# Actual standardization activities for coaxial cable networks

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**Secretary of CENELEC TC 209**

*"Standardization – Buildings' Cable Infrastructure Evolution"*
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# Actual standardization activities for coaxial cable networks

## Step sequence of content

1. Introduction notes
2. System of European standardization for cable networks
3. Second generation of digital transmission standards and specifications
4. EN 50083 and IEC/EN 60728 standards series and standardization projects
5. Updated standards for coaxial cables and coaxial cable assemblies
6. EMC standards for wire-line telecommunication networks

# 1. Introduction notes

## Step sequence of content

1.1 My business biography

1.2 My standardization biography

1.3 Historical development of cable networks

1.4 Market situation

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# 1.1 My Business Biography

**1972** **Dipl.-Ing. degree in communications engineering received from University Stuttgart, Germany**

**1980 – 2004** **Working for Hirschmann Electronics, Germany, as**

- R&D Director,
- Vice President "Multimedia Communications",
- Vice President "Corporate Development and Communication"

**Since 2004** **Independent Consultant for "Multimedia Communication" with focus on**

- Standardization
- Certification
- Technical articles and translations
- General consulting



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# 1.2 My Standardization Biography

**Since 1986** **Actively engaged in National, European and International standardization with focus on**

***"Cable networks for television signals, sound signals and interactive services"***

- Secretary of CLC/TC 209
- German Speaker at IEC 100/TA5
- Convenor of "Safety Group" in IEC 100/TA5
- Member of National Committees K 735 and K 742



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# 1.3 Historical development of cable networks

- **In the past "CATV" networks with distribution-only infrastructure**
- **Today defined as *"Cable networks for television signals, sound signals and interactive services"***
- **Major developments during the last 10 – 15 years in Europe**
  - Huge increase of TV programmes transmitted via cable networks
  - Digitisation of TV signals
  - Extension of capacity by bandwidth and by digitisation
  - Coaxial cabling moved to "Hybrid fibre coax" cabling (HFC)
  - Upgrade of networks for interactive use by use of return path
  - Introduction of DOCSIS/EuroDOCSIS cable modem technology
  - Interoperability with other kinds of telecommunication networks

# 1.4 Market situation (1)

- **Interactive use of cable networks for “triple-play services” is the driving force for market developments**
- **“Triple-play” comprises of**
  - Digital TV
  - Internet access (data transmission)
  - Cable telephony
- **Penetration of triple-play services in European cable networks**
  - Digital TV 23 % (of cable customers)
  - Internet access 24 %
  - Cable phone 18 %
- **Strong competition to other network technologies in the access area like xDSL, FTTx, WiMAX,**



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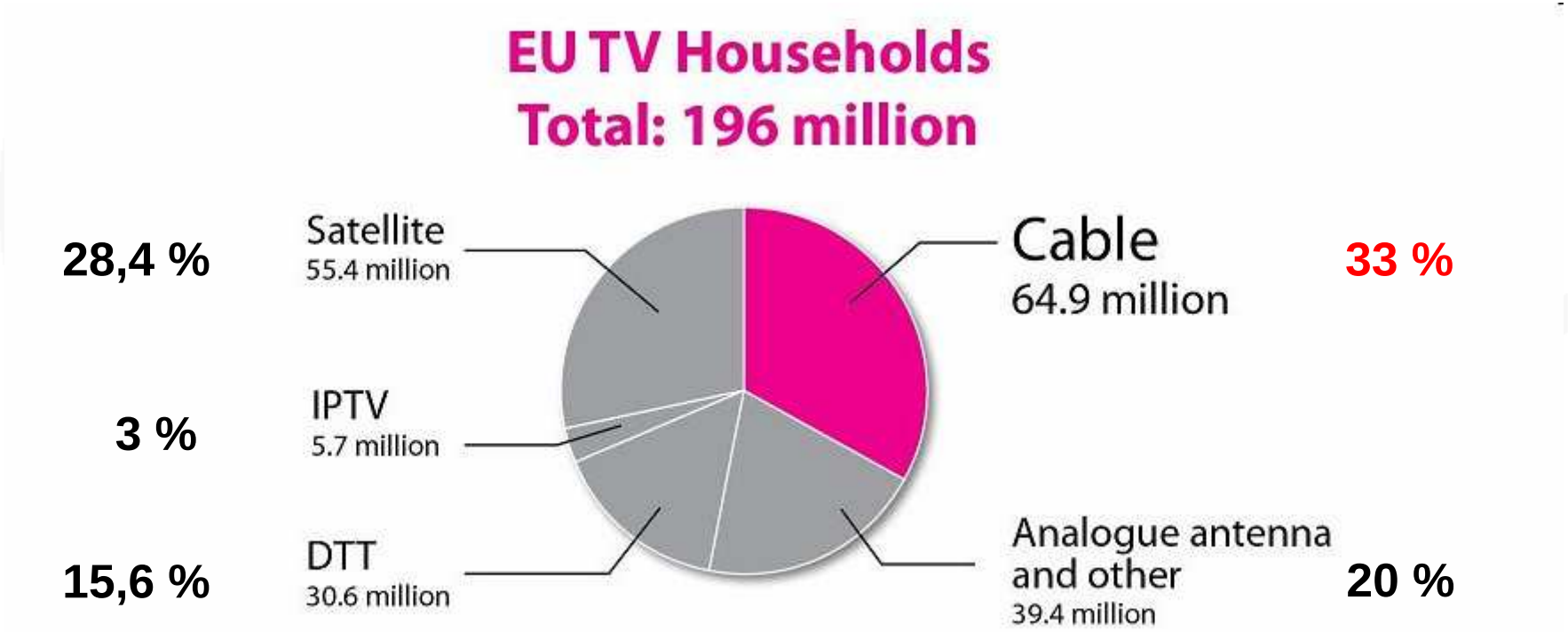
# 1.4 Market situation (2)

## Share of cable TV customers in Europe




Source: Cable Europe, Status: year-end 2007



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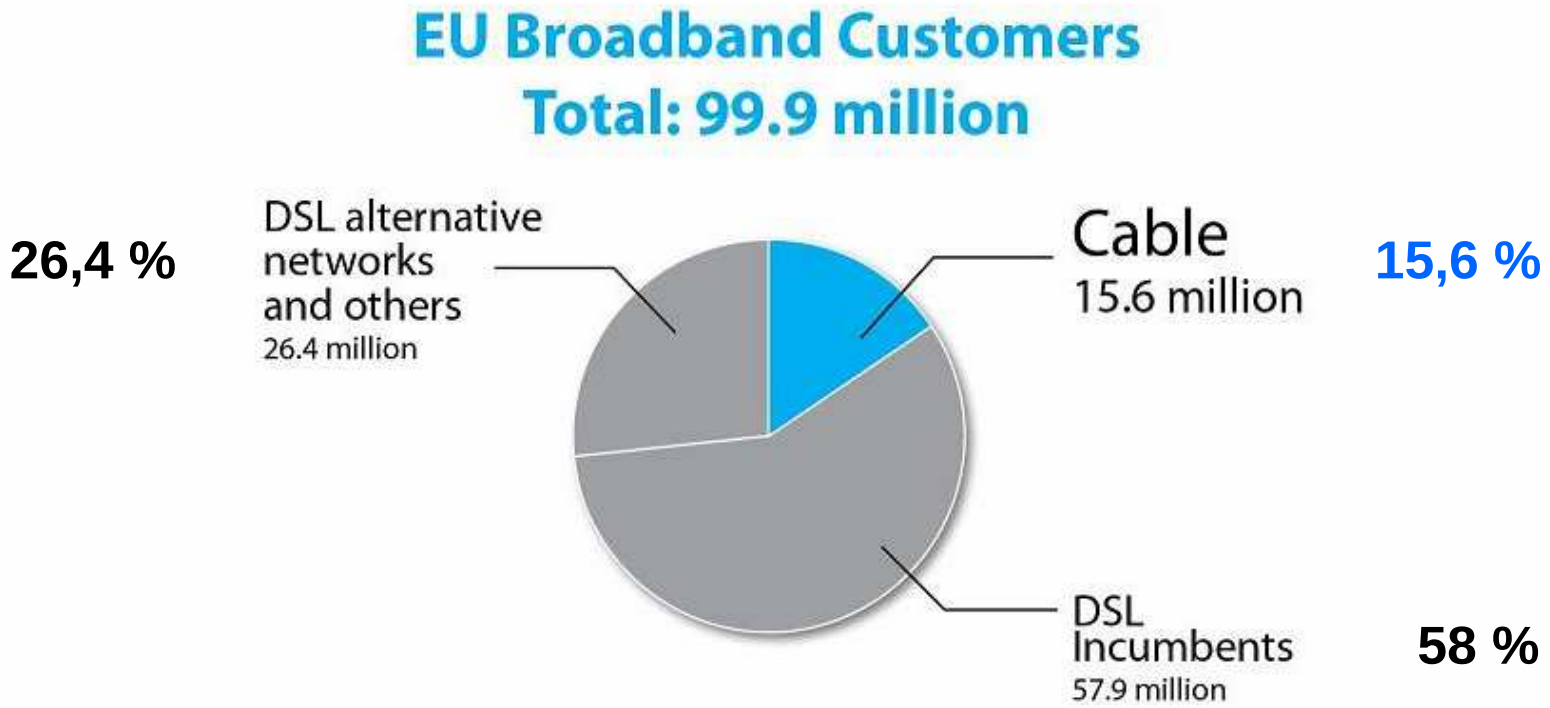
# 1.4 Market situation (3)

## Share of cable internet customers in Europe




Source: Cable Europe, Status: year-end 2007



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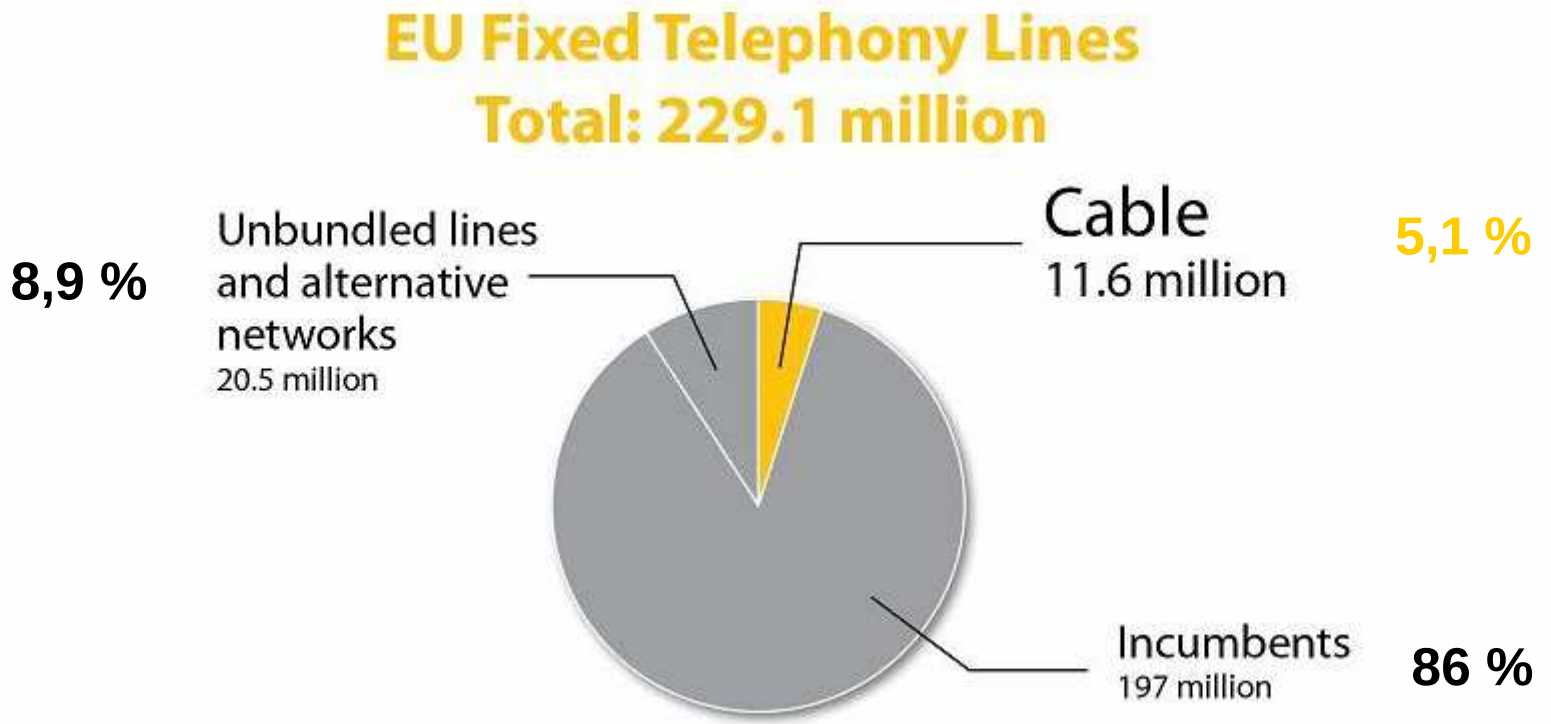
# 1.4 Market situation (4)

## Share of cable telephony customers in Europe




Source: Cable Europe, Status: year-end 2007



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# 2. System of European standardization for cable networks – Definition

- **System is based on different levels of standardisation**
- **CENELEC TC 209 together with IEC 100/TA5 is the core of this system, providing standards for**
  - **Safety (1)**
  - **EMC (2)**
  - **System performance (2)**
  - **Equipment (5)**
  - **Status monitoring (3)**
- **Core standards use results of other standards,**
  **e.g. of DVB transmission standards**
- **Core standards make normative references to other standards,**
  **e.g. to coaxial cable standards**



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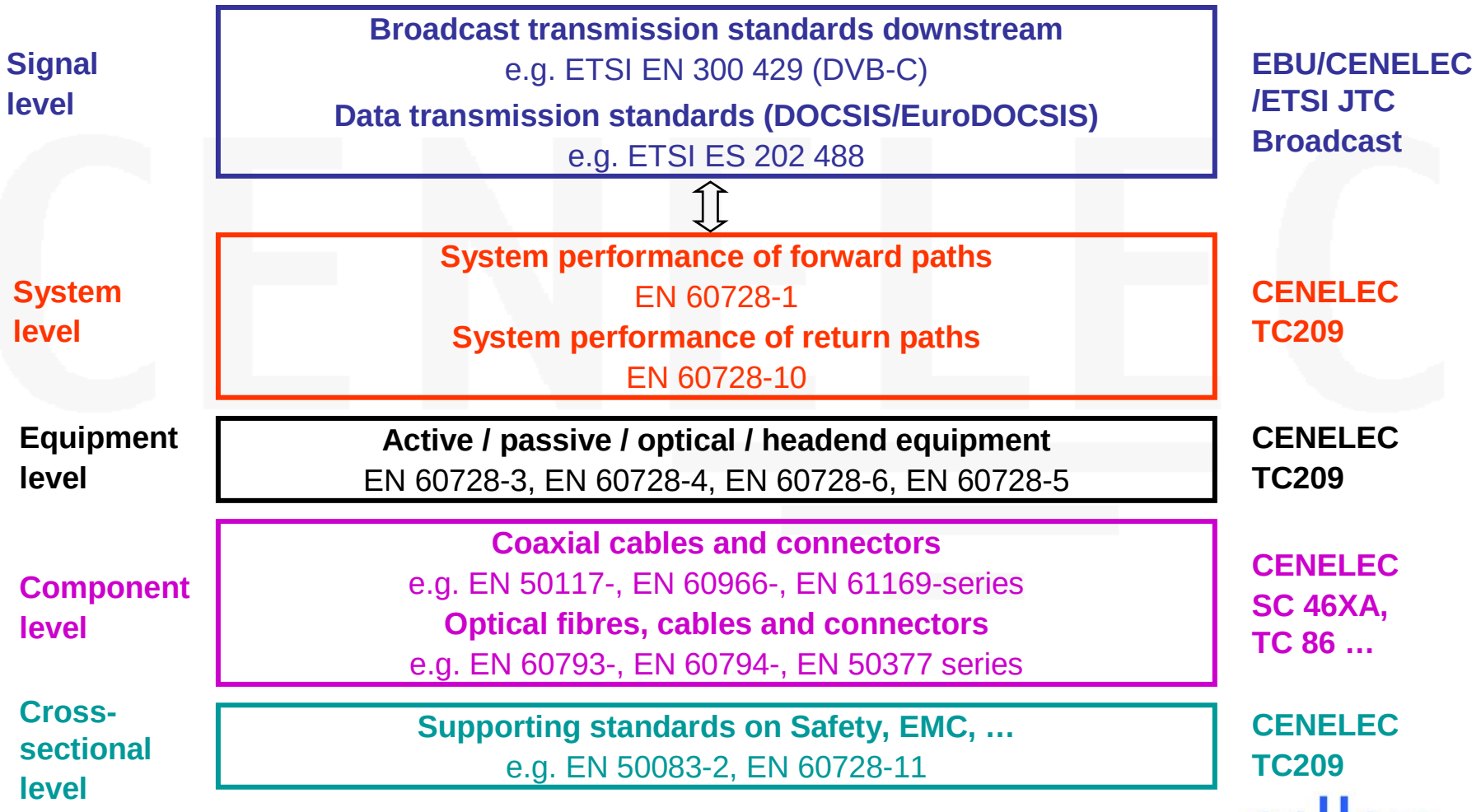
# 2. System of European standardization for cable networks – Levels



