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Technical Specification

Access, Terminals, Transmission and Multiplexing (ATTM); System characteristics of receiver equipment installed in headends of integrated broadband cable and television networks intended to receive broadcast signals in the frequency range 470 MHz to 790 MHz

Reference

DTS/ATTM-003017

Keywords

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650 Route des Lucioles
F-06921 Sophia Antipolis Cedex - FRANCE

Tel.: +33 4 92 94 42 00 Fax: +33 4 93 65 47 16

Siret N° 348 623 562 00017 - NAF 742 C
Association à but non lucratif enregistrée à la
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Foreword

This Technical Specification (TS) has been produced by ETSI Technical Committee Access, Terminals, Transmission and Multiplexing (ATTM).

1 Scope

The present document defines system characteristics of the receiving equipment used in cable headends including but not limited to receiver noise figure, antenna gain, signal-to-noise ratio, etc.

2 References

References are either specific (identified by date of publication and/or edition number or version number) or non-specific. For specific references, only the cited version applies. For non-specific references, the latest version of the reference document (including any amendments) applies.

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2.1 Normative references

The following referenced documents are necessary for the application of the present document.

Not applicable.

2.2 Informative references

The following referenced documents are not necessary for the application of the present document but they assist the user with regard to a particular subject area.

[i.1] ETSI TR 102 881 (V1.1.1): "Access, Terminals, Transmission and Multiplexing (ATTM); Cable Network Handbook".

[i.2] ETSI EN 300 744: "Digital Video Broadcasting (DVB); Framing structure, channel coding and modulation for digital terrestrial television".

[i.3] United States Code of Federal Regulations, Title 47, Part 15, Subpart H: "Television Band Devices".

[i.4] FCC 10-174: "Second Memorandum Opinion and Order in the Matter of Unlicensed Operation in the TV Broadcast Bands", September 23, 2010.

[i.5] ETSI TS 102 639 (April 2009): "Access and Terminals, Transmission and Multiplexing (ATTM);Third Generation Transmission Systems for Interactive Cable Television Services - IP Cable Modems".

3 Definitions, symbols and abbreviations

3.1 Definitions

For the purposes of the present document, the following terms and definitions apply:

cable drop: small gauge coaxial cable that connects the customer premises to a tap

NOTE: This may contain additional information.

fibre node: device which performs a media conversion between a fibre link and a coaxial link in an HFC network

headend: cable operator facility where video signals are received and launched into the cable access network

tap: device having coaxial cable connections that splits downstream input RF signals among various output connections

3.2 Symbols

For the purposes of the present document, the following symbols apply:

MHz	megahertz
dB	decibel(s)
m	meter(s)
km	kilometer(s)
dBm	decibel referenced to 1 milliwatt
kW	kilowatt

3.3 Abbreviations

For the purposes of the present document, the following abbreviations apply:

COFDM	Coded Orthogonal Frequency Division Multiplexing
DVB-T	Digital Video Broadcast - Terrestrial
FCC	United States Federal Communications Commission
HFC	Hybrid Fibre/Coax
MVPD	Multi-channel Video Programming Distributor
NCTA	National Cable & Telecommunications Association
OOB	Out-Of-Band
RF	Radio Frequency
TV	television
TVBD	Television Bands Device

4 Background

4.1 Cable System Architecture

Integrated broadband cable and television networks support delivery of a wide range of digital entertainment and informational programming via the use of a hybrid fibre/coaxial network. As described more fully in [i.1], the typical cable system consists of a "headend" facility and a distribution network. The headend facility is where the cable system interconnects with video content distribution sources, the public switched telephone network, and the Internet. The distribution network (plant) typically consists of optical fibre connectivity to "fibre nodes" located in proximity to residential neighborhoods, followed by coaxial cable connecting the fibre nodes to customer premises equipment. The coaxial portion of the plant is a tree and branch structure, often with a main coaxial line (having signal-boosting amplifiers spaced periodically) and individual cable drops that connect to the main line via "taps". Once the cable drop reaches the customer premises, it is often split to reach multiple customer premises devices.

