBm ¹ at 404 Hz
<i>Operating Levels</i>	1 V peak-to-peak (sync tip to reference white)	+8vu (max) program level
<i>Max Steady-State Levels (averaged over 1 second)</i>	NA	+8dBm, 50Hz-404 Hz 0 dBm, 404 Hz-15/20 kHz
<i>Frequency Range</i>	20 Hz - 4.2 MHz	50 Hz to 15 kHz 20 Hz to 20 kHz

Illustration:



¹This level may not be continuously applied to audio channels

10. Appendix

10.1 Glossary of Terms

10.1.1 General

With the sampling and digitization of video signals into digital bit streams, new terms are being used to describe different aspects of the video associated with the digitization processes that traditional terms associated with analog video are not able to describe. The following list of definitions is provided to familiarize the reader with the new terms and review some traditional terms associated with digitized video. Not all of the listed terms are included in this document.

10.1.2 Common Definitions, Descriptions and Terminology

Algorithm: a set of rules to solving a problem in a finite number of steps, as for finding the greatest number divisor. A sequence of designing steps.

Aliasing: The undesirable “beating” effects caused by sampling rate being too low; also unpleasant stepped images when unfiltered non–horizontal lines are presented on raster lines of a TV system. Examples of aliasing are (a) temporal aliasing, e.g. Wagon Wheels apparently reversing direction, movement seen in standards converters with insufficient temporal filtering; (b) raster scan aliasing, which results in “twinkling” effects on sharp horizontal lines.

Analog–to–Digital (A/D) Conversion: The process of converting an analog signal into a digital signal.

Anti–aliasing: The smoothing and prevention of aliasing effects by filtering and other techniques.

Artifact: The imprecise term used to describe visible defects that result from a technical limitation. Artifacts cannot generally be quantified by traditional methods of evaluation.

Aspect Ratio: The ratio of picture width to picture height as transmitted. The Standard is 4:3 for 525–line System M–NTSC

Average Picture Level (APL): The average level of the picture signal during active scanning time integrated over a frame period and defined as a percentage of the range between blanking and reference white (expressed as a percentage or in IRE).

Baseband Signal: The band of analog frequencies occupied in the [video or audio] source signal before it is modulated by a broadband carrier system.

Burned–In Image: An image which persists in a fixed position on the video screen after the camera has turned to a different scene.

Burst: A phase–reference component of the color signal consisting of nine cycles of the sub–carrier frequency ($f_{SC} = 3.58$ MHz) located on the back porch of each horizontal blanking interval

Chrominance Signal: That portion of the video signal which contains color information.

Clamping: A video—processing operation that provides a line—by—line correction of the video blanking or sync tip level to a fixed dc reference voltage. it is used for restoring the dc component of the video signal prior to processing circuitry such as clipping, blanking insertion, and gamma correction.

Code Element: The smallest unit to form a code word, in the case of binary coding: a bit.

Code Word: The block of a predetermined number of code elements, in the case of a word length with 8 bits a byte.

Coding/encoding: The process of converting quantizing signal values into coded words assigned to a defined code

Coding: The process of converting binary numbers of PAM samples (code words) into corresponding ternary or other multilevel digital signals acceptable to a transmission facility.

Color Flicker: An inconsistent or wavering of light which results from fluctuation of both Chrominance and luminance levels of intensity.

Color Errors: Distortion of all or a portion of the received image in which un—natural or unexpected hues occur.

Component Video Signal: The uncombined output of a video signal source device such as a digital camera to tape recorder, producing the primary colors of red, green and blue (RGB) that when combined produces all necessary picture information.

Component Coding: Coding of the three primary colors of an analog video signal that are converted into a digital signal format.

Composite Video Signal: The completed video signal that is the combined result of the primary colors of red, green and blue (RGB) producing all necessary picture information, such as with the NTSC or PAL formats. A composite video signal of standard amplitude, from correct sync to reference white level, should be presented between –40 and +100 units of the IRE scale on a waveform monitor.

Composite Coding: digitizing, where the complete analog color signal (composite color signal) is converted into a digital signal format.

Contour Distortion: A visual defect arising from quantizing a picture. A gradual change of Chrominance and/or luminance between areas. These areas are replaced by a series of abrupt Chrominance and/or luminance changes.