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# 3. Second generation of digital transmission standards and specifications

## Step sequence of content

**3.1 Reminder to DVB and to first generation of broadcast transmission standards**

3.2 DVB-S2 for satellite transmission

3.3 DVB-T2 for terrestrial transmission

3.4 DVB-C2 for cable transmission (outlook)

# The DVB project

- Founded in 1993 as a "community of interests" for developing and supporting "Digital TV" in Europe
- Today more than 280 members in more than 35 countries worldwide
  - Broadcaster
  - Manufacturer
  - Network operators
  - Regulatory organisations
  - Software industry, …
- "Commercial Module" controls "Technical Module"
- Development of technical specifications based on the business requirements of industry – **Blue Books**



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# The DVB project (2)

- Standardization on the basis of "Blue Books"
  - on European level by ETSI and CENELEC
  - worldwide by ITU

⇒ **Development of a complete digital TV system**

# Overview on most important DVB specifications

| | |
|---|---|
| **DVB-S** | **Satellite broadcast** |
| **DVB-S2** | **Satellite broadcast, 2nd generation** |
| **DVB-C** | **Broadcast transmission in cable networks** |
| DVB-C2 | Broadcast transmission in cable networks (2nd generation, under development) |
| **DVB-T** | **Terrestrial broadcast** |
| **DVB-T2** | **Terrestrial broadcast, 2nd generation** |
| DVB-H | Broadcast to handheld devices |
| DVB-SH | Satellite broadcast to handheld devices |
| DVB-IPTV | Television via internet protocol |
| DVB-MHP | "Multimedia-Home-Platform" for interactive television |
| DVB-RCS | Return channel transmission via satellite |



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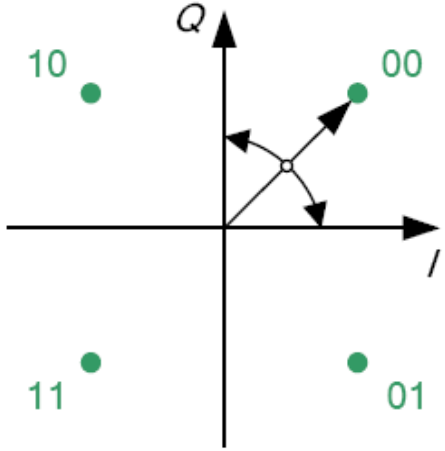
# First generation DVB standards for digital broadcast services

## Actual versions of ETSI standards

| | | |
|---|---|---|
| DVB-S | ETSI EN 300 421 V1.1.2 (1997-08) | Digital Video Broadcasting (DVB); Framing structure, channel coding and modulation for 11/12 GHz satellite services |
| DVB-C | ETSI EN 300 429 V1.2.1 (1998-04) | Digital Video Broadcasting (DVB); Framing structure, channel coding and modulation for cable systems |
| DVB-T | ETSI EN 300 744 V1.6.1 (2008-09) | Digital Video Broadcasting (DVB); Framing structure, channel coding and modulation for digital terrestrial television |

# Characteristics of DVB-S transmission standard

- Satellite channels are, due to large distances, strongly affected by noise and other interfering signals
- Therefore DVB-S uses very robust modulation system **QPSK**
  – **Q**uadrature **P**hase **S**hift **K**eying – with 4 modulation stages
- Large bandwidth demand due to only 4 modulation stages
- Designed for MPEG-2 transport streams




QPSK constellation diagram



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# Characteristics of DVB-T transmission standard

- Terrestrial radio channels are characterised by
  - Reflexions
  - Different signal delay times
  - Multi-path reception
- These cause ***double images*** for analogue TV signal transmission
- These cause ***intersymbol interferences*** for digital TV signal transmission (overlap of adjacent symbols)
- Application of the very complex COFDM transmission schema
  **COFDM = *"Coded Orthogonal Frequency Division Multiplex"***
- Sub-division of the transmission channel into a large number of single carriers – **6817 carriers for 8k-schema**
- Each carrier transports only part of the complete data rate



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# Characteristics of DVB-T transmission standard

- **Modulation systems** defined by DVB-T specification
  - 16 QAM (e.g. used in Germany)
  - QPSK
  - 64 QAM
- **Guard interval** (protection interval) for reduction of intersymbol interferences
- All signals with ***delay times < guard interval duration*** can be evaluated by the receiver

  ⇒ **positive contribution of multi-path signals!**

# Characteristics of DVB-C transmission standard

- Maximum correspondence with DVB-S and DVB-T transmission standards; important for headends of cable networks
- Adaptation of digital data streams to the performance of the physical cable channels
- Variable selection of transmission parameters (at modulation process) allows adaptation to the quality of the cable channels (i.a. signal-to-noise ratio)
- Mixed analogue / digital TV signal transmission does not degrade the quality of the analogue services
- Typ. 38 Mbit/s data rate per cable channel allow the transmission of 6 – 8 SDTV signals



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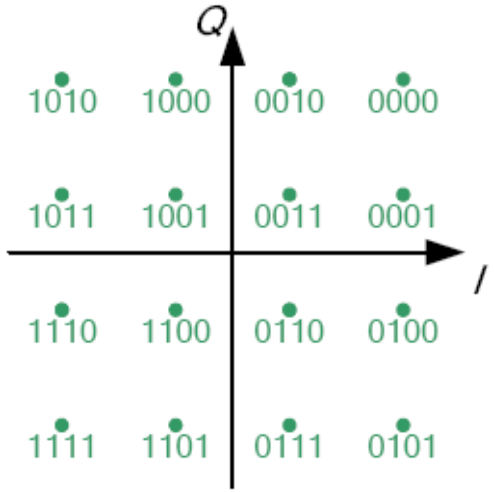
# Modulation systems for DVB-C transmission

- Combination of phase shift keying and amplitude shift keying
- Commonly used in DVB-C systems:
  - 16 QAM — 16 signal stages — coded with 4 Bit
  - 64 QAM — 64 signal stages — coded with 6 Bit
  - 256 QAM — 256 signal stages — coded with 8 Bit
- Presentation by constellation diagram
  - Example 16 QAM



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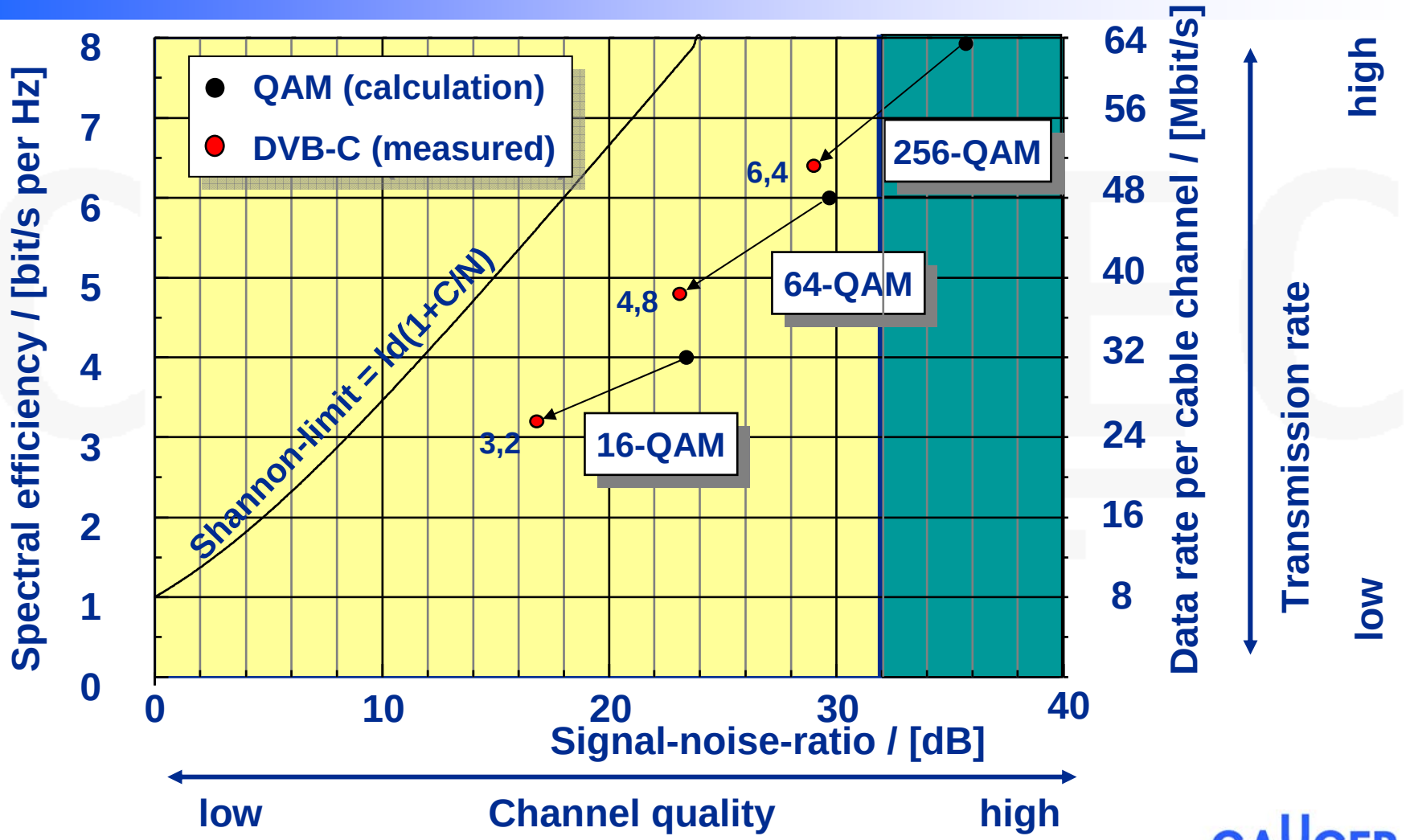
# Performance of DVB-C systems



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# Overview on currently used DVB transmission standards (1st generation)

| System | DVB-S | DVB-C | DVB-T |
|---|---|---|---|
| Standard | EN 300 421 | EN 300 429 | EN 300 744 |
| Modulation system | QPSK | 64 QAM<br>256 QAM | COFDM<br>16 QAM<br>8k mode<br>6817 carriers |
| Bandwidth | 33 MHz / 36 MHz | 7 MHz or 8 MHz | 7 MHz or 8 MHz |
| Symbol rate (typ.) | 27,5 MSymb/s | 6,900 MSymb/s | 5,39 MSymb/s |
| Reference data rate (typ.) | 38,015 Mbit/s | 38,1 Mbit/s | 13,06 Mbit/s<br>13,27 Mbit/s |
| Others | Roll-off factor<br>0,35 | Roll-off factor<br>0,15 | Variable Guard Interval<br>1/4 or 1/8 |



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# 3. Second generation of digital transmission standards and specifications

## Step sequence of content


3.1 Reminder to DVB and first generation of broadcast transmission standards

**3.2 DVB-S2 for satellite transmission**

3.3 DVB-T2 for terrestrial transmission

3.4 DVB-C2 for cable transmission (outlook)

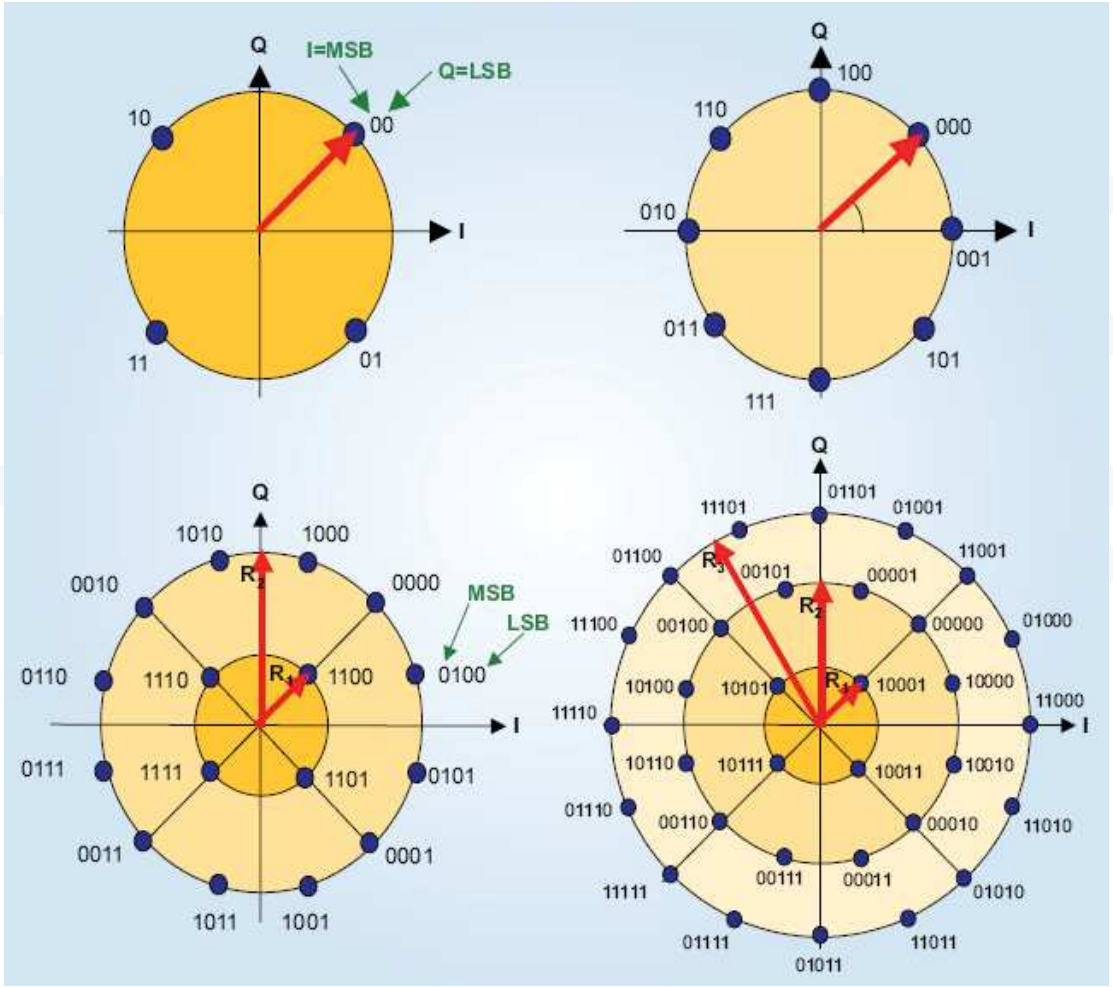
# Characteristics of DVB-S2 transmission standard

- ***DVB-S2*** is an extension to *DVB-S* for the transmission of higher data rates
- Three additional modulation systems
  - **8-PSK** **P**hase **S**hift **K**eying with 8 stages
  - **16-APSK** Combined **A**mplitude and **P**hase **S**hift **K**eying with 16 stages
  - **32-APSK** Combined **A**mplitude and **P**hase **S**hift **K**eying with 32 stages
- Error correction by two combined systems (BCH-Code and LDPC) *)
- 2 operation modes:
  - backwards-compatible to DVB-S
  - non-backwards-compatible to DVB-S
- Designed for MPEG-2 and MPEG-4 transport streams

*) BCH-Code: Bose-Chaudhuri-Hocquenghem-Code / LDPC: Low-Density Parity Check

# Constellation diagrams of DVB-S and DVB-S2 modulation systems

QPSK




8-PSK

32-APSK

32-APSK



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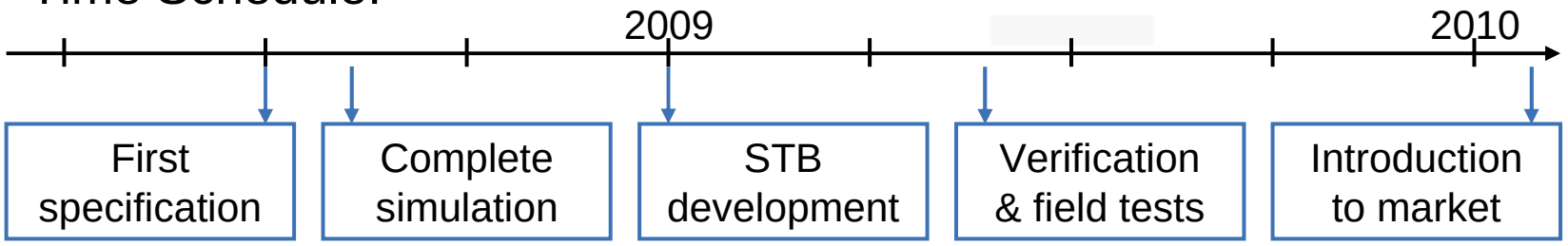
# Requirements for DVB-T2 transmission standard

- Increase of data rate by ≥ 30% (for comparable situations)
- Flexible choice of parameters for increase of immunity at mobile reception
- Compatible to existing DVB-T receiving antennas
- Maximum compatibility to DVB-S2 & DVB-C2 (Standard family approach)
- Flexible support for the transmission of IP-based data
- Time Schedule:



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# First summary and outlook on DVB-T2

