When USB meets pay-TV: an update on CI Plus

Nicholas Frame
TP Vision | Acting TM-CI+ Chair
What we’ll cover

- Recap of CI Plus specifications and DVB’s role
- Latest DVB CI Plus 1.4 features
- DVB CI Plus 2.0 advantages
- A closer look at DVB CI Plus 2.0
- Ecosystem Updates
- Q&A
CI Plus Specification: Recap & DVB’s role
CI Plus Specifications

- CI Plus Specification v1.3.2
- DVB BlueBook A173-2 CI Plus Extensions
- DVB TS 101 699 CI Extensions
- DVB TS 103 205 latest v1.4.1 CI Plus 1.4
- CENELEC EN 50 221 CI
- DVB TS 103 605 CI Plus 2.0
- CI Plus ECP Specification v1.2
- CI Plus USB Specification v2.0.1
- CI Plus Interim License Agreement (ILA)
- CI Plus Licensee Specification
- CI Plus Change Notices
DVB & CI Plus LLP

• DVB develops new specification
  - CI Plus 1.4 (ETSI TS 103 205)
  - CI Plus 2.0 (ETSI TS 103 605)

• CI Plus LLP is the Trust Authority responsible for
  - Licensing CI Plus “secrets” to implementers
  - Device certification
  - Provision of CI Plus credentials (certificates/keys)
  - Working with content distributors (operators/broadcasters) to manage issues such as revocation
  - Enforcing compliance with ILA Robustness & Compliance rules
    - Including revocation of devices in breach of ILA Robustness & Compliance rules
  - Monitoring market for fraudulent usage of CI Plus technology
DVB & CI Plus LLP

Working together to specify & deploy CI Plus technology
New in CI Plus 1.4
TS 103 205 v1.4.1
Latest CI Plus 1.4 features

1. Content Control v5 (negotiation of optional features)
2. Overt Watermarking
1. Content Control v5

- Content Control provides a secure channel between CICAM and Host via the Secure Authenticated Channel (SAC)

- Up to CCv4 feature support determined based on CC version
  - I.e. new mandatory features added with each new resource version

- CCv5 adds negotiation of optional features to allow more granular feature support
  - Enables easier evolution of CC resource features
  - First optional CC feature: Overt Watermarking
Negotiation of optional features

1. CICAM triggers authentication process
2. Host engages in mutual authentication process
3. CICAM requests authentication key host
4. Host confirms authentication key
5. Establish SAC
6. Establish SAC
7. Request URI versions supported by Host
8. Confirm URI version(s)
9. Request optional features supported by Host
10. Confirm supported optional features
Negotiation of optional features
2. Overt Watermarking

- Overt / Covert Watermarking
  - Data embedded in audio or video for various purposes including content origin tracking for copyright protection

- Watermark insertion by the CICAM allowed since first version of CI Plus 1.4 (TS 103 205 v1.1.1)

- Overt watermark insertion by the Host is new in TS 103 205 v1.4.1
Layers

Overt Watermark

Video

SI2794310012803432D
Layers

- Subtitles
- Overt Watermark
- Video

Subtitles Layer
Layers

- Host UI
- Applications
- Subtitles
- Overt Watermark
- Video

Host UI
graphic plane

Subtitles Layer

Application Layer
Overt Watermarking Flow

[1] Channel change: Host tunes to a scrambled program
Overt Watermarking Flow

[2] CICAM requests [watermark A] for this program
[3] Host processes \textit{wm\_instructions}, renders & displays [watermark A] for this program
TV displays options UI that obscures the watermark
In this case, the Host is not required to display the watermark, but it may do so
Overt Watermarking Flow

TV displays options UI that obscures the watermark
In this case, the Host is not required to display the watermark, but it may do so
Overt Watermarking Flow

[4] CICAM requests [watermark B] for this program by sending updated \textit{wm\_instructions}

[5] Host processes \textit{wm\_instructions}, renders & displays [watermark B], replacing [watermark A]
Overt Watermarking Flow

[7] Host stops displaying [watermark B] for this program
Overt Watermarking Flow

[8] CICAM requests [watermark C] by sending the same `wm_instructions` as previously (in step 4)

[9] Host processes `wm_instructions`, renders & displays [watermark C] for this program
Overt Watermarking Flow

