Agenda

Motivation

- Eclipse Cyclone DDS and Eclipse iceoryx
- Eclipse p3com

Initial benchmarking results
Motivation

- SDV platforms often contain platform-specific HW interfaces for data transfer
  - For example:
    1. PCI Express bus on automotive development platform (>800 MB/s bandwidth)
    2. SRAM memory unit accessible from both application and real-time cores
      - Much better throughput than ethernet, but much more difficult to use (no socket API)
Eclipse Cyclone DDS and Eclipse iceoryx

- Established open-source middleware projects

- **Eclipse Cyclone DDS**: Data Distribution Service protocol and API implementation
  - Widely used in robotics and IoT
  - Default middleware in ROS2

- **Eclipse iceoryx**: inter-process-communication middleware
  - Implementation based on shared memory, with zero-copy support
  - Lower-level abstractions, no QoS, but high performance
  - Automotive quality and safety (WIP)

- By default, **Eclipse Cyclone DDS** uses UDP/IP, but it has optimization for inter-process communication:

- **Eclipse iceoryx** integrates into **Eclipse Cyclone DDS** to implement this efficiently
Eclipse p3com

- Idea: Enable middleware libraries to leverage the performance of platform-specific interfaces
- Analogous to how Cyclone DDS leverages SHM via iceoryx

- Eclipse p3com is an extension of Eclipse iceoryx that works over PCIe, IPCF, UDP, TCP…
- Portable – Linux, FreeRTOS
- Pluggable – modular “transport layer” architecture
- Publish/subscribe communication

- p3com consists of:
  - platform-agnostic infrastructure (discovery system, iceoryx endpoints, …)
  - platform-specific transport layers (useful as is, or as examples for other platforms)

- Implemented as a “gateway” daemon process forwarding iceoryx traffic over transport layers
Initial benchmarking results

• Using Eclipse Cyclone DDS ShmThroughput benchmark, with SHM enabled
• Running on NXP BlueBox 3 platform, communication between LX2 and S32G

<table>
<thead>
<tr>
<th>Payload size</th>
<th>Cyclone DDS vanilla* LX2 -&gt; S32G</th>
<th>p3com PCIe LX2 -&gt; S32G</th>
<th>p3com PCIe S32G -&gt; LX2</th>
</tr>
</thead>
<tbody>
<tr>
<td>4 kB</td>
<td>487 Mbit/s</td>
<td>121 Mbit/s</td>
<td>224 Mbit/s</td>
</tr>
<tr>
<td>64 kB</td>
<td>676 Mbit/s</td>
<td>1501 Mbit/s</td>
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<td>256 kB</td>
<td>622 Mbit/s</td>
<td>4346 Mbit/s</td>
<td>5259 Mbit/s</td>
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<tr>
<td>1 MB</td>
<td>646 Mbit/s</td>
<td>5562 Mbit/s</td>
<td>6962 Mbit/s</td>
</tr>
</tbody>
</table>

* no QoS optimization for maximum UDP/IP throughput in Cyclone DDS

• Small payload performance worse than UDP/IP
• Large payload performance almost fully saturates bus bandwidth (8 Mbit/s)
THANK YOU!