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Technical Report

Access, Terminals, Transmission and Multiplexing (ATTM); Cable Network Handbook

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Foreword

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

Introduction

The core expertise within ETSI responsible for European Standards covering Integrated Broadband Cable and Television Networks (ATTM-AT3) has received requests from industry to produce a cable network handbook in order to assist decision makers, both technical and regulatory people.

The current document is a cable handbook produced in cooperation with Excentis and Cable Europe in order to provide the reader with a high level technical understanding of the CATV and Broadband Cable Networks.

1 Scope

The present document is a technical report providing general overview of the Integrated Broadband Cable and Television Networks and is intended as a handbook for engineers and non-engineers to familiarize themselves with the Cable Network infrastructure, architecture, components and protocols including high level description of its transmission principles

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.

Not applicable.

[i.1] ETSI ES 201 488 (all parts): "Access and Terminals (AT); Data Over Cable Systems".

NOTE: EuroDOCSIS 1.1 is ES 201 488 (parts 1, 2, 3).

[i.2] ISO/IEC 13818:"Information technology - Generic coding of moving pictures and associated audio information".

[i.3] ETSI ES 202 488 (all parts): "Access and Terminals (AT); Second Generation Transmission Systems for Interactive Cable Television Services - IP Cable Modems".

NOTE: EuroDOCSIS 2.0 is ES 202 488 (parts 1, 2, 3).

[i.4] ETSI TS 102 639 (all parts): "Access and Terminals, Transmission and Multiplexing (ATTM); Third Generation Transmission Systems for Interactive Cable Television Services - IP Cable Modems".

NOTE: EuroDOCSIS 3.0 is TS 102 639 (parts 1, 2, 3, 4, 5).

[i.5] ETSI TS 101 909-4: "Digital Broadband Cable Access to the Public Telecommunications Network; IP Multimedia Time Critical Services; Part 4: Network Call Signalling Protocol [Partial Endorsement of ITU-T Recommendation J.162 (11/2005), modified]".

[i.6] ISO/IEC 14496-10: "Information technology -- Coding of audio-visual objects -- Part 10: Advanced Video Coding".

3 Symbols and abbreviations

3.1 Symbols

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

Gbps	Gigabit per second
GHz	GigaHertz
kbps	kilobit per second
kHz	kiloHertz
MHz	MegaHertz

3.2 Abbreviations

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

AM	Amplitude Modulation
ANC	Announcement Controller
ANP	Announcement Player
ANS	Announcement Server
AS	Authorization Server
ATV	Analogue TeleVision
CA	Call Agent or Conditional Access
CATV	Cable TeleVision / Community Antenna TeleVision
CM	Cable Modem
CMS	Call Management Server
CMTS	Cable Modem Termination System
CPE	Customer Premise Equipment
CSA	Common Scrambling Algorithm
DC	District Center
DHCP	Dynamic Host Configuration Protocol
DNS	Domain Name Server
DOCSIS	Data Over Cable Service Interface Specification
DS	DownStream
DTV	Digital TeleVision
DVB	Digital Video Broadcasting
ETSI	European Telecommunications Standardisation Institute
EuroDOCSIS	European Data over Cable System Interface Specification
FA	Final Amplifier
FDM	Frequency Domain Multiplexing
FDMA	Frequency Division Multiple Access
FM	Frequency Modulation
GA	Group Amplifier
GC	Gate Controller
HDTV	High-Definition Television
HE	HeadEnd
HFC	Hybrid Fibre Coax
HTTP	HyperText Transfer Protocol
IP	Internet Protocol
IPTV	IP Television
ISO	International Standardisation Organisation
KDC	Key Distribution Center
LC	Local Center
MAC	Media Access Control
Mbps	Megabit per second
MG	Media Gateway
MGC	Media Gateway Controller
MPEG	Moving Pictures Expert Group
MPLS	Multi Protocol Label Switching

MTA	Multimedia Terminal Adapter
MTP	Multi-TaP
MUX	Multiplexing
NIU	Network Interface Unit
NOC	Network Operating Center
NTU	Network Termination Unit
ON	Optical Node
OSS	Operating Support System
PAL	Phase Alternating Line
PSI	Program Specific Information
PSTN	Public Switched Telephone Network
QAM	Quadrature Amplitude Modulation
QoS	Quality of Service
RC	Regional Center
RF	RadioFrequency
SDH	Synchronous Digital Hierarchy
SDTV	Standard-definition Television
SECAM	SEquentiel Couleur A Mémoire
SG	Signalling Gateway
SI	Service Information
SONET	Synchronous Optical NETwork
SS7	Signalling System 7
STB	Set-Top Box
TDMA	Time Division Multiple Access
TFTP	Trivial File Transfer Protocol
TGS	Ticket Granting Server
ToIP	Telephony over IP
US	UpStream
UTP	Unshielded Twisted Pair
VoD	Video on Demand

