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Digital Broadband Cable Access to the Public Telecommunications Network; IP Multimedia Time Critical Services; Part 12: Internet Signalling Transport Protocol (ISTP)

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Digital Broadband Cable Access to the Public Telecommunications Network; IP Multimedia Time Critical Services; Part 12: Internet Signalling Transport Protocol (ISTP)

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650 Route des Lucioles
F-06921 Sophia Antipolis Cedex - FRANCE

Tel.: +33 4 92 94 42 00 Fax: +33 4 93 65 47 16

Siret N° 348 623 562 00017 - NAF 742 C
Association à but non lucratif enregistrée à la
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Foreword

This Technical Specification (TS) has been produced by ETSI Technical Committee Services and Protocols for Advanced Networks (SPAN).

The present document is part 2 of a multi-part deliverable. Full details of the entire series can be found in part 1 [3].

Introduction

This version is based on the 8TD112r2 from SPAN #78 in June 02 and the direct continuation of D8-36 presented at TC-AT-D in July 02. The main changes are due to the new mechnism for OTID assignment and the additions in the Subsystem registration. Proposed text changes from Ray Forbes are also covered.

1 Scope

The present document describes the Internet Signalling Transport Protocol (ISTP) to implement Signalling System No. 7 signalling interconnection to a distributed IPCablecom architecture.

The present document addresses the protocol to implement ETSI SS7 used for signalling interconnection in a distributed IPCablecom architecture. Specifically, it defines the messages and procedures for transporting SS7 ISUP, and TCAP messages as defined by ETSI specifications between the IPCablecom control functions (Media Gateway Controller and Call Management Server) and the SS7 Signalling Gateway. The IPCablecom Networks are always connected to the PSTN/ISDN using standard ETSI SS7 interfaces Ref (ISUP, MTP and SCCP)

Areas beyond the scope of the present document include:

- address layer management (SNMP), security, and measurements; these are covered in other IPCablecom Recommendations;
- implementation and vendor dependant issues, such as performance, functional distribution, network configuration, etc.;
- details about CMS, MGC, and other media communication applications.

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.

[1] ETSI EN 300 356: "Integrated Services Digital Network (ISDN); Signalling System No.7 (SS7); ISDN User Part (ISUP) version 4 for the international interface".

[2] ETSI ETS 300 287-1 (Edition 2): "Integrated Services Digital Network (ISDN); Signalling System No.7; Transaction Capabilities (TC) version 2; Part 1: Protocol specification [ITU-T Recommendations Q.771 to Q.775 (1993), modified]".

[3] ETSI TS 101 909-1: "Digital Broadband Cable Access to the Public Telecommunications Network; IP Multimedia Time Critical Services; Part 1: General ".

3 Definitions, abbreviations and conventions

3.1 Definitions

For the purposes of the present document, the following terms and definitions apply:

Access Node (AN): As used in the present document, an Access Node is a layer two termination device that terminates the network end of the J.112 connection. It is technology specific. In ITU-T Recommendation J.112 annex A it is called the INA while in Annex B it is the CMTS.

Cable Modem (CM): layer two termination device that terminates the customer end of the J.112 connection

Gateway: devices bridging between the IPCablecom IP Voice Communication world and the PSTN

NOTE: Examples are the Media Gateway which provides the bearer circuit interfaces to the PSTN and transcodes the media stream, and the Signalling Gateway which sends and receives circuit switched network signalling to the edge of the IPCablecom network.

IPCablecom: ETSI project that includes an architecture and a series of Recommendations that enable the delivery of real time services over the cable television networks using cable modems

Signalling Gateway (SG): signalling agent that receives/sends SCN native signalling at the edge of the IP network

NOTE: In particular the SS7 SG function translates variants ISUP and TCAP in an SS7-Internet Gateway to a common version of ISUP and TCAP.

