Using Deterministic Networks for Industry Operations and Control

draft-km-detnet-for-ocn-04

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Recap: Industrial Automation (IA) system and DetNet

- An application level set of APIs, interfaces, traffic behavior to communicate with the boundaries of DetNet.

- This was requested to explain how DetNet will have reserved resources per application.

Figure 4: A Realistic DetNet Based Industrial Application Network
Overview

- **What this document is about?**
  - Provide an interface/data valid for Industrial Automation operations.

- **IETF-117 / draft-km-detnet-for-ocn-03**
  - background and motivation provided
  - types of traffic patterns
  - ipv6 extension header based solution

- **Feedback**
  - concerns: extension header changes are a bigger ask.
  - alignment with TSN work.
  - suggestion: reorient to simplify and narrow the scope
Changes since 03

1. Removed extension header topic to appendix - no emphasis on specific type of data plane encoding/encapsulation.

2. Added traffic types aligned with "IEC/IEEE 60802 TSN Profile for Industrial Automation"
   a. The document does not reinvent anything
   b. Collects traffic type specification

4. Operation & Control Traffic Types
   4.1. Overview
   4.2. OCN Traffic Type Equivalence
       4.2.1. Isochronous traffic-type
       4.2.2. Cyclic-synchronous traffic-type
       4.2.3. Cyclic-Asynchronous traffic-type
       4.2.4. Alarms and Events traffic type
       4.2.5. Configuration and diagnostics traffic type
       4.2.6. Network Control
# Table of Traffic Types supported by TSN IA Profile

<table>
<thead>
<tr>
<th>Traffic Type</th>
<th>TT-Code</th>
<th>Param</th>
<th>Param</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Isochronous</td>
<td>ISOC_TT</td>
<td>0x08</td>
<td>DL_TIME</td>
<td>Deadline limit between Src and Dst Optional clock src info</td>
</tr>
<tr>
<td>Cyclic-Synchronous</td>
<td>CSYNC_TT</td>
<td>0x07</td>
<td>DL_TIME</td>
<td>-same-</td>
</tr>
<tr>
<td>Cyclic-Asynchronous</td>
<td>CASYN_TT</td>
<td>0x06</td>
<td>DL_TIME</td>
<td>-same- No clock source needed</td>
</tr>
<tr>
<td>Network Control</td>
<td>NWCTL_TT</td>
<td>0x05</td>
<td>-</td>
<td>-as above-</td>
</tr>
<tr>
<td>Alarms and Event</td>
<td>ALEV_TT</td>
<td>0x04</td>
<td>DL_TIME</td>
<td>Retransmission flag</td>
</tr>
<tr>
<td>Conf. Diag</td>
<td>CFDG_TT</td>
<td>0x03</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Best Effort High</td>
<td>BEHI_TT</td>
<td>0x02</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Best Effort Low</td>
<td>BELO_TT</td>
<td>0x01</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Asynctext: Application controller can specify tolerance to packet loss rate

Network Control: for network operations such as time synchronization, loop prevention, and topology detection

Alarms: bounded latency and should follow bandwidth constraints.

Diagnostics: periodically transmit diagnostics packets and field device configurations
Traffic Types

4.2.1. Isochronous traffic-type
API format:

--- tt_code = ISOC_TT
--- dl_time = value
--- dl_tmunit = ms |us
--- app-flow-ref
--- clock-src : ip address

4.2.2. Cyclic-synchronous
API format

--- tt_code = CSYNC_TT
--- dl_time = value
--- dl_tmunit = ms |us
--- app-flow-ref
--- clock-src : ip address

4.2.3. Cyclic-Asynchronous
API format

--- tt_code = CSYNC_TT
--- dl_time = value
--- dl_tmunit = ms |sec
--- app-flow-ref
--- pkt-loss-tmunit

4.2.4. Alarms and Events traffic type
API format

--- tt_code = ALEV_TT
--- dl_time = value
--- dl_tmunit = ms |sec
--- restrans = yes |no
--- burst-limit

4.2.5. Configuration and diagnostics
API format

--- tt_code = CFDI_TT
--- dl_time = value
--- dl_tmunit = sec
--- restrans = yes |no

4.2.6. Network Control
API format:

--- tt_code = NWCTL_TT
--- dl_time = value
--- dl_tmunit = sec
--- restrans = yes |no
Data plane agnostic approach

Once this data model/Interface is specified following implementations are possible

A. Apply out-of band
   - YANG model approach
   - Application controller will define its data-model and shares with DetNet management or orchestration entity

B. Apply in-band dataplane approaches
   - Suitable for programmability aspects.
   - Extension headers or additional service-sublayer extensions are potential approaches.
     - PoC being planned (leveraging on P4), yet under analysis
Feedback/Comments

Thank you!