PTP Notifications

IETF-105 Hackathon

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IP Fabric for Media

- **New design paradigm in the media & broadcasting** (CBS, BBC, NBC, etc) **industries**
- **Move existing Serial Digital Interface (SDI) based infrastructure to an IP infrastructure**.
- **The traffic on the IP fabric is User Datagram Protocol (UDP) multicast**

- ***Society of Motion Picture and Television Engineers*** (SMPTE) and SMPTE in standard 2010, 2022 describe:
  - Transport
  - Error correction
  - Clock synchronization SMPTE 2059
  - …and more
- **Precision Time Protocol** (PTP) is a IEEE 1588 standard used to synchronize clocks throughout a computer network.
  - Achieves clock accuracy in the sub-microsecond range

Why clock synchronization matters

- **Multi-channel inputs**
  - Audio and video out sync
- **Limited bandwidth**
  - 4K video (2160p60), for example, uses 12 Gbps of bandwidth when full color and uncompressed
    - 10 GB ethernet not enough
    - Buffer sizes are limited
    - How to reliably stitch back
    - What happens with 8K?
    - By converting an asynchronous protocol such as Ethernet into a synchronous one, we can leverage the benefits of time-based protocols.

PTP use cases in IP-Media

- **What happens during a live events like Super Bowl game and**
  - my video and audio are out of sync.
  - or multiple cameras are out of sync
- **NEED active monitoring to ensure my protocol is working**
- **NEED an open method of receiving prompt notifications** whenever PTP offset/correction in the network goes beyond acceptable limit.
- **NEED an open method of configuring acceptable threshold** value for PTP offset/correct based on media profile(s).
- **NEED an open method of configuring duration of PTP offset reporting** (sampling period). PTP notification should provide total violations against monitored samples.

Hackathon

- **Deliverables**
  - Define PTP YANG Notification Model
  - Develop Python script as 3rd Party Application (mPTP) on Cisco Switch
  - Extend Cisco Data Center Network Manager as PTP notification subscriber
    - New REST API to consume PTP notifications
    - Overlay PTP information on network topology (WS Notifications for real time updates)
- **Setup:**

  PTP Network - Cisco Nexus two-tier CLOS/Leaf-Spine Topology

PTP Offset Monitoring Notification Fields

- **`total-samples`** – The total number of samples within a given time delta
- **`max-offset`** – The maximum deviation observed
- **`offset-threshold-exceed-count`** – Count of how many times the `offset-threshold` was exceeded
- **`offset-threshold`** – User set value of what is acceptable deviation
- **`node`** – Identity of slave host
- **`slave-port`** – Interface used by PTP for synchronization

