Stream Identification for Avionics Networks

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Objective

- ***Overview of stream identification in current avionics networks***
- ***Discussion on future TSN based architecture for avionics networks***
- ***Discussion of stream identification requirements for 802.1DP***

End Station Centric Model

Existing avionics networks are very much end station centric, wherein the end station or end system performs:

1. Stream tagging for identification
2. All the shaping functions
3. All the redundancy functions
4. Integrity functions – additions and checks

Requirement: support shaping (Qbv, Qav), Redundancy (FRER), stream identification and transformation at end station without bridge involvement.

Stream Identification

Stream Identification is used by *[Ref: P802.1DG Draft 1.4, Annex H.1.1.]*

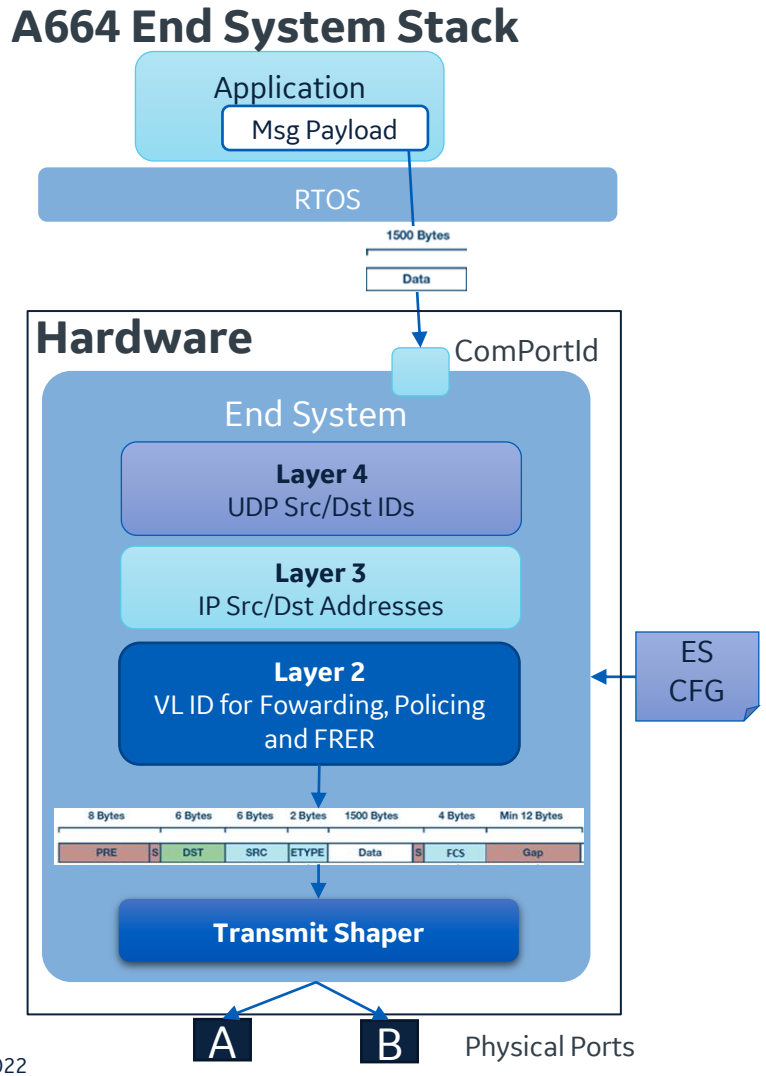
1. Redundancy (CB)
2. PSFP (Qci)
3. Asynchronous Traffic Shaping (Qcr)
4. Congestion Isolation (Qcz)
5. ***Forwarding and therefore shaping***

