

**Terminals' access to Public Telecommunications Networks;
Application of the Directive 1999/5/EC (R&TTE), article 4.2;
Guidelines for the publication of interface specifications;
Part 4: Broadband multimedia cable network interfaces**



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Foreword

This ETSI Guide (EG) has been produced by ETSI Technical Committee Access and Terminals (AT).

The present document is part 4 of a multi-part deliverable covering Terminals' access to Public Telecommunications Networks; Application of the Directive 1999/5/EC (R&TTE), article 4.2; Guidelines for the publication of interface specifications, as identified below:

- Part 1: "General and common aspects";
- Part 2: "Analogue narrow-band wireline interfaces";
- Part 3: "Digital wireline interfaces";
- Part 4: "Broadband multimedia cable network interfaces".**

Introduction

The Radio Equipment and Telecommunications Terminal Equipment (R&TTE) Directive 1999/5/EC [1] introduced a fundamental change in the area of terminal equipment interworking with public telecommunications networks. Formerly there were specifications that applied to terminal equipment ensuring, to varying degrees of confidence, interworking with and via different networks.

As a consequence of the R&TTE Directive an obligation is placed on Public Network Operators (PNO) to publish specifications of network interfaces they provide to the end user, whatever is the connection of the end user with the PNO, direct or indirect. Consequently Public Service Providers (PSPs) such as Internet Service Providers (ISPs) should also publish their interface specifications.

Article 4.2 of the Directive states:

"...Member States shall ensure that such operators [operators of Public Telecommunications Networks] publish accurate and adequate technical specifications of such interfaces before services provided through those interfaces are made publicly available, and regularly publish any updated specifications. The specifications shall be in sufficient detail to permit the design of telecommunications terminal equipment capable of utilizing all services provided through the corresponding interface. The specifications shall include, inter alia, all the information necessary to allow manufacturers to carry out, at their choice, the relevant tests for the essential requirements applicable to the telecommunications terminal equipment. Member States shall ensure that those specifications are made readily available by the operators".

However, it is generally recognized that PNOs can only publish information under their direct control or that which has been disclosed to them and for which they have been given the rights to publish.

The present document provides guidance on the content of such publications for the area of broadband cable multimedia access to the public telecommunications network in order to meet this requirement. Documents for a similar purpose have been produced by ETSI covering the publication of other type of interfaces.

The present document studies aspects related with a technology and systems under development, therefore may need further earlier revisions to align with the knowledge acquired during the running standardization process.

The present document belongs to a multipart document where the parts have a common component of the title:

Terminals' access to Public Telecommunications Networks;

Application of the Directive 1999/5/EC (R&TTE), article 4.2;

Guidelines for the publication of interface specifications

Later new parts may be created and this will be reflected in the present document.

The present document was produced in the context of the integration of all ETSI deliverables published with the aim of facilitating the application of the R&TTE Directive, article 4.2, in a single consistent set of documents. It is also an update of the contents of:

ETSI TR 101 857: "Access and Terminals (AT); Broadband access to the Public Telecommunications Network; Publication of interface specification under Directive 1999/5/EC, art. 4.2; Guidelines for describing Multimedia Cable Network Interfaces".

NOTE: A more complete introductory text is offered in EG 201 730-1 [4].

1 Scope

The purpose of the present document is to assist the Public Network Operators and Public Service Providers sharing the Telecommunications physical support with Broadcast systems based on cable technologies in producing publications that describe their public interfaces in accordance with article 4.2 of the Radio Equipment and Telecommunications Terminal Equipment (R&TTE) Directive 1999/5/EC [1].

The present document lists in special the characteristics of a broadband cable multimedia interface to the Public Telecommunications Network which could be necessary for a description of that interface but does not give guidance on the style of presentation of interface publications. The present document makes also reference to the most relevant ETSI deliverables in the case where the network interface offered uses other technologies.

The present document is applicable to interface specifications for new, modified and existing interfaces.

NOTE: General aspects of the guidance on producing interface publications according to Article 4.2 of Directive 1999/5/EC [1] are offered on part 1 of the present set of documents. The present document gives technology specific guidance. Technology specific guidance for the most common technologies is offered in other parts of the present set of documents.

The present document does not specify how any proprietary interfaces details, which are not already in the public domain, are published.