4.2 Frequency Allocations & Usage

Digital television signals are carried on the cable plant using similar channelization (though different modulation) and similar spectrum as is used for terrestrial broadcast. Due to the physically contained nature of the spectrum in the cable plant, there is no need to have gaps (white spaces) between programme channels, and as a result all of the channels are occupied in carrying content.

Whilst there are country-by-country, operator-by-operator, and even system-by-system differences in plant operations, for carrying programming content from the headend to the customer, the contiguous block of spectrum beginning typically at 80,6 MHz and running up to 862 MHz (with equipment capable of supporting operation up to 1 GHz as defined by ETSI and CENELEC standards, including [i.5]) is utilized. This results in more than 90 channels, each of 8 MHz, all of which are utilized continuously to provide a wide variety of services including linear television programming, video on demand, broadband Internet and telephony.

4.3 Purpose of Cable Headend Receivers

The cable operator provides a variety of television programme channels to its customers. In some cases the channels are selected in order to appeal to customer interests, in other cases local and/or national regulations may require the cable operator to carry certain channels.

In order for the cable operator to provide television channels to its customers, the cable headend needs to have means to receive television programming content from a variety of sources, some may be international television channels, others may be national or regional channels, and still others may be local channels. The distribution of programming content by the content producer to the content distributors (e.g. cable operators) is sometimes referred to as "primary distribution". The cable system operator will establish reliable (and often redundant) means by which to receive each of the programming channels that will be distributed over the cable plant.

4.4 Methods for Primary Distribution of Television Programming to Cable Headends

Cable system operators employ a variety of technologies to receive television programming at their headend facilities for subsequent distribution over the cable plant. In many cases, a cable operator will utilize multiple technologies in order to receive the full set of programming that will be distributed over their cable plant, as well as to provide redundancy.

For reception of local and distant "off-air" broadcasts (DVB-T) [i.2], cable operators frequently utilize a high gain directional antenna and professional receiver. These systems can be used for the main reception of video programming from a local broadcaster, and are also commonly used as a backup when other technologies are employed.

Other technologies include satellite downlink equipment (commonly used for international content), and dedicated optical fibre or point-to-point microwave links (used when the content source is located in relatively close proximity to the cable headend).

5 Headend Receiver Characteristics

Cable headends are facilities that have a variety of functions as the central source of services in a cable television network. Among them is the acquisition and distribution of video signals. In many cases, the Cable headend is equipped with means for the primary (and/or backup) reception of television programmes via terrestrial distribution channels. Equipment used for terrestrial reception in Cable headends typically consists of antennas with high gain and elaborated directional characteristics that are mounted on towers in elevated positions. Signals are processed by professional receivers with technical specifications meeting the requirements of a reliable and low-maintenance network operation. The locations of antenna towers and signal processing equipment may or may not be geographically co-located. They could be located at some distance and be connected via a dedicated point-to-point link. Figure 1 depicts an example architecture of cable headend components. For simplification reasons, only a co-located case is shown where the antenna tower is connected to the receiver by a feeder cable. The illustration is not meant to imply the usage of any particular component, e.g. antenna type.