[10] Channel change: Host tunes to a different program, stops rendering & displaying [watermark C]
Overt Watermarking

- Secure protocol to display a line of text over video from a scrambled service
  - Main purpose is to display subscriber identity over the video
  - As simple and light-weight as possible
  - Supported for broadcast and IP-delivered content
- Protocol secured by Content Control SAC
- Controls position, size, colour and transparency of text
- Host provides confirmation to CICAM that watermark is rendered
  - Host must always display rendered watermarks
  - Limited temporary exceptions for overlap with Host UI, interactive app, MMI
- Timeshift/PVR use cases also covered to prevent watermark avoidance
CI Plus 2.0 Advantages
USB Form Factor
CI Plus 2.0 Benefits 1/2

- Builds on mature, trusted CI Plus standard
  - Additional functionality and benefits of modern interface
  - Without losing existing features and security (i.e. CI Plus 1.4 features, ECP security level)
  - No change to broadcast signal/signalling
  - Common implementation possible for both PCMCIA and USB interfaces
  - Future proof interface (more bandwidth, improved IP connectivity, native multistream...)

- USB “stick” form factor
  - Ubiquitous & recognisable: (almost) everyone has used a USB device or “stick” before
  - Smaller, lighter and more customisable → facilitates logistics, new branding/marketing opportunities

- Robustness
  - Proven connector robustness
  - No more bent pins
  - No more smartcards inserted the wrong way
CI Plus 2.0 Benefits  2/2

• Manufacturing
  ▪ Widespread support for USB and availability of reference designs
  ▪ Worldwide manufacturing capabilities for USB devices
  ▪ Significant space saving on TV/STB circuit boards and device I/O panels

• Opportunity for compelling new products: Virtual STB in a “stick”
  ▪ Single Remote Control
  ▪ Operator channel list installation using Operator Profile
  ▪ CI Plus ECP for premium UHD/HDR content
  ▪ Operator UI look & feel using HbbTV OpApp standard
  ▪ Support for connected & non-connected use cases (CICAM Auxiliary file system)
  ▪ **Much** lower power consumption than any external HDMI STB
  ▪ No extra box with multiple cables to connect

• Facilitates wider CI Plus deployment…
CI Plus already a worldwide standard...

...but PCMCIA is hampering further adoption
USB is ubiquitous and will help deploy CI Plus in more markets including countries in Africa, Middle-East, South America, and Asia-Pacific regions
A closer look at CI Plus 2.0
TS 103 605 v1.1.1
Second Generation CI

- Physical, link & transport layer changes for
  - TS interface
  - Command interface
  - Network interface

- Upper layers unchanged
  - Protocol unchanged*

- PC Card/PCMCIA interface replaced with USB 2.0/3.x

* Almost – see next slides
USB Form Factor

- USB Type-A connector
- “Stick” form factor
- Based on USB 2.0 and USB 3.2 specifications
  - Mechanical, electrical, discovery, configuration, data transfer protocol
- USB 2.0 High-Speed **required**, USB 3.x SuperSpeed **optional**
  - High-Speed data rates are sufficient
    - Media Interface \( \leq 96 \, \text{Mbit/s} \times 2 \)
    - Command Interface \( \geq 3.5 \, \text{Mbit/s} \times 2 \)
    - Network Interface \( \geq 1 \, \text{Mbit/s} \times 2 \) *much faster rates possible*
How USB works

USB data transfer to/from device endpoints

- **USB endpoint zero**
  - For control & discovery – mandated by USB

- **DVB-CI Command Interface** Tx/Rx
  - 1 Command Interface – mandatory

- **DVB-CI Media Interface** Tx/Rx
  - 1 Media Interface – mandatory

- **USB CDC EEM Networking Interface** Tx/Rx
  - Optional

*Figure 3: USB endpoints used by the second generation Common Interface*
DVB-CI Command Interface 1/3