The present document does not specify which interfaces should be published, neither does it address the timing of publication, as these functions are clearly the responsibility of the National Regulatory Authorities. The process of publication is not covered in the present document.

2 References

The following documents contain provisions which, through reference in this text, constitute provisions of the present document.

- References are either specific (identified by date of publication and/or edition number or version number) or non-specific.
- For a specific reference, subsequent revisions do not apply.
- For a non-specific reference, the latest version applies.

Referenced documents which are not found to be publicly available in the expected location might be found at <http://docbox.etsi.org/Reference>.

- [1] Directive 1999/5/EC of the European Parliament and of the Council of 9 March 1999 on radio equipment and telecommunications terminal equipment and the mutual recognition of their conformity.
- [2] ITU-T Recommendation X.200 / ISO/IEC 7498-1: "Information technology - Open Systems Interconnection - Basic Reference Model: The basic model".
- [3] IETF RFC 826: "Ethernet Address Resolution Protocol: Or converting network protocol addresses to 48.bit Ethernet address for transmission on Ethernet hardware".
- [4] ETSI EG 201 730-1: "Terminals' access to Public Telecommunications Networks; Application of the Directive 1999/5/EC (R&TTE), article 4.2; Guidelines for the publication of interface specifications; Part 1: General and common aspects".

3 Definitions and abbreviations

3.1 Definitions

For the purposes of the present document, the terms and definitions given in EG 201 730-1 [4] and the following apply:

Cable Modem Termination System (CMTS): located at the cable television system headend or distribution hub, which provides complementary functionality to the cable modems to enable data connectivity to wide-area network services

Cable Modem Termination System - Network Side Interface (CMTS-NSI): interface, between a CMTS and the equipment on the access network side

direct access: access for TE to services provided by a PNO or PSP exclusively via the infrastructure of that PNO or PSP

Distribution Hub: location in a cable television network which performs the functions of a Headend for customers in its immediate area, and which receives some or all of its television program material from a Master Headend in the same metropolitan or regional area

headend: central location on the cable network that is responsible for injecting broadcast video and other signals in the downstream direction

NOTE: See also Master Headend, Distribution Hub.

indirect access: access for TE to services provided by a PNO or PSP via the infrastructure of another PNO or PSP

master headend: headend which collects television program material from various sources by satellite, microwave, fibre and other means, and distributes this material to Distribution Hubs in the same metropolitan or regional area

NOTE: A Master Headend may also perform the functions of a Distribution Hub for customers in its own immediate area.

Network Equipment (NE): equipment forming the Public Operator's Network up to and including NTP, relevant for the provision of Telecommunications services

Open Systems Interconnection (OSI): framework of ISO standards for communication between different systems made by different vendors, in which the communications process is organized into seven different categories that are placed in a layered sequence based on their relationship to the user

NOTE: Each layer uses the layer immediately below it and provides a service to the layer above. Layers 7 through 4 deal with end-to-end communication between the message source and destination, and layers 3 through 1 deal with network functions.

Public Telecommunications Network (PTN): Telecommunications Network used to provide publicly available Telecommunications Services

Radio Frequency (RF): in cable television systems, this refers to electromagnetic signals in the range 5 MHz to 1 000 MHz

Telecommunication Terminal Equipment (TE): according to R&TTE-D [1], article 2.b:

"a product enabling communication or a relevant component thereof which is intended to be connected directly or indirectly by any means whatsoever to interfaces of public telecommunications networks (that is to say, telecommunications networks used wholly or partly for the provision of publicly available telecommunications services)"

3.2 Abbreviations

For the purposes of the present document, the abbreviations given in EG 201 730-1 [4] and the following apply:

BER	Bit Error Rate
CM	Cable Modem
CMTS	CM Termination System
CPE	Customer Premises Equipment

NOTE: Equivalent to TE.

DOCSIS	Data Over Cable Systems
HFC	Hybrid Fibre Coaxial cable
IGMP	Internet Group Management Protocol

NOTE: Network-layer protocol for managing multicast groups on the Internet.

IP	Internet Protocol
----	-------------------

NOTE: Internet network-layer protocol.

ISO	International Organization for Standardization
LLC	Logical Link Control
MAC	Media Access Control
NDIS	Network Driver Interface Specification
NE	Network Equipment
NIC	Network Interface Card
NSI	Network Side Interface
NTP	Network Termination Point
OSI	Open Systems Interconnection
PHY	PHYSical

NOTE: Layer.

