IP-CC Requirements specification

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Important Information

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Please note, this document has previously been presented to the DVB TM as SI-DAT 621.

Version history

Date	Author	Version	Status[1]	Description
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07-Jan-02	Juha-Pekka Luoma	1.02	Proposal	Disclaimer added for IP over DVB IETF BOF

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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

This is the requirement specification of the Internet Protocol 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.

2. TERMS AND DEFINITIONS

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

Client — *Client* generically describes the combination of user hardware, user software and the human user (or end-user).

DVB cell — Identical to "cell" as defined in EN300468 [6]:

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, which is part of a *DVB service* (TS). Similar concept to "component", which is defined in EN300468 [6]:

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 [6]:

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.

original_network_id: unique identifier of a network.

DVB service — Consists of one for more *DVB components*. Identical to "service" as defined in EN300468 [6] :

service: sequence of programmes under the control of a broadcaster which 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 [6]: **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-CC	The IP Control Channel, which describes IP-based services over a DVB 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 the same and different *IP services*. In the DVB case, an *IP Cell* has a one-to-one relationship with a *DVB Cell*.
IP service	An *IP service* is something an IP network offers and provides to an end-user, normally including content (e.g. live music) and possibly including some added-value service (e.g. error correction or song lyrics). IP services can be divided into two classes: *Unicast* and *Multicast*. An *IP service* can also be used to deliver announcements of other IP services (*IP-CC* is an *IP service*). An *IP service* may also be a bundle of *IP service components,* similar to the DVB SI bouquet concept [6]. For example, *news* could be classified as an *IP service* that includes a *live audio stream IP service*, a *video-clip download IP service*, and a *webpage push IP service*.
IP service bundle	A type of *IP service*. See *IP service*.
IP service component	The most basic type of *IP service*. See *IP service*.

IP session	The end-to-end connection of an *IP service*. This includes the *IP service* and any connection state required by network and client. The terms *IP session* and *IP service* are used interchangeably.
IP session directory	An IP service that delivers announcements of other IP services (for possible implementation, see [2], [3]).
IP stream	The actual IP datagram flow for an *IP service component*.
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* has 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 [6]]: **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 number that labels TS packets unique to a single *DVB component*. 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 [6]: **programme:** concatenation of one or more events under the control of a broadcaster e.g. news show, entertainment show.
program element	A generic term for one of the elementary streams or other data streams that may be included in a *program*. For example, the video stream, 2 audio streams, teletext stream and 2 subtitle streams of a 30-minute news broadcast are *program elements*. There may not be more than one *program element* per *PID*. Also, see *DVB component*.
service announcement	The announcement of a service in sufficient detail that a client can successfully receive (connect to) the service in question, from the network. The *service announcement* is a message that contains service description(s). For possible implementation, see [4].
service description	The *service description* defines the type of service and other parameters related to it. It, usually, include 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	See *service announcement*.
session description	See *service description*.
SI	Identical to "Service Information" as defined in EN300468 [6]: **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 [6]: **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.

