Qualcomm

IEEE 1722c Proposal for Generic Display Format

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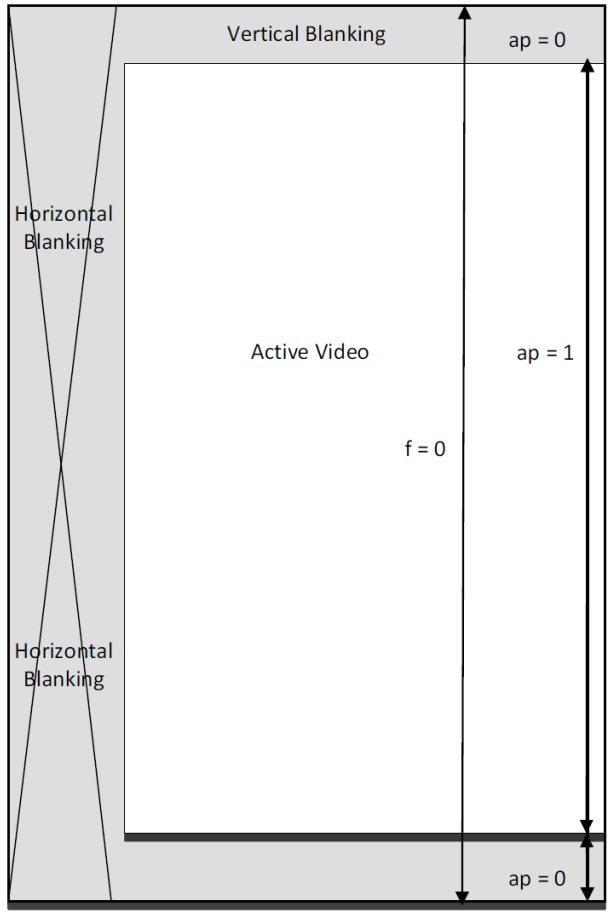
Summary

- This is a proposal to add a new GDF (Generic Display Format) subtype to P1722c
- Asymmetric Ethernet (e.g. P802.3dm) enables optimized links to End Station in sensors and display modules. AVTP GISF is used for Sensors, RVF requires enhancements for display modules
- Specify GDF similarly to existing RVF (Raw Video Format), with modifications for:
  - Generic RAW video format
  - Allow Meta Data to be transported during both Vertical and Horizontal blanking
  - Flexible video frame size and video frame rate
  - Transport of VESA DisplayPort (+ eDP)
  - Transport of MIPI DSI-2 and MIPI SEP
  - Support for visually losless compression with VESA DSC and VDC-M
  - Stream-based Content Protection with IIA HDCP v2.3
  - End-to-end FuSa elements for display data and Meta Data
    - With compatibility for VESA DP AE / MIPI DSE
    - Ease end-to-end FuSa over heterogenous display interfaces
- If accepted, appropriate liaison agreements with VESA and MIPI will be required

Limitations with existing RVF subtype



- RVF does not allow transport of Meta Data during Horizontal Blanking
  - VESA DisplayPort requires VB-ID during horizontal blanking
  - VESA DisplayPort allows SDP transport during horizontal blanking
- RVF supports only discrete frame_rate values
  - MIPI and VESA displays support variable frame rate and make use of it for power saving purposes
- RVF does not provide support for
  - Visually lossless compression such as VESA DSC and VDC-M used by both MIPI and VESA displays
  - HDCP: Content Protection
  - Functional Safety elements
- Some RVF header fields are already included in MIPI / VESA packets. Such fields can be removed