PTP Notification YANG Model

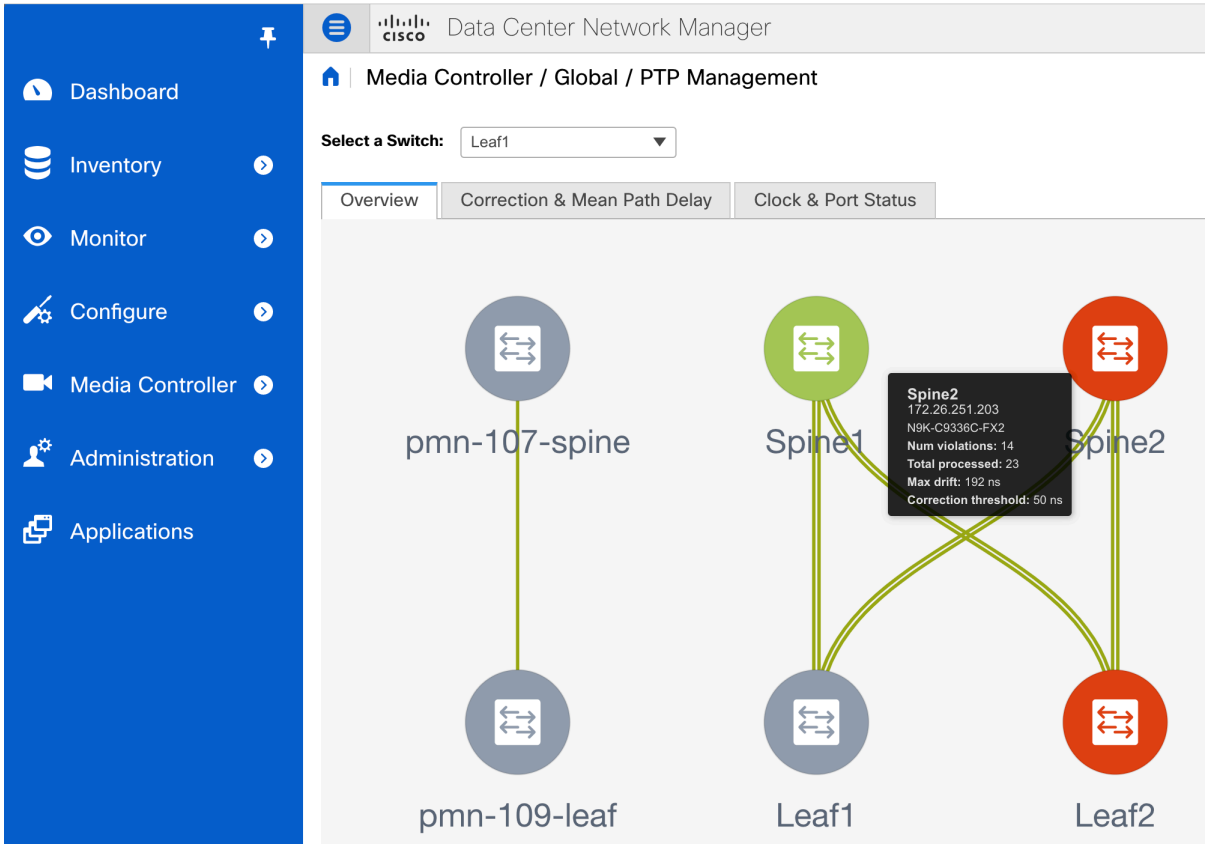
```
module ptp-offset-notification {
  yang-version 1.1;
  namespace "http://cisco.com/ns/yang/cisco-nx-os/ptp-offset-notification";
  prefix ptp-offset-notification;
  organization "Cisco Systems, Inc.";
  contact " Cisco Systems, Inc., Customer Service, Postal: 170 W Tasman Drive, San Jose, CA 95134, Tel: +1 1800 553-NETS, e-mail: nxos-dev-yang@cisco.com";
  description "NXOS PTP Notification YANG Model for offset correction";
  revision 2019-07-20 {
    description "Initial Revision."
  }
  container offset-statistic {
    leaf max-offset {
      type int64;
      description
        "Max value of offset/correction in nanoseconds from master to slave in current sample period."
    }
    leaf total-samples {
      type int32;
       description
        "Total offset samples in current sample period."
    }
    leaf offset-exceed-count {
      type int32;
       description
        "Number of samples that are above offset threshold in current sample period."
    }
    leaf sampling-duration {
      type int32;
       description
        "Time period in millisecond in which threshold violations were observed."
    }
    leaf offset-threshold {
      type int64;
       description
        "Beyond this threshold value (in nanoseconds), violations are reported to subscribers."
    }

  }
  notification source {
    leaf node {
      type string;
       description
        "Node/device reporting ptp offset threshold violations."
    }
    leaf slave-port {
      type string;
       description
    }
  }
}
```

Example Payload

```
<notification
  xmlns="http://cisco.com/ns/yang/cisco-nx-os/ptp-offset-notification:ns:netconf:notification:1.0">
  <offset-statistic  xmlns="ptp-offset-notification">
    <max-offset>270</max-offset>
    <total-samples>17</total-sample>
    <offset-threshold-exceed-count>2</offset-threshold-exceed-count>
    <offset-threshold>200</offset-threshold>
    <node>leaf-2</node>
    <slave-port>>ethernet1/1</slave-port>
  </offset-statistic>
</notification>
```

