IP-CC Requirements specification

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Important Information

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Versions of this document have been distributed to the following standard working groups:

1. DVB-TM of ETSI, as SI-DAT 621

2. IP over DVB BOF of the IETF

Version history

Date	Author	Version	Status[1]	Description
06-Nov-01	Juha-Pekka Luoma	0.01	Draft	Document started, first requirements listed
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12-Nov-01	Juha-Pekka Luoma	0.05	Draft	Requirements added and improved.
16-Nov-01	Juha-Pekka Luoma	1.0	Proposal	Implemented changes based on comments from Rod Walsh, Toni Paila and Matti Puputti.
15-Mar-02	Juha-Pekka Luoma	2.0	Reviewed	Clarifications & improvements resulting from DVB-GBS input
7-May-02	Juha-Pekka Luoma	3.0	Reviewed	Further enhancements and corrections in various places, including new information flow model.

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Draft: Unfinished document representing authors' views.
Proposal: Reviewed by the project manager, represents the views of the project group.
Reviewed: Reviewed by the QA Engineer assigned to the project.
Final: Deliverable that has been formally approved by the customer of the project.

Contents

1. INTRODUCTION

1.1 Purpose of this document

This is the requirement specification of the IP Control Channel (IP-CC) for DVB networks. The IP-CC is proposed as a solution for signaling parameters of IP services available on DVB networks.

1.2 Scope

Requirements for IP related signaling are in scope. Mandatory and optional requirements are in scope. Signaling below layer 3 is out of scope. Technical solutions and implementation are out of scope as is how requirements relate to each other.

2. TERMS AND DEFINITIONS

This chapter defines the terms used in, and relevant to, this document.

client	*Client* generically describes the combination of the hardware and software of a Datacast receiver and terminal equipment and the human end-user
DVB cell	Identical to "cell" as defined in EN300468 [2]: **cell:** cell is a geographical area that is covered with DVB-T signals by means of one or more transmitters each radiating a particular transport stream on only one frequency. The cell may in addition contain repeaters. Two neighboring cells may have an intersection. The cell_id that is used to uniquely identify a cell shall be unique within each original_network_id.
DVB component	A single elementary stream or other data stream that is part of a DVB *service* (TS). There cannot be more than one *DVB component* per *PID*. Similar concept to "component", which is defined in EN300468 [2]: **component (ELEMENTARY Stream):** one or more entities which together make up an event, e.g. video, audio, teletext. For IP-CC, *IP services* are one such entity. *DVB service* and *DVB component* are constant within a *multiplex* and map respectively to *program* and *program element* defined in [1]. The value of the **component_tag** DVB SI parameter can be used to uniquely identify a DVB component within a DVB service.
DVB network	Identical to "network" as defined in EN300468 [2]: **network:** collection of MPEG-2 Transport Stream (TS) multiplexes transmitted on a single delivery system, e.g. all digital channels on a specific cable system.

DVB service	Consists of one for more *DVB components*. Identical to "service" as defined in EN300468 [2] : **service:** sequence of programmes under the control of a broadcaster that can be broadcast as part of a schedule. **service_id:** unique identifier of a service within a TS.
DVB subcell	DVB subcells, within a DVB cell, contain identical data but may use different physical layer parameters (such as frequency). This requires a transposer. Identical to "subcell" as defined in EN300468 [2]: **subcell:** subcell is a geographical area that is part of the cells coverage area and that is covered with DVB-T signals by means of a transposer. In conjunction with the cell_id the cell_id_extension is used to uniquely identify a subcell. **Transposer:** transposer is a type of repeater, which allows to receive a DVB-T signal and to re-transmit it on a different frequency. **Repeater:** repeater is a type of a network element, which allows to receive a DVB-T signal and to re-transmit it. It does not allow changing the TS bits and thus the cell_id.
IP Access Network	A collection of IP services transmitted on a single delivery system, e.g. a DVB-T access network run by a single broadcaster. In the DVB case, an *IP Access Network* has a one-to-one relationship with a *DVB Network*. Consists of one or more *access network cells*. In the DVB case, an *access network cell* has a one-to-one relationship with a *DVB cell*. Each *access network cell* consists of one or more *access network subcells*. In the DVB case, an *access network subcell* has a one-to-one relationship with a *DVB subcell*.
IP Control Channel (IP-CC)	The IP Control Channel, which describes IP-based services over a DVB Datacast network using IP-based protocols. [The scope need not be limited to DVB].
IP cell	An *IP cell* is a logical area that provides *IP services* to a specific *access network cell*. Different *IP cells* may contain same and different *IP services*. In the DVB case, an *IP Cell* may have a one-to-one relationship with a *DVB Cell*. IP cell identifiers are delivered using IP-CC, not SI tables.
IP service	An IP service is defined by parameters such as the identifier of a content provider and the location of the IP service within an IP service category hierarchy. A client can subscribe to an IP service, similarly as in subscribing to a magazine or a pay-TV channel. Content relating to an IP service is distributed in the scope of one or more IP sessions. An IP service normally has a long lifetime, during which any number of IP sessions can be delivered sequentially or in parallel as part of the IP service.

