INTERNATIONAL TELECOMMUNICATION UNION

ITU-T

TELECOMMUNICATION
STANDARDIZATION SECTOR
OF ITU

I.375.3

(03/2000)

SERIES I: INTEGRATED SERVICES DIGITAL NETWORK

Overall network aspects and functions – General network requirements and functions

Network capabilities to support multimedia services: Example of multimedia distribution service class – Switched digital broadcasting (SDB)

ITU-T Recommendation I.375.3

(Formerly CCITT Recommendation)

ITU-T I-SERIES RECOMMENDATIONS

INTEGRATED SERVICES DIGITAL NETWORK

GENERAL STRUCTURE	
Terminology	I.110–I.119
Description of ISDNs	I.120–I.129
General modelling methods	I.130–I.139
Telecommunication network and service attributes	I.140–I.149
General description of asynchronous transfer mode	I.150–I.199
SERVICE CAPABILITIES	
Scope	I.200–I.209
General aspects of services in ISDN	I.210–I.219
Common aspects of services in the ISDN	I.220–I.229
Bearer services supported by an ISDN	I.230–I.239
Teleservices supported by an ISDN	I.240–I.249
Supplementary services in ISDN	I.250–I.299
OVERALL NETWORK ASPECTS AND FUNCTIONS	
Network functional principles	I.310–I.319
Reference models	I.320–I.329
Numbering, addressing and routing	I.330–I.339
Connection types	I.340–I.349
Performance objectives	I.350–I.359
Protocol layer requirements	I.360–I.369
General network requirements and functions	**I.370–I.399**
ISDN USER-NETWORK INTERFACES	
Application of I-series Recommendations to ISDN user-network interfaces	I.420–I.429
Layer 1 Recommendations	I.430–I.439
Layer 2 Recommendations	I.440–I.449
Layer 3 Recommendations	I.450–I.459
Multiplexing, rate adaption and support of existing interfaces	I.460–I.469
Aspects of ISDN affecting terminal requirements	I.470–I.499
INTERNETWORK INTERFACES	I.500–I.599
MAINTENANCE PRINCIPLES	I.600–I.699
B-ISDN EQUIPMENT ASPECTS	
ATM equipment	I.730–I.739
Transport functions	I.740–I.749
Management of ATM equipment	I.750–I.799

For further details, please refer to the list of ITU-T Recommendations.

ITU-T Recommendation I.375.3

Network capabilities to support multimedia services: Example of multimedia distribution service class – Switched digital broadcasting (SDB)

Summary

This ITU-T Recommendation specifies the network capabilities required to support the switched digital broadcast service (SDB). The service requires a point-to-multipoint function that can be provided either by the access network topology or by the addition of a specific Replication Unit (RU). Another new functional element, the Broadcast Control Unit (BCU) instructs the RU which programs have to be delivered to a specific end user. This ITU-T Recommendation provides the service architecture and the reference configuration and then specifies the different functional elements and their interfaces.

Source

ITU-T Recommendation I.375.3 was prepared by ITU-T Study Group 13 (1997-2000) and approved under the WTSC Resolution 1 procedure on 10 March 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.

INTELLECTUAL PROPERTY RIGHTS

ITU draws attention to the possibility that the practice or implementation of this Recommendation may involve the use of a claimed Intellectual Property Right. ITU takes no position concerning the evidence, validity or applicability of claimed Intellectual Property Rights, whether asserted by ITU members or others outside of the Recommendation development process.

As of the date of approval of this Recommendation, ITU had not received notice of intellectual property, protected by patents, which may be required to implement this Recommendation. However, implementors are cautioned that this may not represent the latest information and are therefore strongly urged to consult the TSB patent database.

CONTENTS

ITU-T Recommendation I.375.3

Network capabilities to support multimedia services: Example of multimedia distribution service class – Switched digital broadcasting (SDB)

1 Scope

This ITU-T Recommendation specifies network requirements for the switched digital broadcast service using ATM based network.

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; 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.

- ITU-T Recommendation G.902 (1995), *Framework Recommendation on functional access networks – Architecture and functions, access types, management and service node aspects*.
- ITU-T Recommendation H.222.0 (2000) | ISO/IEC 13818-1:2000, *Information technology – Generic coding of moving pictures and associated audio information: Systems*.
- ITU-T Recommendation H.222.1 (1996), *Multimedia multiplex and synchronization for audiovisual communication in ATM environments*.
- ITU-T Recommendation I.375.1 (1998), *Network capabilities to support multimedia services – General aspects*.
- ITU-T Recommendation I.375.2 (1998), *Network capabilities to support multimedia services – Example of multimedia retrieval service class – Video-on-demand service using ATM-based network*.
- ITU-T Recommendation I.414 (1997), *Overview Recommendations on layer 1 for ISDN and B-ISDN customer accesses*.
- ITU-T Recommendation J.82 (1996), *Transport of MPEG-2 constant bit rate television signals in B-ISDN*.