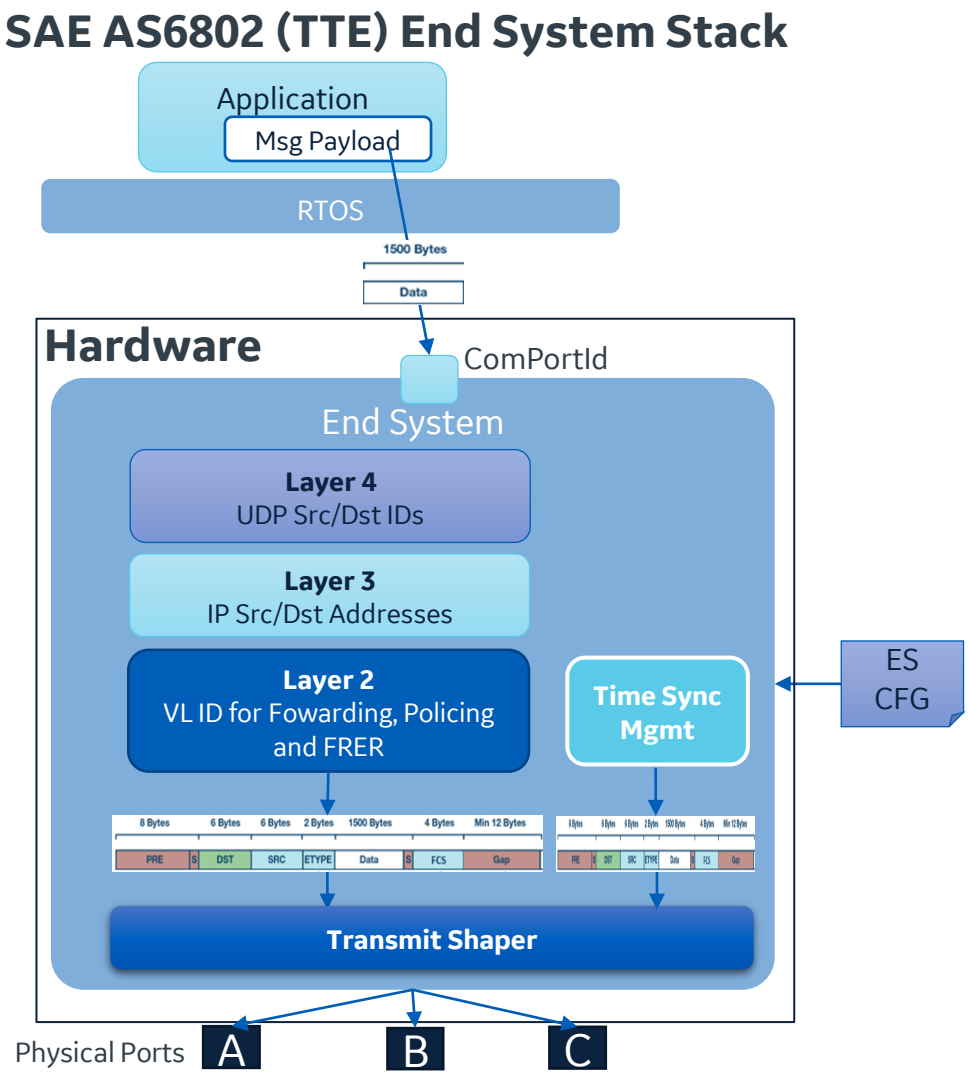
Following is a discussion on stream identification and stream ID generation/tagging for avionics networks

Note that the tagging capabilities may dictate the stream identification requirements

Stream Identification in Current Avionics Networks

Stack View





Stream Identification in Current Avionics Networks

Source and Destination MAC address

ARINC 664 Layer 2

- Performed by Hardware
- Destination Multicast MAC Address (Locally Administered Group Address)
  - Exclusively used for all VL identification (both Multicast & Unicast)
  - Form = 4 byte Network Domain Id + 2 byte VL ID

- Network Domain Id statically defined by the network integrator

- Source MAC Address
  - Controlled by the integrator. In practice, it is used primariliy for troubleshoot, but can be leveraged for Security via Source Validation policing.

AS6802 (TTE) has the similar process for setting the destination MAC address, but uses native (manufacturer assigned) source MAC address

Stream Identification in Current Avionics Networks

Source and Destination IP address

A664 L3 Application Addressing

- Mulitcast and Unicast use different mechanisms
- Unicast IP Src & Dst Addresses range from 10.0.0.0 to 10.255.255.255 at takes the form:

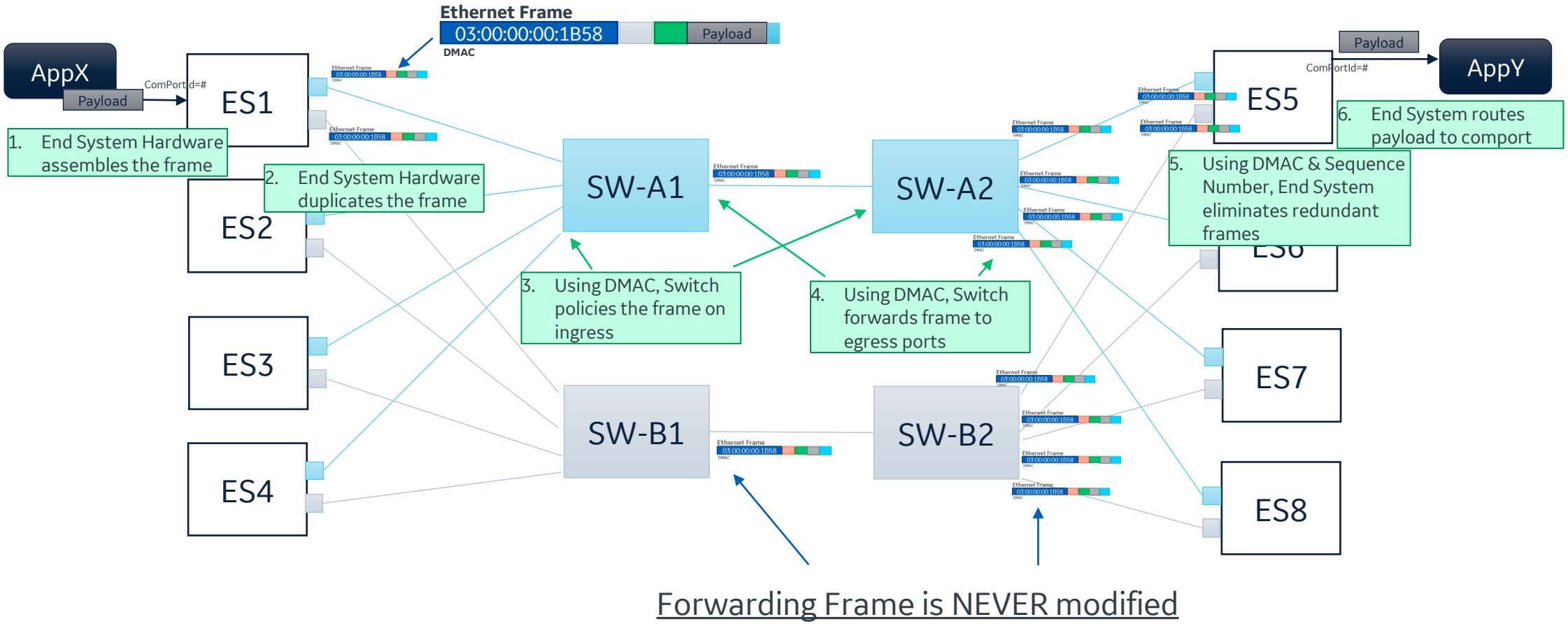
10 8 (bits) constant	Network ID (8 bits)	Equip ID (8 bits)	Partition ID (8 bits)

- Multicast IP Destination addresses takes the form 224.224.[VLID] with the 16-bit VLID is split into two 8-bit octets.

224 8 (bits) constant	224 (8 bits) constant	VL ID 1st Octet (8 bits)	VLID Octet (8 bits)

Stream Identification in Current Avionics Networks

End-to-End Example Example: VL7000 (0x1B58) is transmitted redundantly to ES5, ES6, ES7, ES8



Stream Identification in Current Avionics Networks

Summary

Current Approach

- VL Identification uses a Multicast DMAC & Multicast IP convention consistently across the network
- Simple to understand, implement, and troubleshoot
- Scales for small and large avionic network deployments
- Meets needs for various features required by Aerospace (Redundancy, Security, etc.)
- Adheres to Ethernet Addressing's spirit and intent

Discussion: *Should we adopt similar approach in 802.1DP?*

Pros:

- Builds upon proven methods; accepted by the industry
- Zero to Low learning curve to Aerospace Ethernet community