- The DVB-T2 specification was published in June 2008
- A first draft of the European Standard **ETSI EN 302 755** was internally distributed in September 2008
- An increase of spectral efficiency of ≥30% will be achieved
- Introduction of iterative coding technologies and higher constellations (e.g. number of carriers and modulation systems)
- First implementation of DVB-T2 presumably in the UK
- First STB prototypes expected already by end of 2008



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# Estimation of capacity for DVB-T2

| Application mode | Mobile reception | Portable reception | Stationary reception |
|---|---|---|---|
| No. of carriers | 16K | 16K | 32k extended |
| Guard interval | 1/8 | 1/8 | 1/128 |
| Modulation system | 16-QAM | 64-QAM | 256-QAM |
| LDPC code rate | 5/6 | 2/3 | 3/5 |
| Min. C/I ratio | 11,4 dB | 13,9 dB | 16,8 dB |
| Usable data rate | 19,93 Mbit/s | 23,91 Mbit/s | 35,40 Mbit/s |
| Reference data rate in DVB-T system | 13,27 Mbit/s | 14,93 Mbit/s | 24,13 Mbit/s |
| Gain S2 / S | 50% | 60% | 47% |



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# 3. Second generation of digital transmission standards and specifications

## Steps of content


3.1 Reminder to DVB and first generation of broadcast transmission standards

3.2 DVB-S2 for satellite transmission

3.3 DVB-T2 for terrestrial transmission

**3.4 DVB-C2 for cable transmission (outlook)**

# Motivation for DVB-C2 development

- **Increase of transmission efficiency**
  - Lowers operating costs (more data/programmes per channel)
  - Reduces invests for network upgrades
  - Important for the introduction of personalised services (e.g. VoD)
  - Increase of efficiency not achievable by DVB-C
- **Increase of transmission quality for cable networks by different upgrading measures**
  - Introduction of optical transmission systems in the backbone
  - Reduction of number of subscribers per CATV cluster
  - Reduction of number of analogue signals transmitted in the cable network
- **Introduction of a new flexible transport layer for IP-based signals**
- **Easy and cost-effective signal processing in headends**
  - **DVB-S2 ⇒ DVB-C2 / DVB-T2 ⇒ DVB-C2**



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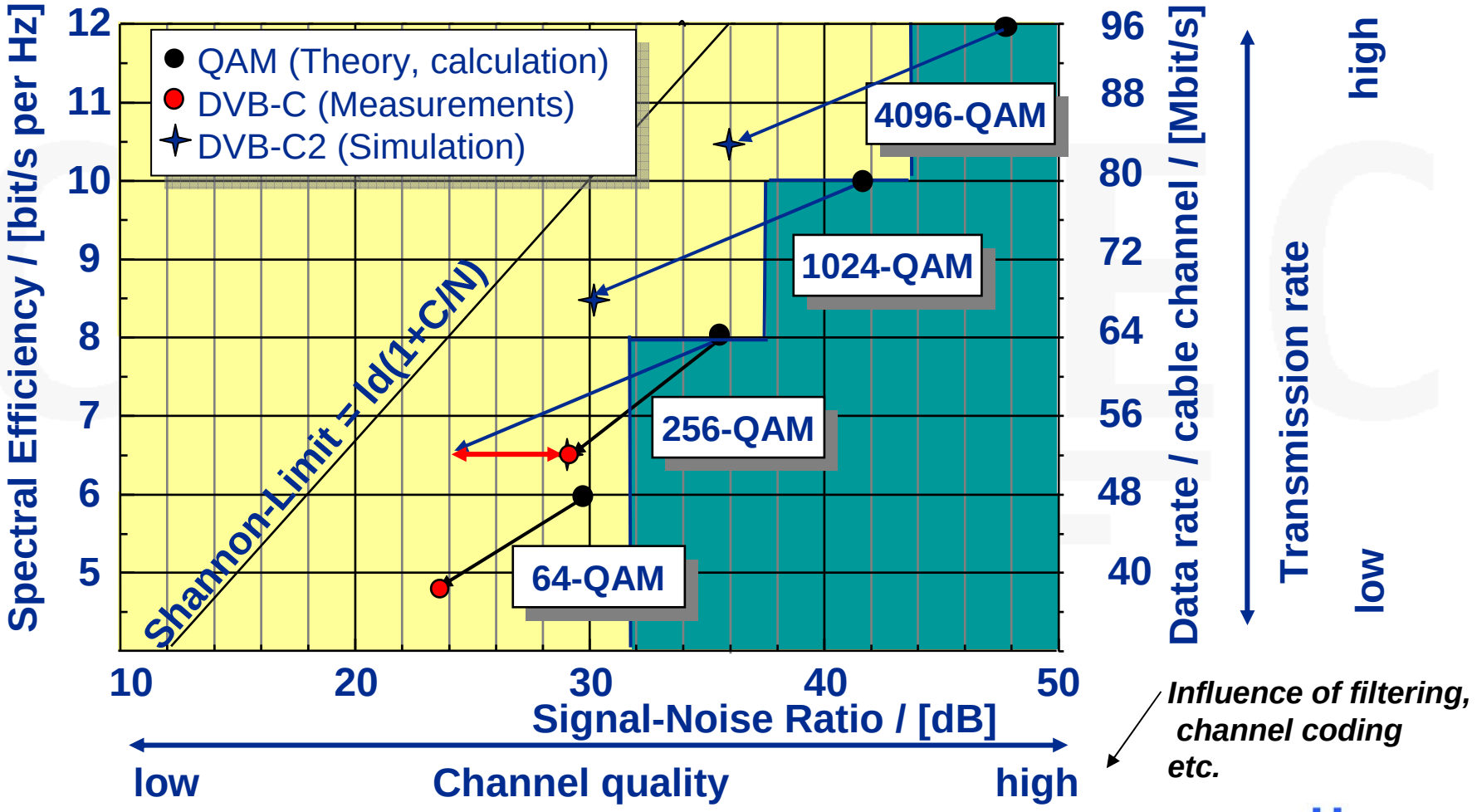
# Performance of DVB-C2 systems



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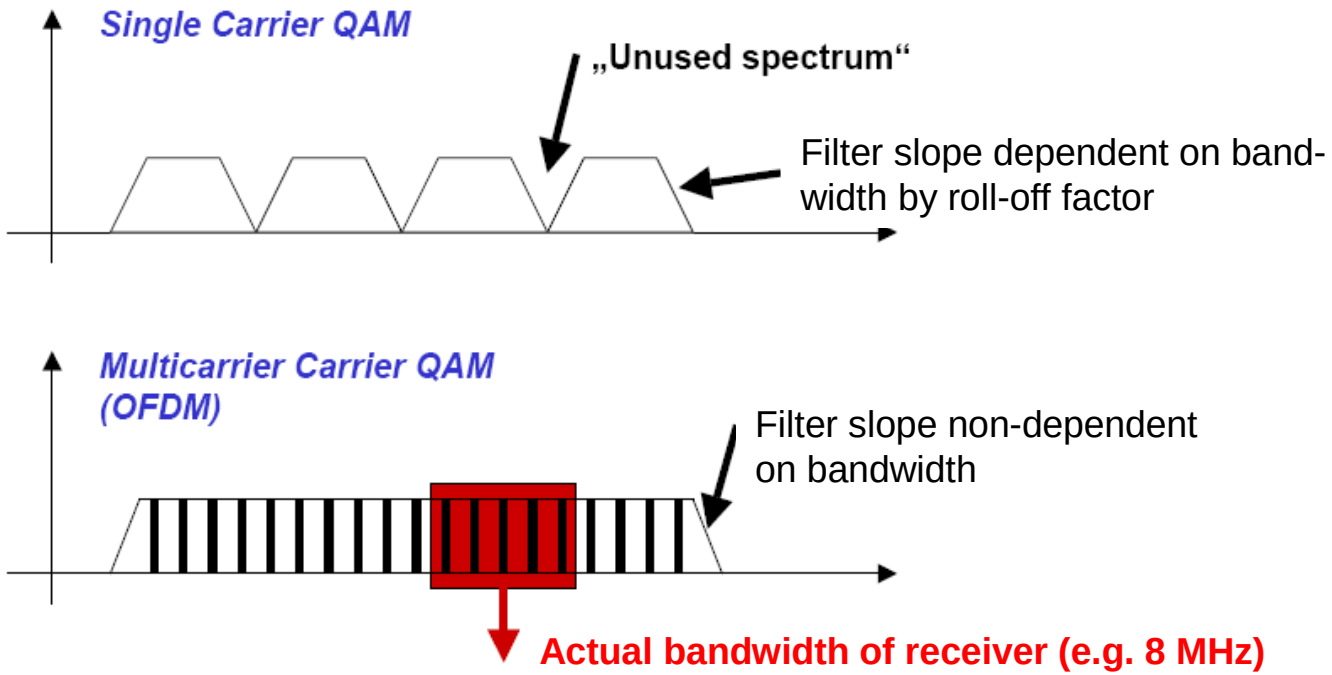
# Aspects of channel bonding for DVB-C2




➔ **Data rate increases with increasing bandwidth of multi-carrier systems compared to single-carrier systems**



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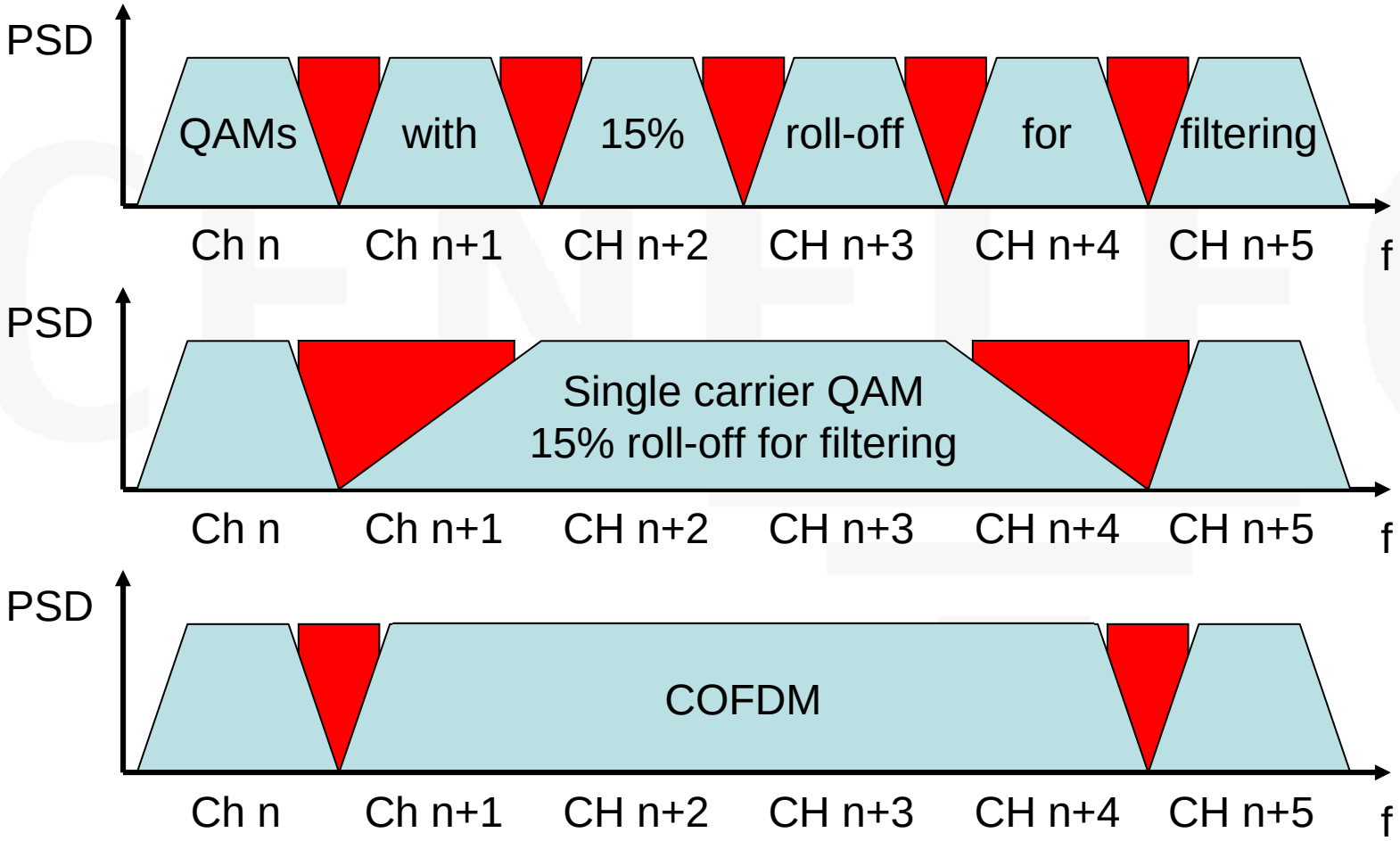
# "Gain" using channel bonding and COFDM for DVB-C2



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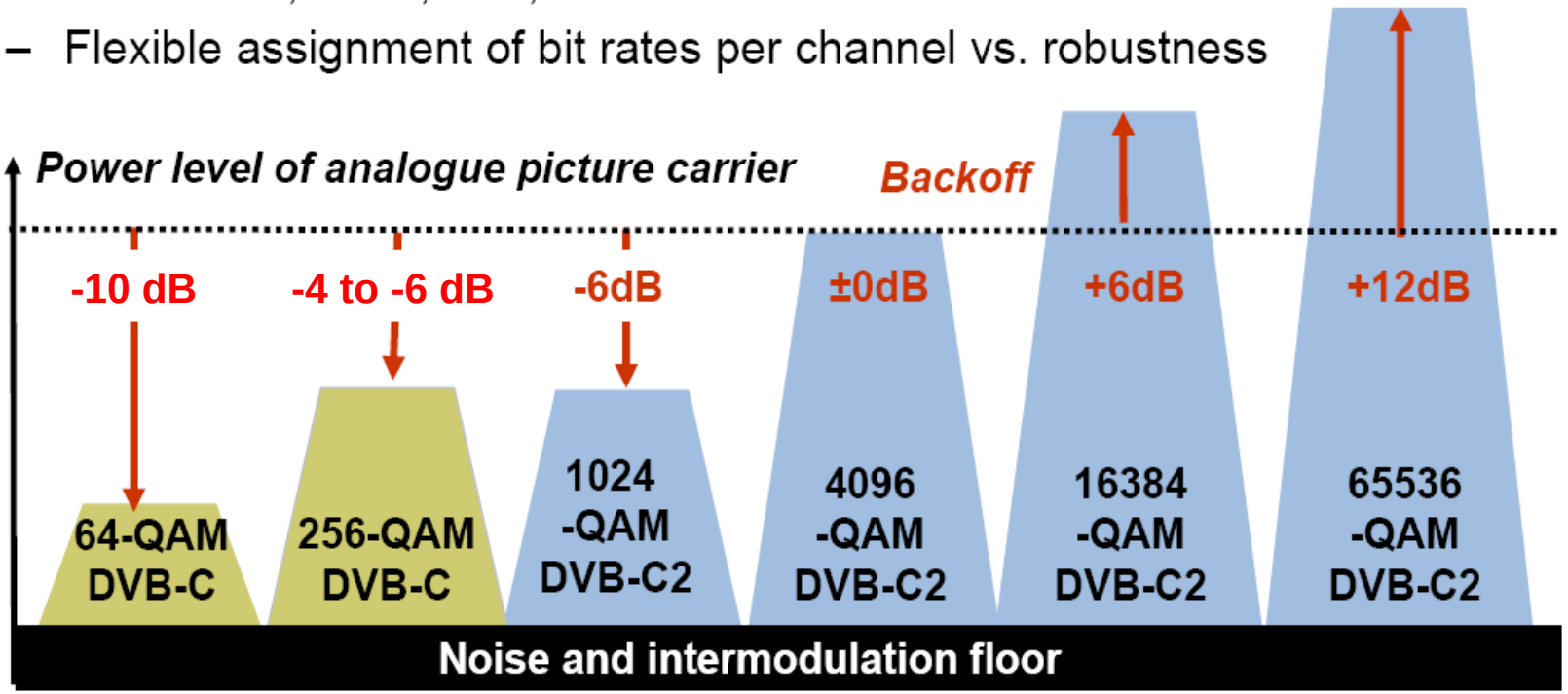
# Performance of different modulation systems for DVB-C2

| *Modulation scheme* | *Bit Rate, min. C/N (for "Quasi error free", QEF)* | *Remark* |
|---|---|---|
| *DVB-C, 256QAM* | *51Mbit/s, CNR=30dB* | |
| *DVB-C2,1024QAM* | *62Mbit/s CNR = approx.30dB ;* | ***+22% gain** versus DVB-C,256 QAM* |
| *DVB-C2, 4096QAM* | *75Mbit/s, CNR = approx.36dB* | |
| *DVB-C2, OFDM/256QAM* | *55Mbit/s, CNR = approx.24dB* | |
| *DVB-C2, OFDM/1024QAM* | *68Mbit/s, CNR = approx. 30dB* | ***+33% gain** versus DVB-C,256 QAM* |
| *DVB-C2, OFDM/4096QAM* | *81Mbit/s, CNR = approx. 36dB* | |

