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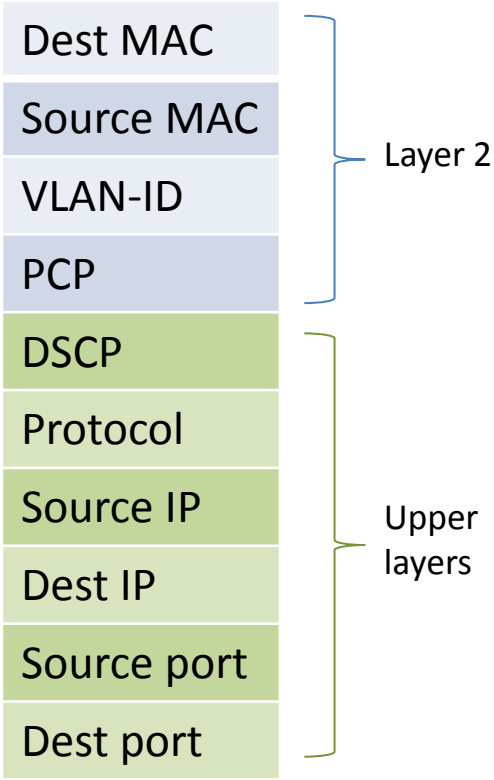
Extension of Stream identification functions

IEEE 802.1 TSN, September ‘17, Saint Johns

Problem statement

- Current stream identification means are limited in TSN standards
  - .1Qcc defines a set of frame information parameters in layer 2 and upper layers that can be used for stream transformation
  - .1CB defines a set of stream identification (and transformation) functions that rely on the same frame information parameters



Problem statement

- The layer-2 parameter sets do not include the Ethertype field
  - Ethertype is often required for the identification of non-IP Upper-layer protocols
    - e.g. Ethernet Industrial Automation protocols,
    - but also AVTP, CPRI.

Ethernet IA protocol	EtherType
EtherNet/IP(DLR)	0x80E1
PROFINET	0x8892
EtherCAT	0x88A4
POWERLINK	0x88AB
SERCOSIII	0x88CD
CC-Link IE	0x890F
…	…
AVTP	0x88B5

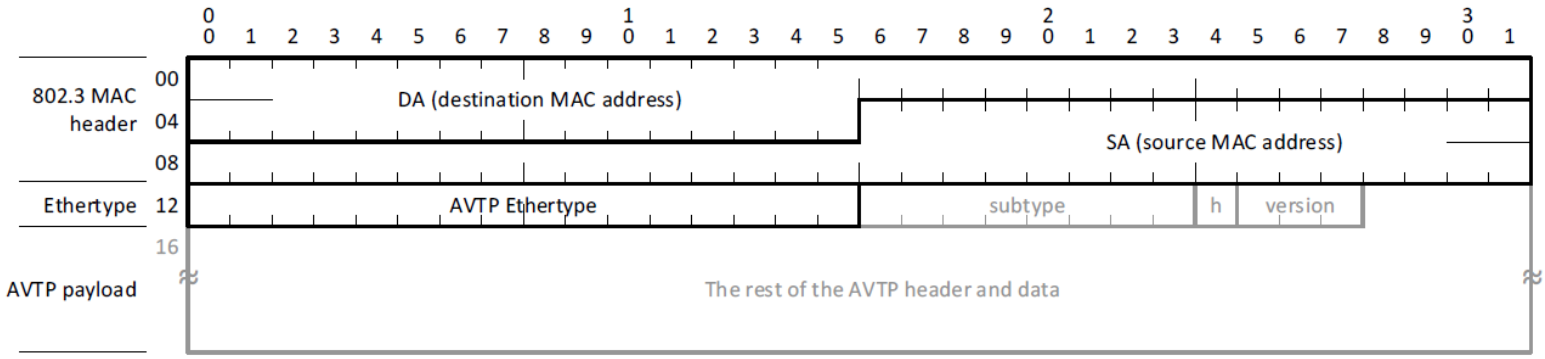
- The Upper-layer parameter set only includes TCP/UDP/IPv4/IPv6 as Upper-layer frame information
  - No provision for non-IP-based protocols
    - like Ethernet Industrial Automation protocols, AVTP…