Differential Gain: The difference in gain of a video facility at the color subcarrier frequency between two luminance levels, from blanking to reference white level.

Differential Phase: The maximum difference in phase of a video facility at the color subcarrier frequency between two luminance levels, from blanking to reference white level.

Digital Transport: A portion of the telecommunications network using digital methods for the transmission of signals from one point to another to complete a transmission service channel. A transmission service channel may have one or more digital transport portions.

Digital–to–Analog (D/A) Conversion: The process of converting a digital signal into an amplitude–discrete signal.

Distortion: An undesired change in waveform of a signal while passing through a transmission system

Edge Effect: The overemphasizing of well defined objects from the addition of black or white outlines to the vertical edges of the objects. Examples of this phenomena are, trailing white, leading black around the outline of a figure in movement within a scene.

Encoding: see coding/encoding

Error Correction: A technique of transmitting a small amount of redundancy to the coded information that can be used to restore the integrity of corrupted received data.

Field: A scan of the picture area once in a predetermined pattern.

Forward Error Correction: See error correction.

Frame (Picture): One complete picture consisting of two (more in some systems) fields of interlaced scanning lines. In the NTSC format, a frame consists of 525 horizontal lines of picture information. In the PAL format, 625 lines. (Non–interlaced systems may transmit 525 scan lines progressively (one after the other) in each full frame).

Frame (Digital): a set of consecutive time slots each consisting of definite numbers of coded words. The position of each time slot can be identified by reference to a frame alignment word.

Ghost: A shadow or weaker image in the television picture, typically offset to the left or right of the image within a scene.

Grain or Graininess: A uniform distribution of dark spots throughout the entire television picture from a motion picture film source. Hence the term should be limited (in the analog sense) to film or film reproduction.

Granular Noise: A visual defect caused by the quantizing errors with different coding, showing as fluctuations of the luminance and/or chrominance level – on uniform or nearly uniform parts of the video image.

Inter–frame Coding: A method of source coding; the temporal correlation of moving pictures is used for data reduction, in order to save transmission capacity.

Interlaced Scanning: Each frame is divided into two fields, with the even and odd lines scanned on alternate fields. To generate interlaced scanning, each frame must have an odd number of scanning lines. This causes the first lines of alternate fields to begin in the center of the picture, so that lines are interleaved. There are 525 scanning lines in each frame and $262\frac{1}{2}$ lines in each field.

Intra–Frame Coding: A method of source coding applicable to still pictures or pictures that may be considered to be still, where the spatial correlation within a picture is used for data reduction, in order to save transmission capacity.

IRE Standard Scale: A linear scale for measuring, in arbitrary IRE units, the relative amplitudes of the various components of a television signal as shown in Table 12.1:

Table 10.1: IRE Standard Scale

Level	IRE Units	Modulation, %
Zero carrier	120	0
Reference white	100	12.5
Blanking	0	75
Sync peaks (max. carrier)	–40	100

Irrelevancy Reduction: A method of reducing information where possible, only the relevant part of the information is transmitted. The irrelevancy reduction is irreversible.

Jitter: Short term variations of the sampling instants from ideal positions in time.

Kell Factor: Is the ratio of the vertical resolution to the number of scanning lines.

Lip Synchronization (Lip Sync): Synchronization of the sound portion (voice) with the visual portion (lip movement) of a video program.

Luminance Signal: That portion of video signal which contains the brightness information.

Motion Response Degradation: The deterioration of motion video such that the received imagery has suffered a loss of spatial–temporal resolution.

Motion Video: Video imagery that conveys movement.

Noise: An extraneous electrical disturbance tending to interfere with the normal reception of a transmitted signal.

- (a) **Impulse Noise:** Noise characterized by non–overlapping transient disturbances commonly introduced by mechanical devices such as switches, relays, etc.
- (b) **Random Noise:** Band–limited noise generated from electron motion within resistive elements of electronic equipment. This noise is developed from a large number of minute current pulses occurring in a completely random sequence. Random noise appears as small gray, black, white or colored dots on the video screen and as a thickening of lines or as very fine spikes on a waveform monitor.

- (c) **Weighted Noise:** Noise energy that has been shaped to meet the needs of power meters.
- (d) **White Noise:** Random noise energy with all frequencies present.

NTSC: *National Television Systems Committee.* The color television system adopted by this committee is called System M–NTSC.