# Flexible utilisation of modulation systems and power levels for DVB-C2

- Capability to adapt to all channel conditions provided by all network types
  - SMATV, CATV, HFC, Next Generation cable
- Flexible assignment of bit rates per channel vs. robustness



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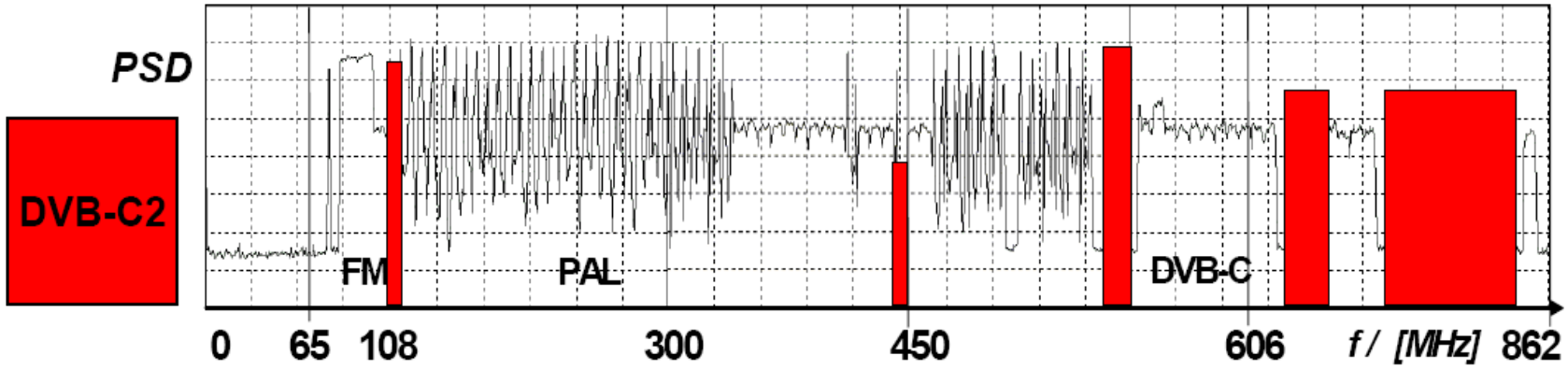
# Potential usage scenarios for DVB-C2 – Short term

- Mixed analogue – digital network occupation
- Coexistence of analogue and digital signals
  - o FM radio, PAL, DOCSIS, DVB-C, and DVB-C2
- Introduction of new services requiring high spectrum efficiency
  - o HDTV, VOD, interactive TV, personalized services



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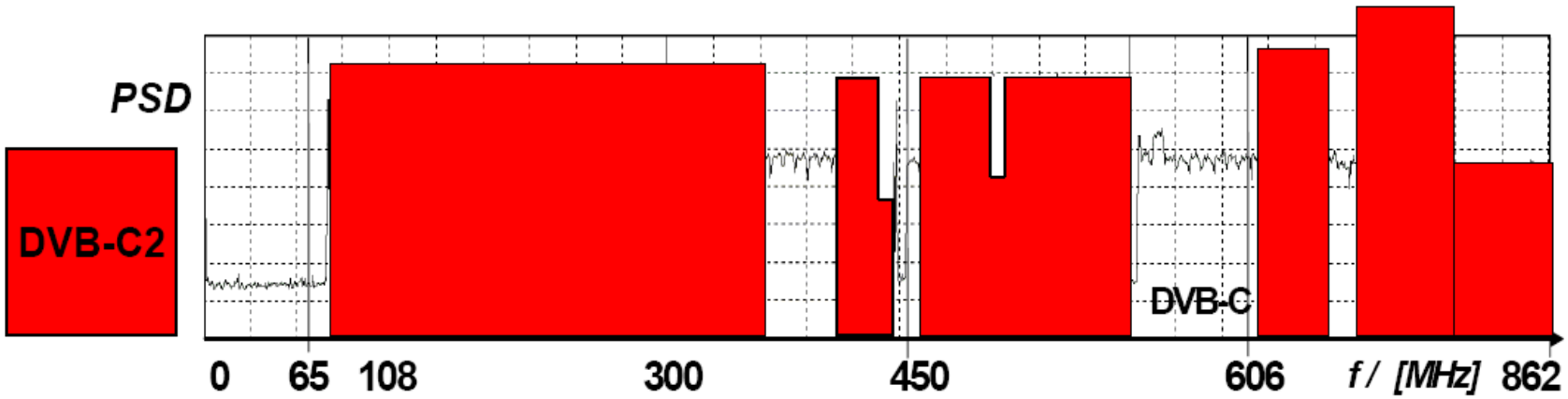
# Potential usage scenarios for DVB-C2 – Mid term

- Analogue switch-off provides higher degree of flexible for utilization of DVB-C2
  - o Varying power level and bandwidth
- Incorporation of DVB-C2 in DOCSIS
- Continuation of DVB-C for legacy reasons



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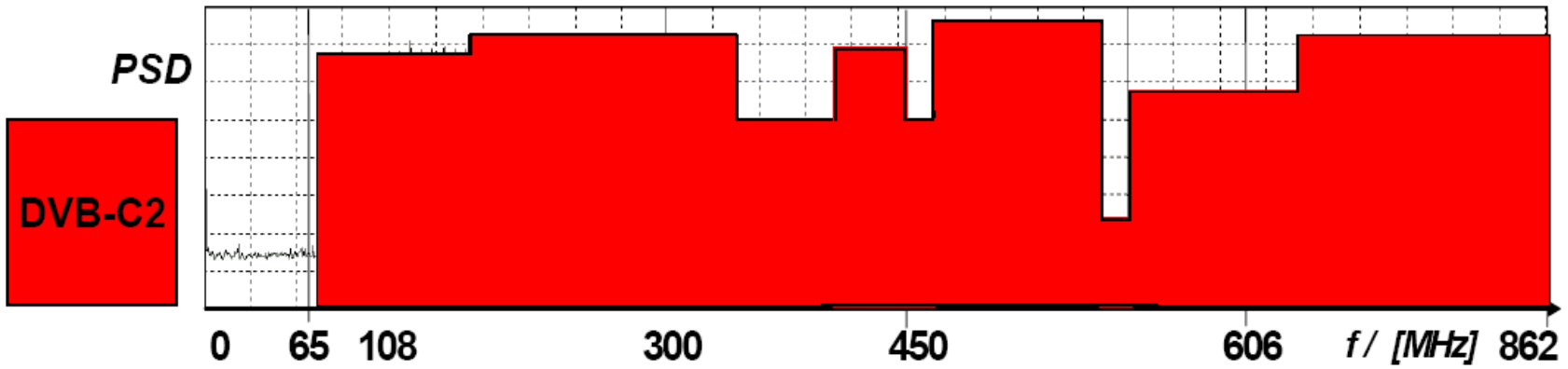
# Potential usage scenarios for DVB-C2 – Long term

- DVB-C2 only remaining physical layer transmission technique
  - Also used by DOCSIS
- 1 OFDM signal carries all services
  - Bandwidth: some 800 MHz
  - Power level: varying over frequency and time



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# Second generation DVB standards for digital broadcast services

## Actual (draft) versions of ETSI standards

| | | |
|---|---|---|
| **DVB-S2** | **ETSI EN 302 307 V1.1.2 (2006-06)** | **Digital Video Broadcasting (DVB); Second generation framing structure, channel coding and modulation systems for Broadcasting, Interactive Services, News Gathering and other broadband satellite applications** |
| **DVB-C2** | **Not yet available** | **Digital Video Broadcasting (DVB); Second generation framing structure, channel coding and modulation for cable systems** |
| **DVB-T2** | **Draft ETSI EN 302 755 V1.1.1 (2008-09)** | **Digital Video Broadcasting (DVB); Framing structure, channel coding and modulation for digital terrestrial television** |



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# 4. EN 50083 and IEC/EN 60728 standards series and standardisation projects

## Step sequence of content


**4.1 Introduction and overview**

4.2 New standards published since 2006

4.3 Maintenance work on existing standards of EN/IEC 60728 series

4.4 New standardisation projects

# What's new in standardization in the cable network environment?

Last report on standardization for "cable networks" was presented during ANACOM-ITED Seminar – *"Technological Development"* Lisbon / Carnaxide, 22 June 2006

The presentation today will give an update on

- New IEC/EN 60728 standards editions published since 2006
- Maintenance work on IEC/EN 60728 series standards
- New standardization projects



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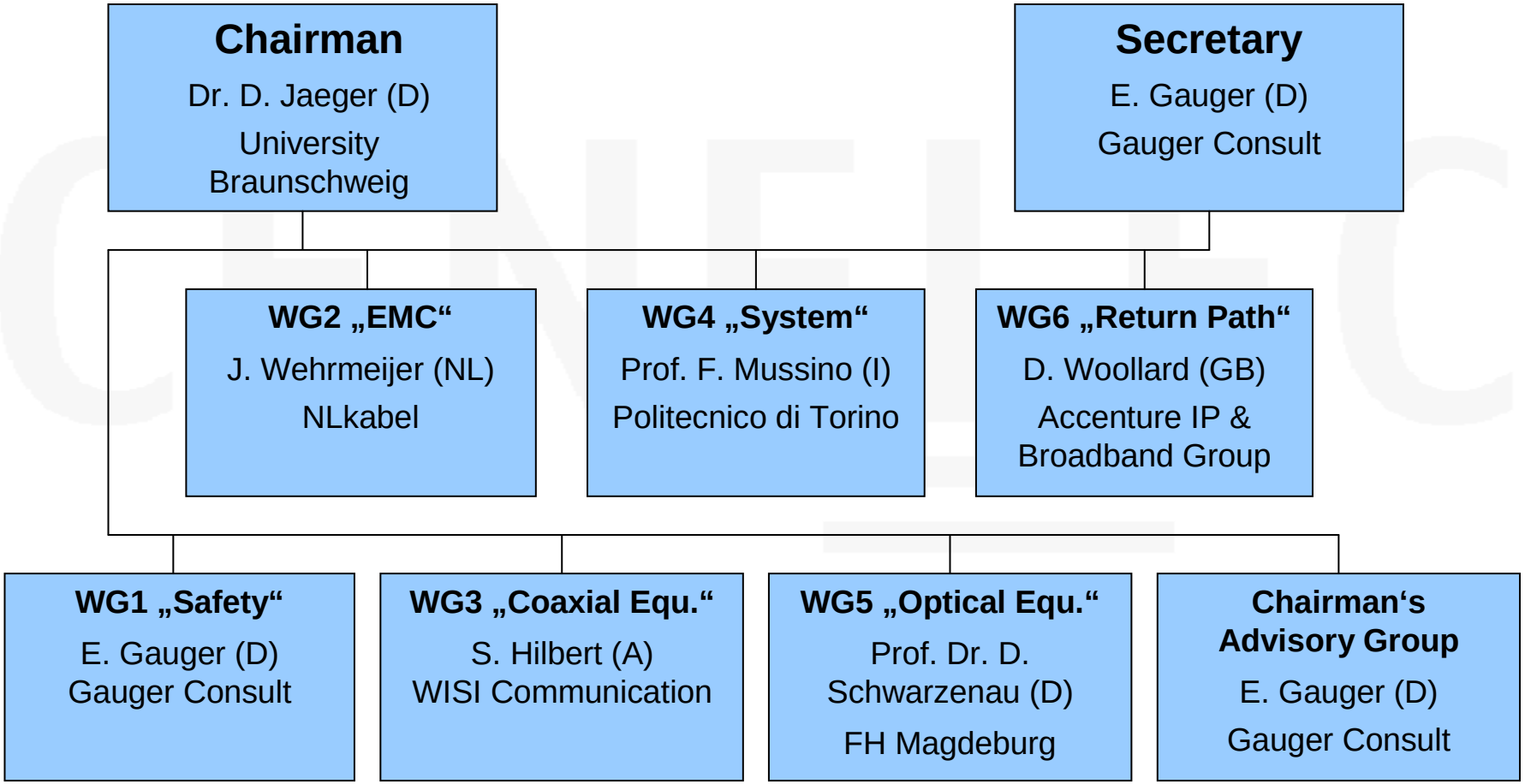
# Organisation of CENELEC Technical Committee 209 “Cable networks …”



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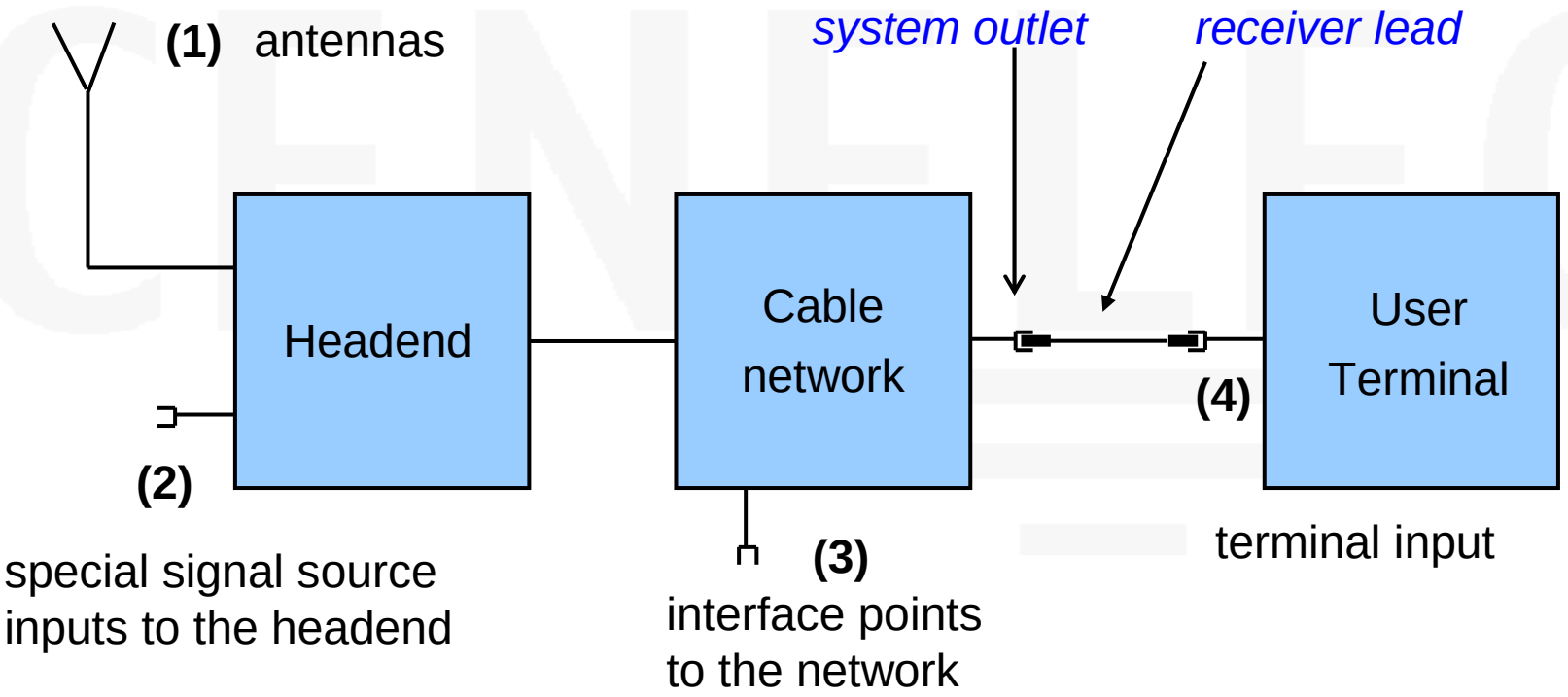
# Extent of standardization work performed by CENELEC TC 209



# Co-operation between IEC TC100/TA5 and CLC/TC209

## Standards transfer

- Since 2003 transfer of the EN 50083 series standards to the IEC / EN 60728 series
- 10 parts transferred
- 3 parts remain in the EN 50083 series (EMC and DVB related parts)

## Work repartition

- Operational work is mainly performed by the working groups of CLC/TC209
- Commenting and voting procedures are performed in parallel procedures according to the “Dresden Agreement” between IEC and CENELEC

***The leading role in standardization for cable networks remains at CENELEC/TC209***



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# Present status of International and European Standards of EN 50083 and IEC / EN 60728 series

| European Standard EN 50083 series | International Standard IEC 60728 series | European Standard EN 60728 series | Title of European Standard "Cable networks for television signals, sound signals and interactive services;" |
|---|---|---|---|
| (EN 50083-7:2000) | IEC 60728-1:2007 | **EN 60728-1:2008** | Part 1: ***"System performance of forward paths"*** |
| **EN 50083-2:2006** | IEC 60728-2:2002 | --- | Part 2: ***"Electromagnetic compatibility for equipment"*** |
| withdrawn | IEC 60728-3:2005 | **EN 60728-3:2006** | Part 3: ***"Active wideband equipment for coaxial cable networks"*** |
| (EN 50083-4:1998) | IEC 60728-4:2007 | **EN 60728-4:2008** | Part 4: ***"Passive wideband equipment for coaxial cable networks"*** |
| (EN 50083-5:2001) | IEC 60728-5:2007 | **EN 60728-5:2008** | Part 5: ***"Headend equipment"*** |