Problem statement

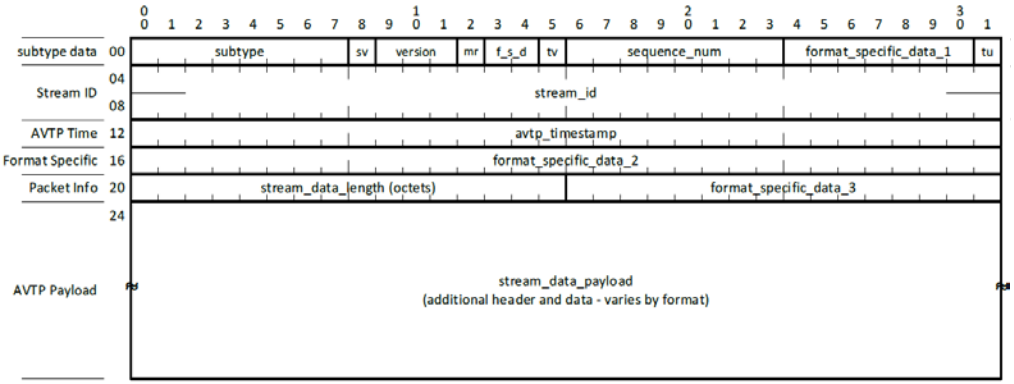
- Stream identification and transformation is necessary at the boundary between TSN and non-TSN nodes
  - At the UNI in case of non-TSN end stations attached to a TSN network
  - or, in a specific gateway such as the data GW defined by AVnu (industrial)
- In the case of industrial automation networks, the co-existence of legacy industrial Ethernet networks with TSN networks will be unavoidable
  - Brownfield migration