3.2 Abbreviations

For the purposes of the present document, the following abbreviations apply:

AN	Access Node
ANS	Announcement Server
ATM	Asynchronous Transfer Mode
CA	Call Agent
CIC	Circuit Identification Code
CID	Circuit ID
CM	Cable Modem
CMS	Call Management Server
DNS	Directory Name Server
DPC	Destination Point Code
HFC	Hybrid Fibre/Coaxial [cable]
IP	Internet Protocol
ISTP	Internet Signalling Transport Protocol
ISUP	ISDN User Part
LAN	Local Area Network
MAC	Media Access Control
MG	Media Gateway
MGC	Media Gateway Controller
MTA	Media Terminal Adapter
MTP	Message Transfer Part
NI	Network Identifier
OPC	Origination Point Code
OTID	Origination Transaction Identity
PHY	Physical Layer
PSTN	Public Switched Telephone Network
QoS	Quality of Service
RTP	Real Time Protocol
SCCP	Signalling Connection Control Part
SCP	Service Control Point
SCTP	Stream Control Transmission Protocol
SG	Signalling Gateway
SIP	Session Initiation Protocol
SLS	Signalling Link Selection
SS7	Signalling System No. 7
SSN	Switching Signalling Node
SSP	Signal Switching Point
TCAP	Transaction Capabilities Application Part
TCP	Transmission Control Protocol
UDP	User Datagram Protocol
WAN	Wide Area Network

3.3 Convention

If the present document is implemented, the key words "MUST" and "SHALL" are to be interpreted as indicating a mandatory aspect of the present document.

4 Signalling Protocols

The signalling protocols used for interconnection in a distributed IPCablecom PSTN gateway architecture shall be designed to support ETSI Signalling System No. 7 (SS7).

5 Void

6 Overview and background motivation

6.1 Service goals

Cable operators are interested in deploying high-speed data and multimedia communications services on cable television systems. It is necessary to have a series of interface Recommendations that will permit the early definition, design, development, and deployment of packetized data-based services over cable systems on a uniform, consistent, open, non-proprietary, multi-vendor interoperable basis. The intended system enables Internet Protocol (IP) based voice communications, video, and data services to be provided to the customer over an all-coaxial or hybrid-fibre/coax (HFC) cable access network by utilizing ITU-T Recommendation J.112 as the basic foundation for data transport. This is shown in simplified form in figure 1.

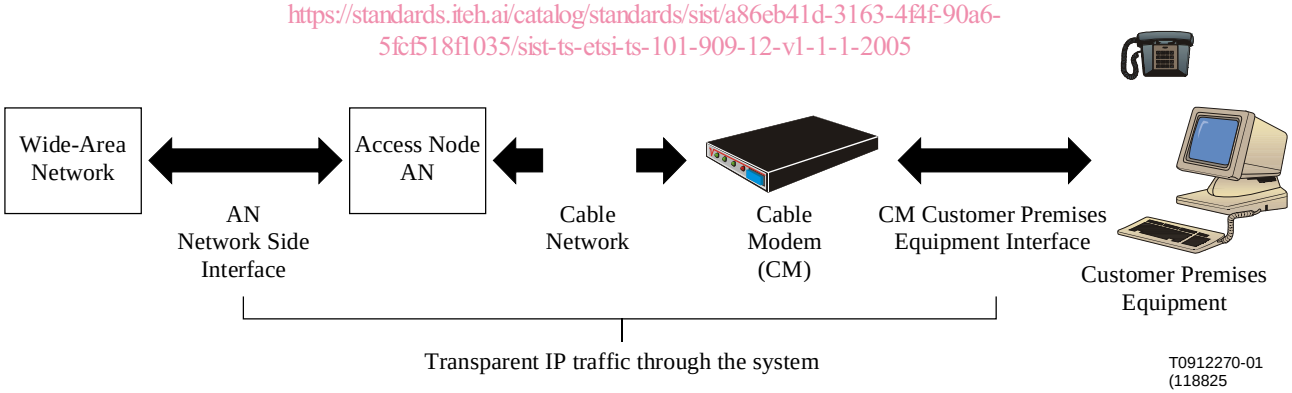

Figure 1: Transparent IP traffic through the data-over-cable system

The transmission path over the cable system is realized at the headend by an Access Node and at each customer location by a CM. The intent is for operators to transfer IP traffic transparently between these interfaces, thereby providing the basic transport mechanism for data-based multimedia services.

When providing voice and other multimedia services over the J.112 access network; many issues need to be addressed for incoming and outgoing communications. These issues include but are not limited to:

- voice or other media content conversion;
- call control signalling;
- quality of service control;
- call control signalling interoperability with the existing public network;

- media interfaces to the existing public network;
- data transactions to public databases;
- routing mechanisms;
- billing;
- operations and maintenance;
- security;
- privacy.

