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SERIES J: TRANSMISSION OF TELEVISION, SOUND
PROGRAMME AND OTHER MULTIMEDIA SIGNALS

Interactive systems for digital television distribution

Access systems for interactive services on SMATV/MATV networks

ITU-T Recommendation J.118

(Formerly CCITT Recommendation)

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ITU-T Recommendation J.118

Access systems for interactive services on SMATV/MATV networks

Summary

This Recommendation "Access systems for interactive services on SMATV/MATV networks" covers the definition of the framing structure, channel coding and modulation for the provision of an Interaction channel throughout SMATV/MATV networks from the user to the SMATV/MATV Head-end.

This Recommendation defines two current technological alternatives for the interactive service provision in SMATV/MATV networks according to a bandwidth dependent classification. In particular, the cable based solution is fitted when broadband applications are concerned while the Master Link Low Rate TDMA is suited for narrow-band applications.

Source

ITU-T Recommendation J.118 was prepared by ITU-T Study Group 9 (1997-2000) and approved under the WTSC Resolution 1 procedure on 18 May 2000.

FOREWORD

The International Telecommunication Union (ITU) is the United Nations specialized agency in the field of telecommunications. The ITU Telecommunication Standardization Sector (ITU-T) is a permanent organ of ITU. ITU-T is responsible for studying technical, operating and tariff questions and issuing Recommendations on them with a view to standardizing telecommunications on a worldwide basis.

The World Telecommunication Standardization Conference (WTSC), which meets every four years, establishes the topics for study by the ITU-T study groups which, in turn, produce Recommendations on these topics.

The approval of ITU-T Recommendations is covered by the procedure laid down in WTSC Resolution 1.

In some areas of information technology which fall within ITU-T's purview, the necessary standards are prepared on a collaborative basis with ISO and IEC.

NOTE

In this Recommendation, the expression "Administration" is used for conciseness to indicate both a telecommunication administration and a recognized operating agency.

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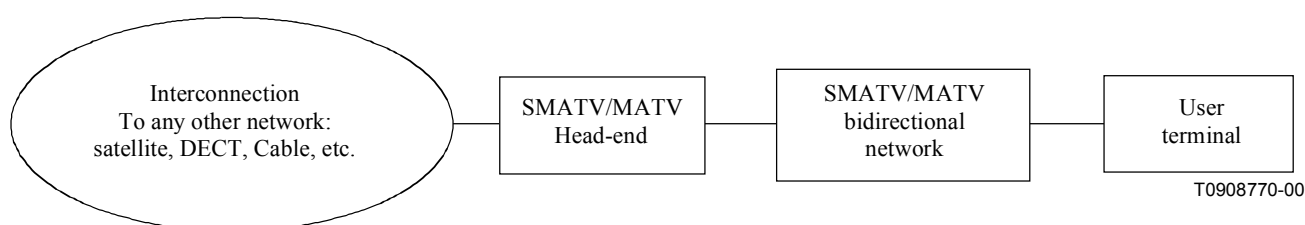
ITU-T Recommendation J.118

Access systems for interactive services on SMATV/MATV networks

1 Scope

This Recommendation extends the scope of the ITU-T J.84 "Distribution of digital multiprogramme signals for television, sound and data services through SMATV/MATV networks" to make provision for bidirectional data over SMATV/MATV coaxial networks for interactive services.

The scope of this Recommendation is the definition of the framing structure, channel coding and modulation for the interactive service provision in SMATV/MATV networks. This Recommendation provides the necessary elements for the implementation of an interaction channel between the user terminal and the SMATV/MATV head-end equipments. Other sort of connections between the SMATV/MATV head-end and the Service Provider can be implemented in a seamless fashion. The system architecture followed in this Recommendation is depicted in the following figure:



This Recommendation describes two different technological possibilities providing the specifications for the systems to be used in SMATV/MATV for interactive purposes.

In particular, the two technological alternatives for the interactive service provision in SMATV/MATV networks have been classified according to a bandwidth dependent criteria. The cable based solution is fitted when broadband applications are concerned (see 6.2) while the Master Link Low Rate TDMA is suited for narrow-band applications (see 6.3).

Alternative Interaction channel systems may be also used by SMATV/MATV users, as for example the PSTN/ISDN and the wireless DECT solutions.

Research and Development activities carried out in the frame of the ACTS¹ European Research Programs have demonstrated the feasibility of the Interaction Channel for SMATV/MATV. Tests and demonstrations have shown that this concept is a short term reality and that preliminary prototypes are available supported by the industry.

This Recommendation is intended to ensure that designers and installers of SMATV networks carrying interactive services will have the information they need to be able to establish and maintain fully satisfactory networks. It also provides the information needed by the designers and manufacturers of equipment (including receivers) for digital interactive signals throughout SMATV networks.

¹ Advanced Communications, Technologies and Services (ACTS) is the European Commission Research and Development Programme. One of its Projects is DIGISAT, which has significantly contributed to the solutions of the Interaction channel for SMATV/MATV networks. S3M Project is also contributing with the Master Link solution for the Interaction channel in the SMATV/MATV environment, in particular, for small SMATV/MATV networks although with the possibility to be used in bigger SMATV/MATV networks due to the modular characteristics of this solution.