Currently valid European standards



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# Present status of International and European Standards of EN 50083 and IEC / EN 60728 series

| European Standard EN 50083 series | International Standard IEC 60728 series | European Standard EN 60728 series | Title of European Standard "Cable networks for television signals, sound signals and interactive services;" |
|---|---|---|---|
| withdrawn | IEC 60728-6:2003 | **EN 60728-6:2003** | Part 6: ***"Optical equipment"*** |
| --- | IEC 60728-7-1:2003 | **EN 60728-7-1:2005** | Part 7-1: ***"Hybrid Fibre Coax Outside Plant Status Monitoring - Physical (PHY) Layer Specification"*** |
| --- | IEC 60728-7-2:2003 | **EN 60728-7-2:2005** | Part 7-2: ***"Hybrid Fibre Coax Outside Plant Status Monito-ring - Media access Control (MAC) Layer Specification"*** |
| --- | IEC 60728-7-3:2003 | **EN 60728-7-3:2005** | Part 7-3: ***"Hybrid Fibre Coax Outside Plant Status Monito-ring - Power supply to Trans-ponder Interface Bus Spec."*** |

Currently valid European standards



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# Present status of International and European Standards of EN 50083 and IEC / EN 60728 series

| European Standard EN 50083 series | International Standard IEC 60728 series | European Standard EN 60728 series | Title of European Standard "Cable networks for television signals, sound signals and interactive services;" |
|---|---|---|---|
| **EN 50083-8:2002** | IEC 60728-12:2001 | --- | Part 8: ***"Electromagnetic compatibility for networks"*** |
| **EN 50083-9:2002** | IEC 60728-9:2000<br><br>IEC 60728-9-am1 | --- | Part 9: ***"Interfaces for CATV/ SMATV headends and similar professional equipment for DVB/MPEG-2 transport streams"*** |
| withdrawn | IEC 60728-10:2005 | **EN 60728-10:2006** | Part 10: ***"System performance for return paths"*** |
| withdrawn | IEC 60728-11:2005 | **EN 60728-11:2005** | Part 11: ***"Safety"*** |
| **CLC/ TR 50460:2005** | IEC/TR 60728-6-1 :2006 | --- | ***"System guidelines for analog optical transmission systems"*** |

Currently valid European standards



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# 4. EN 50083 and IEC/EN 60728 standards series and standardisation projects

## Step sequence of content


4.1 Introduction and overview

**4.2 New standards published since 2006**

4.3 Maintenance work on existing standards of EN/IEC 60728 series

4.4 New standardisation projects

# IEC 60728-1:2007 / EN 60728-1:2008, „System performance of forward paths"

## Major changes compared to EN 50083-7:2000

- Complete set of measurement methods for digitally modulated TV signals
- Performance requirements for digitally modulated TV signals
- System performance for signals according to **HDTV**, **DVB-S2** and **256 QAM** transmission standards
- Extension of scope from "system outlet" up to "terminal input"
- Covering multimedia signal transmission via balanced cables (twisted pair)
- New Clause 6: ***"Performance requirements at receiving antennas"***
- New Clause 7: ***"Performance requirements at home network interfaces of cable networks"***
- New Annex K: ***"Examples of home network implementation"***



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# IEC 60728-1:2007 / EN 60728-1:2008, „System performance of forward paths"

**Methods of measurement for digitally modulated signals (DVB-S, DVB-S2, DVB-C, DVB-T)**

- Signal level
- RF signal to noise ratio $S_{D,RF}$ / *N*
- Bit error ratio ***BER***
- Noise Margin
- Modulation error ratio ***MER***
  „Figure of merit“
- Phase jitter
- Phase noise of RF carrier



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# IEC 60728-1:2007 / EN 60728-1:2008, „System performance of forward paths"

## Performance requirements at receiving antennas

- **Method of measurement of field strength at receiving antenna site**
- **Minimum field strength requirements at receiving antenna for**
  - Analogue broadcast signals
  - Digital broadcast signals
  - Analogue and digital satellite broadcasting
- **Quality of received signals for all kinds of broadcast signals**
  - Signal level
  - Minimum signal/disturbance ratio
  - Minimum signal/echo ratio
  - BER/PER requirements of digital signals
  - “Threshold” behaviour of digital television signals

# IEC 60728-1:2007 / EN 60728-1:2008, „System performance of forward paths"

**Introduction of a new interface, the "Home Network Interface ($HNI_i$)" at the entrance of the individual home**

***Reason for this new interface:***

- **Home networks are becoming more and more important due to**
  - Increasing number of multimedia equipment inside a home
  - Requirement for multimedia services in all rooms
  - Need for interconnecting multimedia equipment
- **Signal quality has to be kept at any system outlet also in wide-extended home networks**

***Idea:***

- **To define all relevant signal quality parameters at $HNI_i$ taking into account**
  - the signal performance requirements at the terminal input (TI)
  - the impairment of the signals due to the chosen home network ($HNI_i$)



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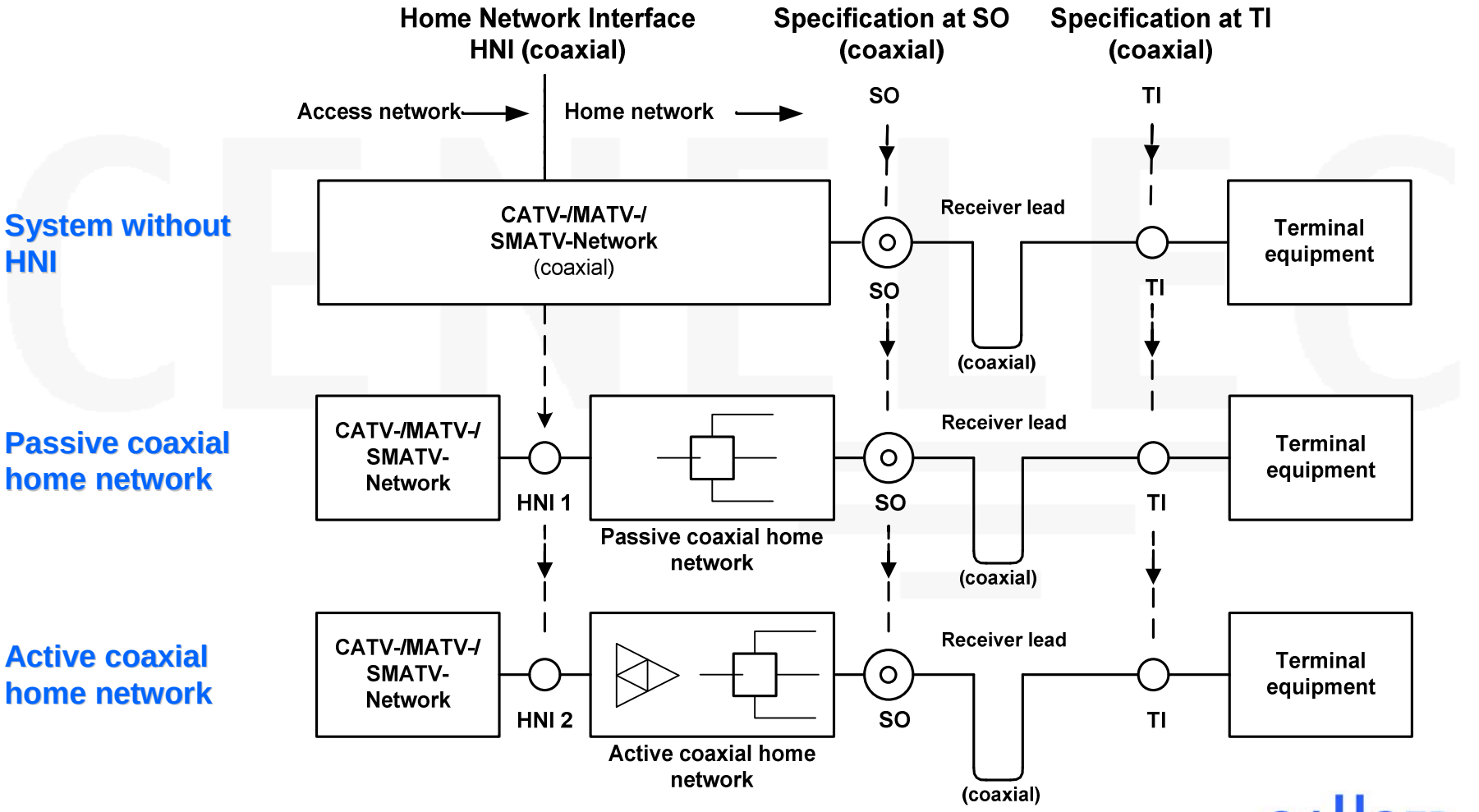
# Types of Home Networks and Home Network Interfaces in EN 60728-1:2008




*"Standardization – Buildings' Cable Infrastructure Evolution"*
ANACOM Workshop, Carnaxide – Portugal, 29 October 2008

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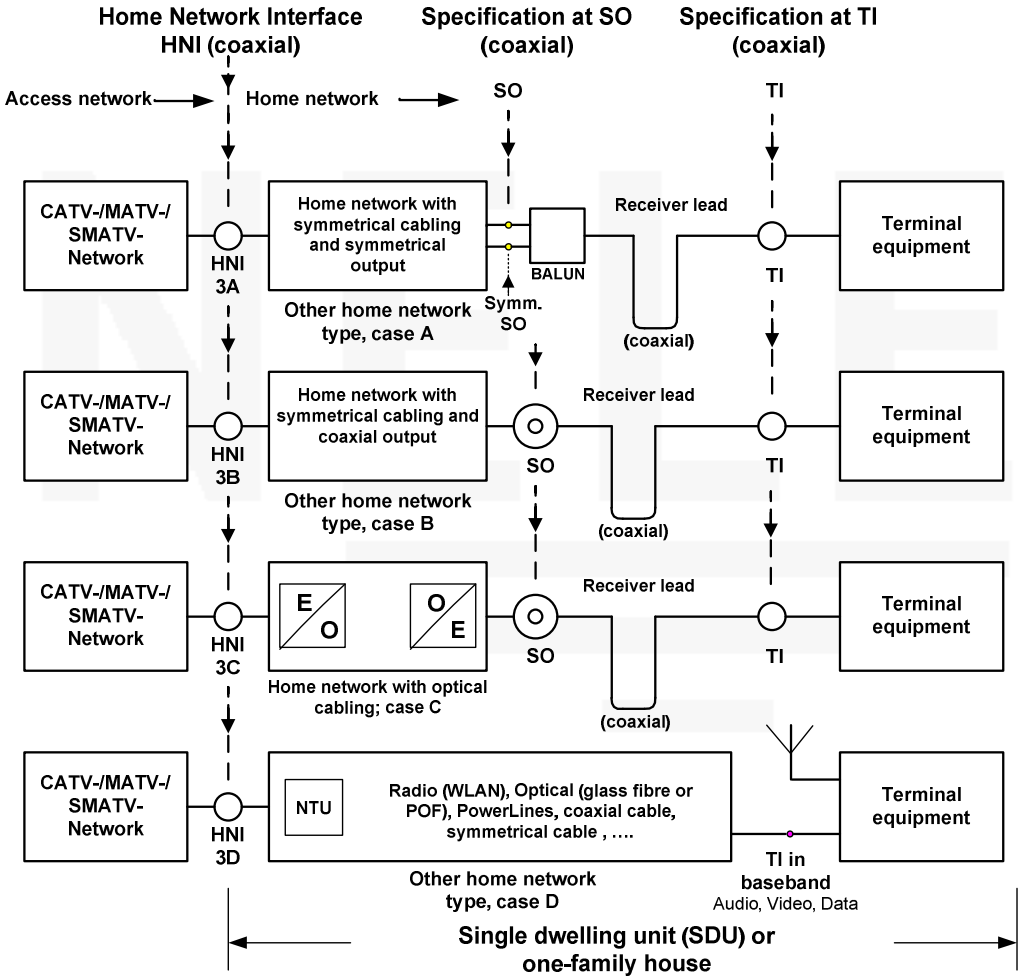
# Types of Home Networks and Home Network Interfaces in EN 60728-1:2008

**Home network with symm. cabling and symm. output**

**Home network with symm. cabling and coaxial output**

**Home network with optical cabling and coaxial output**

**Home network with all kinds of cabling and baseband output**




*"Standardization – Buildings' Cable Infrastructure Evolution"*
ANACOM Workshop, Carnaxide – Portugal, 29 October 2008

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# IEC 60728-4:2007 / EN 60728-4:2008 „Passive wideband equipment for coaxial cable networks"

## Major changes compared to EN 50083-4:1998

- **Several new or modified terms and definitions**
- **Added methods of measurement for**
  - attenuation,
  - isolation,
  - through-loss,
  - group delay variation,
  - amplitude frequency response and
  - two carrier intermodulation measurements for second- and third-order products.
- **Updated and new performance requirements**



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# IEC 60728-5:2007 / EN 60728-5:2008 „Headend equipment"

## Major changes compared to EN 50083-5:2001

- **Several new terms and definitions**
- **Complete set of measurement methods for digitally modulated TV signals, i.a. for**
  - RF signal-to-noise ratio ($S_{D,RF}/N$) for digitally modulated signals
  - Group delay variation on DVB channel converters
  - Phase noise of an RF carrier
- **Performance requirements at headend output for digitally modulated TV signals**
- **System performance for signals according to HDTV, DVB-S2 and 256 QAM transmission standards**



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# IEC 60728-5:2007 / EN 60728-5:2008 „Headend equipment"

## Major changes compared to EN 50083-5:2001 (cont.)

- **Introduction of new or updated Informative Annexes for subjects like**
  - Correction factors for noise
  - Digital signal level and bandwidth
  - Minimum frequency distance of converted satellite signals in the IF range
  - Measurement errors which occur due to mismatched equipment
  - Correction factor for spectrum analyser

# 4. EN 50083 and IEC/EN 60728 standards series and standardisation projects

## Step sequence of content


4.1 Introduction and overview

4.2 New standards published since 2006

**4.3 Maintenance work on existing standards of EN/IEC 60728 series**

4.4 New standardisation projects

# Maintenance work on existing EN/IEC 60728 series standards

| International Standard IEC 60728 series | European Standard EN 60728 series | Title of European Standard "Cable networks for television signals, sound signals and interactive services;" |
|---|---|---|
| **IEC 60728-3:2005** CD procedure on new edition to be started end of 2008 | **EN 60728-3:2006** | Part 3: ***"Active wideband equipment for coaxial cable networks"*** |
| **IEC 60728-6:2003** CD procedure on new edition to be started end of 2008 | **EN 60728-6:2003** | Part 6: ***"Optical equipment"*** |
| **IEC 60728-7-3:2003** CDV procedure on new edition with deadline 2009-03-27 | **EN 60728-7-3:2005** Parallel vote on new edition with deadline 2009-03-27 | Part 7-3: ***"Hybrid Fibre Coax Outside Plant Status Monitoring - Power supply to Transponder Interface Bus (PSTIB) Specification"*** |
| **IEC 60728-11:2005** CDV procedure on new edition to be started 11/2008 | **EN 60728-11:2005** Parallel vote on new edition, to be started 11/2008 | Part 11: ***"Safety"*** |

# Maintenance work on EN/IEC 60728-3 „Active wideband equipment for coaxial cable networks"

## Subjects under maintenance work (Step 1)

- **Extension of scope to active wideband equipment with symmetrical ports**
- **Frequency extension for cable network equipment from 862 MHz to 1 GHz**
- **Frequency range for SAT-IF equipment extended to 3 GHz**
- **Immunity to surge voltages**
  - Test method
  - Requirements for different kinds of equipment

**Start of commenting phase (CD procedure, 3 months)**

**end of 2008**



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# Maintenance work on EN/IEC 60728-3 „Active wideband equipment for coaxial cable networks"

## Subjects under maintenance work (Step 2)

- **Multi-channel method of measurement for non-linearity of equipment with full digital load**
  - A method of measurement using *CINR* as quality criteria is favoured
- **Complementary approach to the multi-channel methods of measurement for analogue TV signals**
  - Composite triple beat
  - Composite second order beat
  - Composite crossmodulation

**Further study needed!**

# Maintenance work on EN/IEC 60728-6 "Optical equipment"

## Subjects under maintenance work

- **Several new requirements for optical equipment resulting from the new standardization project IEC 60728-13**

  ***"Optical systems for broadcast signal transmission"***

- **i.a. minimum values for**
  - *RIN (relative intensity noise)*
  - *CSO*
  - *CTB*

  **for a given minimum modulation index**

- **Adaptation to different methods of measurement from TC 86C**

**Start of commenting phase (CD procedure, 3 months)**

**end of 2008**



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# Maintenance work on EN/IEC 60728-11 "Safety"

## Subjects under maintenance work

- **New *"Terms and definitions"***
- **Clause *"Equipotential bonding and earthing"***
- **Clause *"Protection against atmospheric over-voltages and elimination of potential differences"* on the basis of *Lightning protection standards series EN/IEC 62305***
- **Decision tree for selecting the appropriate protection measures for antenna systems on**
  - Buildings with lightning protection system
  - Buildings without lightning protection system