PMD	Physical Media Dependent
-----	--------------------------

NOTE: Sublayer.

PNO	Public Network Operators
PSP	Public Service Providers
PTN	Public Telecommunications Network
QoS	Quality of Service
RF	Radio Frequency
STB	Set Top Box
VoIP	Voice over Internet Protocol

4 Position of the interface

A more complete analysis on the possible scenarios and configuration of the user access to the Public Network is presented in the clause 7 of EG 201 730-1 [4] and should be easily applicable to this type of communications systems. In this clause only most common configurations used for access systems in the scope of EG 201 730-1 [4] are cited.

The parameters described in the present document are applicable to various categories of CM and STB equipment.

In application of the clause 6.2.1 and particularly of the figure 3 of EG 201 730-1 [4], the table 1 describes two scenarios for CM/STB interface connection arrangement identifying the location of the NTP and user interfaces.

Table 1: Position of the NTP

Scenario	Who Publishes	Comments
<p>Scenario 1. See clause 5.1</p> <p>The diagram shows a box labeled 'CMTS' on the 'Cable Network Side' connected to a box labeled 'CM/STB' on the 'User Side'. The connection is labeled 'PNO' and 'HFC(RF)'. A vertical dotted line represents the Network Termination Point (NTP), which is positioned at the interface between the CMTS and the CM/STB.</p>	The Cable Network Operator publishes specification for the RF interface between the CM/STB and the CMTS.	Details of the RF interface description are given in clause A.7.2. CM/STB is a TE according the R&TTE Directive and therefore in the scope of this Directive
<p>Scenario 2. See clause 5.2</p> <p>The diagram shows a box labeled 'CMTS' on the 'Cable Network Side' connected to a box labeled 'CM/STB' on the 'User Side'. The connection is labeled 'PNO' and 'HFC(RF)'. A vertical dotted line represents the Network Termination Point (NTP), which is positioned at the interface between the CM/STB and a box labeled 'CPE/TE'.</p>	The Cable Network Operator publishes specifications relating to the interfaces between the CM/STB for connection to CPE/TE.	CM/STB is not a TE according the R&TTE Directive and therefore not in the scope of this Directive.

NOTE: A PNO offering or supporting both scenarios is requested to fulfil the conditions associated with each of them.

For both scenarios the specification of the interface at the NTP has to be published in accordance with article 4.2 of Directive R&TTE-Directive [1].

There may be further scenarios that have not been considered in the present document.

5 Parameters to be specified

The present clause gives guidance on how a Broadband Multimedia Cable interface specification might be produced.

The parameters included in this clause facilitate a description in some more detail of some items covered by the presentation style suggested in the annex A of EG 201 730-1 [4] which is provided for illustrative purposes only. Some aspects like safety or EMC aspects are generic, covered by EG 201 730-1 [4] and therefore not covered in the present document. Additional aspects may be needed, but the present guidance should provide enough support for a reasonable interface description in the context of the scope.

The technology and systems under study are in a development process. This can determine important deviations from the suggestions below and is likely to justify earlier revisions of the present document.

Annex A offers an overview of the most common standards covering the large majority of interfaces treated in the scope of the present document.

5.1 Cable Modem-Network (RF) interface characteristics to be specified

This clause studies parameters particularly relevant in scenario 1 of table 1.

There are different Telecommunications technologies sharing the physical support in the local Network ("last mile") with Broadcast technologies. This clause should be a support for all of them and does not intend to create a privilege situation to any of those technologies.

5.1.1 Physical characteristics

5.1.1.1 Network Termination Point (NTP)

NTP covered by the this clause should be identified.

5.1.1.2 Connection method

The mechanical characteristics of the network connection point should be described in sufficient detail as to allow a terminal manufacturer to design or select connectors or adapters capable of reliably connecting the terminal at the NTP.

5.1.1.3 Connection arrangements

Full details of connection arrangements used at the NTP and characteristics of all relevant cable types should be provided.

5.1.1.4 Sizing constraints/dimensioning the installation

Any characteristic that may limit the number of terminals that can be connected to the PTN interface should be specified.

5.1.2 Electrical or optical characteristics

5.1.2.1 Power feed conditions

Where power is or may be provided over the interface, full details of the power feeding arrangements should be given, including information on the protection provided.

