Network-wide Protocol Monitoring (NPM): Use Cases

draft-chen-npm-use-cases-00

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Mar. 24, 2019
Control Plane Telemetry

- **Management/control/data plane telemetry**
  - **Management plane telemetry**: network operational state retrieval and configuration management
  - **Control plane telemetry**: routing protocol monitoring and routing related data retrieval, e.g., topology, route policy, RIB...
  - **Data plane telemetry**: traffic performance measurement and traffic related data retrieval

- **Role of control plane telemetry**:
  - **Network troubleshooting**
    - 48% of the problems are based on protocol errors or misconfiguration impact both tracking of operational and provisioning
  - **Network planning**
    - No effective route policy/configuration validation approach, and lacks route-traffic correlation insight
    - Real time applications of 5G require real-time TE optimization, and accurate what-if simulation for network planning

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*Hawei Internal Statistics: control protocol failures take up about 48% of all network issues.*

**2016 Internal statistics: Network Failure Cause**

- 20% Protocol neighbor setup failure
- 18% Protocol table issue
- 14% Protocol neighbor damping
- 12% Protocol table state
- 10% Protocol table issue
- 6% Protocol neighbor
dumping
- 7% Protocol neighbor
damping
- 4% Traffic table state
- 4% Protocol table state
- 3% Protocol neighbor
damping
- 2% Protocol neighbor
dumping

- **Traditional troubleshooting methods**
  - Time-consuming
  - Labor-consuming
  - Data acquisition difficult
  - Require OAM experience for operators
- **Issues, like route flapping, hard to localize**
Network-wide Protocol Monitoring (NPM) Framework

Data Source:
- Topology, protocol PDU
- RIB, route policy
- Statistics...

NPM problem space:
- Sufficient data type coverage
- Sufficient device coverage

Data Generation:
- Data encapsulation
- Data serialization
- Data subscription

NPM problem space:
- Data model definition
- Data process efficiency

Data Transportation:
- BMP, gRPC, Netconf, new protocol?

NPM problem space:
- Transportation protocol selection
- Exportation efficiency

Data collection:
- RIB/FIB, protocol PDU, topology, route policy...

NPM problem space:
- Data synchronization
- Data parse efficiency

Data Analysis:
- Protocol troubleshooting
- Policy validation
- Traffic optimization
- What-if simulation

NPM problem space:
- Data synchronization
- Data parse efficiency
Use case 1: LSDB Synchronization Failure

• Cause 1: LSP authentication error
  • E.g., L1 LSP with area authentication
  • Algorithm mismatch, key mismatch due to misconfigurations or synchronization issue

• Cause 2: LSP too large to propagate
  • LSP fail to be sent due to too many link states in one LSP for the configured MTU

• Cause 3: Logic bugs
  • Logic bug leads to PDU not sent
  • Logic bug leads to PDU discarded when received

• Improvement with NPM
  • Reason code
  • LSDB and LSP comparison
Use case 2: Route Policy Validation

- Existing route policy validation:
  - Lacks the vision of how policy impacts the route attributes

- Route policy pre-check simulation:
  - Simulation based on device configurations: not 100% mirroring of on-going network

- Possible improvements with NPM
  - **Policy/Route correlation:** Real-time track of how policy changes route attributes
  - **Control plane snapshots:** as the simulation input: topology, protocol neighbor state, RIB… to improve the simulation accuracy

<table>
<thead>
<tr>
<th>Prefix</th>
<th>Route event</th>
<th>Route policy</th>
<th>Time stamp</th>
<th>Next hop</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>172.17.0.0/16</td>
<td>1</td>
<td>ISIS: Route-policy r1 : permit/permit : cost 100</td>
<td>xx:xx:xx</td>
<td>192.168.2.2/24</td>
<td>100</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>RM: Route-policy r2 : permit/deny : next-hop</td>
<td>xx:xx:xx</td>
<td>192.168.1.1/24</td>
<td>100</td>
</tr>
</tbody>
</table>
More Use Cases

• More use cases to be found in the draft
  • IS-IS Route Flapping
  • Route Loop
  • Tunnel Set up Failure
Summary

• General Requirements from above use cases
  1. A "tunnel" for the control plane data export:
     • Performance guarantee for: data modeling, encapsulation, serialization, exportation, transportation performance
  2. Adequate protocol data collection:
     • The data type coverage:
       • Protocol PDUs (LSP, LSA, Hello, Open, Update...)
       • Network-wide RIBs
       • Correlated policy and route attributes...
     • The network coverage: network-wide data collection

• Next step
  • Want to get feedbacks on the use cases
  • Identify and tease the requirements and gaps