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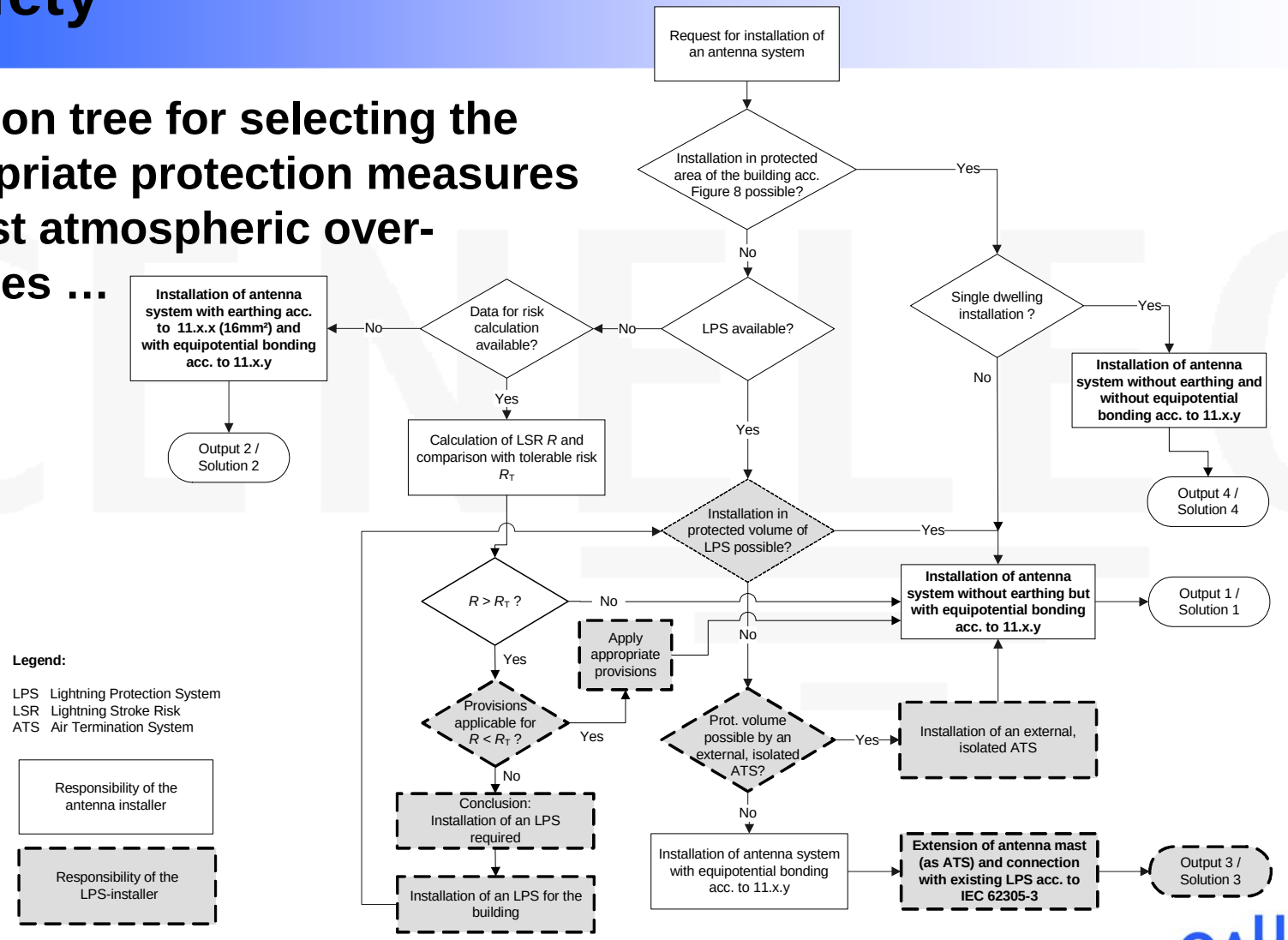
# Maintenance work on EN/IEC 60728-11 "Safety"

## Decision tree for selecting the appropriate protection measures against atmospheric over-voltages …



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# Maintenance work on EN/IEC 60728-11 "Safety"

## Subjects under maintenance work (cont.)

- **Strong separation of responsibilities in this respect between**
  - Antenna installer
  - LPS installer
- **New Informative Annex *"Earth loop impedance"***
- **New Informative Annex *"Examples of calculation of risk due to lightning"***

**Start of parallel voting in IEC and CENELEC (CDV procedure, 5 months)**

**December 2008**



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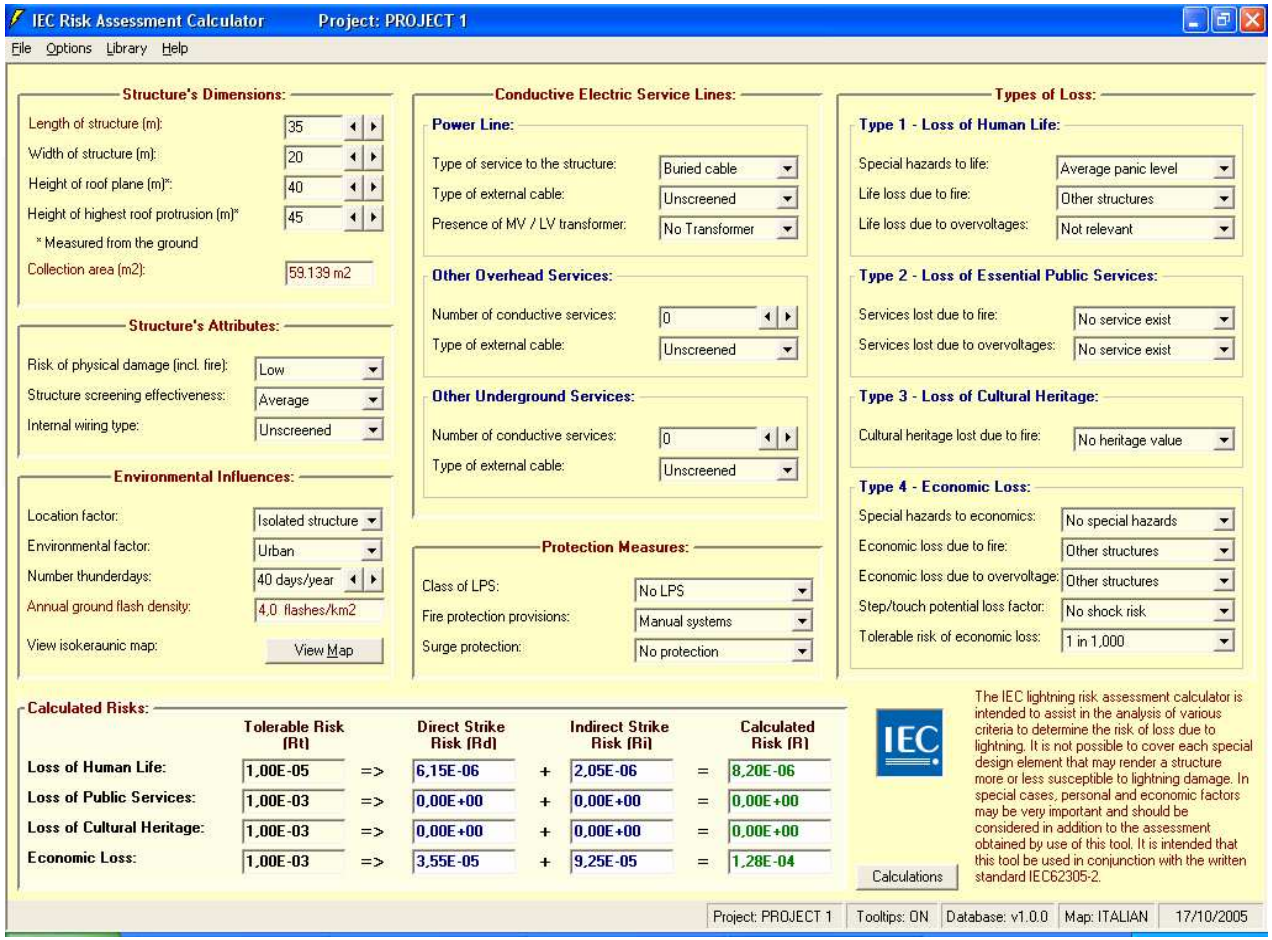
# Maintenance work on EN/IEC 60728-11 "Safety"

**Template out of EN 62305-2 for calculation of risk due to lightning**



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# 4. EN 50083 and IEC/EN 60728 standards series and standardisation projects

## Step sequence of content


4.1 Introduction and overview

4.2 New standards published since 2006

4.3 Maintenance work on existing standards of EN/IEC 60728 series

**4.4 New standardisation projects**

# New projects of CLC/TR 50083 and EN/IEC 60728 series standardisation documents

| European Standardisation Document EN 50083 series | European/International Standard EN/IEC 60728 series | Title of European Standard "Cable networks for television signals, sound signals and interactive services;" |
|---|---|---|
| --- | EN/IEC 60728-1-1 UAP/CDV procedure to be started 11/2008 | Part 1-1: ***"RF cabling for two way home networks"*** |
| --- | EN/IEC 60728-1-2 CDV procedure with deadline 2008-12-05 | Part 1-2: ***"Performance requirements for signals delivered at the system outlet in operation"*** |
| --- | EN/IEC 60728-13 UAP/CDV procedure to be started 11/2008 | Part 13: ***"Optical systems for broadcast signal transmissions"*** |
| CLC/TR 50083-5-1 Start of Formal Vote 11/2008 | --- | Technical Report, Part 5-1: ***"IP gateways and interfaces for headends"*** |
| CLC/TR 50083-10-1 Formal Vote with deadline 2008-11-21 | --- | Technical Report, Part 10-1: ***"Guidelines for the implementation of return paths in cable networks"*** |



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# New project EN/IEC 60728-1-2

**Introduction of a new part of EN/IEC 60728 standards series**
***" Performance requirements for signals delivered at the system outlet in operation "***

***Reason for this new part:***

- **EN/IEC 60728-1 describes in clause 5 the performance requirements for the CATV/MATV/SMATV cable network at the system outlet (SO) *assuming unimpaired input signals at the input of the headend***
- **This precondition was and is very often neglected or miss-interpreted by the user of EN/IEC 60728-1**

***Idea:***

- **To define the requirements at the system outlet in operation taking additionally into account the performance requirements of the signals received at the headend input**



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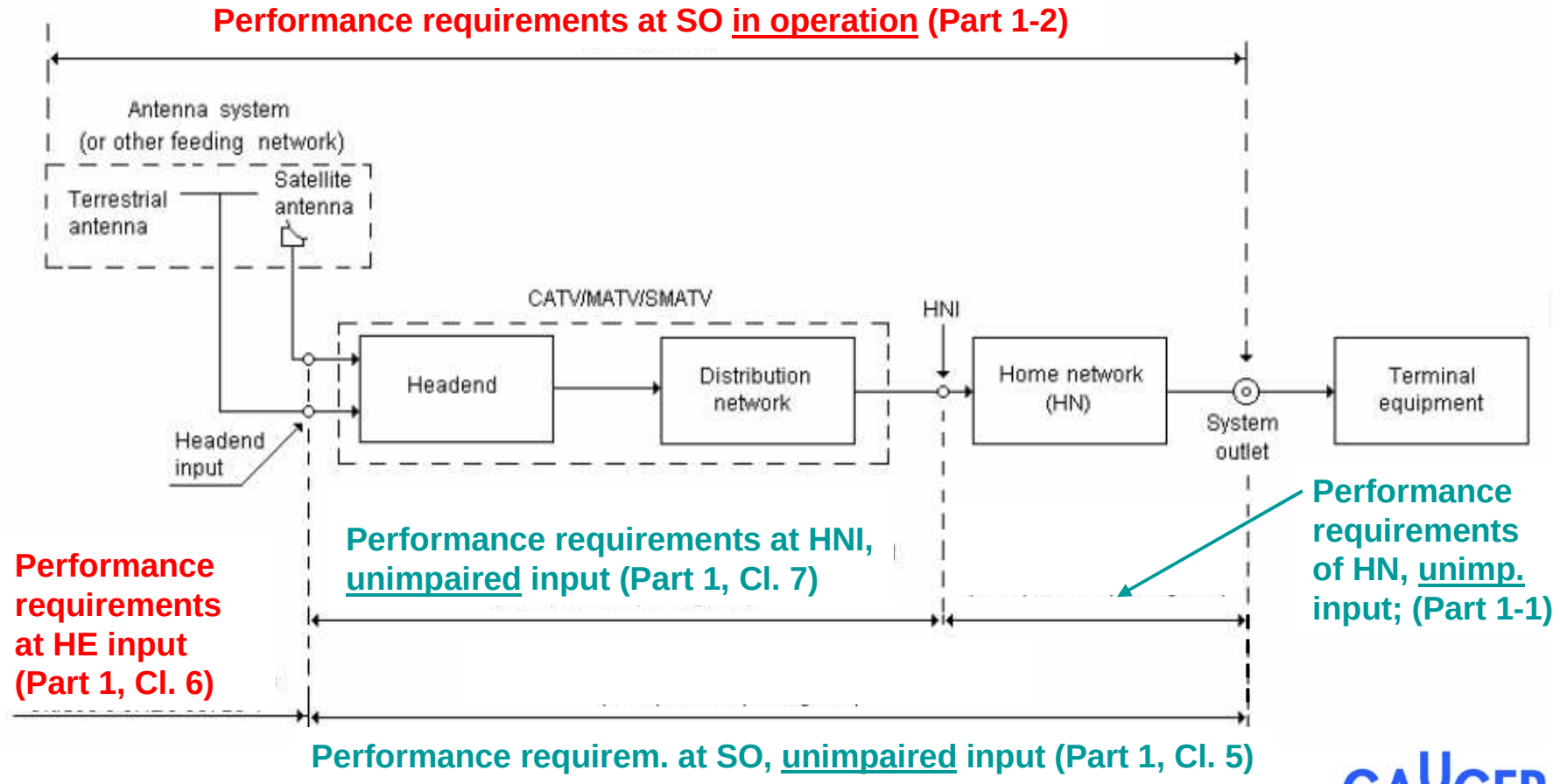
# New project EN/IEC 60728-1-2

## Definition of system performance for different parts of cable networks



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# New project EN/IEC 60728-1-2

**Introduction of a new part of EN/IEC 60728 standards series**
***" Performance requirements for signals delivered at the system outlet in operation "***

**Parallel voting in IEC and CENELEC**
**(CDV procedure, 5 month)**

**until 5 December 2008**



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# New project EN/IEC 60728-1-1

**Introduction of a new part of EN/IEC 60728 standards series**
***"RF cabling for two way home networks"***

***Reason for this new part:***

- **EN/IEC 60728-1 describes in clause 5 the performance requirements for cable networks at the system outlet (SO)**
- **EN/IEC 60728-1 describes in clause 7 the performance requirements for cable networks at the home network interface (HNI)**

  ***In both cases unimpaired input signals are assumed at the input of the headend***

- **The performance requirements of different types of home networks are missing in EN/IEC 60728-1**

# New project EN/IEC 60728-1-1

**Introduction of a new part of EN/IEC 60728 standards series**
***"RF cabling for two way home networks"***

***Idea:***

- **To define the different performance requirements parameters of the home network itself by calculating the following "differences":**

$$PR_i\,(HN) = PR_i\,(HNI) - PR_i\,(SO)$$

With:

***$PR_i$* (HN):** performance requirement i of the home network

***$PR_i$* (HNI):** performance requirement i at the home network interface

***$PR_i$* (SO):** performance requirement i at the system outlet

**NOTE: The equation is not to be seen in a mathematical sense! For each parameter the individual "combination rules" have to be applied!**



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# New project EN/IEC 60728-1-1 "RF cabling for two way home networks"

**Main system performance requirements parameters defined for home networks**

- **Carrier level differences in the home network from HNI to system outlet**
- **Frequency response within a television channel in the home network**
  - Amplitude response
  - Group delay
- **Random noise produced in the home network**
- **Interference produced into down stream channels within a home network**

**Start of parallel voting in IEC and CENELEC (CDV procedure, 5 months)**

**November 2008**



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# New project CLC/TR 50083-10-1 "Guidelines for the implementation of return paths …"

## Essentials of this Technical Report

- **Network Architecture**
  - Basic HFC architecture
  - Upgrade alternatives
  - Active or passive return path
  - In-building network
  - In-home network
- **Network Design**
- **Channel Planning**
  - ……..
  - European upstream bandwidths
  - Channel width
  - QPSK/16QAM operation and channel widths
  - Available return path spectrum
  - Channel plans