IP service announcement	Similar to service announcement, but with parameters specific to IP-based protocols.
IP service description	Similar to service description, but with parameters specific to IP-based protocols.
IP service category	An IP service category can be used to group together related IP services. It is intrinsically hierarchical, i.e. any IP service category can include subcategories. The location of an IP service category within a hierarchy could be described using a dotted notation, for example "myISP.news.sport.football".
IP service provider	IP service provider – identified by source_ISP_id - is associated with IP services it provides. Hence, IP service provider in many cases is the originator of IP-CC.
IP session	An IP session includes one or more IP session components carrying content (e.g. live music) and possibly including some added-value service (e.g. error correction or song lyrics). It is typically time-limited and can be distributed as part of an IP service. For example, news could be classified as an IP session that includes a live audio IP stream, a video-clip download IP stream, and a web page push IP stream.
IP session component	An IP session component corresponds to the media stream described in [5]. It is used to identify a content flow within the scope of an IP session. The content flow of an IP session component is implemented using one or more IP streams.
IP session directory	An IP session component that delivers announcements of other IP sessions (for possible implementation, see [6], [7]). The "root" *IP-CC* itself can be considered an IP session directory without a parent directory. The use of multiple IP session directories allows the network load of IP session announcements to be distributed on more than one multicast group. Different IP session directories can be carried on the same or on different physical/logical access network channels.
IP stream	An IP datagram flow identified by the source and destination IP address. An IP stream can be encrypted, allowing only clients who have received a corresponding key to decrypt the stream.
IP subcell	An *IP subcell* is a logical area that is part of an *IP cell's* coverage area and provides *IP services* to a specific *access network subcell*. All *IP subcells* within an *IP cell* contain identical *IP services* (i.e. identical data at the IP network layer and higher protocol layers). In the DVB case, an *IP subcell* may have a one-to-one relationship with a *DVB subcell*.
multicast service	Multicast services are multiparty services between two or more hosts (e.g. point-to-multipoint). Examples include a broadcast news service (audio and/or video) and group file distribution.

multiplex	Multiplex (or MUX) is a combination of *DVB services* and *DVB components* into one TS. This may be remultiplexed, which involves combining some or all of the *DVB services* on multiple multiplexes (each its own TS) into a single, new, multiplex (a new TS). Identical to "multiplex" as defined in EN300468 [2]]: **Multiplex:** stream of all the digital data carrying one or more services within a single physical channel.
PID	A Packet Identifier is a 13-bit integer field in the TS packet header, identifying a logical channel within a TS. Some values are reserved by MPEG and DVB standards.
Program	A time limited event on a DVB system that includes *program elements*. For example, a 30-minute news broadcast. Identical to "programme" as defined in EN300468 [2]: **Programme:** concatenation of one or more events under the control of a broadcaster e.g. news show, entertainment show.
service announcement	The announcement of a service in sufficient detail that a client can successfully receive the service. The *service announcement* is a message that contains service description(s).
service description	The *service description* defines the type of service and other parameters related to it. It, usually, includes sufficient human readable information to be rendered in a *service guide*. For possible implementation, see [5].
service discovery	The mechanism and protocols involved in a *client* finding information about available services. *Service announcement* is one instance of this.
service guide	A *client* application which provides a user-interface of available services to a human user. Similar concept to a DVB EPG (Electronic Program Guide).
session announcement	Similar to service announcement, but with session details.
session description	Similar to service description, but with session details.
SI	Identical to "Service Information" as defined in EN300468 [2]: **Service Information (SI):** digital data describing the delivery system, content and scheduling/timing of broadcast data streams etc. It includes MPEG-2 PSI together with independently defined extensions.
TS	Identical to "Transport Stream" as defined in EN300468 [2]: **Transport Stream (TS):** TS is a data structure defined in ISO/IEC 13818-1[1]. It is the basis of the DVB standards. **Transport_stream_id:** unique identifier of a TS within an original network.