PAL: *Phase Alternation Line.* A color television system developed and used in Germany and adopted by a number of other countries for use as a standard.

Peak: The highest amplified (point) of a waveform or voltage

Pel: see pixel.

Pixel: “The picture element”: Is defined as the smallest area of a television picture that can be transmitted within the parameters of the system. More specifically, the height of a pixel is the spacing between scanning lines divided by the Kell factor, and its width is the space on a scanning line occupied by one–half hertz of the highest frequency in the transmission bandwidth.

POTS: *Plain Old Telephone Service.*

Pulse Code Modulation: A method of source coding where the code words are obtained by sampling, quantizing and coding of the analog input signal.

Quantizing Error/Noise: Inaccurate digital representations of an analog signal. This error/noise condition occurs during the analog to digital transmission signal processing/conversion stage. Typically, the digital interpretation of video resolution is limited through the digital sampling of the analog video input signal.

Quantizing: The process of sampling an analog waveform to convert its voltage levels into digital data.

Ringling: is simulated by sharp edges with large color and brightness changes.

RMS (*Root, Mean, Square*): Measurement of *effective* (as opposed to *peak*) voltage of an AC periodic waveform, through one cycle. A sine wave is .707 times the peak voltage. This calculation is derived by any periodic waveform, it is the square root from the averages of the squares of the values through one cycle.

Sampling: A process of obtaining a series of discrete instantaneous values of a signal, usually at regular instants.

Scene Cuts: Video imagery where adjacent frames are not highly correlated.

SECAM: *Sequentiel Couleurs a Memoire.* A color television system developed and used in France and adopted by a number of other countries as their standard.

Serial Transmission: A transmission method of a digitally coded signal where only one single transmission path is used for the time sequential transmission of the code elements representing the code words of a digital signal.

Signal-to-Noise Ratio (SNR): Relative power of the signal to the noise in a channel.

Snow: Light gray, white and dark gray or black spots distributed throughout a television picture. This term is used to indicate that a picture has very high noise degradation.

Source Coding: The coding of sample values of a picture signal, usually for the purpose of reducing redundancy and/or entropy of the signal.

Spatial Performance: A measure of the ability of a video transmission system to accurately reproduce still scenes.

Staircase Video Waveform: A waveform consisting of a series of discrete steps resembling a staircase. In practical application, this is combined with blanking and synchronizing pulses.

Still Video: Video imagery that does not convey movement.

Streaking: A picture condition in which objects appear extended horizontally beyond their normal boundaries, usually seen on the vertical [streaking] outline of moving images within a scene.

Temporal Performance: A measure of the ability of a video transmission system to accurately reproduce moving scenes.

Transmission Service Channel: A transmission service channel is the one-way transmission path between two designated points (analog in, analog out).

Truncation: The removal of lower significant bits, possibly leading to errors or unpleasant artifacts.

VANDA: A code word or acronym meaning video and audio combined.

Wander: The long term variations of the significant instants (e.g., zero level crossings) of a digital signal from their idea positions in time. Long-term implies that these variations are of low-frequency (less than 10Hz).

11. References

- (1) Technical Reference TR-TSV-000338, "Television Special Access and Local Channel Services – Transmission Parameter Limits and Interface Combinations," Issue 2, Bellcore, August 1994.
- (2) Technical Reference TR 73557, "BellSouth Private Line Video Services," Issue C, BellSouth, March 1994.
- (3) Technical Reference TR 73583, "Interface and Performance Specifications for Digital Video Transport Service at the DS3 Rate," BellSouth, September 1994.
- (4) American National Standards Institute T1.502-1988, "System M-NTSC Television Signals – Network Interface Specifications and Performance Parameters," April 1988.
- (5) American National Standards Institute T1.505-1989, "Advanced Digital Program Audio Services – Analog Interface and Performance Specifications," February 1989.
- (6) ANSI/SMPTE 244M-1993, "Television – System M/NTSC Composite Video Signals – Bit-Parallel Digital Interface, 1993
- (7) Electrical Industrial Association, RS-170-A, "Electrical Performance Standards – Color Television Studio Facilities," November 1977.
- (8) Generic Requirements Document GR-338-CORE, "Television Special Access and Local Channel Services – Transmission Parameter Limits and Interface Combinations," Issue 1, Bellcore, December 1995.