This Recommendation contains two informative appendices (I and II) with useful information for the implementation of the interactive system in SMATV/MATV installations.

2 Normative references

The following ITU-T Recommendations and other references contain provisions which, through reference in this text, constitute provisions of this Recommendation. At the time of publication, the editions indicated were valid. All Recommendations and other references are subject to revision; all users of this Recommendation are therefore encouraged to investigate the possibility of applying the most recent edition of the Recommendations and other references listed below. A list of the currently valid ITU-T Recommendations is regularly published.

- [1] ITU-T J.84 (1997), *Distribution of digital multi-programme signals for television, sound and data services through SMATV networks*.
- [2] ITU-R BO.1211 (1995), *Digital multi-programme emission systems for television, sound and data services for satellites operating in the 11/12 GHz frequency range*.
- [3] ITU-T J.83 (1997), *Digital multi-programme systems for television, sound and data services for cable distribution*.
- [4] ITU-T J.112 (1998), *Transmission systems for interactive cable television services*.
- [5] ITU-T J.111 (1998), *Network independent protocols for interactive systems*.
- [6] ITU-T V.24 (2000), *List of definitions for interchange circuits between data terminal equipment (DTE) and data circuit-terminating equipment (DCE)*.
- [7] ITU-T V.28 (1993), *Electrical characteristics for unbalanced double-current interchange circuits*.
- [8] ITU-T X.25 (1996), *Interface between Data Terminal Equipment (DTE) and Data Circuit-terminating Equipment (DCE) for terminals operating in the packet mode and connected to public data networks by dedicated circuit*.
- [9] ISO 2110:1989, *Information Technology – Data communication – 25-pole DTE/DCE interface connector and contact number assignments*.
- [10] ETSI EN 50201 (1998), *Interfaces for DVB-IRD*.

3 Abbreviations and relevant definitions

3.1 This Recommendation uses the following abbreviations:

BC	Broadcast Channel
BIM	Broadcast Interface Module
CATV	Cable TV distribution system
CDM	Code Division Multiplex
CTS	Clear To Send
DCE	Data Communications Equipment
DTE	Data Terminal Equipment
DVB	Digital Video Broadcasting
ETS	European Telecommunications Standard
IB	In-Band

IC	Interaction Channel
IIM	Interactive Interface Module
INA	Interactive Network Adapter
IRD	Integrated Receiver Decoder
ISCM	Interactive Services Commercial Module (DVB)
ITU	International Telecommunication Union
ITU-R	International Telecommunication Union – Radiocommunication Sector
ITU-T	International Telecommunication Union – Telecommunication Standardization Sector
MAC	Media Access Control
MATV	Master Antenna Television
MMDS	Microwave Multipoint Distribution System
MTU	Maximum Transfer Unit
NIU	Network Interface Unit
OOB	Out of Band
OSI	Open Systems Interconnection
PSTN	Public Switched Telephone Network
QAM	Quadrature Amplitude Modulation
QPSK	Quaternary Phase Shift Keying
RTS	Request to Send
SLIP	Serial Line Interconnection Protocol
SMATV	Satellite Master Antenna Television
STB	Set Top Box
STU	Set Top Unit
TDM	Time Division Multiplex
TDMA	Time Division Multiplex Access
TS	Transport Stream

3.2 The following relevant definitions are provided:

3.2.1 SMATV system A (SMATV-DTM): This system approach consists of the transmodulation from satellite Quaternary Phase Keying (QPSK) signals as defined in [2] to a Quadrature Amplitude Modulation (QAM) scheme as defined in [3]. The process of transmodulation without baseband interfacing is also known as Transparent Transmodulation and the head-end unit performing this function is known as Transparent Digital Transmodulator (TDT).

3.2.2 SMATV system B: This system is based on the use of QPSK modulation. The SMATV system B concept allows a direct reception of digital satellite signals using frequency conversion of the received satellite signal to a frequency band appropriate to the characteristics of the SMATV distribution network. The functional elements of this system are given in the baseline satellite specification provided in [2]. Two configurations of SMATV system B are considered as follows:

- **SMATV-IF:** which uses the Intermediate Frequency (IF) as delivered by the Low Noise Block (LNB) (e.g. 950-2150 MHz)
- **SMATV-S:** which uses a conversion to the extended S band (e.g. 230-470 MHz)

3.2.3 SMATV grouping terminal or interactive head-end: The Grouping Terminal at the SMATV performs the collection and the distribution of information coming from and going to the user terminals. It is composed by the Grouping Terminal Interactive Network Adapter (INA), the MAC functions and the interfaces with the other networks in order to collect/distribute the information in the SMATV coax network related to each user terminal (Interactive Interface Module – IIM).

