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

Switched digital video over cable networks

Functional requirements for IP-based switched digital video using data over cable service interface specifications

Recommendation ITU-T J.1101

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Functional requirements for IP-based switched digital video using data over cable service interface specifications

Summary

Recommendation ITU-T J.1101 describes the functional requirements of IP-based switched digital video (SDV) using data over cable service interface specifications (DOCSIS) in a digital cable network. The cable broadcasting system has been changed to use resources efficiently and transmit them to easily accommodate the varying needs of subscribers. Therefore, it is necessary to define the functional requirements of IP-based SDV for maintaining quality of service (QoS) and using bandwidth effectively in a hybrid fibre/coaxial (HFC) network environment. This Recommendation contains descriptions of the functional requirements of transmission, subscriber and control functions of IP-based SDV on IP-based cable networks.

History

Edition	Recommendation	Approval	Study Group
1.0	ITU-T J.1101	2012-06-13	9

FOREWORD

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As of the date of approval of this Recommendation, ITU had received notice of intellectual property, protected by patents, which may be required to implement this Recommendation. However, implementers are cautioned that this may not represent the latest information and are therefore strongly urged to consult the TSB patent database at http://www.itu.int/ITU-T/ipr/.

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Functional requirements for IP-based switched digital video using data over cable service interface specifications

1 Scope

This Recommendation defines the functional requirements of IP-based switched digital video (SDV) using data over cable service interface specifications (DOCSIS). The functionalities described in this Recommendation are defined according to the requirements of cable television system operators. The IP-based SDV is the service mechanism for providing interfaces and functionalities to enable cable television system operators to offer quality of service (QoS)-guaranteed broadcasting. SDV is a service mechanism for distributing digital video via RF-based cable networks; an IP-based SDV is a support SDV function which works via IP-based cable networks.

2 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; 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. The reference to a document within this Recommendation does not give it, as a stand-alone document, the status of a Recommendation.

[ITU-T J.210] Recommendation ITU-T J.210 (2006), *Downstream RF interface for cable modem termination systems*.

[ITU-T J.222.1] Recommendation ITU-T J.222.1 (2007), *Third-generation transmission systems for interactive cable television services – IP cable modems: Physical layer specification*.

[ITU-T J.222.2] Recommendation ITU-T J.222.2 (2007), *Third-generation transmission systems for interactive cable television services – IP cable modems: MAC and Upper Layer protocols*.

3 Definitions

3.1 Terms defined elsewhere

None.

3.2 Terms defined in this Recommendation

This Recommendation defines the following term:

3.2.1 IP-based switched digital video (SDV): A service mechanism which provides interfaces and functionalities to enable cable television system operators to offer QoS-guaranteed broadcasting and multicasting.

4 Abbreviations and acronyms

This Recommendation uses the following abbreviations and acronyms:

CCP Channel Charge Protocol

CMTS Cable Modem Termination System

DEPI Downstream External PHY Interface

DOCSIS Data Over Cable Service Interface Specifications

GBE Giga Bit Ethernet

HFC Hybrid Fibre/Coaxial

IGMP Internet Group Management Protocol

IPC Inter-Process Communications

MAC Media Access Control

MDD MAC Domain Descriptor

NSI Network Service Interface

RPC Remote Procedure Call

SDV Switched Digital Video

SIP Session Initiation Protocol

STB Set-Top Box

VSI Video Service Interface

5 Conventions

In this Recommendation:

The keywords "**is required to**" indicate a requirement which must be strictly followed and from which no deviation is permitted if conformance to this Recommendation is to be claimed.

The keywords "**is recommended**" indicate a requirement which is recommended but which is not absolutely required. Thus, this requirement need not be present to claim conformance.

The keywords "**is prohibited from**" indicate a requirement which must be strictly followed and from which no deviation is permitted if conformance to this Recommendation is to be claimed.

The keywords "**can optionally**" indicate an optional requirement which is permissible, without implying any sense of being recommended. This term is not intended to imply that the vendor's implementation must provide the option and the feature can be optionally enabled by the network operator/service provider. Rather, it means the vendor may optionally provide the feature and still claim conformance with the specification.

In this Recommendation, the words *shall*, *shall not*, *should* and *may* sometimes appear, in which case they are to be interpreted, respectively, as *is required to*, *is prohibited from*, *is recommended*, and *can optionally*. The appearance of such phrases or keywords in an appendix or in material explicitly marked as *informative* are to be interpreted as having no normative intent.

6 Reference model

As shown in Figure 1, functionally IP-based SDV using the DOCSIS system can be categorized into three parts, for example, 'Transmission function', 'Subscriber function' and 'Control function'.