The IPCablecom project is addressing these issues through the development and publication of reference architecture and a series of corresponding interface specifications. The present document, the IPCablecom Internet Signalling Transport Protocol (ISTP) addresses the issue of call control signalling interoperability with the existing public network.

6.2 IPCablecom reference architecture

The conceptual diagram in figure 2 portrays a high level architectural view of the IPCablecom network.

Subscriber equipment consists of a Media Terminal Adapter (MTA), the primary purpose is to provide a gateway between the subscriber-side voice/video media devices and the rest of the IPCablecom network. Two types of MTAs exist. The first is a standalone MTA that connects via a local area network (LAN) interface (e.g. IEEE 802.3) to a CM. The second is an embedded MTA, which integrates the standalone MTA functions with the CM media access control (MAC) and physical layer (PHY) functions in the same physical package.

Physical connectivity to the backbone consists of an all-coax or a hybrid fibre-coax (HFC) J.112 enabled cable access network with J.112 Quality of Service (QoS). The J.112 HFC access network terminates at the head end Access Node. The Access Node provides either a bridging point or a routing point to the backbone managed IP network.

The Call Management Server (CMS) provides control, routing, and signalling services in connection with voice communications provided via IPCablecom. It is responsible for authorization and plays a roll in feature implementation. The media servers provide support services for media streams such as conference mixing bridges and announcement servers.

CMS is a meta-term for a collection of functions (both specified and unspecified within IPCablecom) within a server or cluster of servers that work together to perform "line-side" control functions within an IPCablecom network. The simplest way to think of a CMS is to imagine the functions of a local switch call controller being extrapolated and placed into a server farm. The CMS includes a minimum of a call agent and a gate controller. It may have feature and routing logic. It may or may not contain a media gateway controller, meaning that it can implement some transit switch functionality as well as local. A SIP-proxy may also be contained within a CMS, although IPCablecom does not include SIP in the architecture.

A Call Agent is a specific control function contained within the CMS. It implements the server side of the protocol interface and controls MTAs. The MGC is a specific control function that may be contained within a CMS or may be standalone in the network. It implements the server side of the TGCP protocol interface and is used to control PSTN media trunking gateways.

The Public Switched Telephone Network (PSTN) gateway provides access from the subscriber network into the PSTN network. For outgoing communications, the Media Gateway (MG) converts the voice samples arriving in RTP packets into the appropriate TDM format and delivers the resulting voice stream to the public network. The Media Gateway Controller (MGC) provides signalling information related to the communication to the PSTN through the services of the Signalling Gateway (SG). This signalling information exchanged with the PSTN is used by the components of the IPCablecom network to manage the communication's progress and provide required features and functionality. In addition, IPCablecom gateways also interwork with the public databases of the PSTN using SS7 TCAP queries, allowing the IPCablecom network to query for publicly available data (freephone numbers, local number portability service, credit card data, etc.).

For incoming communications, IPCablecom equipment will convert arriving TDM circuit voice to RTP packets carrying appropriately coded samples. It will also take the incoming communication related SS7 ISUP signalling and convert it to signalling understood by IPCablecom devices.

The OSS back office provides support services such as billing, provisioning, fault determination, problem resolution, and other support services.

Note that ISTP makes no assumptions on how the CMS and MGC and other ISTP-User functions are distributed or physically located: they all MAY be collocated, each distributed on separate computers, or all distributed as separate nodes and processes across a wide network and a large number of computers. ISTP was designed to handle all these cases.

