Use case: MPLS path monitoring

Monitoring MPLS paths

- network topology (the implementation detects and stacks LDP signaled Labels)
- the MPLS path monitoring packets remain in data plane
- a single PMS is able to address all LSPs of a domain, a PMS allows arbitrary path combinations
- Example task shown here: PMS based data plane failure detection between LER i and LER j.

In general, all MPLS LSPs of a domain can be monitored this way.

PMS: MPLS Path Monitoring System

PMS based LSP measurement, here with 3 LSP segments

LER i
LER j
Regional
Regional

Label 21
Label 25
Label 24

20
25
24

data

PMS

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PMS implementation report
July 2016
Measurement Topology (extract)

case one: IPPM and PMS comparison of RT Delay measurement:
- PerfMA 1 ↔ PerfMA 3 (reference)
- PMS ↔ LER 3

case two: LER 2 ↔ LER 3 measurements:
- LER 2 ↔ LER 3 = PMS → LER 1 → LER 2 → LER 3 → LER 2 → LER 1 → PMS
  - PMS ↔ LER 2
- LER 3 ↔ LER 2 in analogy by subtracting PMS ↔ LER 3
Measurement Results and Evaluation

- measurement: 288 mean RT Dealy values each calculated of 10 singleton samples (8 hours measurement)
- Anderson-Darling-K-Sample (ADK) is successful ($\leq 1.993$, RFC 6576) after adjustment of the mean/median
- high precision of the values
- no network emulator inserted
- LER 2 $\leftrightarrow$ LER 3 two calculation methods result in mean/median values differing by 10 $\mu$s

<table>
<thead>
<tr>
<th>Test metric</th>
<th>PERFAS+</th>
<th>PMS</th>
</tr>
</thead>
<tbody>
<tr>
<td>minimum [$\mu$s]</td>
<td>691.5</td>
<td>695.5</td>
</tr>
<tr>
<td>maximum [$\mu$s]</td>
<td>701</td>
<td>704.5</td>
</tr>
<tr>
<td>mean [$\mu$s]</td>
<td>695.4</td>
<td>699.6</td>
</tr>
<tr>
<td>median [$\mu$s]</td>
<td>695.5</td>
<td>699.5</td>
</tr>
<tr>
<td>standard deviation [$\mu$s]</td>
<td>1.4</td>
<td>1.7</td>
</tr>
<tr>
<td>ADK-value</td>
<td>278.445</td>
<td></td>
</tr>
<tr>
<td>ADK-value (adj. of mean)</td>
<td>1.701</td>
<td></td>
</tr>
<tr>
<td>ADK-value (adj. of median)</td>
<td>1.982</td>
<td></td>
</tr>
</tbody>
</table>

**Table:** PERFAS+ and PMS OWD measurement results for path LER 1 to LER 2 and ADK test results
IP-address variation

- identical routing paths for all measurements, no Equal-cost multi-path routing
- 11 mean round-trip delay values of 10 singletons per measurement, collected at different times of a day
- only IP-addresses varied, MPLS-stack kept the same
- PMS connected to two different LER “one” and “two”
- difference in mean values of 19.5 \( \mu s \) and 14.4 \( \mu s \), RTD a.b.c.0 is always smaller than that of a.b.c.32

<table>
<thead>
<tr>
<th>Interface IP-address</th>
<th>mean [( \mu s )]</th>
<th>median [( \mu s )]</th>
</tr>
</thead>
<tbody>
<tr>
<td>one / a.b.c.0</td>
<td>1413.2</td>
<td>1412</td>
</tr>
<tr>
<td>one / a.b.c.32</td>
<td>1432.7</td>
<td>1433</td>
</tr>
<tr>
<td>two / a.b.c.0</td>
<td>1446.4</td>
<td>1446</td>
</tr>
<tr>
<td>two / a.b.c.32</td>
<td>1460.8</td>
<td>1460.5</td>
</tr>
</tbody>
</table>

Table: Destination-IP-address variation
Progress on SPRING based OAM within IETF

- SPRING allows for new OAM features
- a single PMS may send packets to any router and collect responses or it may send and receive circular routed measurement packets
- no need to standardize protocols
- SPRING WG is chartered to produce also OAM related use cases, draft-ietf-spring-oam-usecase is stable for a while
- draft-leipnitz-spring-pms-implementation-report documents first experiences with SPRING enabled OAM features
- How to make progress on SPRING enabled new OAM features within IETF?