unicast services	Unicast services are individual services between only two hosts (point-to-point). Examples include true video-on-demand and (normal HTTP) web browsing.

Please also note the following use of the words "shall", "shall not", "may", "may not" in this document to indicate requirement levels:

shall	This is an absolute requirement - "shall" is synonymous with "must".
shall not	This is an absolute prohibition.
may	In most cases the requirement should be implemented, but there might be valid reasons not to follow the requirement.
may not	In most cases the prohibition should be implemented, but there might be valid reasons not to follow the prohibition.

3. REFERENCE MODEL

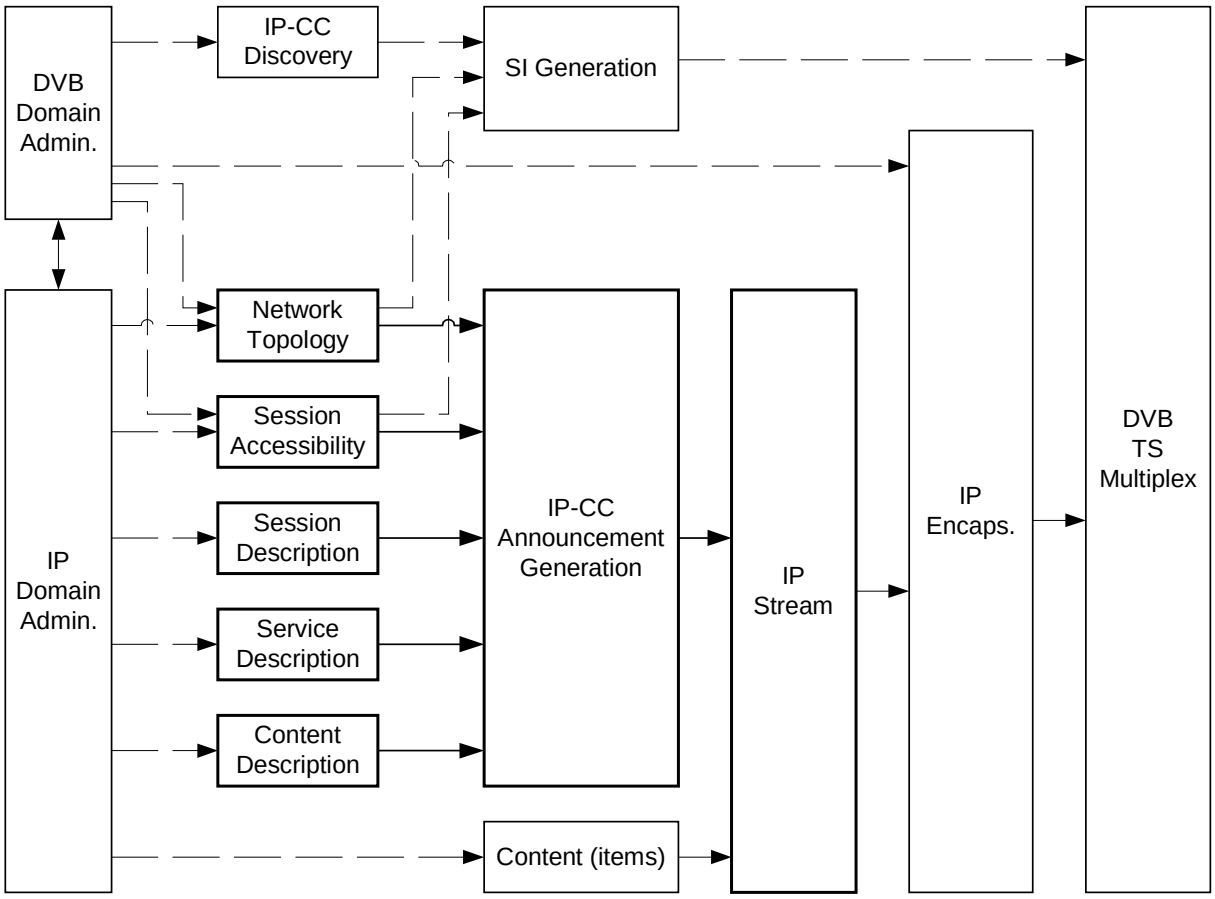

Figure 1: IP-CC Information Flow

Figure 1 presents a reference model for IP service discovery in DVB systems. It represents a logical architecture, not a physical deployment. Each entity shown could be a single or several such entities, for example, there could be multiple IP streams and IP-routed networks. Solid arrows in the figure correspond to data flows that are within the scope of IP-CC, and dashed arrows to data flows that are out of scope. Only the network-end is shown. The client-end performs the inverse process.

See the following subsections for brief descriptions of the information elements identified in the figure above. The following chapters cover the *IP-CC Announcement*, *Session Accessibility* and *Session Description* elements in more detail.

3.1 DVB Domain Administration

DVB domain administration is the activity controlling allocation of resources of a DVB network. It coordinates the allocation of logical channels and bandwidth for IP data, SI tables and elementary streams on the *TS multiplexes* of each DVB network. It provides some of the information elements as shown in the figure above.

3.2 IP Domain Administration

IP Domain Administration controls the allocation of resources within IP networks. It provides some of the information elements as shown in the figure above.

3.3 IP-CC Discovery

IP-CC discovery is information which the DVB system provides so that clients can locate IP-CC logical channels in DVB-TS.

3.4 Network Topology