Automotive is driving aggregated display bandwidh requirements

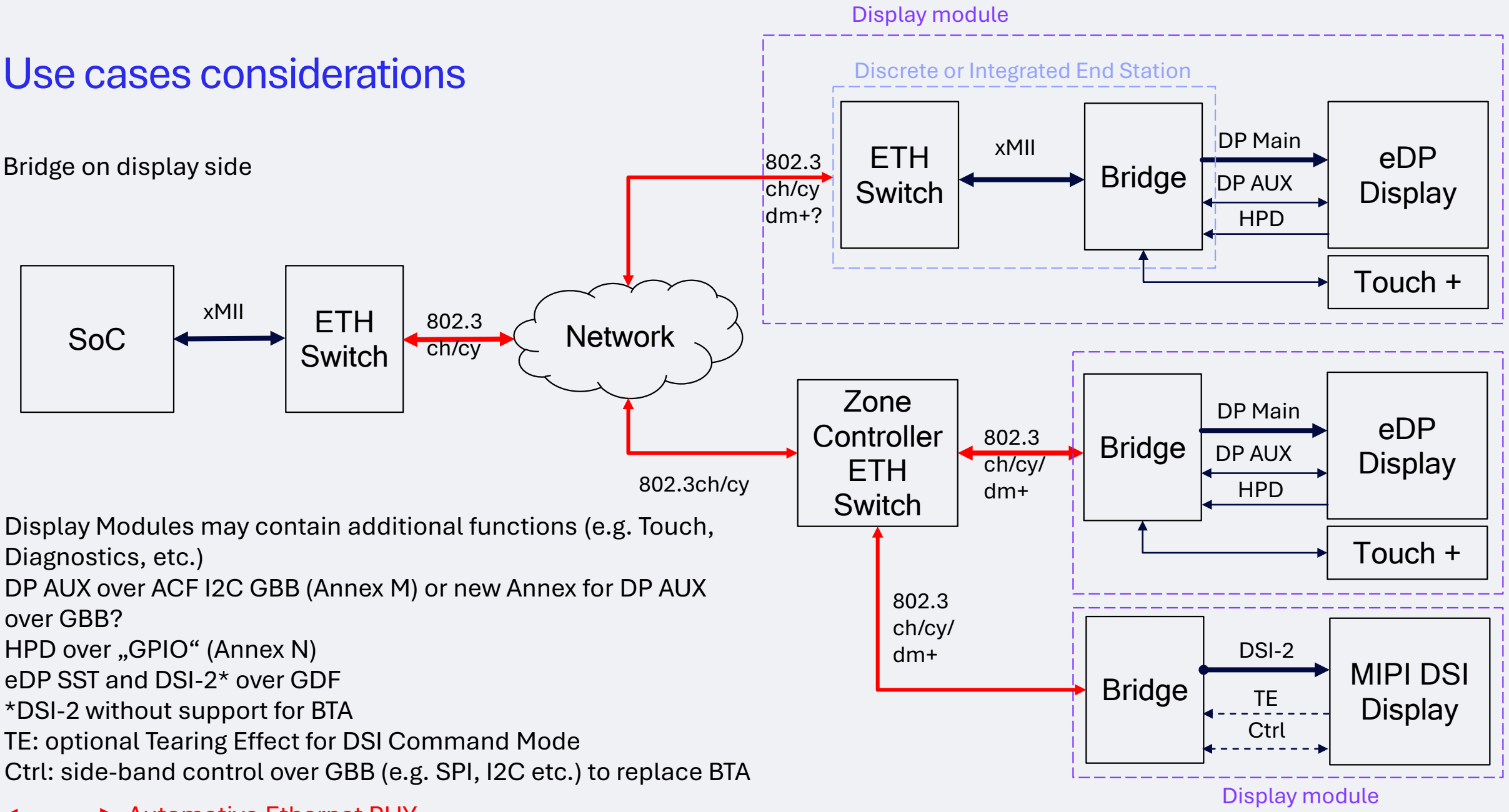
- Increasing number of displays in a car: 10+ displays
  - Examples: Driver Instruments Display, Center Information Display, Co-Driver Display, Lower Control Display, Left and right mirror displays, Head-Up Display, Rear Seat Entertainment Displays etc...
- Increasing resolutions: from FHD to 4K and 8K
- Examples were presented at the Electronic Display Conference 2023
  - Total aggregated bandwidth can be close to ~100 Gbps (depending on the resolution and number of displays)
- Visually lossless compression is needed to reduce the aggregated display bandwidth
  - VESA DSC compression[1]: 3:1 compression ratio (24 bpp to 8 bpp)
  - VESA VDC-M compression[1]: 4:1 compression ratio (24 bpp to 6 bpp)
  - DSC and VDC-M are used by multiple display interface standard[1]: eDP/DP, MIPI DSI/DSI-2 , HDMI
- Reducing overall aggregated bandwidth contributes to the relative cost reduction in an automotive Ethernet IVN
  - Lower required load on the ethernet backbone
  - Lower required load on the „last mile“ from the Zone ECU to the Display Module

Reference [1]: VESA Display Compression Codecs - VESA - Interface Standards for The Display Industry