3. REFERENCE MODEL FOR THE SYSTEM

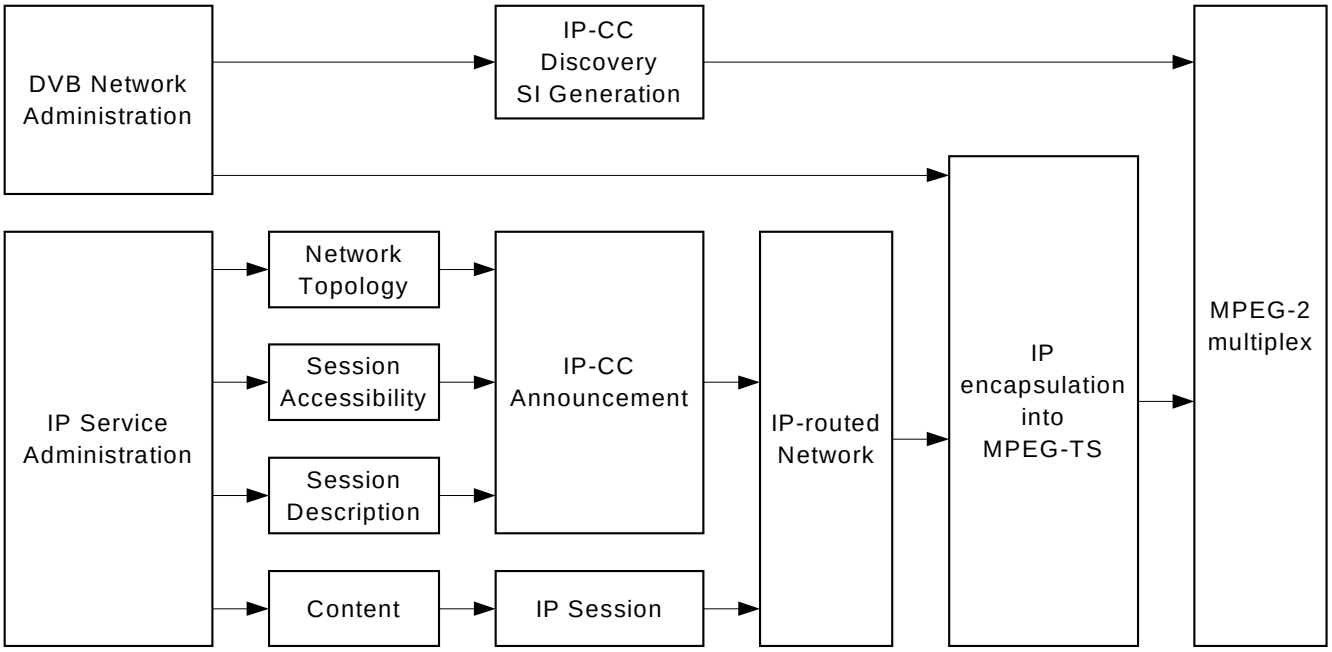

Figure 1, Logical network elements

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 sessions and IP-routed networks. Only the network-end is shown. The Client-end performs the inverse process.

The scope of this document is the *IP-CC Announcement*, *Network Topology*, *Session Accessibility* and *Session Description* elements. Some of the related issues to each of these are introduced below.

IP-CC Announcement: a set of related IP-protocol and IP-network based announcements, which describe IP services on an IP access network. Includes:

- Network Topology descriptions
- Session Accessibility descriptions
- Session (content) Descriptions

Network Topology: descriptions of physical and logical network topology, which may be dynamic. Includes:

- Physical geographic/spatial information
- Physical link (e.g. radio) parameters
- Logical cell structure

Session Accessibility: details of availability and access for IP services. Includes:

- Logical cells in which services are available

- What, who, where and how to contact for access to services
- Access rights and requirements (e.g. client authentication)
- Bundles of IP services
- Time availability of services

Session Descriptions: description of content and services themselves. Includes:

- Details of content
- Details of Client requirements (e.g. audio codec)
- Digital signatures (e.g. source authentication)

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 [9] address assignments.

SAC:4 – Coordination of unicast IP addresses

All unicast IP addresses used on the IP access network shall be globally unique and comply with IANA [9] 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, destination port number and unicast IP source address.

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 bundles

The use of session directories shall be supported, allowing service providers to offer clients a bundle of sessions as a single offering.

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

The IP-CC system shall deliver 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 phone 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 phone number of a preferred Internet 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.

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 [8] 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

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

SDR:2 – Unicast IP service types

At least the following basic one-to-one IP service types shall be described and announced: messaging, reliable file transfer, bidirectional access to the Internet, bidirectional 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 parsed 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 [10] 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 by 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 cell identifier.

The cell identifier may include the network identifier.

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

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

NTO:1.7 – The format of a subcell identifier

The subcell identifier shall comply with existing IETF standards.

NTO:1.8 – The structure of a subcell identifier

The subcell identifier may include the 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

The IP-CC system may announce the Layer 1 and Layer 2 parameters of neighboring IP cells in each IP 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, provided that 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 announced on a non-DVB network.

PRI:2 – IPv4 and IPv6

Both IPv4 and IPv6 shall be supported for signaling and service delivery.

PRI:3 – 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 Internet Protocol (IP) on Layer 3.

PRI:4 – Protocol choice for Layer 4 and above

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

PRI:5 – IP-CC addressing

IP-CC may be delivered using a well-known multicast IP address and port.

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 [4] may be used with IP-CC.

PRI:6 Mapping between Layer 2 and Layer 3 parameters

In each DVB cell, it shall be possible to map a range of IP addresses to a DVB component identified by the DVB SI parameters *service_id* and *component_tag*. As an alternative, it may also be possible to identify a DVB component by its PID value.

If a DVB component is identified with a PID value and the PID changes as a result of transport stream remultiplexing, the IP-CC announcements carrying the PID value need to be changed accordingly.

PRI:7 – 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:8 – Validity of service announcement

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

PRI:9 – 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.