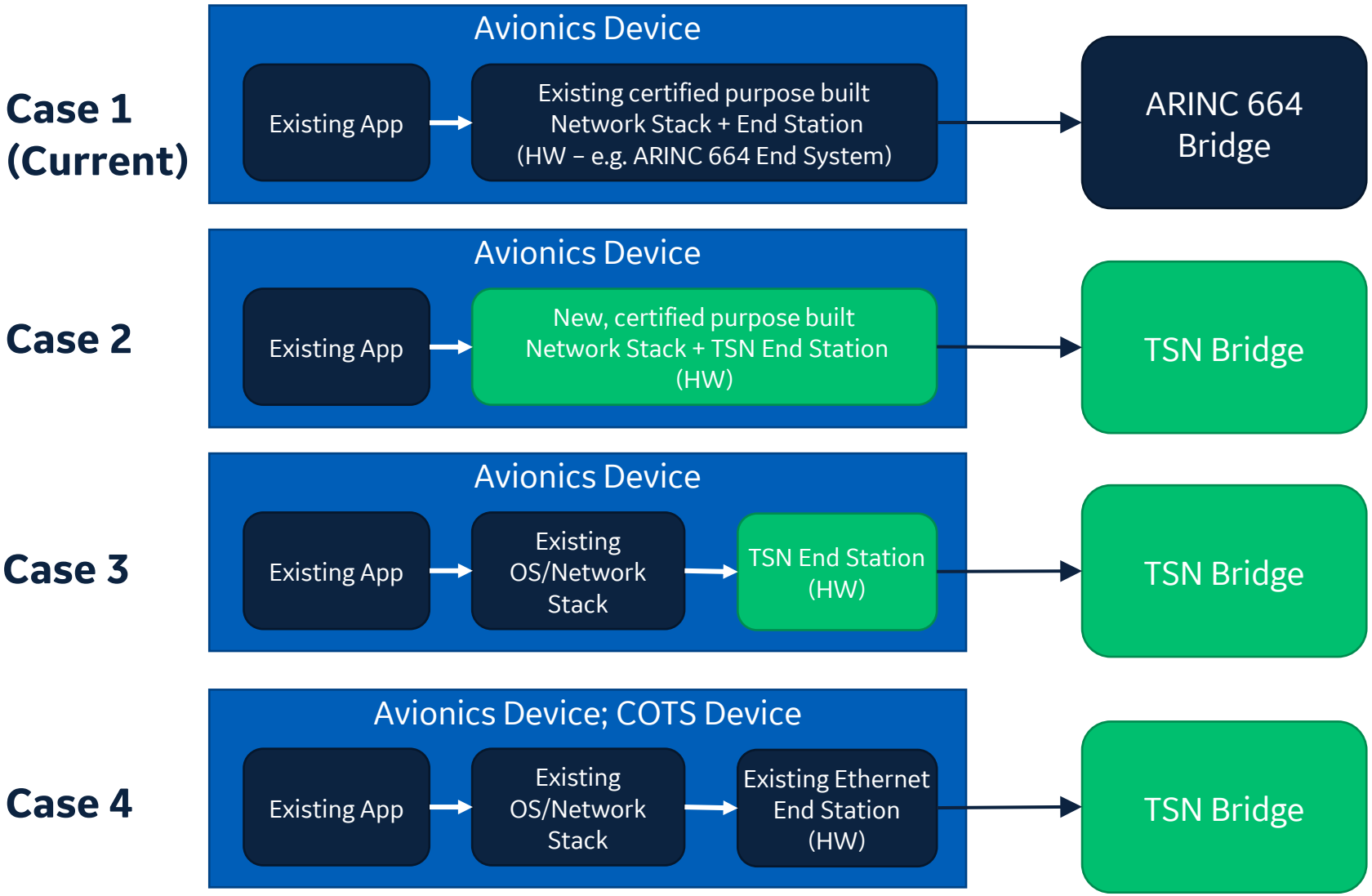
Cons:

- May limit flexibility and support for new architectures

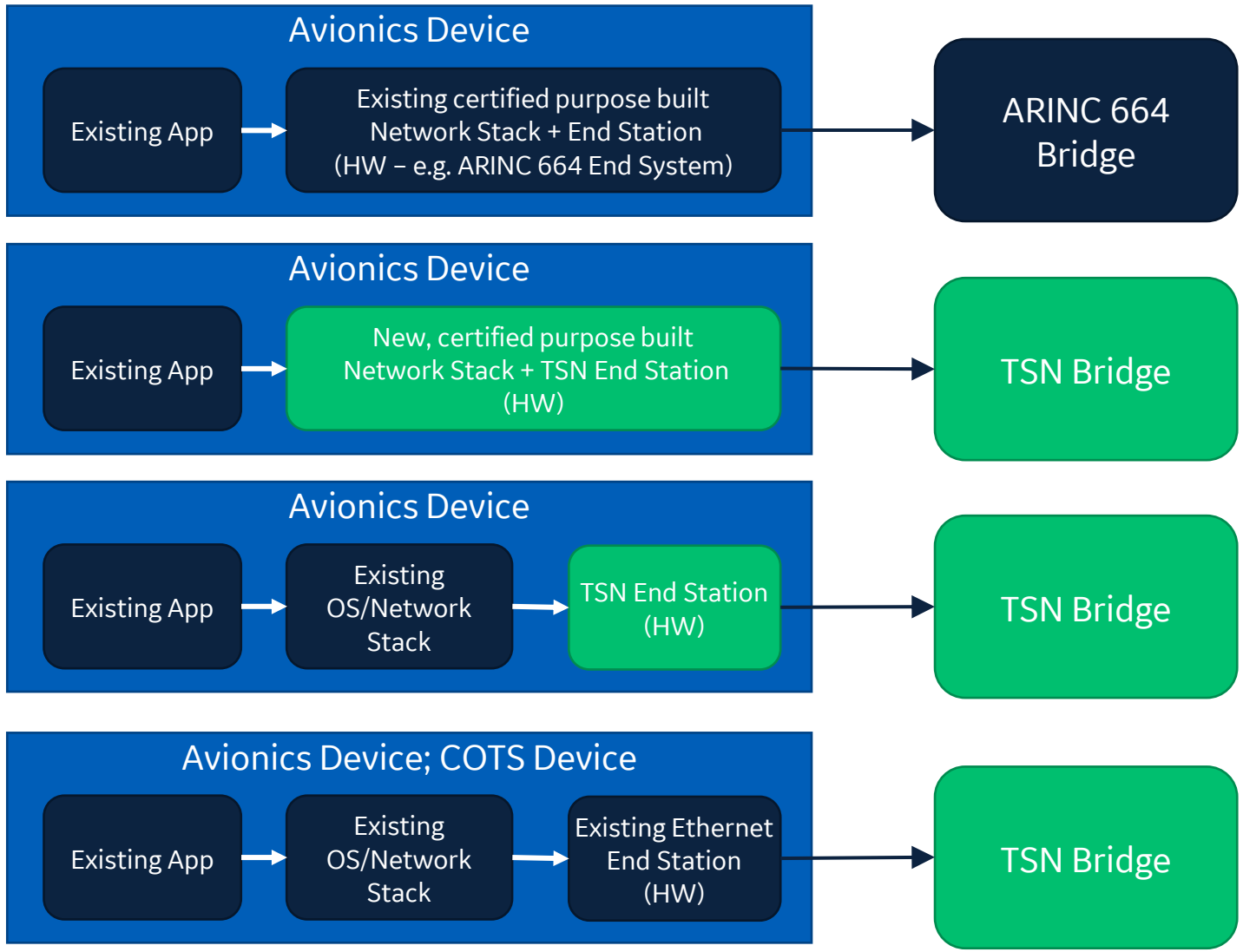
Stream Identification as defined in 802.1CB and 802.1 CBdb

Stream Identification Function	Active/passive	Examines	Overwrites
Null Stream identification	Passive	destination_address, vlan_identifier	None
Source MAC and VLAN Stream identification	Passive	source_address, vlan_identifier	None
Active Destination MAC and VLAN Stream identification	Active	destination_address, vlan_identifier	destination_address, vlan_identifier, priority
IP Stream identification	Passive	destination_address, vlan_identifier, IP source address, IP destination address, DSCP, IP next protocol, source port, destination port	None
Mask-and-match Stream identification function	Passive	destination_address, source_address, mac_service_data_unit	None

Stream Identification Requirements Based on Use Cases



Stream Identification Requirements Based on Use Cases



Null Stream Identification on ES and bridge

a. Null Stream Identification on ES and Bridge (with careful use of multicast streams)
b. IP stream identification + Active stream identification on ES. And Null stream identification on Bridges

IP stream identification + Active stream identification on Bridge

Questions/Discussions

- Aerospace use cases may require flexibility in stream identification to expand beyond the current architectures
- What are the current approaches for tagging of TSN streams with pre-existing applications and network stacks
- What stream identification methods should be prescribed in DP for end stations and bridges
- How to support end station centric model with TSN standards
    - FRER stack for a dual homed end station?

