Automation of Power System Reliability: Remote Monitoring as Case

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Contribution to IEEE SRPSDVE Study Group
8 December 2014
Agenda

- Reliability: Power System Communication

- Can Monitoring be a case of SDN/NFV?
  - Remote Monitoring and Data Aggregators
  - Comparing with Industrial Ethernet-Managed Switches for Example
Reliability: Power System Communication

Power System Functions can be classified as Protection, Control and Monitoring and based on IEEE Std. 2030-2011, Smart Grid Interoperability Reference Model States.

<table>
<thead>
<tr>
<th>Type of Function</th>
<th>Protection</th>
<th>Control</th>
<th>Monitoring</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reach</td>
<td>2km</td>
<td>2km</td>
<td>2km</td>
</tr>
<tr>
<td>Data occurrence interval</td>
<td>Millisecond</td>
<td>Second</td>
<td>Second</td>
</tr>
<tr>
<td>Method of broadcast</td>
<td>All</td>
<td>Unicast</td>
<td>Multicast</td>
</tr>
<tr>
<td>Priority</td>
<td>High</td>
<td>Medium</td>
<td>Low</td>
</tr>
<tr>
<td>Latency</td>
<td>Low-Low (&lt;3ms)</td>
<td>Low-Low (&lt;3ms)</td>
<td>High (&gt;160ms)</td>
</tr>
<tr>
<td>Synchronicity</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Availability</td>
<td>High</td>
<td>Medium</td>
<td>Medium</td>
</tr>
<tr>
<td>Information reliability</td>
<td>Critical</td>
<td>Important</td>
<td>Important</td>
</tr>
</tbody>
</table>

Figure 1: Communication Aspects in Smart Grid
Can Monitoring be a case for SDN/NFV in Power System Communication

- IEC Standard 60870-5 (IEC 104) in particular discusses the functions supported by these aggregators.
- Data Concentrators/Aggregators in Power System Communication Networks could be seen as remote monitoring interfaces, which can possibly be the initial step to be approached for applying Network Functions Virtualization. This is due to the fact that achieving the QoS as well as redundancy can be handled here, especially in cases where the cost is as well important (for example in community grids). Functions done remotely include:
  - Station Initialization
  - Acquisition of Events
  - Clock Synchronization
  - Command Transmission
  - Parameter Loading
  - Test Procedure

<table>
<thead>
<tr>
<th>Function</th>
<th>Quality Factor</th>
<th>Importance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acquisition of Events</td>
<td>Visibility</td>
<td>High</td>
</tr>
<tr>
<td>Clock Synchronization</td>
<td>Quality of Control</td>
<td>High</td>
</tr>
<tr>
<td>Command Transmission</td>
<td>Quality of Control</td>
<td>High</td>
</tr>
</tbody>
</table>

Reliability of the System need to consider Quality of Control and Visibility (Part of Dependability of System)
Comparison with Industrial Ethernet – Managed Switches

• As a measure of success the SDN/NFV based approach would be most probably compared with Industrial Ethernet equipment today.

• An Example of such a switch has:
  – Plug-n-play Turbo Ring (recovery time < 20 ms), RSTP/STP (IEEE 802.1w/D) for Ethernet redundancy
  – QoS, IGMP snooping/GMRP, VLAN, LACP, SNMPv1/v2c/v3, RMON supported
  – MTBF like, 392,000 hrs & 1,102,845 hrs
  – Some support IEEE 1588 for Time Synchronization
References

Thank you!

Questions & Discussion