PRI:10 – DVB service scan

The client shall be able to discover the PIDs of any DVB components carrying IP-CC signaling by receiving and parsing DVB SI and PSI tables.

5. REFERENCES

[1] ISO/IEC 13818-1. "Information technology - Generic coding of moving pictures and associated audio information - Part 1: Systems".

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[5] Handley, M. & Jacobson, V. SDP: Session Description Protocol (RFC 2327). IETF, April 1998. http://www.ietf.org/rfc/rfc2327.txt

[6] EN 300 468 V1.4.1, "Specification for Service Information (SI) in DVB systems". ETSI, November 2000. http://www.etsi.org

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[8] Perkins, C. IP Mobility Support (RFC 2002). IETF, October 1996. http://www.ietf.org/rfc/rfc2002.txt

[9] Internet Assigned Numbers Authority (IANA). http://www.iana.org

[10] Internet Engineering Task Force (IETF). http://www.ietf.org

6. ANNEX A: IP-CC DISCOVERY USING DVB SI

This chapter presents one refererence proposal for IP-CC discovery using DVB SI.

The proposed IP-CC discovery is based on the following requirements:

- IP-CC shall be delivered within one DVB component of each DVB service containing IP services.
- In each DVB service containing IP services, the DVB component carrying IP-CC shall be assigned the highest value of *component_tag* among the MPE components of the DVB service.
- A DVB service component may be used exclusively for IP-CC signaling.
- There may be more than one DVB service carrying IP-CC signaling.

The following pseudo-code can be used for finding the PIDs carrying IP-CC signaling in the current transport stream:

```
L = empty list
get the SDT table
for each DVB service in SDT {
   service_id = the id of the DVB service
   highest_component_tag = 0
   for each DVB component in the DVB service {
      if a data broadcast descriptor is associated with the DVB component {
         D = data broadcast descriptor
         if D.data_broadcast_id == 0x0005 {
            if D.component_tag > highest_component_tag {
               highest_component_tag = D.component_tag
            } // end if
         } // end if
      } // end if
   } // end for
   if highest_component_tag > 0 {
      get the PAT table
      for each program in PAT {
         program_number = the program number in PAT
         if program_number == service_id {
            pmt_pid = the PID carrying PMT associated with program_number in PAT
            P = the PMT section received on PID pmt_pid
            for each DVB component described in P {
               S = the stream identifier descriptor of the DVB component
               if (S.component_tag == highest_component_tag) {
                        ipcc_pid = elementary PID of the DVB component in P
```

```
                        insert the pair (service_id, ipcc_pid) in list L
                    } // end if
                } // end for
            } // end if
        } // end for
    } // end if
} // end for
```

The steps of the above algorithm can be described in natural language as follows:

1. The list L containing the *PID*s used for IP-CC signaling is initially empty.
2. The client parses the SDT table to find the set of DVB components (identified by the value of the *component_tag* SI parameter) within each DVB service (identified by the value of the *service_id* SI parameter).
3. For each DVB component found in step 2, the client parses the SDT to find DVB components carrying data. Such a DVB component is identified by the presence a *data_broadcast_descriptor* associated with the DVB component in the SDT.
4. For each DVB component found in step 3, the client parses the SDT to find DVB components carrying multiprotocol encapsulated data. Such a DVB component component is identified by the value of 0x0005 in the *data_broadcast_id* field of the *data_broadcast_descriptor* associated with the DVB component.
5. The client parses the SDT to find the *service_id* of each DVB service containing one or more of the DVB components found in step 4.
6. For each DVB service found in step 5 and for each DVB component found in step 3, the client parses the *data_broadcast_descriptor* associated with the DVB component to find the DVB component with the highest value of *component_tag* in each DVB service.
7. For each DVB service found in step 6, the client parses the PAT to find the *PID* of the PMT corresponding to the DVB service.
8. For each *PID* found in step 7, the client parses the PMT to find the *stream_identifier_descriptors* contained in the PMT.
9. For each *stream_identifier_descriptor* found in step 8, the client compares the value of *component_tag* in the *stream_identifier_descriptor* to the highest *component_tag* found in step 6 for this DVB service.
10. If step 7 is succesful for some stream_identifier_descriptor, the client parses the PMT to find the *PID* of the DVB component. This *PID* carries IP-CC signaling.
11. The client adds a pair consisting of the *service_id* found in step 5 and the *PID* found in step 9 to the list L.
12. As a result, the list L consists of (*service_id, PID*) pairs describing the *PID* that shall be used for IP-CC signaling in each DVB service.