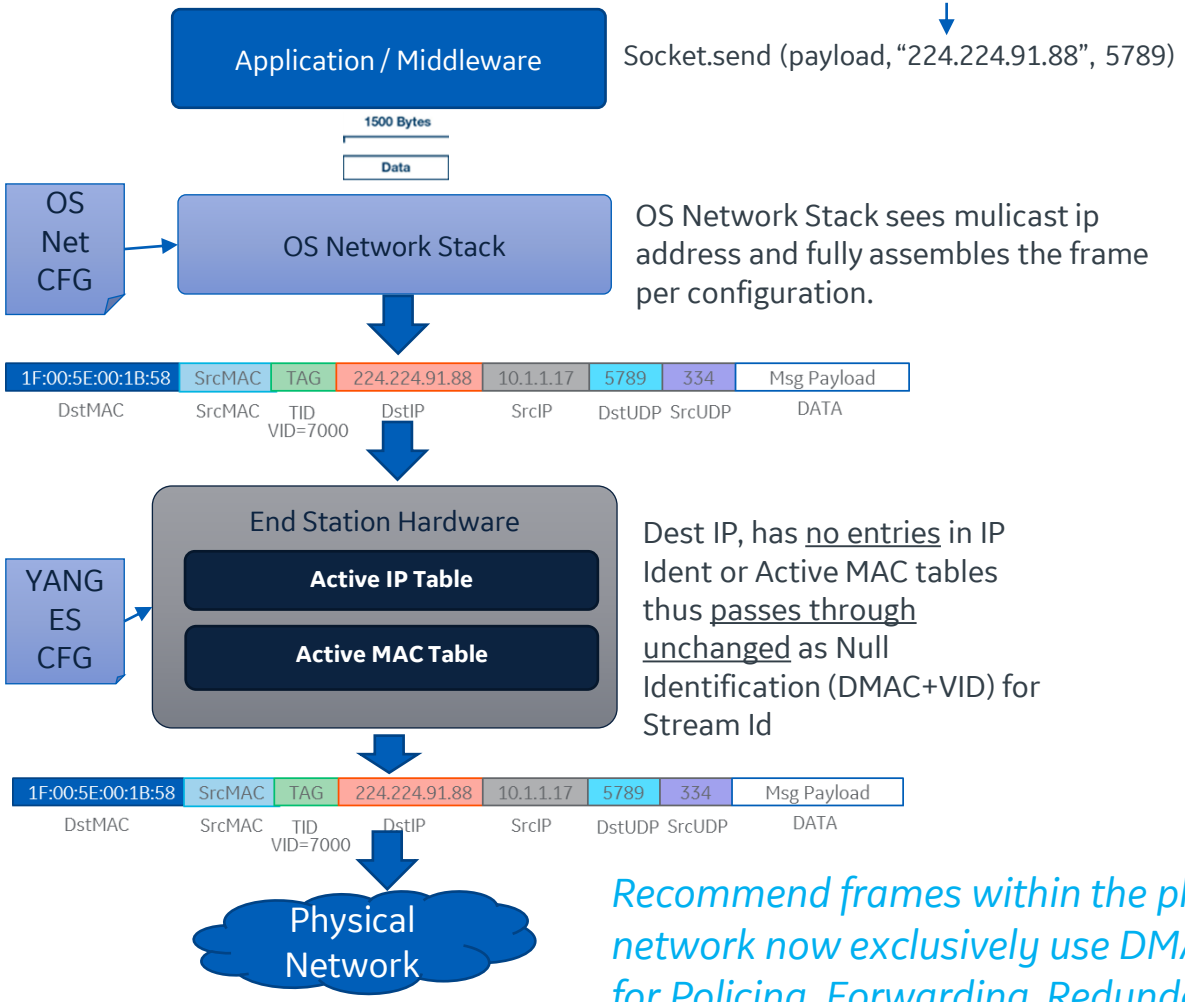
Case 3 Conceptual Working Examples on following slides