3 Abbreviations

This ITU-T Recommendation uses the following abbreviations:

BCU	Broadcast Control Unit
CPE	Customer Premises Equipment
POTS	Plain Old Telephony Service
REMUX	Re-multiplexer
RU	Replication Unit
SDB	Switched Digital Broadcasting

STB Set-top Box

TE Terminal Equipment

4 Description

The SDB service offers access to a large number of broadcast programs over access networks with a relatively low capacity requirement per end-user. The service requires that the end-user has control capabilities for program selection and the network provides replication and routing functions for the selected programs.

Unlike the existing TV broadcasting or CATV services, broadcast programs are delivered to a Replication Unit (RU), generally located in the access network, and from there the programs are distributed to the end-users according to their selection.

Figure 1 below shows the architecture of the switched digital broadcast service. End-user(s) select a desired program from the program menu downloaded from a content server. Broadcast programs are delivered to the RU via appropriate protocols before the program selection is performed. Given the end-user's program selection, the Broadcast Control Unit (BCU) instructs the RU to deliver the program to the end-user(s). The RU can be implemented either in the Access Network or in the Core Network by network operators or service providers.

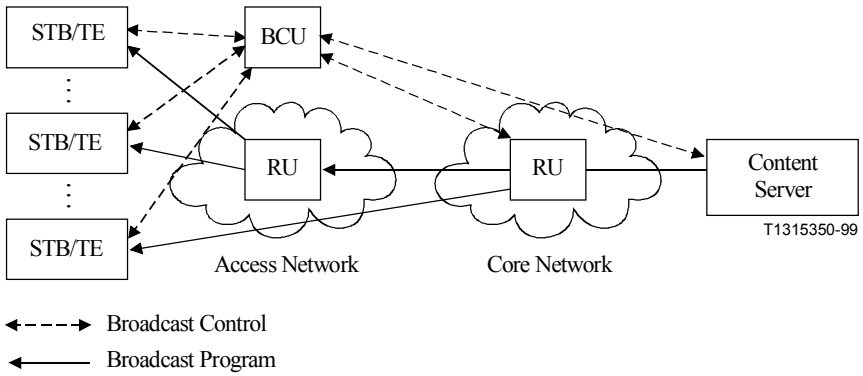


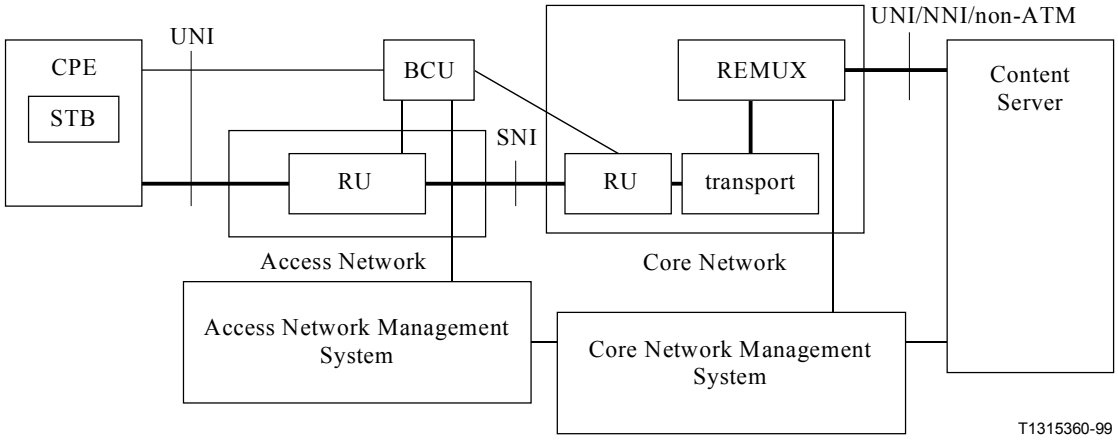
Figure 1/I.375.3 – Switched Digital Broadcast Service Architecture

5 The reference configuration

Figure 2 provides the reference configuration. The functions of access network and their interfaces are specified in ITU-T Recommendation G.902. The access network can provide the replication function for the SDB basically in two ways. If the access network topology provides point-to-multipoint communication, the signals are replicated implicitly. If this is not the case a specific RU has to be provided in the access network or in the core network. The core network performs a re-multiplexer (REMUX) function to adapt program transport streams for transport and delivery by the network (i.e. Access Network plus Core Network).The core network also performs a transport function. In general, the REMUX function is done by several devices distributed geographically. The REMUX function can also be located in the Content Server, and deliver the program streams directly in the appropriate form. In this case, there is no REMUX in the core network. The BCU function, can be implemented by one device or by more devices working in cascade and can be located either in the access network or in the core network.