4 SMATV/MATV Interactive system concepts

The Satellite Master Antenna Television (SMATV/MATV) system was previously intended for distribution of television and sound signals to households located in one or more adjacent buildings. However, the advent of new digital interactive services implies that the SMATV/MATV networks should be equipped with a return channel allowing the introduction of digital interactive services. This kind of network is also known as community antenna installations or domestic TV cable networks. A SMATV system represents a mean of sharing the same resources among several users for the Transmission/reception of contents.

This Recommendation provides reference examples for the implementation of an interaction channel system to cope with two different scenarios.

Scenario A) An environment of *asymmetric interactive services supporting broadcast to home with narrowband return channel*. This is the typical broadcasting scenario enhanced with low capacity interactive services, the implementation of which is foreseen to be widespread within a short period of time.

Scenario B) An environment oriented towards *wideband Multimedia services* where the SMATV/MATV interconnection infrastructure can play a very effective role.

The generic ITU Reference model for interactive systems described in ITU-T J.110 has been followed by the system described in this Recommendation. The Interaction Network is split into a supporting network, a coaxial section and an interface in-between. The SMATV/MATV section provides the two-way communications between each user Terminal and the SMATV/MATV head-end, which is located on the roof of each building.

The interactive SMATV/MATV systems described in this Recommendation propose solutions for bidirectional communications between the user and the SMATV/MATV head-end. The system consists of two main components: the Interactive Head-end or Grouping Terminal and the SMATV/MATV Interactive Interface Module or user terminal. Freedom is given for any further network connection at the head-end to link with the Service Provider. Solutions for the interconnection are being developed by other ITU Study Groups assuming either a wireless or wired solutions (satellite, terrestrial, CATV, etc.)

The Interactive SMATV/MATV head-end performs the collection and the distribution of information coming from and going to the user terminals. It is composed of the Grouping Terminal Interactive Network Adapter or Interactive Head-end Network Adapter (INA), the MAC functions and the interfaces with other networks in order to collect/distribute the information in the SMATV/MATV coaxial network related to each user terminal (Interactive Interface Module – IIM).

For the SMATV/MATV section two approaches are proposed according to a bandwidth dependent classification. For wideband applications, a subset of the options provided for cable systems [4] is recommended (see 6.2) allowing a system simpler than the CATV one, thus matching the requirements of the SMATV/MATV scenario. One of the key aspects of the SMATV/MATV scenario with respect to the CATV one is that the Grouping Terminal at the SMATV/MATV head-end should be a consumer equipment in a similar way as the Set Top Box, although the SMATV/MATV head-end cost is shared among the users connected to the same SMATV/MATV network. For narrowband applications the approach based on the Master Link system is recommended (see 6.3).

The system described here is compatible with the ITU-T Network Independent Protocols specification for Interactive services [5].

The system described in this Recommendation is an open system allowing the interoperability with other networks irrespective of the technology supported. Guidelines are provided in this sense, allowing the use of alternative technologies with the aim to allow the users or operators to select the technology best suited for each situation depending on the type of network, required services, quality of services, number of users, traffic requirements, etc.

The interface between the Coaxial section and the other networks is defined with the aim of facilitating the interoperability between subsystems from different vendors and technologies. In principle a very low cost interface, RS-232 based, is recommended although alternative interfaces are identified in order to allow the use of existing equipment as well as to facilitate the provision of multimedia broadband applications as identified in scenario B above.

5 Reference Model for system architecture of narrowband interaction channels in a broadcasting scenario (asymmetric interactive services)

A reference model for the system architecture of narrowband interaction channels in a broadcasting scenario (asymmetric interactive services) is presented in this clause.

5.1 Protocol Stack Model

For asymmetric interactive services supporting broadcast to the home with narrowband return channel, a simple communications model consists of the following layers (the layers do not coincide exactly with the OSI layers).

- **Physical layer:** where all the physical (electrical) transmission parameters are defined.
- **Transport layer:** defines all the relevant data structures and communication protocols like data containers, etc.
- **Application layer:** is the interactive application software and runtime environments (e.g. home shopping application, script interpreter, etc.).

This Recommendation addresses the lower two layers (the physical and transport) leaving the application layer open to competitive market forces.

A simplified model of the OSI layers was adopted to facilitate the production of specifications for these nodes. Figure 1 points out the lower layers of the simplified model and identifies some of the key parameters for the lower two layers.

Layer Structure for Generic System Reference Mode

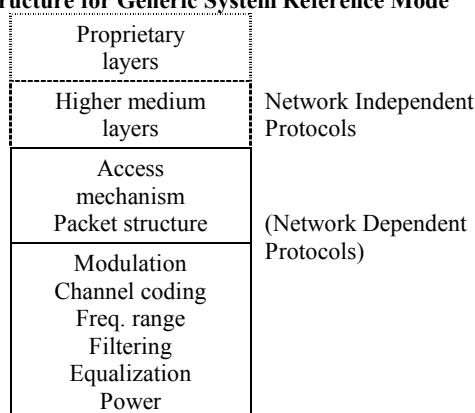


Figure 1/J.118 – Layer Structure for Generic System Reference Model

This Recommendation addresses network specific aspects only. The network independent protocols are specified separately in ITU-T J.111.