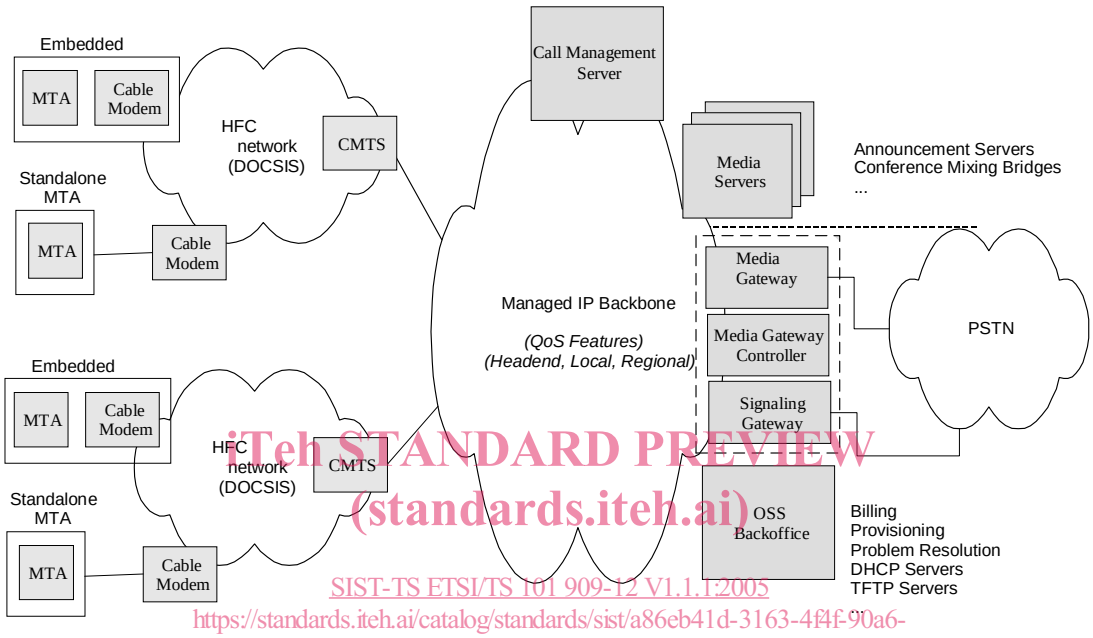

Figure 2: IPCablecom reference architecture

6.3 Introduction to ISTP

ISTP contains features for initialization; address mapping from the SS7 domain to the IP domain; message delivery for SS7 Integrated Services Digital Networks (ISDN) User Part (ISUP), Transaction Capabilities Application Part (TCAP); congestion management; fault management; maintenance operations; and redundant configuration support. ISTP bridges the gap between basic IP transport mechanisms and application level signalling. Although not a translation of the SS7 Message Transport Protocol 3 (MTP3) and Signalling Connection and Control Protocol (SCCP) protocols, ISTP implements analogues to some of the MTP3 and SCCP functions in a fashion appropriate to distributed systems communicating over an IP network.

Thus ISTP distributes transparently the ISUP and TCAP functions into multiple elements while retaining the computational intensive SCCP/MTP2/MTP3 SS7 stack elements in the Signalling Gateway (see figure 3). This also keeps the SCCP Global Title tables in a secure central location, as preferred by SS7 network operators. This breakdown also allows ISTP-User applications to have access to all the TCAP and ISUP data, which may be necessary for some advanced features. It provides the maximum isolation from SS7 details while providing full transaction and signalling information. It also allows new ISTP-User applications that require other SS7 application part protocols, such as GSM MAP and IS41 MAP, to be added in a graceful and backward compatible manner by installing the MAP agents over ISTP as needed.

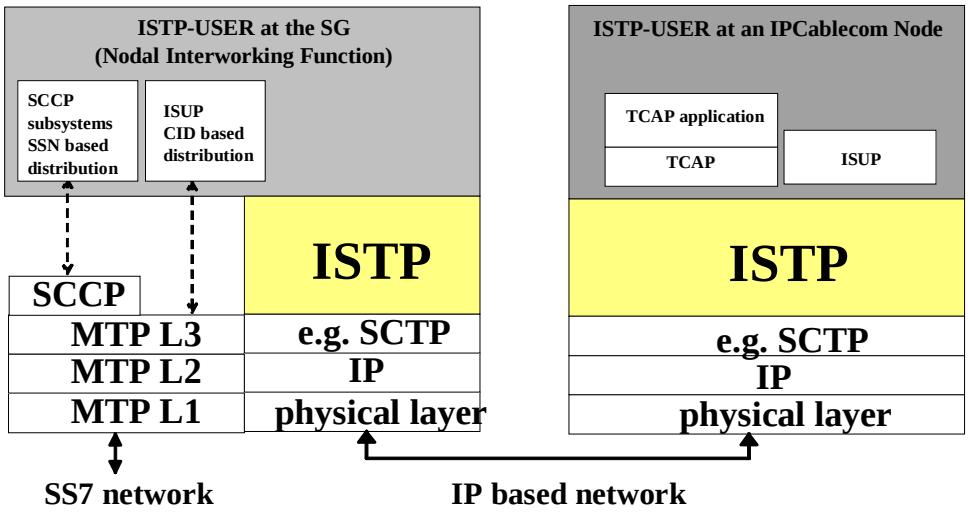

Figure 3: Protocol stack in IPCablecom elements

The ISTP is designed to support a wide variety of configurations, ranging from a non-redundant SS7 Signalling Gateway serving a single non-redundant Media Gateway Controller to a distributed, fully redundant SS7 Signalling Gateway serving multiple distributed and redundant Media Gateway Controllers and Call Management Servers, and potentially other network elements.