The management systems of access and core networks can be two different systems, but both networks can also be managed by one system. In case of two separate management systems, there is an interface between them. The interfaces for network element management between the management systems and their networks are not drawn in the figure.

The customer premises equipment (CPE) consists in its minimal form of one STB and a terminal (e.g. television set). But the CPE can also contain several STBs and/or terminals.



NOTE – There are several alternatives of RU implementation. RUs can be provided in the Access Network and/or the Core Network.

Figure 2/I.375.3 – Reference configuration for SDB service

5.1 Functional elements

5.1.1 Customer premises equipment functions

The CPE provides the functions of devices at the end-users home used to provide SDB. The functions of the CPE for SDB includes the functions of Set-top Box (STB) and functions of the Terminal Equipment (TE). The TE may be a TV set.

The STB functions present to the user various forms of menus and selection objects for desired program and other control purposes such as e.g. authentication, on-line program purchase, etc. They contain the necessary hardware and software functions to provide SDB service in the home. The STB acts as an interface and an adaptation unit between the NT and the TE.

The STB functions provide the platform on which the service's user application runs, and the infrastructure for user applications to offer sophisticated user interfaces.

5.1.2 Network functions

For the SDB service, the network functions are replication and broadcasting of program transport streams, and on-demand delivery of program transport streams to end-users.

The network (i.e. Access Network plus Core Network) does not perform authorization, nor authentication, nor conditional access. However, the network can evolve to perform some or all of these functions.

5.1.2.1 Broadcast control unit

The BCU interprets end-user's selections sent by means of the zapping protocol, and directs the RU to send the selected program transport stream to the STB.

To this end the BCU needs for all the program transport streams that can be selected in the domain of the access network, the relation between the identifier of the program transport stream (simply called "program identifier") and the identifiers (VPI+VCI) of the VC on which this identified program transport stream is delivered to the access network, plus the bandwidth of this VC.

At the time VCs with program transport streams are set up, it is necessary that the management system provides the BCU the needed information about the relation between the program identifiers and the VC parameters.

5.1.2.2 Replication unit

An RU function is an important function for switched digital broadcast (SDB). It replicates "broadcast" multimedia signals to a group of CPEs.

The replication function is performed by one or more devices, or implicitly by the transport function of the access network. For example, if the access network is based on bus architecture like coax CATV, the replication function is implicitly implemented by the coax cable. The coax bus cable replicates electronic signal and delivers to signal receivers. It automatically provides point-to-multipoint signal transport, therefore, there is no explicit physical entity dedicated for replication.

On the other hand, if the access network architecture is a star topology like a traditional optical fibre network, there is no implicit replication function in the access network. The fibre provides only point-to-point signal transport and it requires the replication function to have point-to-multipoint capability. In this case, there are two possible alternatives of RU function's location, one is in the access network, and the other is in the core network.

An access network is based on a transmission network and has no explicit switching function. The RU function that is located in the access network replicates "broadcast" signals to a set of subscribers. It is a simple point-to-multipoint function. The access network with RU function might lose flexibility, for example, instead of gaining point-to-multipoint capability, the network might lose point-to-point signalling capability or bidirectional signalling capability.

The RU function is also able to be located in the core network. For example, if the core network is based on ATM switches, it is possible the switches have the replication function. In this case, the access network can transport an individual signal over end-to-end full bandwidth and the core network (switching network) is able to provide more flexibility and intelligence. The RU function might be implicitly implemented by one of the core switch functions or be implemented as an independent unit from the switching unit. Instead of this superiority, implementing the RU function might be more expensive than implementing the RU function in the access network.

5.1.2.3 REMUX

Program transport streams must be formatted according to ITU-T Recommendation H.222.0. The REMUX performs the following functions on these program transport streams:

- programs are rearranged over transport streams so that the bandwidths of the resulting streams fit the capacity of the UNIs. For example, a MPTS of large bandwidth is splitted in several SPTSes and/or smaller MPTSs;
- program transport streams are encapsulated in either AAL1 or AAL5 packets and ATM cells for transport over the B-ISDN networks, according to ITU-T Recommendations H.222.1 and J.82. In accordance with ITU-T Recommendation J.82 the choice of the AAL type should be made based on the desired Quality of Service.