Network topology describes the physical network lay-out. Thus a client is able to identify networks and cells, which may include information about the cells neighboring the client's current cell. Attributes may include: Physical geographic/spatial information; Physical link (e.g. radio) parameters; Logical cell structure

3.5 Session Accessibility

Session accessibility provides clients with information on IP sessions regarding the protocols and their parameters used, as well as the session availability in time.

3.6 Session Description

Session description provides metadata describing an entire IP session. This can include service classification common to all the content delivered as part of an IP session. Details of the bandwidth requirements and codecs needed at the client side can also be described on IP session basis.

3.7 Service Description

Service description is an entity similar to *session description*, but applies to an entire IP service including all IP sessions and content items transmitted as part of that IP service.

3.8 Content description

Content description provides metadata describing content items delivered as part of an IP session. *Content description* may classify each content item, allowing users to select from between different content.

3.9 Content

Content is provided over an IP protocol stack and routed by the same IP-routed network as the IP-CC.

3.10 SI Generation

SI generation produces DVB SI tables under the control of the *DVB domain administration*. These include the IP-CC Discovery information.

3.11 IP-CC Announcement

IP-CC announcement generation provides encoding, framing and transport for the information that contribute to IP-CC descriptions.

3.12 IP Stream

IP streams are flows of IP packets with an identifiable destination and source. They deliver both content and IP-CC announcements.

3.13 IP Encapsulation

IP encapsulation adds a DVB compliant Layer2 framing to IP packets and inserts the Layer2 frames into MPEG-2 TS packets. The TS packets produced by IP Encapsulation can be used as an input to a DVB TS multiplex.

3.14 DVB TS multiplex

DVB TS multiplex receives TS packet flows from one or more sources and combines these into a DVB compliant MPEG-2 TS. The output of a DVB TS multiplex can be fed into a DVB transponder.

4. REQUIREMENTS

4.1 Session Accessibility (SAC)

SAC:1 – Support for multicast IP

The IP-CC system shall announce the accessibility details of multicast IP services available via the IP access network.