5.1.2.2 Signal characteristics

Details of the electrical characteristics of the interface such as the range of input and output frequencies, the range of RF signal levels accepted and delivered by the interface, etc. should be provided.

5.1.3 Transmission characteristics

For systems that are standardized or where the proprietary specification is in the public domain refer to the appropriate standards or specifications.

5.1.3.1 RF channel transmission characteristics

The RF channel transmission characteristics of the cable network in the upstream and downstream directions shall be fully specified.

5.1.3.2 Frequency plan

Details of the downstream and upstream frequency plan should be specified for the cable modem. This should include where relevant limitations on emissions to protect Broadcast or other network signals and/or services.

5.1.3.3 Transmission levels

The transmission levels of the downstream CMTS signal(s) within channel spacing as described by the Cable Operator and the range of power levels of the upstream CM signal(s) shall be specified.

5.1.3.4 Frequency conversion

Requirements for frequency inversion in the transmission path in either the downstream or upstream direction shall be specified.

5.1.3.5 Synchronization

Where the service provides a network source of synchronization or requires synchronization to the network for it to function, sufficient information should be provided to enable the designer to produce a terminal that can synchronize with the network.

5.1.3.6 Other transmission characteristics

All the other relevant characteristics, e.g. impedance, acceptable signal to noise ratio, relevant immunity aspects, modulation, should be also specified.

5.1.4 Physical layer

The Physical (PHY) layer shall comprise two sublayers, a transmission convergence sublayer (present in the downstream only) and Physical Media Dependent (PMD) sublayer.

Details of the structure and description of the downstream sublayer shall be given.

A description of the PMD sublayer and RF interface points shall be given.

5.1.4.1 Upstream physical media dependent sub-layer

Description and technical characteristics of the Upstream PMD sub-layer modulation format used shall be given.

If the upstream modulation scheme implements a scrambler (randomizer) and/or variable length preamble field that is prepended to the data after being randomized and encoded, full details should be provided.

The characteristics and functionality of any transmitter pre-equalizer should be given.

The characteristics and functionality of burst profiles supported by the CM should be given.

The characteristics, functionality, limits and measurement methods for transmit power, fidelity, spurious emissions, symbol rate error, filter distortion, carrier phase noise, channel frequency accuracy, symbol rate accuracy, symbol timing jitter shall be given.

Also details of the frame structure, signalling processing requirements, upstream CMTS input power characteristics, upstream output power from the CM should be given.

5.1.4.2 Downstream physical media dependent sub-layer

The CM shall be able to locate and accept RF modulated signals located within channels for frequency plans as defined by the Cable Operator.

The CM BER performance shall be given.

5.1.4.3 Downstream transmission convergence sub-layer

Any information specific to the CM for downstream convergence sub-layer shall be given.

5.1.4.4 Fault isolation impact on services

Faults and fault isolation procedures have potential harmful impact on numerous users of the data-over-cable and other services. Any specific requirements on fault isolation procedures should be specified.

5.1.4.5 Other aspects

Further details may have to be provided in order to satisfy the legal requests of article 4.2 of the R&TTE-Directive, i.e. make possible the design of TE.

5.1.5 Data link layer

Support of Data Link Layer that is divided into sublayers shall be provided with details of the specifications that it shall be in accordance with.

Class 1 only shall be supported for Logical Link Control (LLC) sublayer and shall be provided with details of the specifications it is in accordance with. Address resolution shall be used as defined in RFC 826 [3]. The specification to be used for MAC-to-LLC service definition shall be given.

The implementation of a Media Access Control (MAC) sublayer shall be provided. In particular the cable modem implementation of downstream and upstream channel transmission mechanism, behaviour and policy shall be given.

The MAC shall provide a protocol service interface to upper-layer services, such bridging, embedded applications (e.g. Packetcable/VoIP), a host interface (e.g. NIC adapter with NDIS driver), and layer three routers (e.g. IP router).

The MAC Service interface defines the functional layering between the upper layer service and the MAC. As such it defines the functionality of the MAC which is provided by the underlying MAC protocols. This interface is a protocol interface, not a specific implementation interface. A description of the data services provided by the MAC service interface shall be given.

5.1.5.1 Media Access Control

Any information relating to MAC, frame format, MAC management messages specific to the CM shall be given.