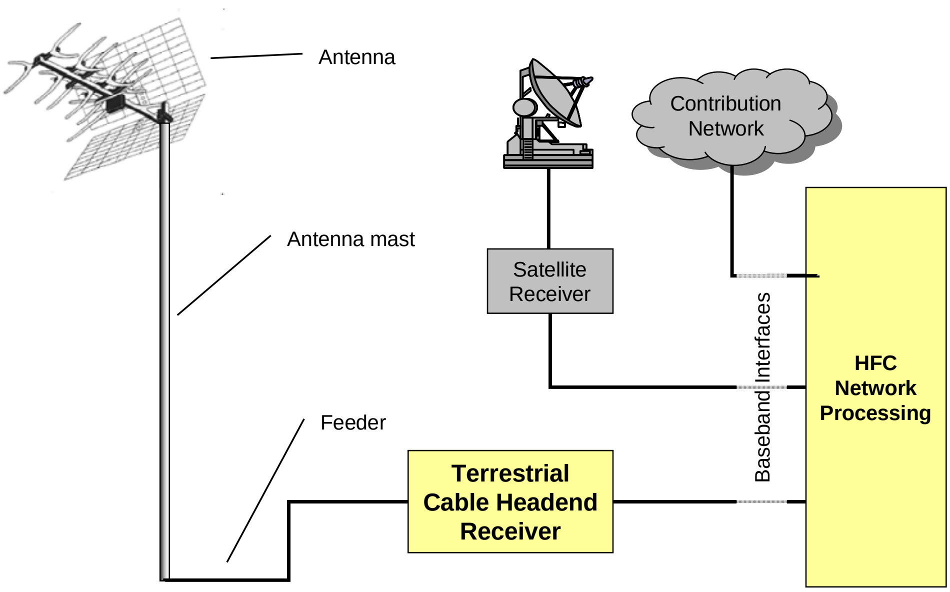

Figure 1: Signal contribution in cable headends

5.1 Antenna Characteristics

5.1.1 Parameters for Antenna Installations

Table 1 gives the main parameters required for antenna installations used in Cable headend receivers.

Table 1: Antenna Parameters

Parameter	Typical Value	Value Range
Antenna gain	10 dB	8 dB to 12 dB; up to > 20 dB with sophisticated antenna configurations
Mounting height	20 m	12 m to 35 m

5.1.2 Directional Patterns

Figure 2 depicts a sample directional pattern for a log periodic antenna typically used in Cable headend receivers.

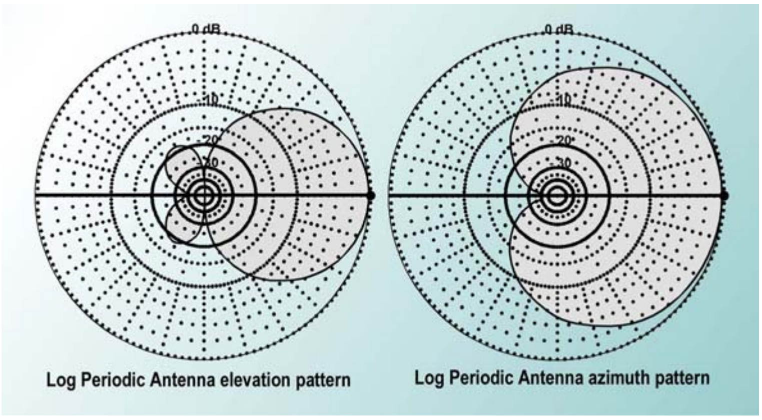

Figure 2: Sample Antenna Directional Pattern

5.2 Receiver Characteristics

Table 2 gives the main parameters required for professional receivers used in Cable headend installations.

Table 2: Receiver Characteristics

Parameter	Typical Value	Value Range
Input level	-65 dBm to -25 dBm	-80 dBm to -10 dBm
Modulation	COFDM (DVB-T/T2)	
Noise figure	5 dB	3 dB to 8 dB
Suppression of OOB signals	40 dB (for adjacent carriers) 50 dB to 60 dB (for others)	

5.3 Resulting Receiver System Characteristics

The combination of high gain antennas and professional receiving equipment with high sensitivity and noise performance allow for terrestrial receivers installed at Cable headends to acquire and demodulate TV station signals that are well beyond the service area of the TV transmitter as defined for a residential terrestrial receiver. An example link budget, which illustrates this point is provided in annex B.

6 Deployment Scenarios

System characteristics of headend receivers as analyzed in clause 5 allow Cable headends to be located outside the area in which a TV transmitter is able to serve residential equipment and still receive terrestrial broadcasting services. Redistribution of those TV services through the cable television network even further enlarges the geographical area where customers are able to consume the TV service. Figure 3 depicts a typical scenario for cable headend installations in- and outside the residential service area of a terrestrial transmitter. Subscriber X, located outside the GE06 area, consumes the broadcast TV services by way of a professional cable headend receiver, thus extending the serving area of the terrestrial broadcaster.