bpp: Bit Per Pixel

Use cases considerations

Bridge on display side

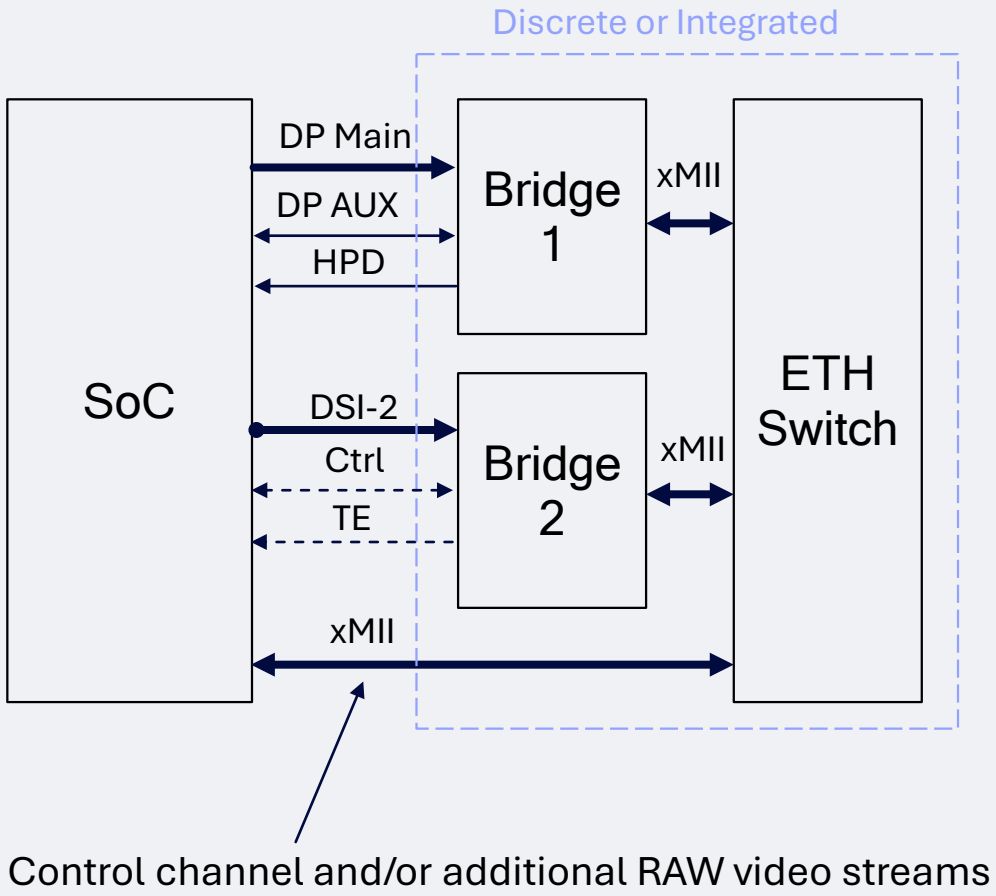


Display Modules may contain additional functions (e.g. Touch, Diagnostics, etc.)
DP AUX over ACF I2C GBB (Annex M) or new Annex for DP AUX over GBB?
HPD over „GPIO“ (Annex N)
eDP SST and DSI-2* over GDF
*DSI-2 without support for BTA
TE: optional Tearing Effect for DSI Command Mode
Ctrl: side-band control over GBB (e.g. SPI, I2C etc.) to replace BTA

Automotive Ethernet PHY

Use cases considerations

Bridge on SoC side



- Bridge #1, #2 and Ethernet Switch can be discrete devices or integrated device
- Bridge 1: eDP/DP to AVTP
  - Converts eDP/DP MST to multiple SSTs. No tunnelling of MST
  - eDP/DP SST over GDF
  - DP AUX over ACF I2C GBB (Annex M) (or a new Annex for DP AUX over GBB)
  - HPD over „GPIO“ (Annex N)
  - HDCP to be terminated in bridge. Bridge adds IIA HDCP per stream.
  - DP AE is maintained End-to-End on per stream base
- Bridge 2: DSI-2 to AVTP
  - DSI pixel streams over GDF
  - BTA terminated in Bridge 2. No support for BTA to display module
  - Read/write from/to display module over xMII (GBB) or side band control SPI/I2C that is connected to Bridge
  - DSE End-to-End is maintained when no BTA

Assumptions

- VESA DisplayPort / eDP
  - Only DP Main channel is transported
  - Single Stream Transport (SST) as 1 Lane only → single transport format
    - Talker converts MST (Multi Stream Transport) to multiple SSTs. Each SST with its own stream_id
    - Listener adapts the number of Lanes as per the display module requirements
  - DP AUX channel is transported over GBB or I2C GBB (Annex M)
  - HPD (Hot Plug Detect) transported as „GPIO“ (Annex N)
  - Audio to be transported over AAF instead of SDPs (SDPs are still possible in case of SDP tunneling)
    - Listener converts to I2S/TDM as needed
  - End to End FuSa and Security is maintained as per VESA DP AE
- MIPI DSI-2
  - BTA (Bus Turn Around) can be avoided by using GBB for command and control interface
    - Can still be tunneled, but would require a BTA back from the Listener
    - Can be replaced with a DSI-2 PENP (Physical Event Notification Packet)
  - TE (Tearing Effect) signal transported as „GPIO“ (Annex N)
  - End to End FuSa is maintained as per MIPI DSE
- Talker ideally generates RAW GDF format (interface independent)
- Listener bridges from the RAW GDF format to the native display interface format

- Stream-based Content Protection with IIA HDCP
- IIA HDCP is natively supported with MIPI DSI-2 using DSE with SEP
- DisplayPort / eDP requires termination of Link based HDCP and new generation of stream-based IIA HDCP

References

- MIPI DSI-2 v2.2 (MIPI Members only)
- MIPI Display Service Extensions (DSE) v1.1 (MIPI Members only)
- VESA Display Port v2.1a (VESA Members only)
- VESA Embedded Display Port (eDP) v2.0 (VESA Members only)
- VESA Display Port Automotive Extension Services v1.0 (VESA Members only)
- VESA Display Stream Compression (VDC) v1.2b (fee download)
- VESA Display Compression-M (VDC-M) v1.2 (fee download)
- HDCP Interface Independent Adaptation Specification Revision 2.3 + Errata
- „Using a Standards-based Framework to meet the growing bandwidth and safety requirements of next generation automitive displays“ presentation at Electronic Display Conference 16 March 2023

Thank you

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