Some examples

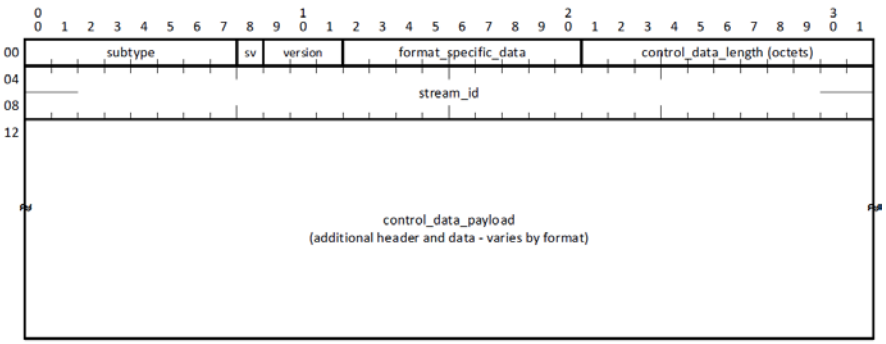
- AVTP non-reserved untagged frames



  - A stream identification is present in the payload



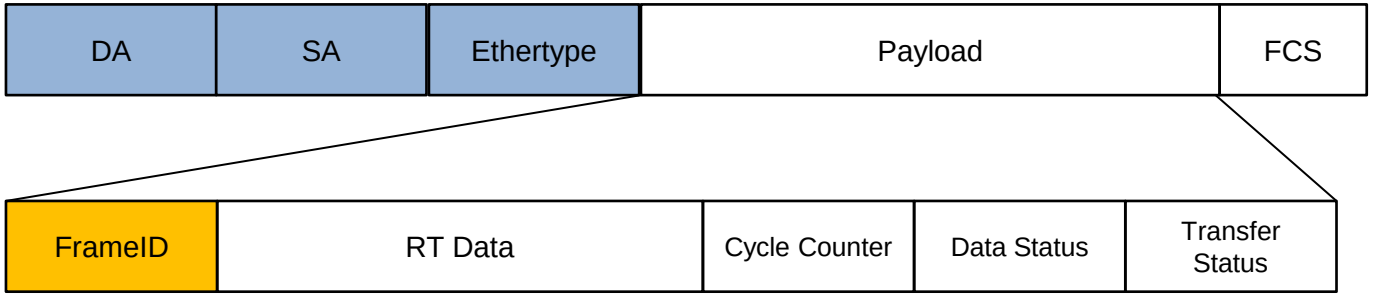
AVTP common stream



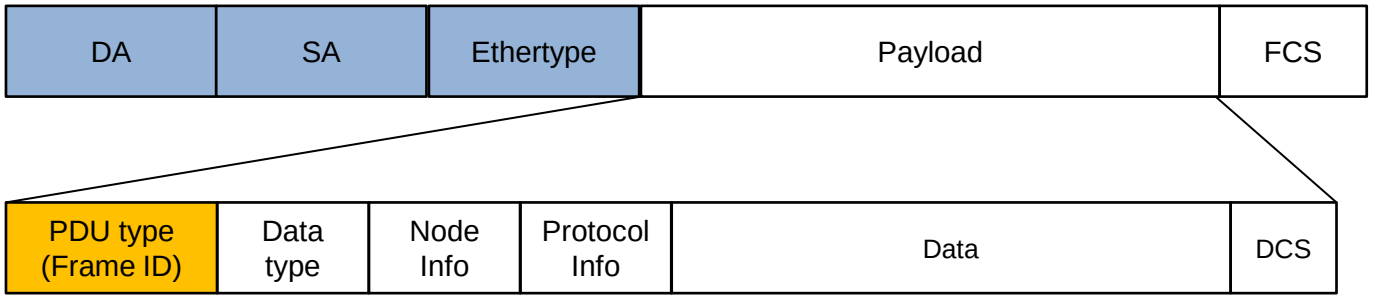
AVTP common control

Some examples

- PROFINET IRT frames



- CC-Link IE frames



  - The FrameID information distinguishes between different types of “streams”
    - PROFINET IRT: RT, acyclic, time synchronization
    - CC-Link IE: Cyclic, Transient, Token, Mystatus, etc…
  - Typically, FrameID, or PDU Type, and Ethertype can be part of the stream identification

Solution proposal

- A generic stream identification function

- Define 2 groups of identification parameters
  - Layer-2 identification parameters : *layer-2 group*
  - Upper-layers identification parameters: *upper-layers group*

- 1 identification parameter = 1 element

- Stream identification function = combination of 1 or more element(s) from one or both group(s)

Solution proposal

- Layer-2 group's elements
  - Considering 1 level of VLAN encapsulation only, the elements match the Ethernet frame header fields that can participate in the indication of stream content, and selection of path and queues in the stream's frame forwarding operations
    - *Dest MAC*
    - *Source MAC*
    - *VLAN-ID*
    - *PCP*
    - *Ethertype*

  - 2 options to define (encode) the Layer-2 group "type"
    - a unique value per valid header field combination
    - a (5-bit) bitmap indicating the presence/absence of a given header field in the identification.