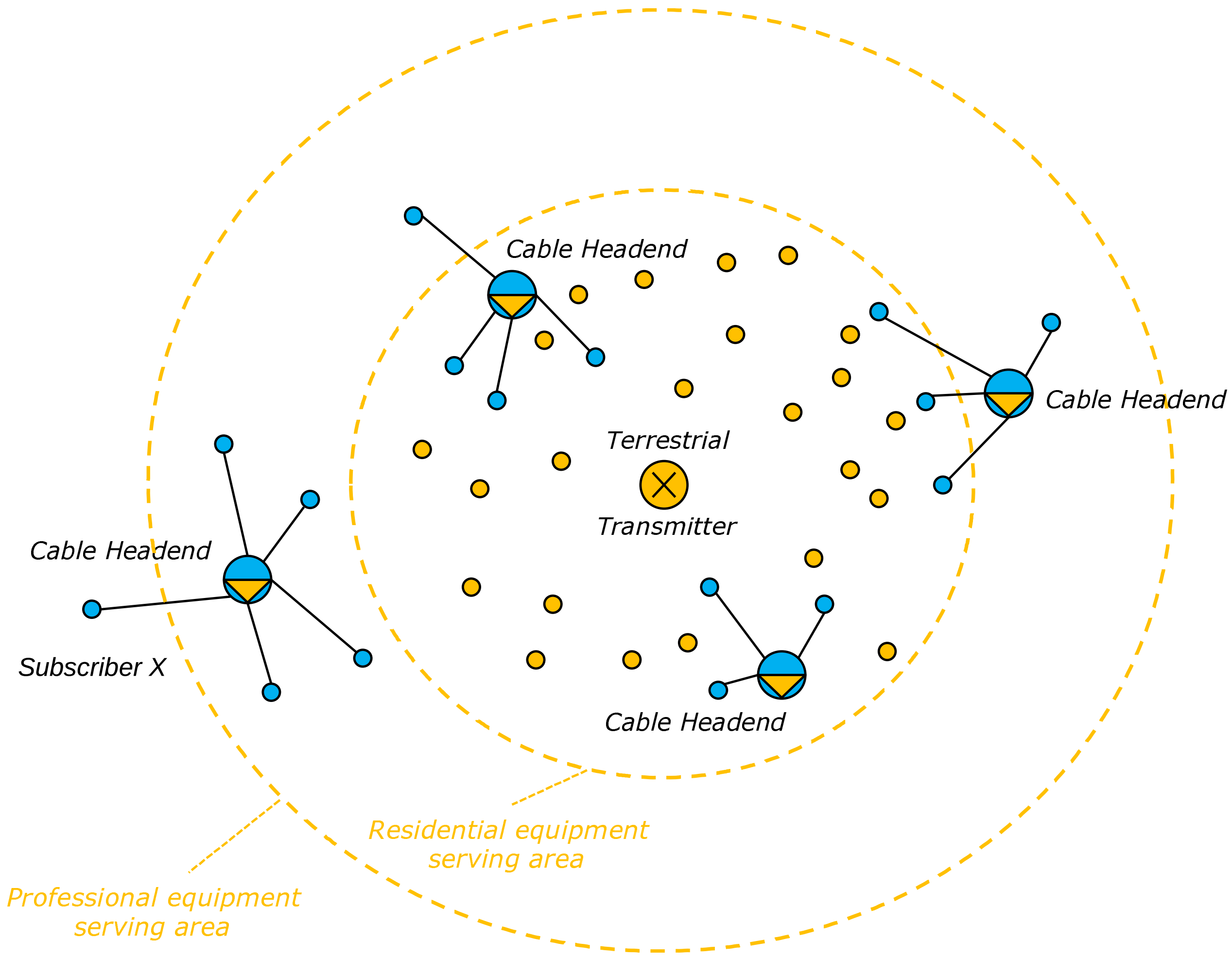

Figure 3: Cable headends in- and outside the residential equipment serving area of a terrestrial TV transmitter

