Traffic Categories & Overall Performance Goals

Amrit Gopal – Ford Motor Company
Jim Lawlis – 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 – A/C, seats, vehicle status, 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 DAT etc.)
- Video Stream 2 – Camera at low speed, Entertainment
- Best Effort – Data collection upload, OTA download, vehicle diagnostic
## Traffic Priority

<table>
<thead>
<tr>
<th>PCP</th>
<th>Priority</th>
<th>Traffic Class</th>
<th>Traffic type</th>
<th>Attributes</th>
<th>Criticality</th>
<th>Loss Tolerance</th>
</tr>
</thead>
<tbody>
<tr>
<td>7</td>
<td>Highest</td>
<td>TC 8</td>
<td>Command &amp; Control 1</td>
<td>Timing constraint: 1ms</td>
<td>High</td>
<td>None</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Size: 64 – 512 bytes Periodicity: 1 – 20ms</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td></td>
<td>TC 7</td>
<td>Reserved for future use</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>5</td>
<td></td>
<td>TC 6</td>
<td>Video Stream 1 (ADAS)</td>
<td>Timing constraint: 16ms</td>
<td>High</td>
<td>Few</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Size: 1518 bytes Periodicity: 16ms</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
<td>TC 5</td>
<td>Command &amp; Control 2</td>
<td>Timing constraint: 100ms</td>
<td>Medium</td>
<td>Few</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Size: 64 – 1024 bytes Periodicity: 21 – 500ms</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
<td>TC 4</td>
<td>Network Control/Management</td>
<td>Timing constraint: 100ms</td>
<td>Medium</td>
<td>Few</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Size: 64 – 500 bytes Periodicity: Variable</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td>TC 3</td>
<td>Reserved for future use</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>1</td>
<td></td>
<td>TC 2</td>
<td>Video Stream 2 (Infotainment)</td>
<td>Timing constraint: 33ms</td>
<td>Low</td>
<td>Some</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Size: 1518 bytes Periodicity: 33ms</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0</td>
<td>Lowest</td>
<td>TC 1</td>
<td>Best Effort (Data Tx, Diag., Others)</td>
<td>Timing constraint: 2000ms</td>
<td>Low</td>
<td>Some</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Size: 64 – 1518 bytes Periodicity: Variable</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Definitions

- **PCP**: Priority Code Point.

- **Timing constraint (latency)** is the time within which an Ethernet frame is required to be received.
  - This is not application to application latency. This is MAC (source) to MAC (destination) latency. Time taken from last bit in – last bit out on 100BASE-T1 with maximum of 3 hops.

- **Criticality** -
  - 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** -
  - None: 0 frame loss
  - Few ??
  - Some ??
## Traffic Priority

<table>
<thead>
<tr>
<th>PCP</th>
<th>Priority</th>
<th>Traffic Class</th>
<th>Traffic type</th>
<th>Attributes</th>
<th>Criticality</th>
<th>Loss Tolerance</th>
</tr>
</thead>
<tbody>
<tr>
<td>7</td>
<td>Highest</td>
<td>TC 8</td>
<td>Command &amp; Control 1</td>
<td>Size: 64 – 512 bytes</td>
<td>High</td>
<td>None</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Timing constraint: 1ms</td>
<td>Periodicity: 1 – 20ms</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td></td>
<td>TC 7</td>
<td>Reserved for future use</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>5</td>
<td></td>
<td>TC 6</td>
<td>Video Stream 1 (ADAS)</td>
<td>Size: 1518 bytes</td>
<td>High</td>
<td>Few</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Timing constraint: 16ms</td>
<td>Periodicity: 16ms</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
<td>TC 5</td>
<td>Command &amp; Control 2</td>
<td>Size: 64 – 1024 bytes</td>
<td>Medium</td>
<td>Few</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Timing constraint: 100ms</td>
<td>Periodicity: 21 – 500ms</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
<td>TC 4</td>
<td>Network Control/Management</td>
<td>Size: 64 – 500 bytes</td>
<td>Medium</td>
<td>Few</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Timing constraint: 100ms</td>
<td>Periodicity: Variable</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td>TC 3</td>
<td>Reserved for future use</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>1</td>
<td></td>
<td>TC 2</td>
<td>Video Stream 2 (Infotainment)</td>
<td>Size: 1518 bytes</td>
<td>Low</td>
<td>Some</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Timing constraint: 33ms</td>
<td>Periodicity: 33ms</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0</td>
<td>Lowest</td>
<td>TC 1</td>
<td>Best Effort (Data Tx, Diag., Others)</td>
<td>Size: 64 – 1518 bytes</td>
<td>Low</td>
<td>Some</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Timing constraint: 2000ms</td>
<td>Periodicity: Variable</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Examples of Ingres/Egress profile that well-defined priority classes can feed into
Ingress Profile

- Command & Control 1 (TC 8)
- Reserved for future use (TC 7)
- Video Stream 1 (TC 6)
- Command & Control 2 (TC 5)
- Network Control/Management (TC 4)
- Reserved for future use (TC 3)
- Video Stream 2 (TC 2)
- Best Effort (TC 1)
Egress Profile

- Command & Control 1 (TC 8) → TAS
- Reserved for future use (TC 7) → TAS
- Video Stream 1 (TC 6) → CBS → TAS
- Command & Control 2 (TC 5) → CBS → TAS
- Network Control/Management (TC 4) → CBS → TAS
- Reserved for future use (TC 3) → CBS → TAS
- Video Stream 2 (TC 2) → CBS → TAS
- Best Effort (TC 1) → CBS → TAS

Strict Priority Shaper

O/P Port
Definitions

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