NOTE: The term ISTP-User will be a generic term for any element, node, or process that uses the ISTP stack for signalling communications. For the first phase of IPCablecom this includes the CMS, MGC and SG. In the future, other types of elements may include the stack.

The ISTP contains functions for:

- Initialization.
- Registration Of Circuit IDs With The SS7 Gateway.
- Address Mapping Between The SS7 and IP domains.
- ISUP Maps Based On Point Code and Circuit Identification Code.
- TCAP Maps Based On Point Code and Origination Transaction ID (OTID) from the SS7 side of the SG to the transaction ID used on the IPCablecom side and vice versa.
- ISUP/TCAP Message Delivery Using Reliable Transport.
- Maintenance Operations.
- Activation/Deactivation of Circuit IDs within the SS7 Gateway. (The actual physical circuits terminate on the Media Gateway.)
- Error Recovery Due To Faults.
- SS7 Signalling Point Inaccessible.
- SS7 Signalling Network Inaccessible.
- MGC Inaccessible.
- CMS Inaccessible.
- Error Recovery Due To Congestion.
- Signalling Point Congested.
- Signalling Link Congested.

- MGC Congested.
- CMS Congested.

The above functions are implemented messages and procedures defined in the present document.

In order to meet the performance and reliability requirements mandated by IPCablecom and SS7 interconnection, ISTP requires the services of an underlying reliable transport service. The reliable transport preferred is Stream Control Transport Protocol (SCTP) as defined in the IETF SIGTRAN working group in RFC 2960 and RFC 3309. TCP can provide a workable solution, as long as the network is engineered properly, but SCTP is preferred. UDP is not considered an acceptable option, as it does not supply sufficient reliability to meet IPCablecom requirements.

6.4 Specification goals

The goal of the present document is to meet and satisfy the business and technical requirements of cable operators, including the following:

- Support for cable companies' penetration into residential and business markets for multimedia services, including voice.
- A low cost replacement for PSTN switching, peripheral, and control elements using IP-based technology.
- A network that can provide higher level features (such as multimedia) in addition to the PSTN features.
- A transparent interface to the existing PSTN.
- An open architecture, that will support the interworking of multiple vendors' equipment in the same IPCablecom network.
- A scalable gateway architecture, allowing solutions ranging, for example, from the equivalent of a single T1/E1 media gateway up to a system that is the equivalent of a large tandem switch supporting multiple central offices (about 40 000 trunks).
- An architecture that can achieve the same high degree of reliability and performance as the PSTN, while allowing for a simplified network (simplex connections) to support lower cost enterprise and customer premise implementations.

6.5 Specification interfaces

The basic reference architecture (see figure 2) involves two interface categories between the SS7 Signalling Gateway and the IPCablecom call control elements:

- *SS7 Signalling Gateway to Media Gateway Controller*: Enables signalling interconnection between the SS7 network and the Media Gateway Controller for SS7 ISUP message interworking. ISUP is used for out-of-band call signalling in the PSTN.
- *SS7 Signalling Gateway To TCAP User*: Enables signalling interconnection between the SS7 network and certain trusted entities ("TCAP Users") within the IPCablecom network, such as Call Management Servers and Media Gateway Controllers, for SS7 TCAP message interworking. TCAP is used primarily to query external PSTN databases for applications such as freephone calling and number portability (NP) routing.

7 Architecture

7.1 IPCablecom to PSTN

The ISTP is specified within the context of an architecture intended to interwork an IP-based cable network with the Public Switched Telephone Network (PSTN). At this time, only the Call Management Server, the Media Gateway controller, and the Signalling Gateway use ISTP; however, the protocol is designed to support future network elements where access to the SS7 network or transactions from the SS7 network are needed.