Case 3 Conceptual Working Example

Scenario 1:

Assign App Payload to Stream 7000

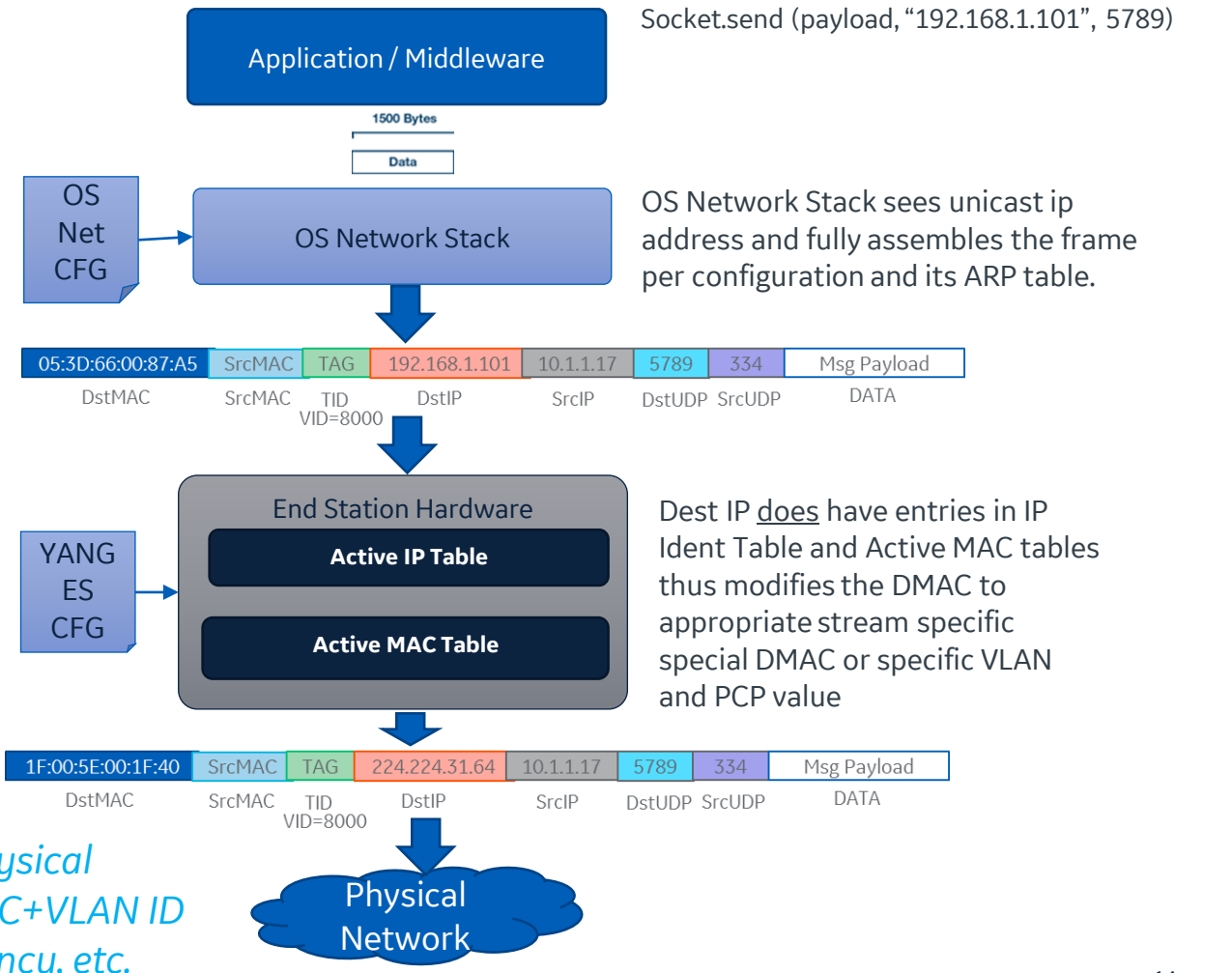
Here the app supports mulicast IP



Scenario 2:

Assign Existing App Payload to Stream 8000

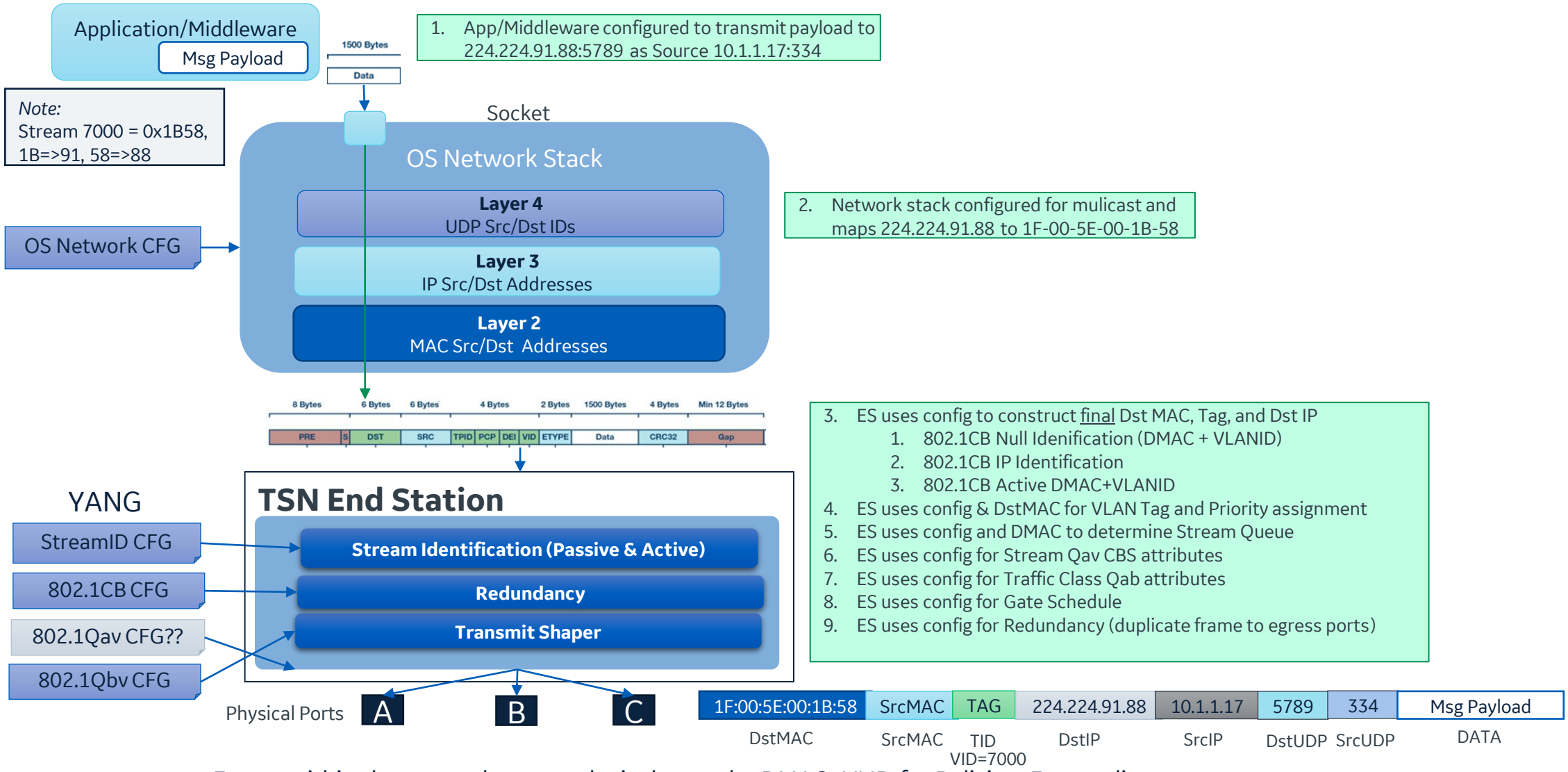
Here the app only supports unicast IP



Recommend frames within the physical network now exclusively use DMAC+VLAN ID for Policing, Forwarding, Redundancy, etc.

Case 3 Working Example Breakdown

Send UDP payload on Stream 7000 to multiple listeners



Frame within the network now exclusively use the DMAC+VLID for Policing, Forwarding, etc.