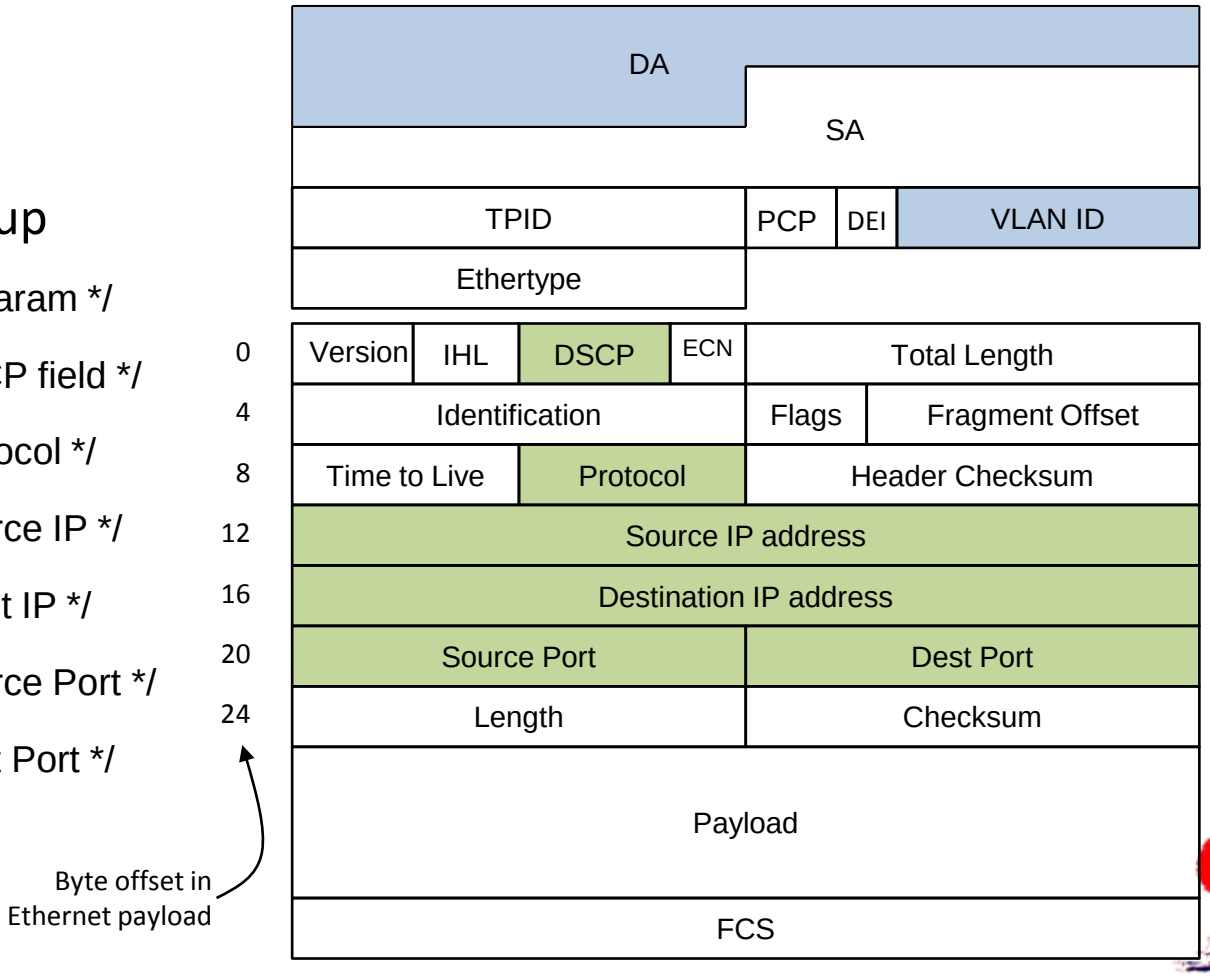
Solution proposal

- Upper-layers group's elements
  - Since the Ethernet frame payload can be of various types, it would be more flexible not to define elements that are specific of a given protocol
    - i.e. being able to identify other streams than layer-4 (UDP or TCP) flows transported over IP
  - Use a generic method for defining each element of the Upper-layers group
    - 1 element = 1 protocol field defined by its:
      - *Offset* = distance from the beginning of the payload (assumption: protocol fields are byte-aligned)
      - *Length* = protocol field length in bits
    - Indication of the number of elements
    - Upper Layers group format:
      - {Nb Elements = N; [Elem 1], [Elem 2], ..., [Elem N]}
      - Elem n = (Offset,Length)

Solution proposal

- Upper-layers group's elements
  - An example: .1CB's IPv4 + UDP stream identification (using Layer-2 group bitmap encoding)

- Layer-2 group
  {1,0,0,1,0}
- Upper-layer group
  {6; /* Nb param */
  (1,6), /* DSCP field */
  (9,8), /* Protocol */
  (12,32), /* Source IP */
  (16,32), /* Dest IP */
  (20,16), /* Source Port */
  (22,16)} /* Dest Port */



Conclusion

- Further stream identification methods are required to handle interoperability of TSN networks with various existing real-time applications
- Application protocol (Upper-layers) parameters have to be taken as input for the stream identification functions
- A stream identification method based on a generic Upper-layer protocol parameter selection would be preferable due to the variety of these protocols
  - The solution presented here is an outline
  - Just for continuing the discussion on stream identification

Next steps

- How could we proceed with stream identification ?

- An amendment to 802.1CB to:
  - Add another type of stream identification function in 802.1CB
    - *tsnStreamIdIdentificationType* 5 (OUI = 00-80-C2)
  - Define the managed objects for the new type
  - Define the information model, YANG data model and MIB for the new type
    - To avoid interference with 802.1CBcv development
  - Combine with other candidate additions to 802.1CB ?

Thank you for your attention

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