5.1.5.2 QoS and fragmentation

Any information relating to the QoS and packet fragmentation characteristics specific to the CM should be given.

5.1.5.3 CM interaction with CMTS

Details of the CM functionality, initialization process, interaction with the CMTS that are to be supported shall be given.

5.1.5.4 Communication protocols

The communication protocols that shall be used in the cable system and detailed specifications for the physical media dependent, downstream transmission, and media access control sublayers are to be fully specified.

5.1.5.5 Basic coding structure

Details should include items such as state machine, bit stuffing, traffic prioritization mechanisms, alarm reporting, etc.

5.1.5.6 Other aspects

Further details may have to be provided in order to satisfy the legal requests of article 4.2 of the R&TTE-Directive, i.e. make possible the design of TE.

5.1.6 Network layer

Details of the network layer to be supported shall be fully specified.

5.1.6.1 IGMP management

The CM should support IGMP forwarding. Full details of any network specific rules, e.g. on cable, that apply in order for the CM to be fully conformant shall be given.

5.1.6.2 Other aspects

Further details may have to be provided in order to satisfy the legal requests of article 4.2 of the R&TTE-Directive, i.e. make possible the design of TE.

5.1.7 IP Multimedia time critical services

Where applicable, this clause should contain a list of the services supported by the network.

5.1.7.1 Voice services

The coding algorithm used to digitize the speech should be detailed.

5.1.7.2 Other aspects

Further details may have to be provided in order to satisfy the legal requests of article 4.2 of the R&TTE-Directive, i.e. make possible the design of TE.

5.1.8 Additional features

Not all interfaces will support all the features identified in this clause. The information suggested should be published where applicable.

5.1.8.1 Charging information

Where charging information is applied or supplied by the network at the NTP, this should be specified.

5.1.8.2 "Supplementary" services and optional user facilities

Elements and procedures for the control of supplementary services and optional user facilities, where provided, should be detailed.

5.1.8.3 Presentation aspects

Any information related to specific text character presentation by the terminals during communication should be provided. This clause has particular relevance for Telex systems.

5.1.9 Other aspects and characteristics

This clause should identify any other characteristics that the PNO is aware of to assist the manufacturer in his implementation of the TE. This could cover such issues under any other considerations e.g. the essential requirements of R&TTE Directive [1] article 3, applicable to the terminal.

5.1.9.1 Higher Network Layers

Where CM services provide transparent IP capability as a bearer for higher layer services, use of these services will be transparent to the CM.

In addition to the transport of such user data, full details of the support for any network management and operational capabilities which are dependent on the Network Layer shall be specified.

5.1.9.2 Coexistence with other services

The conditions under which the Cable Modem is to coexist with other services on the cable network and any requirements of its interoperability in the specified cable spectrum assigned for CMTS-CM interoperability is to be specified.

The conditions under which the CM should not cause measurable degradation should be specified with full details on the levels and measure of degradation.

The conditions under which the CM should not cause not cause harmful interference to any other services assigned to the cable network in spectrum outside that allocated to CMTS should be specified.

5.1.9.3 Downloading new Operating Software

Details of downloading new operating software to the CM in support of future new capabilities shall be given.

5.1.9.4 Protocol elements and procedures for signalling

Where the Public Telecommunications Network uses a layered protocol architecture, the functions and characteristics of each layer that involves interaction between the terminal equipment and the Public Telecommunications Network should be specified.

As an example, for interfaces based on the Open Systems Interconnection Model [2] - characteristics of layers 1, 2 and 3 will need to be considered, although some characteristics within any specific layer may not be relevant for all types of interface. Where interaction between the terminal and the network is required above layer 3, characteristics of these higher layers will also need to be provided. A similar level of detail will need to be provided for interfaces not based on the ISO 7 layer model.

Any protocol elements and procedures for establishing, maintaining, modifying and terminating communications should be detailed as well as the methodology for dealing with any unrecognized protocol data units or data elements.

Protocol elements might be code, frame format and size, messages, information elements, timers, window size, etc.

5.2 Cable Modem-User interface characteristics to be specified

This clause covers scenario 2 of table 1.

In this case the technologies used may be the most different to take the best advantage of Network infrastructure capabilities and users requests on Telecom services.