SAC:2 – Support for unicast IP

The IP-CC system shall announce the accessibility details of unicast IP services available via the IP access network.

SAC:3 – Coordination of multicast IP addresses

The destination multicast addresses of IP services shall be coordinated by each IP service provider. It shall be possible for more then one IP service provider to use the same multicast IP destination address. The use of multicast IP addresses shall comply with IANA [11] address assignments.

SAC:4 – Coordination of unicast IP addresses

Unicast IP addresses used in the IP-CC system shall be globally unique and comply with IANA [11] address assignments.

SAC:5 – Identification of multicast IP services

A multicast IP service consisting of one or more multicast IP streams shall be identifiable by a globally unique identifier.

SAC:6 – Identification of multicast IP streams

A multicast IP stream shall be globally uniquely identifiable by the combination of a multicast IP destination address and a globally unique identifier of the originating IP network. The globally unique

identifier of the originating network shall be an information entity specific to one IP service provider (identified by source_ISP_id).

Where source specific multicast (SSM) [10] is available (generally identified by services using destination address range 232/8 for IPv4 and FF3x::/96 forIPv6), the source_ISP_id may include, or be exclusively, a unique source IP address. The further definition and administration of source_ISP_id is out of the scope of this document.

SAC:7 – Routing of multicast IP streams

It shall be possible to route multicast IP streams to different IP cells and to different clients in the same IP cell, based on the combination of the destination multicast IP address and the unicast IP source address.

SAC:8 – IP service categorisation

Categorisation of IP services shall be supported, allowing service providers to group related IP services together.

SAC:9 – Announcing contact details of an IP service provider

The IP-CC system shall support the delivery of information on how the end-user can contact the IP service provider.

For example, this information can be in the in the form of an HTTP URL or a telephone number that allows end-users to contact the IP service provider. Using the contact information, end-users may obtain access rights to an encrypted IP service in return for submitting a payment.

SAC:10 – Hybrid network access

The IP-CC system may deliver information on how to establish a return data path connection to a service provider.

The return data path connection may be established over any two-way IP-based network while using DVB or other unidirectional IP access network as the forward data path.

The details of return data path connectivity include e.g. the telephone number of a preferred IP service provider and/or the IP address of a server providing the return data path.

SAC:11 – Access rights and requirements

The IP-CC system shall deliver information on the access rights required to access each IP service.

Such access rights requirements may indicate for example that the client is required to authenticate itself in order to obtain decryption keys for an IP service. Client may also be required to periodically signal that it wishes to continue receiving the service.

SAC:12 – Announcing the time availability of IP services

The IP-CC system shall deliver information on the time availability of IP services. Such information includes the start and end times of an IP service transmission. In addition, details on transmission period repetitions may be included in the time availability information.

SAC:13 – Multicast address collision avoidance

Reuse of Multicast IP destination addresses between domains shall not cause multicast routing and join problems in the common IP routed-networks and client devices.

SAC:14 – Grouping logical announcement channels to client network interfaces

It is assumed that Layer 2 signaling enables identifying IP streams according to the client's IP service provider. This enables client interfaces (in the IP routing table) to be per ISP, and thus multicast destination collisions between different ISPs' traffic would not occur on a single interface.

SAC:15 – Hierarchies of service categorization

The IP-CC shall support categorization of services according to a hierarchical scheme. The classification is entirely definable by the originator of IP-CC.

For example, normal dotted notation, familiar from Internet host naming of NNTP (Network News Transfer Protocol) may be used. This requirement does not set any limits how the hierarchical classification should be used.

4.2 Support for Session Maintenance (SEM)

SEM:1 – Multicast session maintenance for mobile clients

The IP-CC system shall be extensible to include support for maintaining multicast sessions for mobile clients. The details of multicast session mobility support are outside the scope of this document.

SEM:2 – Unicast session maintenance for mobile clients

The IP-CC system may not provide support for maintaining unicast sessions for mobile clients. Techniques such as Mobile IP [9] may be used for this purpose, but the details of unicast session mobility are outside the scope of this document.