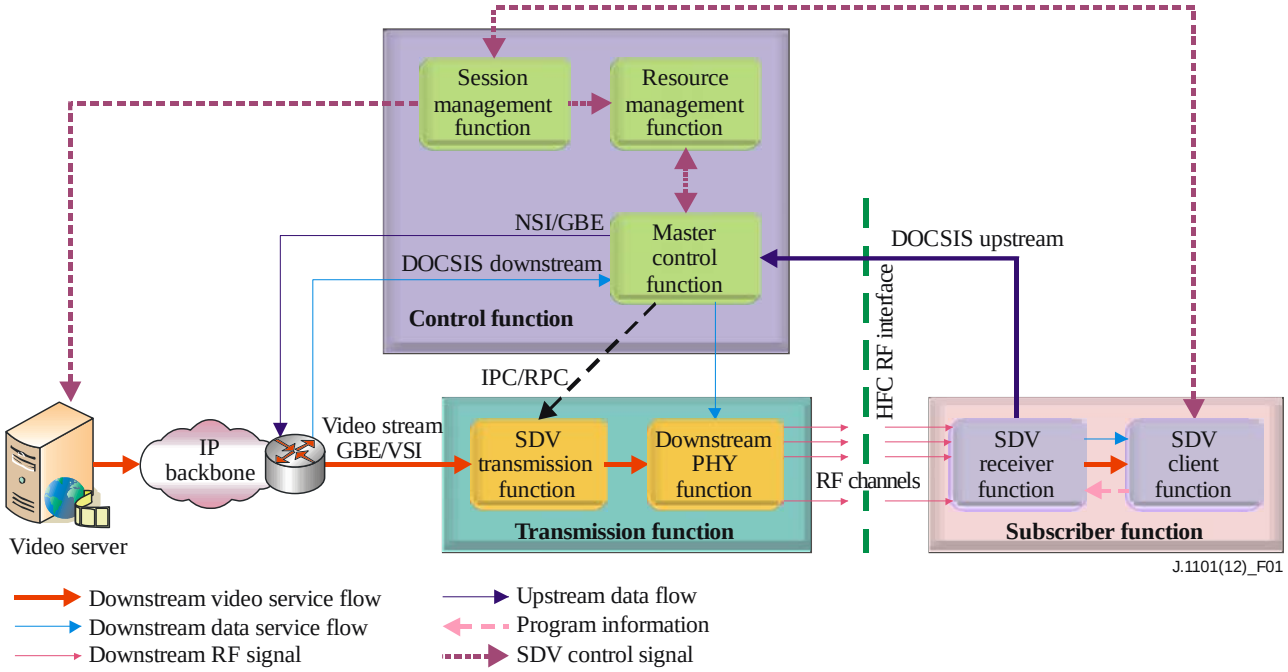

Figure 1 – Diagram of an IP-based switched digital video system

6.1 Transmission function

The transmission function processes the DOCSIS frame header and transmits it to the multicast service group. The transmission function consists of an SDV transmission function and a downstream PHY function. The SDV transmission function processes service flow and packet header processing on the DOCSIS MAC layer [ITU-T J.222.2]. The downstream PHY function transmits the DOCSIS header processed video stream to the subscriber.

6.1.1 SDV transmission function

The SDV transmission function processes service flow and does packet header processing on the DOCSIS MAC layer.

6.1.2 Downstream PHY function

The downstream PHY [ITU-T J.222.1] function transmits the DOCSIS header processed video stream to the subscriber.

6.2 Subscriber function

The subscriber function processes the video data stream from the transmission function. The subscriber function consists of the SDV client service function and SDV receiver function. The subscriber function also sends request information of an SDV video service programme to the control function.

6.2.1 SDV client function

The SDV client function recovers an IP-based received video data stream from an MPEG-2 based video stream and outputs it to the set-top box (STB).

6.2.2 SDV receiver function

The SDV receiver function processes physical signal processing; it is a function of the DOCSIS cable modem.

6.3 Control function

The control function creates a service group for the authorized subscriber and manages the channel resources of the transmission function. The control function consists of a session management function, resource management function and a master control function.

6.3.1 Session management function

The session management function periodically transmits service information of video programmes, and sets the transmission path for video data streaming.

6.3.2 Resource management function

The resource management function controls the frequency channel resource, and it allocates the frequency of the modular cable modem termination system (CMTS).

6.3.3 Master control function

The master control function controls SDV transmission, and manages the modular CMTS [ITU-T J.210].

7 Functional requirements

7.1 Transmission functional requirement

7.1.1 SDV transmission function

7.1.1.1 Service flow processing

The SDV transmission function is required to obtain the following information for input packets.

– Packet type (e.g., channel bonding or not, high priority or not, unicast/multicast/broadcast)
– Service flow ID
– Downstream service ID list
– Transmission priority
– Available downstream transmission channel list.

The SDV transmission function is required to classify the service flow using the destination IP group address and departure information.

7.1.1.2 Scheduling

The SDV transmission function is required to receive the control data from the control function as follows:

– MDD message transmission interval
– transmission mode of downstream channels
– MDD message
– downstream channel ID.

The SDV transmission function is required to schedule the service flow as follows:

– decide the available downstream channel
– multiplex DOCSIS management message (e.g., MDD) and multicast video data packet.

The SDV transmission function is recommended to minimize the delay in transmission time.