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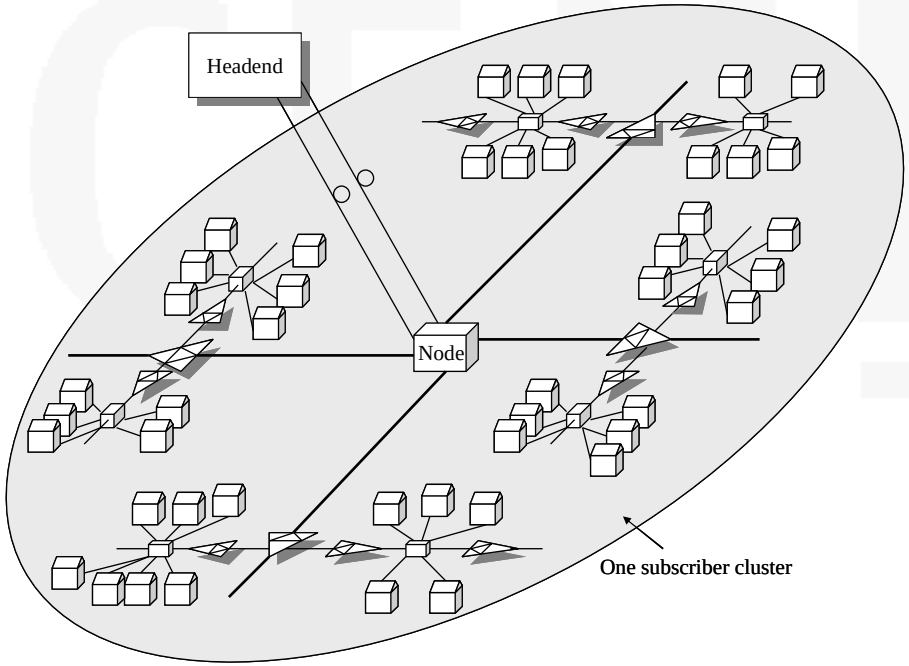
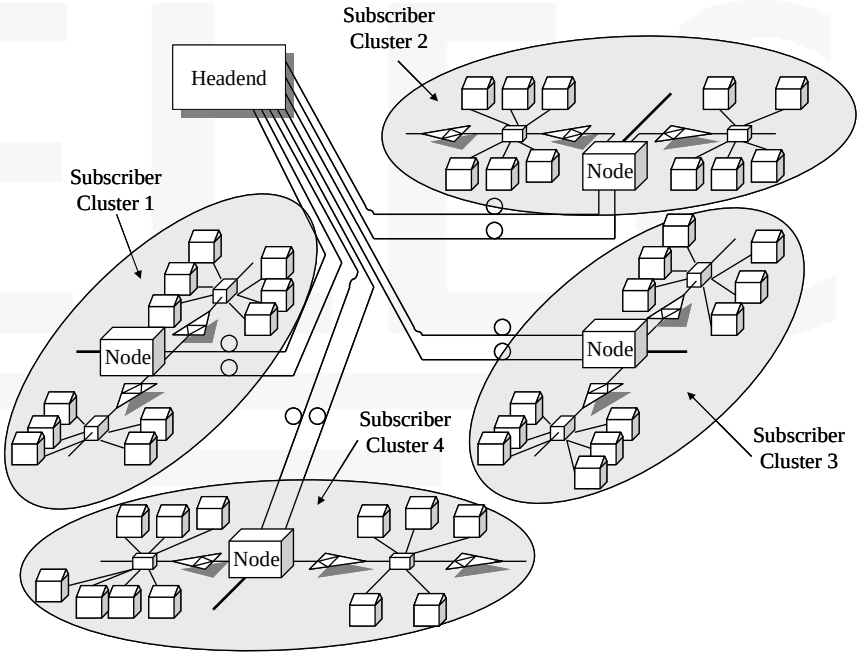
# New project CLC/TR 50083-10-1 "Guidelines for the implementation of return paths …"

## Examples of network architecture




Basic node architecture




Division of the node areas using additional fibres



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# New project CLC/TR 50083-10-1 "Guidelines for the implementation of return paths …"

## Data carriers in the gaps between broadcasting bands

| | | | Data carrier width kHz | | | | |
|---|---|---|---|---|---|---|---|
| **Non-broadcast spectrum kHz** | | | **200** | **400** | **800** | **1 600** | **3 200** |
| **From** | **To** | **Gap** | **Data carriers available** | | | | |
| 5 000 | 5 950 | 950 | 4 | 2 | 1 | 0 | 0 |
| 6 200 | 7 100 | 900 | 4 | 2 | 1 | 0 | 0 |
| 7 300 | 9 500 | 2 200 | 11 | 5 | 2 | 1 | 0 |

……..

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 21 850 | 25 670 | 3 820 | 19 | 9 | 4 | 2 | 1 |
| 26 100 | 40 000 | 13 900 | 69 | 34 | 17 | 8 | 4 |
| Total carriers | | | 154 | 74 | 35 | 15 | 6 |
| Total upstream bandwidth, kHz | | Summ of the above | 30 800 | 29 600 | 28 000 | 24 000 | 19 200 |
| Utilisation, % | | | 97 | 93 | 88 | 75 | 60 |



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# New project CLC/TR 50083-10-1 "Guidelines for the implementation of return paths …"

## Essentials of this Technical Report (Cont.)

- **Equipment for return path implementation**
- **Installation and maintenance**
- **Interference on return paths**
  - Multiple interference
  - Impulse interference
  - Interference from home terminals
  - Hum modulation
  - Common path distortion (CPD)
- **Special methods of measurements**



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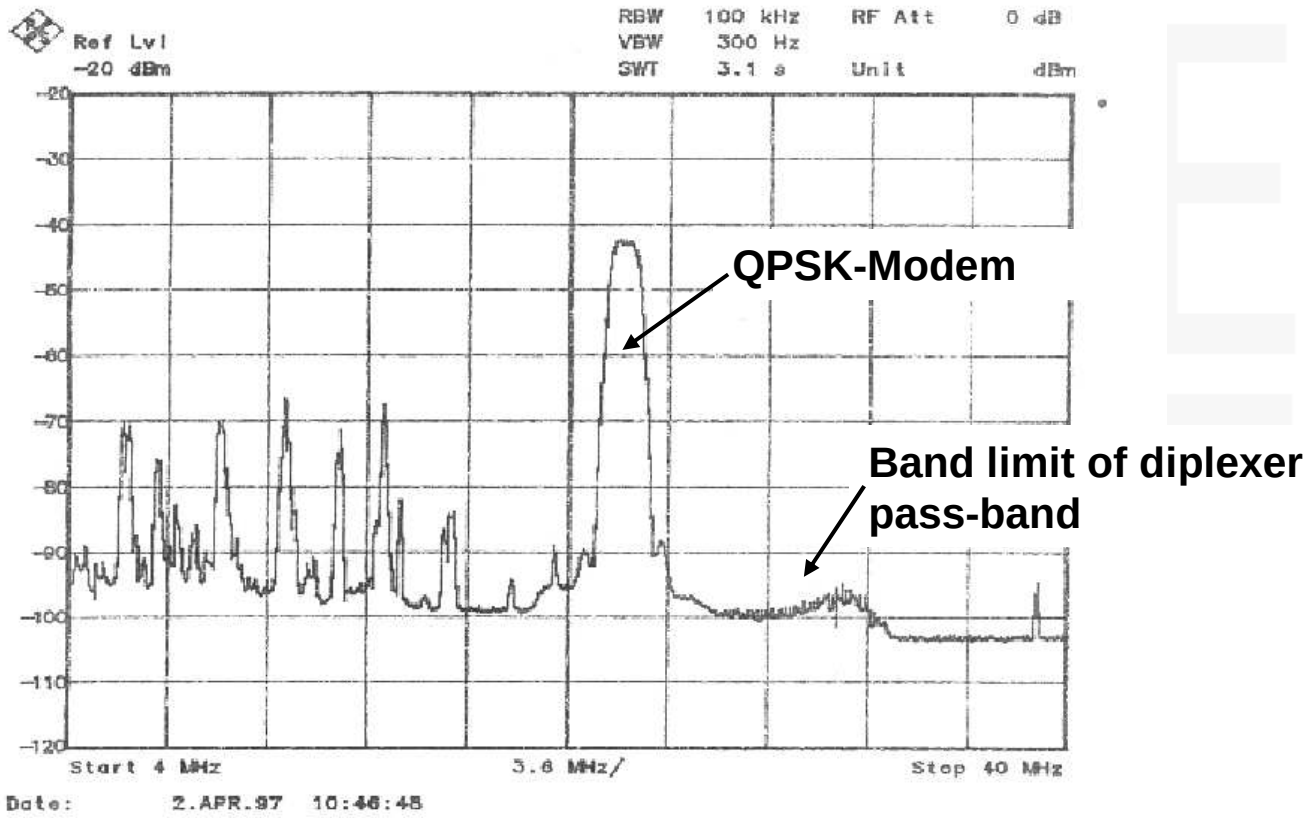
# New project CLC/TR 50083-10-1 "Guidelines for the implementation of return paths …"

## Typical spectrum of a return path



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# New project CLC/TR 50083-10-1 "Guidelines for the implementation of return paths …"

## Availability of Technical Report

**Formal voting in CENELEC**
**until 21 November 2008**



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# New project CLC/TR 50083-5-1

**Introduction of a new Technical Report on**
***" IP gateways and interfaces for headends "***

***Reason for this new document:***

- **An IPTV transmission standard is published as ETSI TS 102 034, V1.3.1, since 10/2007 with the title**

  ***"Digital Video Broadcasting (DVB);Transport of MPEG-2 TS based DVB services over IP based networks"***

- **In the meantime HFC cable networks are connected to IP based networks in various applications**

- **Headends according to EN 60728-5 are major locations where such an interconnection between both network types take place**



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# New project CLC/TR 50083-5-1 "IP gateways and interfaces for headends"

**Introduction of a new Technical Report on**
***"IP gateways and interfaces for headends"***

***Idea:***

- **To describe the characteristics of equipment which is used for the connection of IP based networks to and from headends such as described in EN 60728-5**
- **The content of the data streams can be digital video, audio or other digital data**
- **This technical report describes the necessary characteristics and parameters of equipment such as IP gateways or IP interfaces on equipment at the**
  - input of headends
  - output of headends



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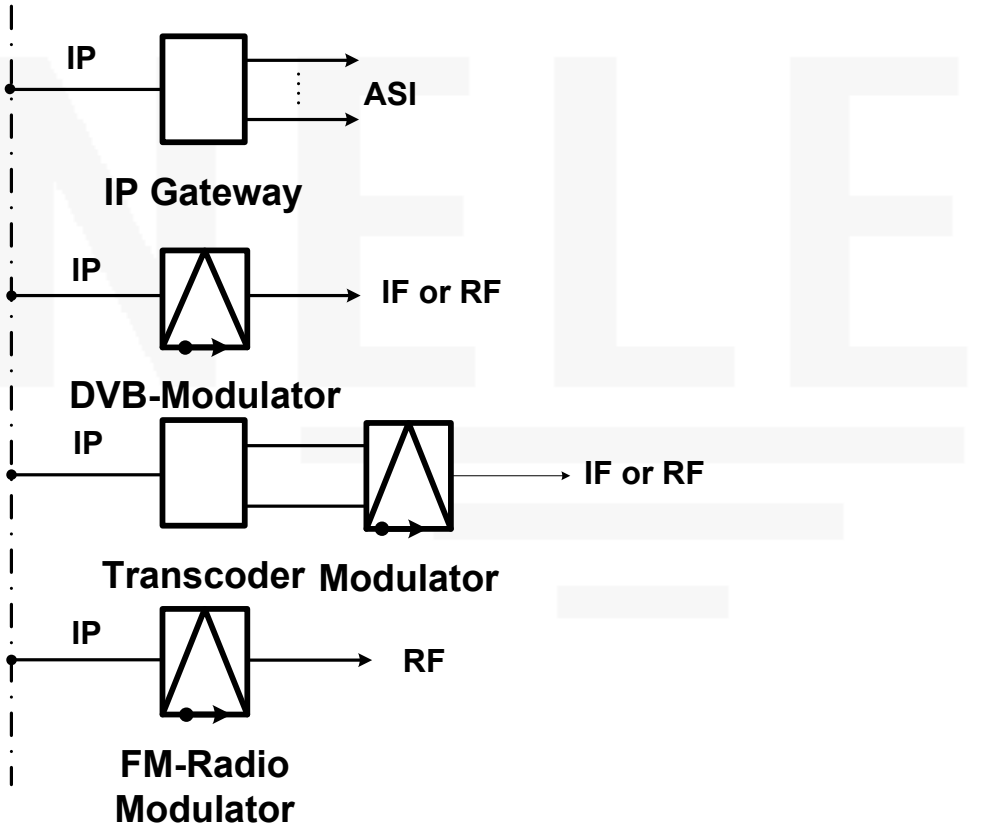
# New project CLC/TR 50083-5-1 "IP gateways and interfaces for headends"

## Examples of IP gateways/interfaces at the input of headends



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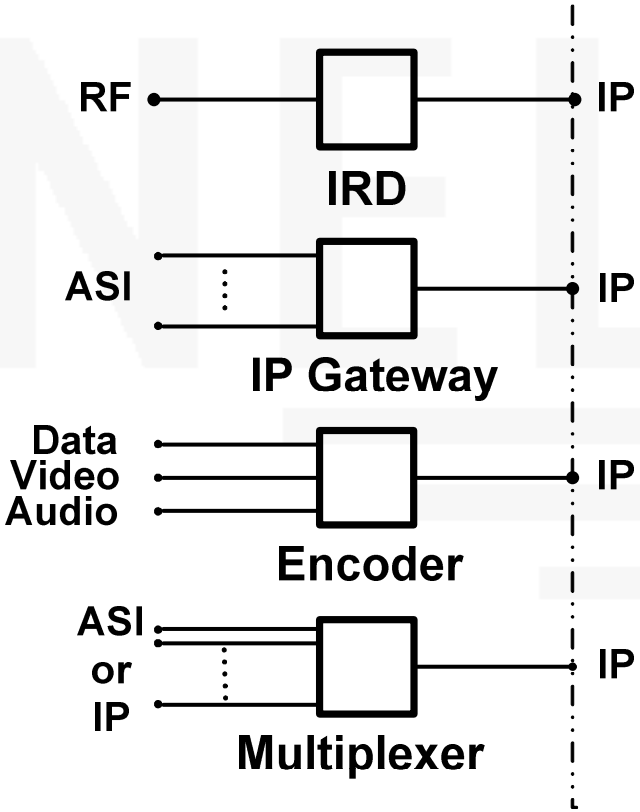
# New project CLC/TR 50083-5-1 "IP gateways and interfaces for headends"

## Examples of IP gateways/interfaces at the output of headends



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# New project CLC/TR 50083-5-1 "IP gateways and interfaces for headends"

## Essentials of this Technical Report

- **Application of IP transmission in cable networks**
  - Transmission from central headends to sub-headends
  - Transmission via sub-headends into regional and local networks
- **MPEG transport streams**
  - Programme specific information tables (PSI) and service information tables (SI)
  - Programme clock reference
  - Constant bit rate (CBR) vs. variable bit rate (VBR)
- **Encapsulation of MPEG-2 transport streams**
  - Principles of encapsulation
  - Payload data rate
  - The Ethernet interface according to ISO/IEC 8802-3
  - Internet protocols



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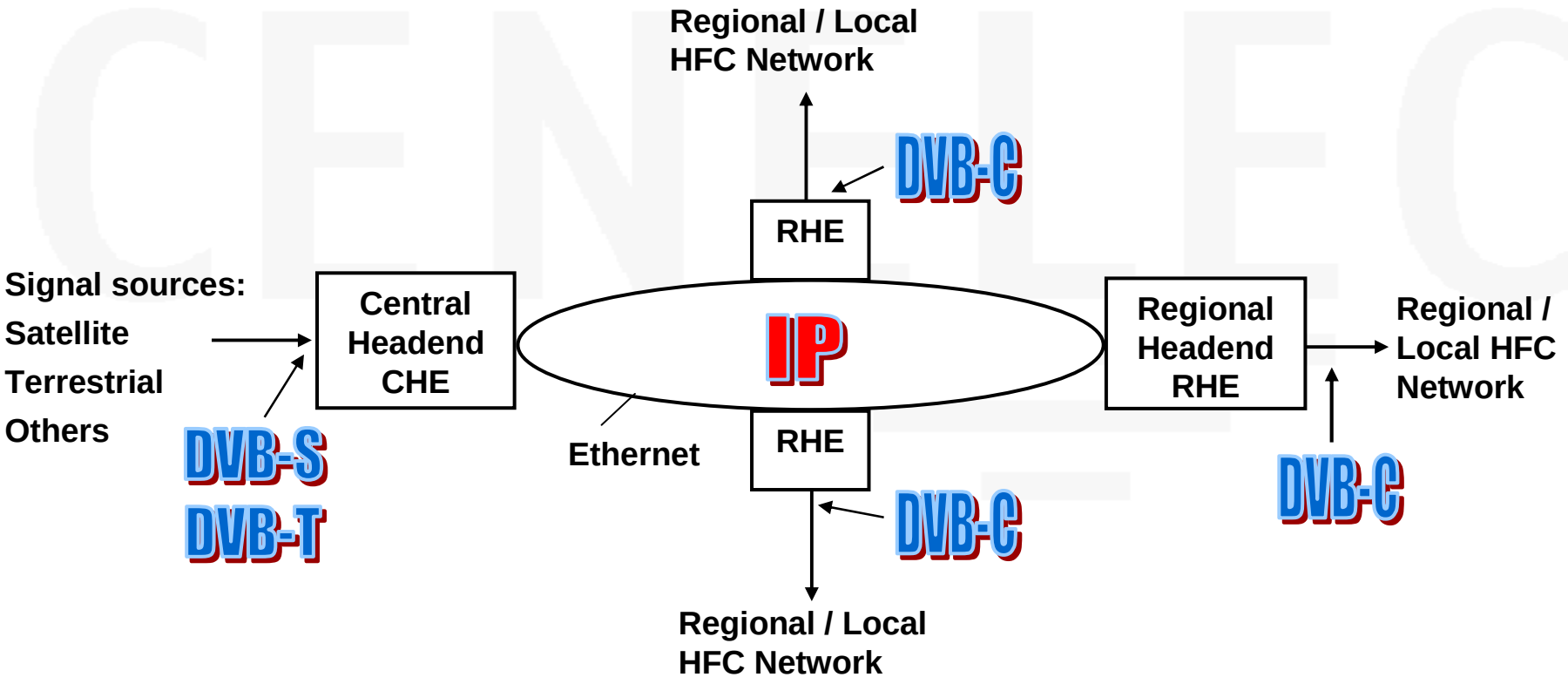
# New project CLC/TR 50083-5-1 "IP gateways and interfaces for headends"