4.3 Session Description (SDR)

SDR:1 – Multicast IP service types

It shall be possible to describe and announce at least the following basic one-to-many IP service types: streaming audio/video, unreliable file transfer (without acknowledgements), reliable file transfer (with acknowledgements), session directories (see SAC:8).

SDR:2 – Unicast IP service types

It shall be possible to describe and announce at least the following basic one-to-one IP service types: messaging, reliable file transfer, bi-directional access to the Internet, bi-directional access to the Intranet (walled garden) of an IP service provider.

SDR:3 – Content descriptions

The IP-CC system shall announce descriptions of the available IP services. Parts of an IP service description may contain human-readable information that is presented to the end-user, while the rest of the description is interpreted by the client software.

SDR:4 – Details of client requirements

The IP-CC system shall announce the details of client requirements for each IP service.

For example, the required bandwidth and types of audio/video codecs needed for presenting the IP service may be announced.

4.4 Network Topology (NTO)

4.4.1 Network, Cell and Subcell Addressing and Identification

NTO:1.1 – Identifying IP access networks

Each IP access network shall be identified by a globally unique identifier.

NTO:1.2 – The format of an IP access network name

The format of the access network identifier shall comply with existing IETF [12] standards.

[For example, an IP address (in the dotted decimal or DNS format) or a URI may be used to identify an access network. E.g. "urn:ipdc_network_id:london.datacast.bbc.co.uk".]

NTO:1.3 – Identifying IP cells within an IP access network

Each IP cell shall be identified by an identifier that is unique within an IP access network.

NTO:1.4 – The format of an IP access network cell name

The format of the cell identifier shall be defined using existing IETF standards.

[An example of a URN – "urn:ipdc_cell_id:cell123.london.datacast. bbc.co.uk".]

NTO:1.5 – The structure of the IP cell identifier.

The IP cell identifier may include the IP network identifier.

NTO:1.6 – Identifying IP subcells within an IP access network IP cell

An IP subcell shall be identified by an identifier that is unique to a single IP cell.

NTO:1.7 – The format of an IP subcell identifier

The IP subcell identifier shall comply with existing IETF standards.

NTO:1.8 – The structure of an IP subcell identifier

The IP subcell identifier may include the IP cell identifier.

NTO:1.9 – Independence from the IP access network type

The IP network, IP cell and IP subcell addressing schemes shall be independent of the access network type.

For example, the network types DVB-x, DAB, ISDB-x, WLAN and others may be supported.

NTO:1.10 – Physical and link layer parameter announcements

IP-CC may provide physical and link layer parameters of an access network.

NTO:1.11 – cell neighborhood discovery

The IP-CC system may announce the Layer 1 and Layer 2 parameters of neighboring cells in each cell.

4.4.2 Spatial Location

NTO:2.1 – Cell geographical coverage information

IP-CC may provide information on the geographical coverage of access network cells.

The geographical coverage information may optionally be included in cell descriptions.

4.4.3 IP access network type

NTO:3.1 – Network type independence

IP-CC signaling shall be transportable on any IP-based access network.

NTO:3.2 – Discovery of IP services in other cells

It shall be possible to signal the availability of IP services in IP cells other than the one the client is currently connected.

The other IP cells may or may not use the same access network type as the current cell.

NTO:3.3 – Filtering of IP-CC messages

It shall be possible for network elements to filter IP-CC announcements transmitted in each IP cell.

IP-CC announcements can be filtered for example according to the geographical location of the IP cell, so that only information about the current cell and its neighboring cells is transmitted in each cell.

Another example is the filtering of IP-CC announcements based on the access network type, so that verbose link-layer information about cells of one access network type is not transmitted in cells of another access network type.

NTO:3.4 – Offline IP-CC access

It shall be possible to receive IP-CC announcements describing DVB services when not receiving a DVB signal, via a non-DVB access network.

4.4.4 Network Initiated Service Relocation

NTO:4.1 – Horizontal handover

IP-CC shall support the network-initiated relocation of IP Services between cells of the same access network type.

NTO:4.2 – Vertical handoff

IP-CC may support the network-initiated relocation of IP Services between cells of different access network types.