Annex A (informative): Protection of Cable Headend Receivers

In many regions, the terrestrial television broadcast bands are subject to licensing, and license holders are protected from interfering signals within a defined area surrounding the broadcast antenna. The outer boundary of the protected area is known as the broadcast contour for the station. The licensing authority seeks to assign frequency licenses to stations to ensure that receiver locations within the broadcast contour for each station are assured that they can receive the station's signal without disruptive interference from other users of that frequency or adjacent frequencies. In order to achieve this, the licensing authority ensures that other licensees for that frequency and the adjacent frequencies are a sufficient distance away from the broadcast contour of the station in question. For each frequency in the broadcast band, the result from a geographic perspective can be a set of "islands" of licensed use within a sea of "white space". Conversely, any selected geographical location may be within the broadcast contour for some number of stations, each transmitting on its licensed frequency, and the remaining frequencies are essentially unused.

In certain regions these unused frequencies, or "white spaces" are currently planned to be used for radiocommunications, primarily for data services. Such usage is expected to be unlicensed on a non-exclusive and non-protected basis. Therefore it will be subject to rules that, for example, require users to avoid frequencies that are in use by the licensed broadcasters.

In the United States, for example, the US Federal Communications Commission (FCC) has defined rules allowing unlicensed "Television Bands Devices" (TVBDs) to operate on most frequencies of the television broadcast band, providing that they consult a "geo-location database" in order to determine which frequencies are available for use in their present location. The geo-location database therefore contains data about the licensed users of the television band, along with the geographical information about the broadcast contour for each licensee. In addition, the FCC has allowed that certain other areas can be protected via registration with the geo-location database. For example, the FCC has allowed that performance venues that use low-power wireless microphones can be registered. Furthermore, certain professional sites which receive broadcast transmissions, but which fall outside the broadcast contour for a licensed terrestrial broadcaster, can be registered and provided with a protection contour in order to assure continued reliable use of the terrestrial broadcast signal.

The FCC has determined that such sites, which include cable headends, shall be protected as follows [i.3], (Part 15, Section 712, paragraph b):

> *"TV translator, Low Power TV (including Class A) and Multi-channel Video Programming Distributor (MVPD) receive sites.* MVPD, TV translator station and low power TV (including Class A) station receive sites located outside the protected contour of the TV station(s) being received may be registered in the TV bands database if they are no farther than 80 km outside the nearest edge of the relevant contour(s). Only channels received over the air and used by the MVPD, TV translator station or low power/Class A TV station may be registered. TVBDs may not operate within an arc of ±30 degrees from a line between a registered receive site and the contour of the TV station being received in the direction of the station’s transmitter at a distance of up to 80 km from the edge of the protected contour of the received TV station for co-channel operation and up to 20 km from the registered receive site for adjacent channel operation, except that the protection distance shall not exceed the distance from the receive site to the protected contour. Outside of this ±30 degree arc, TVBDs may not operate within 8 km from the receive site for co-channel operation and 2 km from the receive site for adjacent channel operation. For purposes of this section, a TV station being received may include a full power TV station, TV translator station or low power TV/Class A TV station."

Additionally, the FCC has allowed for operators of existing sites located more than 80 km from the edge of the broadcast contour to apply for a waiver of the rules, so that those sites can be registered in the geo-location database as well [i.4]:

> "42. We recognize that there are cable headends that receive TV station signals located at distances beyond 80 km from the edge of a television station's protected service contour and understand NCTA’s concern for possible disruption service to cable subscribers. These same considerations would apply to other MVPDs and to TV translator, low power TV and Class A TV stations that re-transmit programming from another TV station. We do not believe that the requested change would have significant impact on the availability of TV white space because these facilities are generally in remote areas where many channels will be available for white space devices. However, we also recognize that parties may wish to have an opportunity to review such requests to confirm the assessment. We are therefore providing that current MVPD operators, TV translator, low power TV and Class A TV stations with receive sites located beyond the 80 km co-channel protection distance in the rules may apply for a waiver of that distance during a period that will end 90 days after the effective date of the rules adopted herein. Such waiver requests would also involve shifting the 20 km adjacent channel protection distance so that it is measured from the actual receive site. We will then issue a public notice requesting comment on requests we receive and issue decisions. MVPD operators and TV translator, low power TV and class a TV stations that commence operation in the future with receive sites located beyond the co-channel and adjacent protection distances may apply for a waiver of those distances within 90 days of commencing operation. Following receipt of such request(s), we will then issue a public notice asking for comment on the request(s) and issue decision(s)."

Figure A.1 illustrates the protection regions defined by the FCC for professional receive sites.

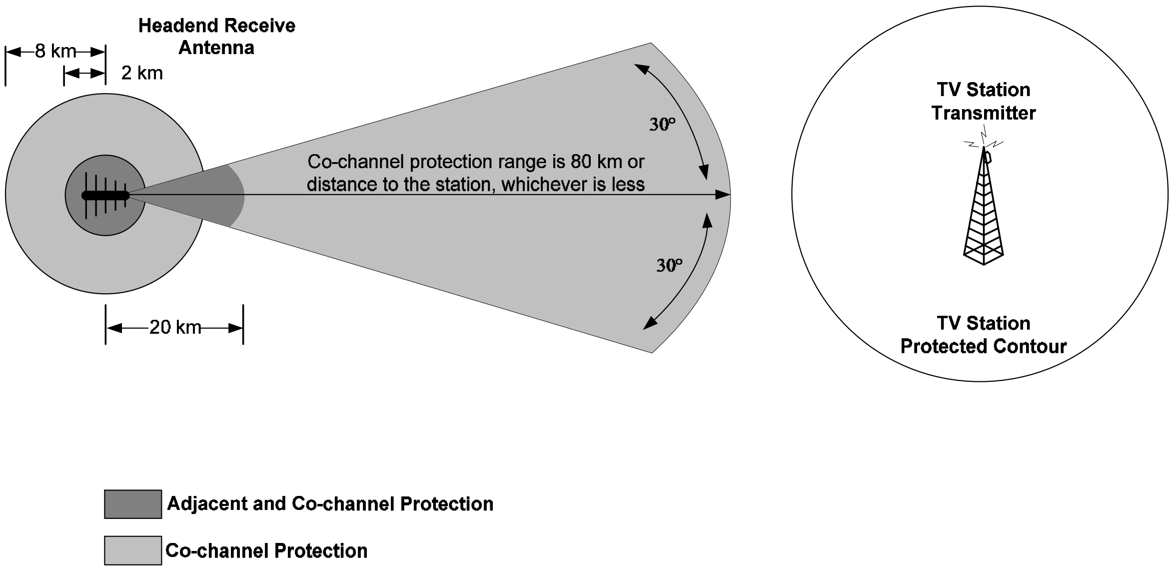

Figure A.1: Adjacent and Co-channel Protection Regions Defined by the US Federal Communications Commission

Annex B (informative): Example Link Budget Calculation

For a case of a terrestrial broadcaster operating at 630 MHz, transmitting at 70 dBm (10 kW), and received by a cable headend receiver at a distance of 200 km utilizing the typical values listed above, the following is an example link budget.

Table B.1: Example Link Budget

Attribute	Value	Notes
Transmit Power	70 dBm	
Propagation Loss	-127 dB	Tx Antenna Height = 200 m Rx Antenna Height = 20 m Suburban terrain Link Distance = 200 km Frequency = 630 MHz
Receive Antenna Gain	10 dB	
Receiver Cabling	-3 dB	
Receiver Level	-50 dBm	

The resulting receive level is well within the typical range for receiver input levels.

History

Document history		
V1.1.1	November 2011	Publication