Traffic Categories & Overall Performance Goals

Amrit Gopal – Ford Motor Company
Purpose

• To build consensus on
  – Traffic types
  – Priority
  – Overall required performance goals

• Understanding and agreeing on above parameters is required for optimum TSN strategy
Automotive In-Vehicle Traffic Types

- Command & Control 1 – Time critical and safety-relevant control signals
- Command & Control 2 – Status, A/C, seats, infotainment system, etc.
- Network Control/Management – PTP, LLDP, network configuration, network diagnostics
- Audio – Chimes/Alerts, entertainment
- Video Stream 1 – Sensor fusion related features (AR/V2V/Driver Assist)
- Video Stream 2 – Camera at low speed, Streaming, Map, Entertainment, Web, Audio
- Best Effort – Data upload, OTA download, vehicle diagnostic
# Traffic Priority

<table>
<thead>
<tr>
<th>PCP</th>
<th>Priority</th>
<th>Traffic type</th>
<th>Attributes</th>
<th>Criticality</th>
<th>Link Utilization</th>
<th>Loss Tolerance</th>
</tr>
</thead>
<tbody>
<tr>
<td>7</td>
<td>Highest</td>
<td>Command &amp; Control 1</td>
<td>Size: 64 – 512 bytes</td>
<td>High</td>
<td>1 - 5%</td>
<td>None</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Timing constraint: 1ms</td>
<td>Periodicity: 1 – 20ms</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>.</td>
<td>Reserved for future use</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>5</td>
<td>.</td>
<td>Video Stream 1</td>
<td>Size: 1518 bytes</td>
<td>High</td>
<td>1 - 5%</td>
<td>Few</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Timing constraint: 2ms</td>
<td>AVB SR - A</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>.</td>
<td>Command &amp; Control 2</td>
<td>Size: 64 – 1518 bytes</td>
<td>Medium</td>
<td>1 - 40%</td>
<td>Few</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Timing constraint: 100ms</td>
<td>AVB SR - A</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>.</td>
<td>Network Control/Management</td>
<td>Size: 64 – 500 bytes</td>
<td>Medium</td>
<td>1 - 5%</td>
<td>Few</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Timing constraint: 100ms</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>.</td>
<td>Reserved for future use</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>1</td>
<td>.</td>
<td>Video Stream 2</td>
<td>Size: 1518 bytes</td>
<td>Low</td>
<td>1 - 20%</td>
<td>Some</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Timing constraint: 50ms</td>
<td>AVB SR - B</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0</td>
<td>Lowest</td>
<td>Best Effort (Data Tx, Diag., Others)</td>
<td>Size: 64 – 1518 bytes</td>
<td>Low</td>
<td>25%+</td>
<td>Some</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Timing constraint: 2000ms</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Definitions

- PCP: Priority Code Point.

- Timing constraint (latency) - The time within which an Ethernet frame is required to be received.
  - Measured from MAC (source) to MAC (destination) as time taken from first bit out to last bit in with a maximum of 3 hops.

- Periodicity - Rate at which streams are scheduled

- Criticality - Application criticality rating
  - High: Critical system malfunction may occur if packet is lost or delayed.
  - Medium: Degraded operation may occur if packet is lost or delayed.
  - Low: Packet loss can be compensated by retransmission; delayed packets will not cause major loss in functionality.

- Loss Tolerance - Tolerance to consecutive packet loss
  - None: 0 frame loss
  - Few: TBD
  - Some: TBD
# Video utilization over Ethernet

<table>
<thead>
<tr>
<th>Video Type</th>
<th>Raw Rate (Mb/s)</th>
<th>150:1 Rate (Mb/s)</th>
<th>35:1 Rate (Mb/s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>NTSC 720x486 d32 @30FPS</td>
<td>342</td>
<td>2.3</td>
<td>9.8</td>
</tr>
<tr>
<td>720p HD 1280x720 d24 @30FPS</td>
<td>676</td>
<td>4.5</td>
<td>19.3</td>
</tr>
<tr>
<td>1080p HD 1920x1080 d24 @30FPS</td>
<td>1523</td>
<td>10.2</td>
<td>43.5</td>
</tr>
</tbody>
</table>

Too many input/output combinations
Examples of Ingres/Egress profile that well-defined priority classes can feed into
Ingress Profile

I/P Port

- Command & Control 1
- Reserved for future use
- Video Stream 1
- Command & Control 2
- Network Control/Management
- Reserved for future use
- Video Stream 2
- Best Effort

Rate Limit Per Stream
Rate Limit Per Stream
Rate Limit Per Stream
Rate Limit Per Stream
Rate Limit Per Stream
Rate Limit Per Stream
Rate Limit Per Class
Rate Limit Per Class

Egress Block
Egress Profile

- Command & Control 1
- Reserved for future use
- Video Stream 1
- Command & Control 2
- Network Control/Management
- Reserved for future use
- Video Stream 2
- Best Effort

- CBS
- TAS

O/P Port

Strict Priority Shaper
Definitions

- CBS – Credit Based Shaper
- TAS – Time Aware Shaper
Thank you!