ETSI maintains a web page with the relevant information on work produced to the R&TTE Directive [1]:

- <http://portal.etsi.org/radio/RTTEDirective/RTTEdirective.asp>.

This includes information concerning the application of article 4.2 of the R&TTE Directive [1]. It is recommended to consider the other deliverables available in this multi-part deliverable for the most common interface technologies. EG 201 730-1 helps finding the generic guidance and applicable specific parts.

Many other ETSI deliverables (related to TE or to NTP) may be used to facilitate application of the article 4.2 of the R&TTE Directive [1].

Annex A (informative): List of most useful standards

A.1 General

This clause can be used by the PNO as a source of information for the publication of the specifications of the publicly offered interfaces.

Unless specific regulation states otherwise, a PNO may refer partly to one standard or to the standard as a whole. The PNO may also refer to a standard and indicate some specific points in addition or in replacement of some clauses or requirements in the standard.

In all the cases a short overview of the standards in this sector may be useful.

SR 002 211 V1.1.1 offers an overview of a very large number of standards that might have impact in regulatory aspects. The interfaces offered to the user are also covered in that Special Report and the technologies covered by the present document were also considered. The usage of SR 002 211 may therefore be useful.

A.2 RF and basic signal aspects

ES 201 488 series for the first generation of Data Over Cable Systems (DOCSIS) and ES 202 488 series for the second generation of Data Over Cable Systems (DOCSIS) are together with ES 200 800 (earlier ETS 300 800) the most used standards in the context of the present clause.

A.3 Communications protocols

TS 101 909-1 is part 1 of the series TS 101 909 which in its whole specifies IP Multimedia Time Critical Services offered over Digital Broadband Cable Access to the Public Telecommunications Network. TS 101 909 represents the European implementation of IP-Cablecom based on J.16x and J.17x ITU-T series of Recommendations. TS 101 909-1 offers a good overview of the overall system, explains the relationship with ITU-T recommendations and is regularly updated.

The use of this TS 101 909 set of documents is recommended but care should be taken on the selection of the parts relevant for the user interface. In fact some parts refer to parameters not necessarily linked to the user interface.

A.4 Additional documents

TS 101 909 series specify the main characteristics of interfaces associated to the scope of the present document. Other standards may be needed to cover special aspects.

The use of standards is in all the cases strongly recommended.

EG 201 973 series reflect the wider European implementation of network characteristics supported by the legacy (analogue and digital) PSTN terminals. These contain recommendations intended as guidance for the definition and design of broadband IP networks and equipment (NGNs) supporting legacy terminals.

NOTE: An ETSI register of supplementary service codes is listed in TR 102 083. The ETSI Register of Supplementary Service codes http://portal.etsi.org/HF/hf_service_codes.asp is often updated and may also be helpful.

Annex B (informative): Bibliography

CEC decision 2002/C 331/04: "List of standards and/or specifications for electronic communications networks, services and associated facilities and services (interim issue)".

CEC decision 2003/548/EC: "List of standards and/or specifications for electronic communications networks, services and associated facilities and services".

ETSI SR 002 211 (V1.1.1): "List of standards and/or specifications for electronic communications networks, services and associated facilities and services; in accordance with Article 17 of Directive 2002/21/EC".

ETSI TS 101 909 (series): "Digital Broadband Cable Access to the Public Telecommunications Network; IP Multimedia Time Critical Services".

ETSI TR 102 083: "Human Factors (HF); Supplementary service codes for use in public network services".

ETSI EG 201 973 (series): "Access and Terminals (AT); Public Switched Telephone Network; Support of legacy terminals by Broadband IP networks and equipment".

ETSI ES 201 488 (series): "Access and Terminals (AT); Data Over Cable Systems".

ETSI ES 202 488 (series): "Access and Terminals (AT); Second Generation Transmission Systems for Interactive Cable Television Services - IP Cable Modems".

ETSI ES 200 800: "Digital Video Broadcasting (DVB); DVB interaction channel for Cable TV distribution systems (CATV)".

ETSI TR 101 857: "Access and Terminals (AT); Broadband access to the Public Telecommunications Network; Publication of interface specification under Directive 1999/5/EC, art. 4.2; Guidelines for describing Multimedia Cable Network Interfaces".

ETSI TR 102 083: "Human Factors (HF); Supplementary service codes for use in public network services".

History

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