2 samples exceeded offset threshold of 200ns in last 2 sec w/ max being 270ns

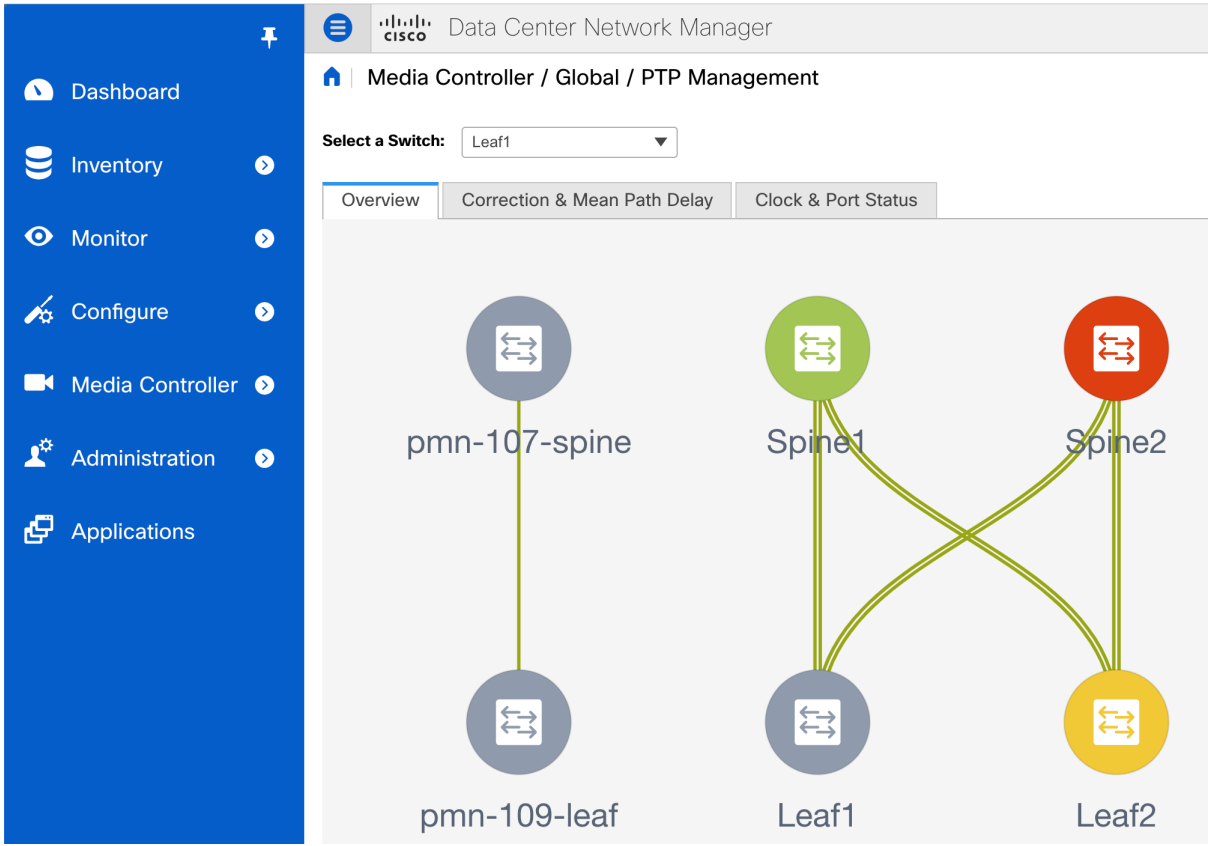
Demo Implementation GUI



Node Offset Exceed Status

- Violations < 20%
- Violations 20% - 50%
- Violations > 50%
- No PTP Updates Received

Demo Implementation GUI



Node Offset Exceed Status

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Demo Implementation Backend

```
Leaf2(config)# sh mPTP nxsdk state

Custom App State infomration
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App Name                       : mPTP(PTP Monitoring)
Nexus Mapped App Name          : nxsdk_app1
Uuid                           : 1379 (VSH)
Environment                    : Python
App Priority                   : Low(25% CPU)
Sup State                      : Active
Start Resason                  : controlled
Start State                    : Stateless

Custom CLI Cmd State infomration
--------------------------------

Name                           : mPTP_set_ptp_correction_threshold_cmd
Syntax                         : [no] mPTP correction-threshold <correction-threshold-value>
Mode                           : Conf
State                          : ADDED_TO_PARSER

Tech-Support(TS)               : Off
CLI Parser Init                : Yes
CLI Parser Err                 : Registered with NX CLI Parser
CLI Callback Handler           : Registered
```

Monitor PTP (mPTP) deployed as 3rd party app on Cisco Nexus Switch

- CLI support to start/stop/monitor app
- Custom CLI for setting up offset/correction threshold