4 Network of the Cable operator

4.1 History of the CATV network

The CATV (Community Antenna TeleVision) network was originally set up to deliver one-way, analogue broadcast TV transmission (unidirectional from headend to subscriber) services (Figure 1). A headend (HE) has in the cable network operator's terminology two meanings: the first one refers to the equipment for receiving television signals for processing and distribution over a cable television system, the second one describes facilities in which the equipment is installed that converts the received signals into ones that are distributed in the CATV or HFC (see clause 4.2) network.

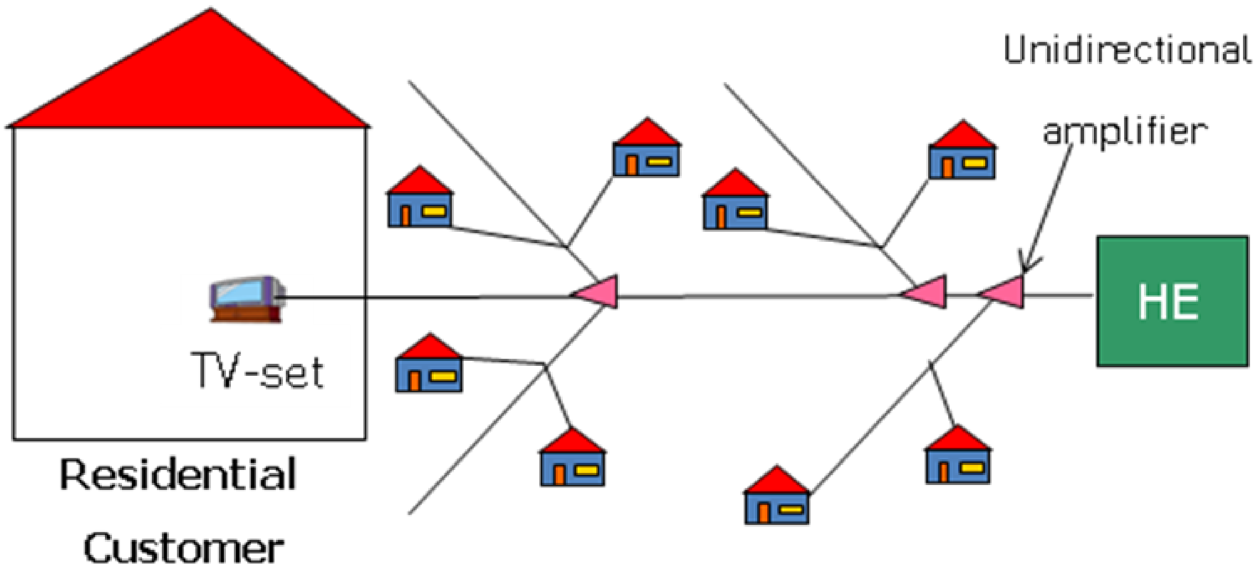

Figure 1: The CATV network (HE=headend)

Signals were captured using terrestrial and satellite antennas and distributed using a coaxial network within the local community. The earliest deployments started in the thirties. Until the nineties, there were thousands of small networks all over Europe most of these are now consolidated into larger cable operators.

Amplifiers are used to compensate for the attenuation of the coaxial cables. Although the attenuation for two types of cable for in-home use is depicted in Figure 2, it shows the general frequency-dependent trend of the attenuation of coaxial cables. This frequency dependency is normally compensated for by equalisation filters in the amplifiers. However the length of the cables between the amplifiers may not be too long in order that the input signal at the amplifier is above the noise level. This shows that extending the frequency spectrum above 1 GHz would necessitate the reduction of the distance between the amplifiers which would require a complete re-implementation of the CATV/HFC network. This brings us to the conclusion that the frequency spectrum of the CATV and HFC network is limited at present to below 1 GHz.

The amplifiers and tap values were chosen such that each house gets an equal TV signal. A huge number of houses (e.g. between 50 000 and 1,6 million) can be served by one headend.