NTO:4.3 – IP layer mechanisms used for IP service relocation

Relocation of IP services shall be based on IP layer addressing and routing.

NTO:4.4 – Announcement of IP service relocation

The relocation of an IP service shall be announced in every IP cell where the IP service was transmitted prior to the relocation and after the relocation.

NTO:4.5 – Continuity of IP service reception

The IP-CC signaling shall enable any client receiving an IP service to continue receiving it after the relocation, if the IP service is still available in the client's physical location.

4.5 Protocol Issues (PRI)

PRI:1 – Overlap between DVB SI and IP-CC

IP-CC may signal parameters that are already available in DVB SI.

This allows for example the link-level parameters of a DVB access network to be included in IP-CC announcements that are transmitted unchanged on homogenous and non-homogenous networks.

PRI:2 – IP versions

IPv4, IPv6 or both shall be supported for signaling and service delivery.

PRI:3 – IP-CC delivery independence

The delivery of the descriptors (information elements & their format) shall be independent of the delivery protocols used. For example, IP-CC may be delivered using SAP or UHTTP.

PRI:4 – IP used as a basis for IP-CC.

Protocols below Layer 3 shall not be used for IP-CC signaling. IP-CC is based on IP on Layer 3.

PRI:5 – Protocol choice for Layer 4 and above

Layer 4 and above protocols in IP-CC shall comply with existing IETF or other open standards or be extended from protocols defined in those standards.

PRI:6 – IP-CC addressing

IP-CC may be delivered using a single well-known multicast IP address and port or multiple IP addresses and ports. In the latter case, different parts of IP-CC may be transported using different protocols. The IP-CC addresses and ports are dependent of the protocols used for IP-CC transport.

For example, the port 9875 and the global scope multicast IPv4 address 224.2.127.254 or IPv6 address FF0X:0:0:0:0:0:2:7FFE reserved for SAPv2 [2] may be used with IP-CC.

PRI:7 – Mapping between Layer 2 and Layer 3 parameters

It shall be possible for an IP-CC client to map IP streams to specific access network parameters in an efficient manner.

In the case of a DVB access network, a subset of the following parameters could be used for IP stream mapping: *source_ISP_id*, *network_id*, *original_network_id*, *cell_id*, *transport_stream_id*, *service_id*, *component_tag* and *PID* (where all but *source_ISP_id* are previously defined by DVB).

PRI:8 – Updating and canceling of service announcements

It shall be possible for the IP-CC system to send service announcements that update or cancel service announcements sent earlier.

PRI:9 – Validity of service announcement

It shall be possible for clients to determine whether a given service announcement is still valid or has expired.

PRI:10 – Signing of service announcements

It shall be possible to insert a digital signature to a service announcement, allowing clients to confirm that a service announcement has not been tampered with and optionally to authenticate the source of the service announcement. Providing the IP-CC announcements with authenticity protection is highly recommended.

PRI:11 – PID reassignment resilience

Service discovery shall survive PID number reassignments in remultiplexors in an autonomous way. Human intervention shall not be required for this.

PRI:12 – Encapsulation of layer 2 and layer 3 addressing

An abstract addressing information element may be used to identify a collection of IP streams (i.e. an IP address range) in layer 2 signaling (SI in the DVB case) and generalise the layer 2 channels in layer 3 (IP) signaling. Such an information element enables IP-routed networks to see MPEG-TS networks as if they were transparently switched - comparable with Multiprotocol Label Switching [8].

PRI:13 – IP-CC discovery

There shall be a mechanism for Clients to discover the physical/logical channel of an access network used for IP-CC signaling.

Such a mechanism could be specific to an access network type. In the case of DVB networks, one of the following mechanisms might be used:

1. Use IP address to PID mapping information to locate the PIDs carrying IP-CC signaling, based on the well-known IP address used for IP-CC.

2. Add an IP-CC specific information field in the SI tables, allowing the PIDs carrying IP-CC to be identified.

3. Locate the PIDs carrying IP-CC using existing DVB SI tables (e.g., IP-CC could be delivered on the DVB service component with the highest value of the component_tag field within each DVB service).

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