7.1.1.3 MAC header processing

The SDV transmission function is required to process the packet according to transmission priority.

The SDV transmission function is required to create the DOCSIS MAC header according to the service flow information of the input packet.

7.1.1.4 MPEG-2 TS convergence

The SDV transmission function is required to place the DOCSIS MAC frame in the queue. The SDV transmission function requires the DOCSIS MAC frame to map to MPEG-2 TS. The SDV transmission function is required to output the multiplexing MPEG-2 TS.

7.1.1.5 Downstream PHY interface

The SDV transmission function is recommended to interface with the downstream PHY function using the downstream external PHY interface (DEPI).

7.1.1.6 SDV transmission controlling

The SDV transmission function is required to receive the information from the master control function as follows:

– service flow control information
– multicast message information
– hardware control information of SDV transmission function
– performance and statistical information of SDV transmission function.

7.1.2 Downstream PHY function

7.1.2.1 Downstream PHY

The downstream PHY function is required to process the channel coding from MPEG-2 TS. The downstream PHY function is required to process the digital modulation signal from the channel coded data. The downstream PHY function is required to transmit the modulated symbol stream on the RF frequency. The downstream PHY function is required to control the signal power level of the transmitted signal.

7.1.2.2 Downstream MAC interface

The downstream PHY function is recommended to interface with the SDV transmission function or master control function using the DEPI protocol.

7.2 Control function

7.2.1 Session management function

7.2.1.1 Session management protocol processing

The session management function is recommended to interface with the SDV client function using the session initiation protocol/channel charge protocol (SIP/CCP).

7.2.1.2 Session information management

The session management function is recommended to transmit the programme ID and IP group address to the SDV client function.

The session management function is recommended to operate the information of the STB as follows:

– IP address information

– service group

– access authority.

7.2.1.3 Session management interface

The session management function is recommended to interface with the resource management function using the frequency channel request protocol message. The frequency channel request protocol message is recommended to include the following information.

– Bandwidth for programme transmission

– QoS information

– IP group address.

7.2.1.4 Programme information table management

The session management function is recommended to update the following information.

– Programme ID

– Group IP address

– Session information.

7.2.2 Resource management function

7.2.2.1 Resource management protocol processing

The resource management function is recommended to receive the resource management protocol unit from the master control function.

7.2.2.2 Resource information management

The resource management function is required to determine the network frequency channel resources and physical topology information. The resource management function transmits the frequency allocation request message to the master control function, and it reports the results. The resource management function is required to make additional channel resources allocation as per the following status:

– lack of channel resources

– the master control function cannot support transmission according to physical topology.

7.2.2.3 Session management interface

The resource management function is recommended to interface with the session management function.

7.2.3 Master control function

7.2.3.1 CMTS

The master control function is required to process the master SDV transmission function as follows:

– transmit the DOCSIS MAC protocol message for the transmission function

– control the multicast service flow of the SDV transmission function.

The master control function is required to process the DOCSIS MAC management message for downstream and upstream transmission.

7.2.3.2 SDV service flow control

The master control function is required to extract and/or report the following information.

– Service flow ID
– MAC address
– Session information
– Classifier information
– Classifier pattern information
– Downstream service ID information (e.g., ID, packet type, priority, QoS class).

7.2.3.3 DOCSIS service flow information table management

The master control function is required to periodically update the DOCSIS service group information table in order to respond to a programme request.

7.2.3.4 Resource management protocol processing

The master control function is required to identify and allocate the appropriate frequency channel resource.

7.2.3.5 SDV transmission device management

The master control function is required to transmit the following control information to the SDV transmission function.

– Multicast service flow control information
– IGMP message information
– Hardware device control information of the SDV transmission function.

The master control function is required to request the hardware configuration of the SDV transmission function according to user request. The master control function is required to access the performance and statistical information of the SDV transmission function.

7.3 Subscriber function

7.3.1 SDV client function

7.3.1.1 MPEG-2 TS demultiplex

The SDV client function is required to demultiplex the MPEG-2 TS stream.

7.3.1.2 Programme request protocol processing

The SDV client function is required to send and/or receive the programme request protocol.

7.3.1.3 Programme information table processing

The SDV client function is required to receive the programme information table and obtain the IP group address.

7.3.1.4 Cable modem control

The SDV client function is required to control the cable modem in order to use DOCSIS transmission processing.

7.3.2 SDV receiver function

7.3.2.1 Cable modem

The SDV receiver function is required to process the PHY and MAC functions of the cable modem.

7.3.2.2 DOCSIS MAC protocol processing

The SDV receiver function is required to process the following function.

– Initialization of cable modem downstream/upstream modulation/demodulation

– Creation and control of the MAC management message.

7.3.2.3 DOCSIS service group information table processing

The SDV receiver function is required to operate the information table according to the response of the programme request.

7.3.2.4 SDV receiver control

The SDV receiver function is required to control the service flow. The SDV receiver function is recommended to obtain the IP multicast group address.

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