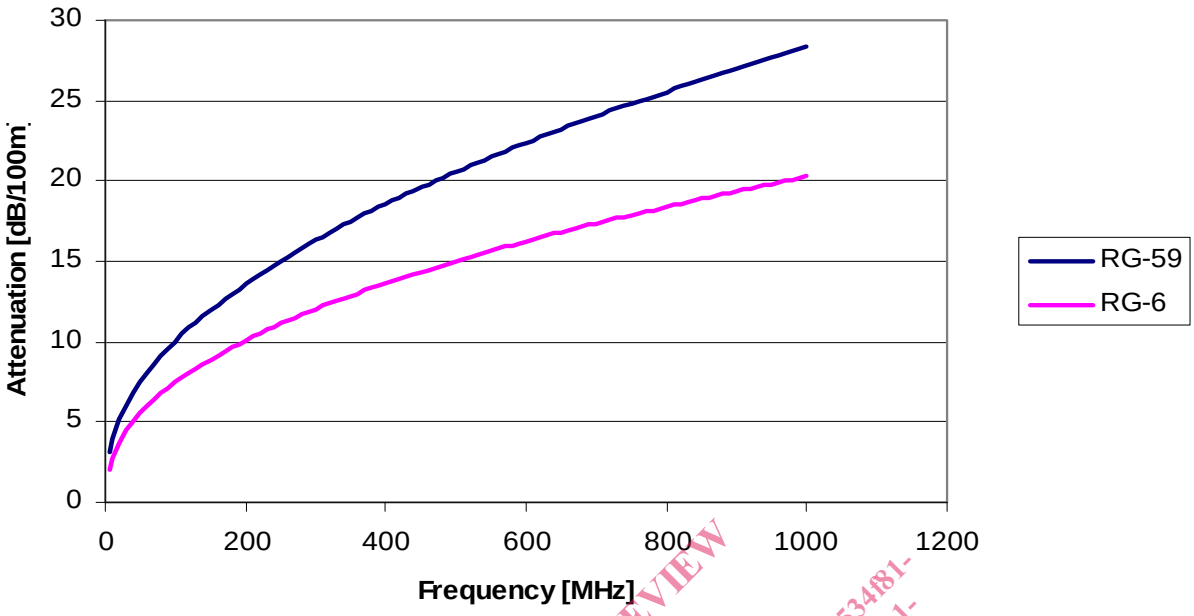

Figure 2: Frequency dependence of the attenuation of two types of coaxial cables

Since the end of the nineties, most of the CATV networks have been converted for bi-directional operation into a Hybrid Fibre Coax (HFC) architecture.

4.2 HFC Network

4.2.1 Architecture

Hybrid Fibre Coax (HFC) access networks are composed of optical fibre and coaxial cables (Figure 3).

Typically, optical fibre rings radiate from the regional headend to optical nodes where the signals are transferred to coaxial cables and then carried to the customer location. A headend may serve many tens of thousands of customer premises, with substantial resilience in the access network resulting in the need for network power at many roadside locations. Optical nodes typically serve between several hundred to some thousands of homes.

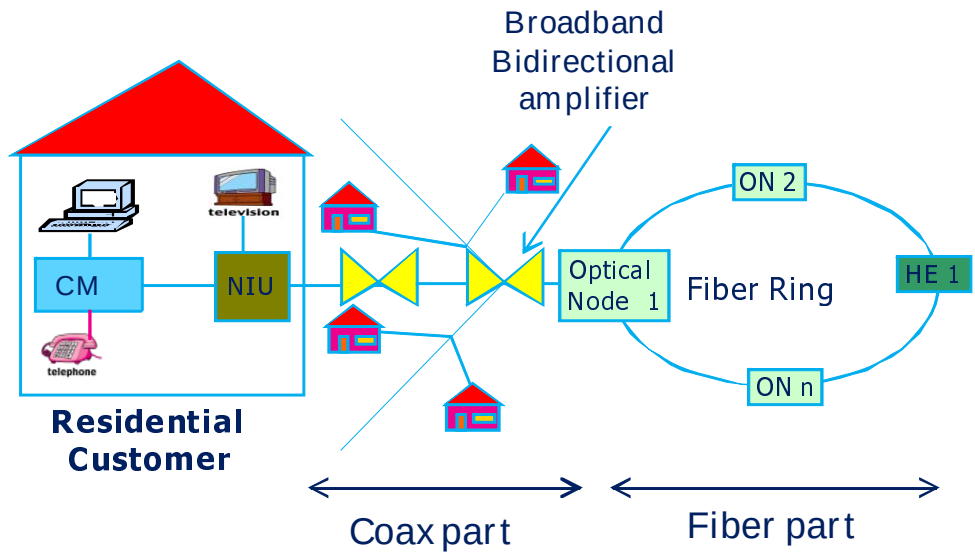

Figure 3: HFC network