- **USB bulk transfer** replaces PCMCIAs-based transport layer

- **Command data transported as SPDUs** *(Session Protocol Data Unit)*
  - SPDUs = Session Layer = Unchanged (defined in EN 50 221)
  - 1 single bulk USB transfer = 1 SPDU = 1 APDU = 1 command

```
USB Bulk Transfer

SPDU

APDU  Command e.g. ca_pmt()```
DVB-CI Command Interface 2/3

• Limited protocol changes due to differences between PCMCIA and USB

• USB CICAMs can reset themselves → no need to ask Host
  ▪ Application Information (00 02 00 4x) request_ci_cam_reset() APDU
  ▪ CAM Upgrade (00 8E 10 01) cam_firmware_upgrade_complete() APDU reset_request_status field

• USB Hosts all support at least 96Mbit/s → no need for Host to inform CAM of supported data rate
  ▪ Application Information (00 02 00 4x) data_rate_info() APDU
USB offers significantly improved network connectivity
  - Simulated Ethernet Network Interface (NIC)
  - Using USB Communications Device Class Ethernet Emulation Model (USB CDC EEM)

- Replaces Low Speed Communication (00 60 xx)

- LSC still allowed by CI Plus Specification v2.0.1 from CI Plus LLP
  - Facilitate transition from PCMCIA to USB
  - Optional to implement USB CDC Ethernet Emulation Model
DVB-CI Media Interface 1/2

- **USB bulk transfer** replaces PCMCI-based transport layer

- MPEG Transport Stream packets mapped into Fragments

- Basic Fragment rules
  - Host determines largest fragment size
  - CAMs can send back smaller fragments

- No change to handling of scrambled MPEG-TS data
DVB-CI Media Interface 2/2

- **Fragment Header**
  - Metadata related to media content
  - For broadcast MPEG-TS packets all fields set to 0 except for **LTS_id**
  - Other fields used in CICAM player and Host player modes (e.g. when transferring ISOBMFF samples)

- **Transfer order**
  - Fragment Header
  - Followed by Fragment
  - Single USB bulk transfer for each

---

![Fragment Header Diagram]

- **DVB Transport Stream**
  - **TS Packets**
  - **Fragment Data**
  - **USB Transfers**
  - **USB Data Packets**

= Short Packet (i.e. packet size < wMaxPacketSize or 0-length packet)
Ecosystem Updates
News, testing & deployment
What happened over the past few years?

- September 2017  Sunrise of CI Plus v1.4 based on TS 103 205
- September 2018  Launch of ECP designed to meet MovieLabs requirements
- October 2018    ETSI TS 103 605 v1.1.1 published
- April 2019      New Content Distributor Agreement published (revocation)
- October 2019    CI Plus Specification v2.0.1 published based on TS 103 605
- July 2020       Launch of CI Plus 2.0 Host certification
- May 2021        Launch of CI Plus 2.0 Module certification
What’s next?

• DVB CI Plus groups currently in hibernation
  ▪ New feature requests can be submitted to the Commercial Module

• CI Plus LLP about to publish CI Plus Specification v1.4.4
  ▪ Adds features from ETSI TS 103 205 v1.4.1
    – Content Control v5
    – Overt Watermarking
    – Operator Profile v3
  ▪ Test tool updates will follow
Logos & ports

• Device CI Plus USB support should be indicated (*logo would be useful*)
  ▪ Devices should support CI Plus on all USB inputs
    – Many different features associated with USB ports
    – USB port labelling important for devices that *don’t*
  ▪ Already something manufacturers carefully consider for USB & HDMI
    – Even more care needed with the addition of CI Plus support to USB ports
Other activities

• Deutsche TV-Plattform
  ▪ German TV Platform now launching open round table for further discussions on CI Plus 2.0 in the DACH region and elsewhere
  ▪ Held 2 successful industry workshops with up to 50 participants
  ▪ Interested? Contact mail@tv-plattform.de
  ▪ Next Round Table sessions planned for June 17\textsuperscript{th}, July 22\textsuperscript{nd}, August 26\textsuperscript{th}
Other activities

• Telecom Regulatory Authority of India (TRAI) recommendation
  ▪ Mandatory support for DVB CI Plus 2.0 (ETSI TS 103 605) for TVs & STBs
  ▪ Coordination between Indian government ministries (MIB, MeitY), regulator (TRAI), Bureau of Indian Standards (BIS), and industry (e.g. TV manufacturers)
More information

• DVB resources
  ▪ Security: dvb.org/solutions/security/
  ▪ CI Plus 1.4 DVB Extensions to the CI Plus specification (DVB-CI Plus)
  ▪ CI Plus 2.0 Second Generation DVB Common Interface (DVB-CI USB)

• CI Plus LLP resources
  ▪ www.ci-plus.com
Thank you for attending

Q & A