## Example for the interaction of HFC networks and IP based networks



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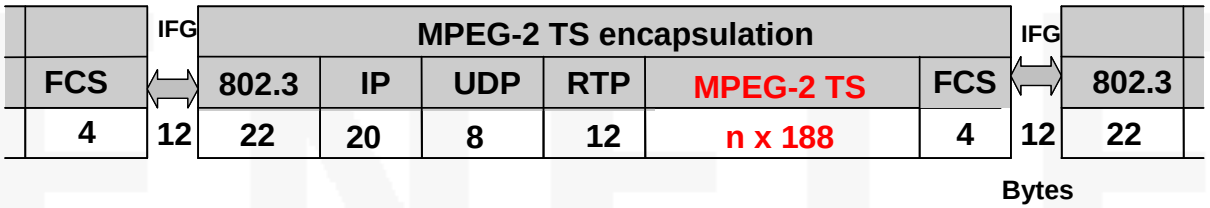
# New project CLC/TR 50083-5-1 "IP gateways and interfaces for headends"

## Encapsulation of n MPEG-2 transport stream packets in an IP frame




**802.3:** Basic MAC Frame Format according to IEEE 802.3

**IP:** Internet Protocol Header (Routing)

**UDP:** User Datagram Protocol Header (connectionless)

**RTP:** Real-Time Transport Protocol (Detection of packet loss and sequence errors)

**FCS:** Frame Check Sequence according to IEEE 802.3

**IFG:** Inter-Frame Gap, 96 bit, 12 bytes



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# New project CLC/TR 50083-5-1 "IP gateways and interfaces for headends"

## Availability of Technical Report CLC/TR 50083-1

**Formal voting in CENELEC**
**will start in November 2008**



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# New project EN/IEC 60728-13 "Optical systems for broadcast signal transmissions"

**Report on this standardization project will be given in the paper**

***"General activities in the optical cable network environment"***

**by**

**Dr. Juergen Seidenberg**



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# 5. Updated standards for coaxial cables and coaxial cable assemblies

## Step sequence of content

5.1 **European standards series EN 50117 – "Coaxial cables used in cabled distribution networks"**

5.2 Radio frequency and coaxial cable assemblies

# European standards series EN 50117 – "Coaxial cables … used in cabled distribution networks"

## Overview on published and updated standards

| | | |
|---|---|---|
| EN 50117-1:2002 + A1:2006 | Generic specification | |
| EN 50117-2-1:2005 + A1:2008 | Indoor drop cables | 5 MHz - 1000 MHz |
| EN 50117-2-2:2004 + A1:2008 | Outdoor drop cables | 5 MHz - 1000 MHz |
| EN 50117-2-3:2004 + A1:2008 | Distribution and trunk cables | 5 MHz - 1000 MHz |
| EN 50117-2-4:2004 + A1:2008 | Indoor drop cables | 5 MHz - 3000 MHz |
| EN 50117-2-5:2004 + A1:2008 | Outdoor drop cables | 5 MHz - 3000 MHz |



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# European standards series EN 50117 – "Coaxial cables … used in cabled distribution networks"

## Extensions to EN 50117-2-x standards series by Amendments "A1:2008"

- Introduction of screening class "A+" for installation cables

- Introduction of screening class "C" for installation cables

- Presentation of typical parameters for different cable sizes



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# European standards series EN 50117 – "Coaxial cables … used in cabled distribution networks"

## Overview on screening classes defined in EN 50117 standards series

| Standard | Application/ Frequency range | Screening classes | | | | |
|---|---|---|---|---|---|---|
| | | A++ | A+ | A | B | C |
| EN 50117-2-1:2005 +A1:2008 | Installation, indoor 5 - 1000 MHz | --- | X | X | X | X |
| EN 50117-2-2:2004 +A1:2008 | Installation, outdoor 5 - 1000 MHz | --- | X | X | X | X |
| EN 50117-2-4:2004 +A1:2008 | Installation, indoor 5 - 3000 MHz | --- | X | X | X | X |
| EN 50117-2-5:2004 +A1:2008 | Installation, outdoor 5 - 3000 MHz | --- | X | X | X | X |
| EN 50117-2-3:2004 +A1:2008 | Distr. and line networks 5 - 1000 MHz | X | X | --- | --- | --- |



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# European standards series EN 50117 – "Coaxial cables … used in cabled distribution networks"

## Transfer impedance and screening attenuation over frequency and for the different screening classes

| | Transfer impedance [mΩ/m] and Screening attenuation [dB] for Frequency ranges | | | |
|---|---|---|---|---|
| Screening class | 5 - 30 MHz | 30 - 1000 MHz | 1 GHz - 2 GHz | 2 GHz - 3 GHz |
| A | ≤ 5 mΩ/m | ≥ 85 dB | ≥ 75 dB | ≥ 65 dB |
| A+ | ≤ 2,5 mΩ/m | ≥ 95 dB | ≥ 85 dB | ≥ 75 dB |
| A++ | ≤ 0,9 mΩ/m | ≥ 105 dB | (≥ 95 dB) 1) | (≥ 85 dB) 1) |
| B | ≤ 15 mΩ/m | ≥ 75 dB | ≥ 65 dB | ≥ 55 dB |
| C | ≤ 50 mΩ/m | ≥ 75 dB | ≥ 65 dB | ≥ 55 dB |

1) Not defined in standard



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# 5. Updated standards for coaxial cables and coaxial cable assemblies

## Step sequence of content

5.1 European standards series EN 50117 – “Coaxial cables used in cabled distribution networks”

**5.2 Radio frequency and coaxial cable assemblies**

# European standards series EN 60966 – "Radio frequency and coaxial cable assemblies"

## Overview

EN 60966-1:1999 General requirements and test methods

EN 60966-2-1:2003 Sectional specification for flexible coaxial cable assemblies

**EN 60966-2-4:2003 Detail specification for cable assemblies for radio and TV receivers – Frequency range 0 to 3 000 MHz, IEC 61169-2 connectors**

**EN 60966-2-5:2003 Detail specification for cable assemblies for radio and TV receivers – Frequency range 0 to 1 000 MHz, IEC 61169-2 connectors**

**EN 60966-2-6:2003 Detail specification for cable assemblies for radio and TV receivers – Frequency range 0 to 3 000 MHz, IEC 61169-24 connectors (F-connectors)**



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# European standards series EN 60966 – "Radio frequency and coaxial cable assemblies"

## New editions of IEC/EN 60966-2-x standards

- **New editions are under final voting procedures until 2008-12-05**
- **These new versions cover the same EMC requirements and methods of measurements as described in EN 50117 standards series**
- **For coaxial cable assemblies two screening classes are defined**
  - Class A
  - Class B



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# Actual standardization activities for coaxial cable networks

## Step sequence of content

1. Introduction notes
2. System of European standardization for cable networks
3. Second generation of digital transmission standards and specifications
4. EN 50083 and IEC/EN 60728 standards series and standardization projects
5. Updated standards for coaxial cables and coaxial cable assemblies
6. EMC standards for wire-line telecommunication networks

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# EMC standard for wire-line telecommunication networks

- **Since 2001 a joint working group of CENELEC and ETSI deals with the preparation of a European Standard on *"EMC for wire-line telecom-munication networks"***
- **This work is based on Mandate M/313 received from the European Commission**
- **In early 2006 the work was interrupted due to problems in finding a unique solution for different kinds of telecommunication networks**
- **In 10/2007 re-start of work**
- **Decision to develop three EMC network standards for**
  - "Telephone wires" (twisted-pair technology)
  - "Coaxial cables"
  - "Power lines"
- **Standards will be "umbrella standards" only referencing to existing EMC equipment standards published in the OJ under the EMC Directive**



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# Preparation of a first draft standard for "Coaxial Cable Networks" by CLC/TC209

## Structure of draft standard

1. **Scope**
2. **Normative references**
3. **Terms and definitions and abbreviations**
4. **EMC requirements for networks using coaxial cables**
   - 4.1 Introduction
   - 4.2 Equipment for coaxial cable networks
   - 4.3 Coaxial cables used in coaxial cable networks
   - 4.4 Coaxial cable assemblies used in coaxial cable networks

**Annex A Example of good engineering practice**

**Annex ZZ Coverage of Essential Requirements of EC Directives**

**Bibliography**



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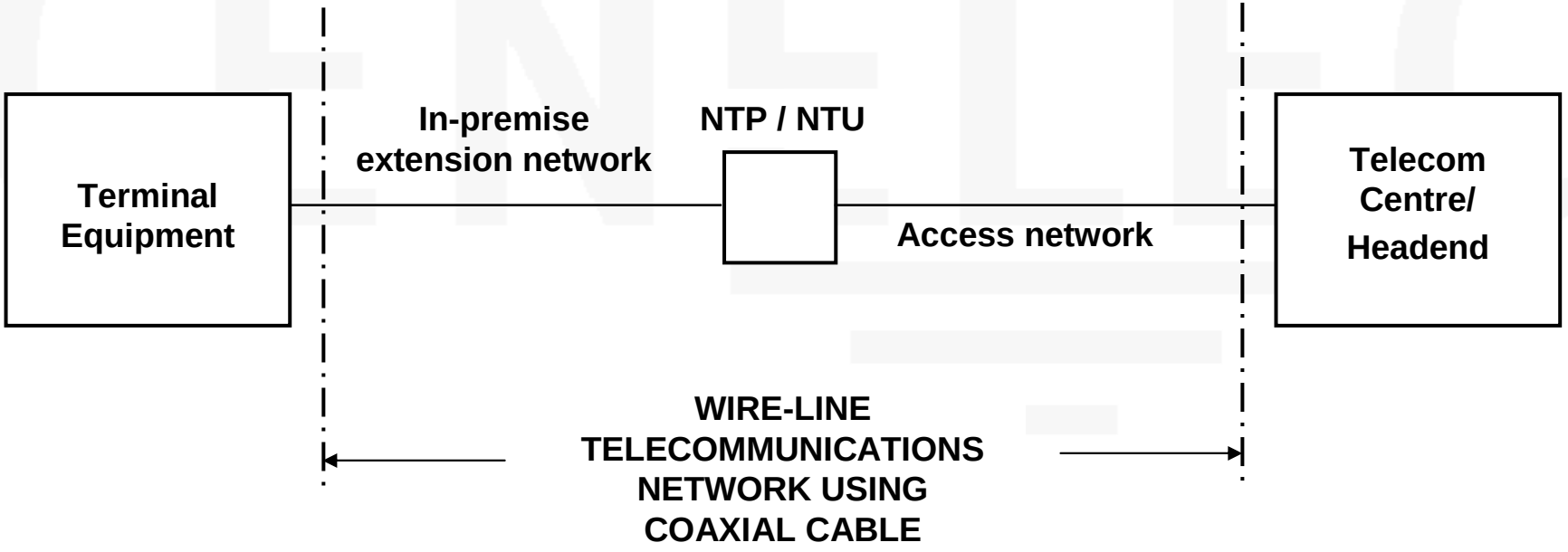
# Preparation of a first draft standard for "Coaxial Cable Networks" by CLC/TC209

## Alignment of definitions to wire-line telecommunication networks using coxial cables



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# Preparation of a first draft standard for "Coaxial Cable Networks" by CLC/TC209

**Presumption of conformity with EMC network standard if:**

- Terminal equipment [1] connected to the network meet the EMC requirements defined in the applicable EMC product standards;
- Headend [2] / Telecommunication centre equipment [3] meet the EMC requirements defined in the applicable EMC product standards;
- Equipment comprising the network meet EMC product standards acc. to Table 1

[1] For EMC requirements of terminal equipment see EN 55013 and EN 55020

[2] For EMC requirements of headend equipment see EN 50083-2

[3] For EMC requirements of Telecom Centre equipment see ETSI EN 300 386, EN 55022 and EN 55024

# Preparation of a first draft standard for "Coaxial Cable Networks" by CLC/TC209

## Harmonised EMC standards for coaxial cable network equipment (Table 1)

| Standards No. | Last publication year | Title |
|---|---|---|
| EN 50083-2 | 2006 | Cable networks for television signals, sound signals and interactive services -- Part 2: Electromagnetic compatibility for equipment |
| ETSI EN 300 386 | V1.3.3 2005 | Electromagnetic compatibility and Radio spectrum Matters (ERM);Telecommunication network equipment; ElectroMagnetic Compatibility (EMC) requirements |
| EN 55022 + A1 | 2006 2007 | Information technology equipment – Radio disturbance characteristics – Limits and methods of measurement (CISPR 22, mod.) |
| EN 55024 +A1 +A2 | 1998 2001 2003 | Information technology equipment - Immunity characteristics - Limits and methods of measurement (CISPR 24, mod.) |



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# Preparation of a first draft standard for "Coaxial Cable Networks" by CLC/TC209

**Presumption of conformity with EMC network standard if *also*:**

- Coaxial cables used in the network meet the *EMC requirements* defined in EN 50117 standards series
- Coaxial cable assemblies by which TE is connected to the network meet the *EMC requirements* defined in EN 60966 standards series

**The EMC requirements for coaxial cables and coaxial cable assemblies are defined by:**

- Transfer impedance in the frequency range 5 MHz to 30 MHz
- Screening attenuation in the frequency range 30 MHz to 1 000 MHz or 30 MHz to 3 000 MHz



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# Preparation of a first draft standard for "Coaxial Cable Networks" by CLC/TC209

## Why coaxial cables and c.c. assemblies in the normative part ?

- EMC performances of coaxial cables and c.c. assemblies have essential influence on EMC performance of the complete network;
- EMC problems in telecommunication networks very often occur from coaxial cables and c.c. assemblies of poor quality;
- In in-house and in-premise-extension networks nearly all EMC problems are caused by coaxial cables and c.c. assemblies;
- Coaxial cables and c.c. assemblies in the informative annex could imply minor importance of these components.



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# Preparation of a first draft standard for "Coaxial Cable Networks" by CLC/TC209

## Why coaxial cables and c.c. assemblies in the normative part ? (2)

- EMC performance requirements of coaxial cables and c.c. assemblies were defined in co-operation between CLC/SC46XA and CLC/TC209
- The initiative for the incorporation of EMC performance requirements came from the system approach for cable networks, performed by CLC/TC209
- We are happy to have the EN 50117 standards – we shall use them in the best way!



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# Actual model for preparing three EMC network standards

**EN 50471 series**
**EMC standards for wire-line telecommunication networks**

| EN 50471-1 | EN 50471-2 | EN 50471-3 |
|---|---|---|
| Part 1: Wire-line telecommunication networks using telephone wires | Part 2: Wire-line telecommunication networks using coaxial cables | Part 3: Wire-line telecommunication networks using power lines |

- **Harmonised standards**, mandated by M/313
- Published in the OJ with reference to EMC Directive
- Used for declaration of conformity of networks acc. to EMC directive



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# Positioning of existing EMC-network standard EN 50083-8

**EN 50471 series**
**EMC standards for wire-line telecommunication networks**

**EN 50471-1**

**Part 1: Wire-line telecommunication networks using telephone wires**

**EN 50471-2**

**Part 2: Wire-line telecommunication networks using coaxial cables**

**EN 50471-3**

**Part 3: Wire-line telecommunication networks using power lines**

**EN 50083-8**
**„Cable networks for tele-vision signals, sound signals and interactive services; Part 8 – Electromagnetic compatibility for networks“**



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# Positioning of existing EMC-network standard EN 50083-8

**EN 50471-2**

**Part 2: Wire-line telecommunication networks using coaxial cables**

**EN 50083-8**
**„Cable networks for tele-vision signals, sound signals and interactive services; Part 8 – Electromagnetic compatibility for networks“**

- **Voluntary (?) standard**, for a sub-group of networks using coaxial cables
- Not published in the OJ but defining „state-of-the-art“
- To be used for EMC measurements in cable networks
- Limit values for radiation and immunity aligned with EN 50083-2 and with EMC requirements of coaxial cable standards series EN 50117



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# Actual status of JWG “EMC” work on EMC-network standards

- 2nd draft was introduced to 21st meeting of JWG „EMC“ end of September 2008 by representatives of UPC Netherlands
- No acceptance of this draft within CLC/TC209 due to handling coaxial cables and c.c. assemblies only in the informative part („Good engineering practice“)
- Importance of coaxial cables is neglected by UPC people
- The current draft will go within short notice to parallel commenting phases in CENELEC and ETSI
- Decision on further proceeding will depend on the decisions of National Committees and ETSI members
- We from CLC/TC209 will wait and see!



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# Thank you for your attention!