As such, one VC connection carries one program transport stream (SPTS or MPTS), and in case of MPTS, the set of programs must be selected by the end-user as a whole. The way the VCs are multiplexed in VP connections is up to the network provider. As an example, all programs transported in the same VP connection might be delivered by the same service provider.

6 Interfaces

6.1 Content server – core network management system

This interface is used by the service provider to transfer information to the network about offered program transport streams and geographical distribution of program or service offering.

6.2 Core network management system – REMUX

This interface is used by the service provide to control REMUX profiles such as data transfer rate and coding scheme of program.

6.3 Core network management system – access network management system

This interface is used to forward information about offered program transport streams and geographical distribution of program or service offering. In particular the relations between program identifiers and VC identifiers are provided by core network management system to access network management system.

6.4 Access network management system – BCU

This interface is used to forward the relations between program identifiers and VC identifiers.

6.5 STB – access network

At the physical layer, any protocol for the Tb reference point (ITU-T I.414) can be applied.

6.6 BCU – RU

This interface is used to let the BCU instruct the RU to deliver the program to the end user(s).

7 Logical interrelations

The SDB service implementation envisages that each CPE receives the following types of channels:

7.1.1 Zapping channel

This is the VC on which program select messages are exchanged between STB and BCU. The zapping protocol is the SDB-CCP, as specified in [1].

The zapping channel is provisioned via the OS when the customer subscribes to the SDB service. There is one zapping channel per UNI.

The VPI+VCI of the zapping channel is pre-configured in the STB.

7.1.2 Standby channel

This is the channel on which the STB is tuned in standby, to receive the standby program. The standby program contains the EMM stream. The VPI+VCI of the standby channel is communicated by the BCU to the STB in response to the sending by the STB of a program select message containing the program identifier of the standby program.

The bandwidth of the standby channel is low, and is allocated via the OS at subscription time.

Each STB has one standby channel.

The program identifier of the standby program is pre-configured in the STB.

7.1.3 Audiovisual channel

This is the generic channel to carry program transport streams.

The bandwidth for audiovisual channels can be allocated in one of the following ways:

- The total bandwidth for audiovisual channels over an UNI is allocated via the operating system (OS) at subscription time. This bandwidth is dislocated only when the customer unsubscribes.
- The bandwidth of an audiovisual channel for a STB is allocated when the STB sends the first program select message, or a program select message containing a new session identifier; this bandwidth is dislocated when the STB terminates the corresponding session (by selecting the standby program or the program with identifier = 0).

There can be, at a particular moment in time, several audiovisual channels in use per STB, provided that the UNI bandwidth is not overbooked.

The VPI+VCI of an audiovisual channel is not fixed; in general it changes with the program transport stream that is selected to be transported over the audiovisual channel. There is a one-to-one relation between an audiovisual channel and a session. An audiovisual channel carries one program transport stream at the time.

The selection of a program is refused when the audiovisual channel has not enough bandwidth to carry the selected program transport stream, or the UNI has not enough bandwidth available anymore for another audiovisual channel.

Each session identifier must be unique within the scope of one UNI.

7.1.4 Return channel

This is used by the STB to transfer service usage data to the service provider, on request of this service provider.

The return channel is a POTS connection between STB and service provider. The POTS address of the service provider is pre-configured in the STB.

Bibliography

[1] DAVIC 1.1 – Switched Video Broadcasting Channel Change.

ITU-T RECOMMENDATIONS SERIES

Series A	Organization of the work of the ITU-T
Series B	Means of expression: definitions, symbols, classification
Series C	General telecommunication statistics
Series D	General tariff principles
Series E	Overall network operation, telephone service, service operation and human factors
Series F	Non-telephone telecommunication services
Series G	Transmission systems and media, digital systems and networks
Series H	Audiovisual and multimedia systems
Series I	**Integrated services digital network**
Series J	Transmission of television, sound programme and other multimedia signals
Series K	Protection against interference
Series L	Construction, installation and protection of cables and other elements of outside plant
Series M	TMN and network maintenance: international transmission systems, telephone circuits, telegraphy, facsimile and leased circuits
Series N	Maintenance: international sound programme and television transmission circuits
Series O	Specifications of measuring equipment
Series P	Telephone transmission quality, telephone installations, local line networks
Series Q	Switching and signalling
Series R	Telegraph transmission
Series S	Telegraph services terminal equipment
Series T	Terminals for telematic services
Series U	Telegraph switching
Series V	Data communication over the telephone network
Series X	Data networks and open system communications
Series Y	Global information infrastructure and Internet protocol aspects
Series Z	Languages and general software aspects for telecommunication systems

Geneva, 2001