The value of Network Impairment Testing in Power Grids

Facing a growing challenge

The nature of power utilities networks is that they are increasingly reliant on the use of communications networks. Moreover there is a growing trend to move away from legacy technologies (in this case Time-Division Multiplexing or TDM) and adopt packet-based (TCP/IP) networks. TDM is a technology that was developed in the infancy of telecommunications. It provides the stability that is needed in these networks but is limited in ability to transport the volume of data now sought to be carried. Packet-based networks provide the scale needed but present other challenges.

Teleprotection

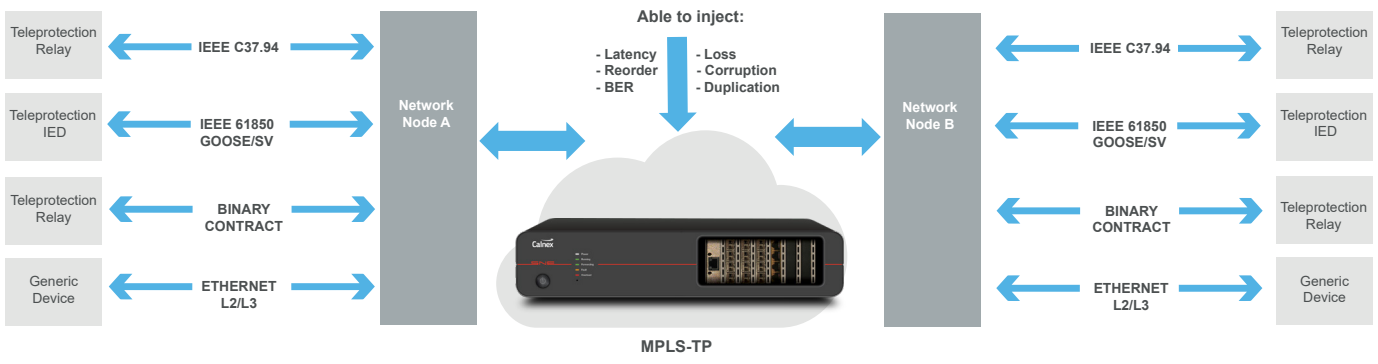
One of the most common and important types of traffic being sent across the network is differential protection traffic. This is critical data in that it supports the safe operation of power grids by controlling relays in the network to trip if needed. Because TDM-based protocols are still widely used there is a strict requirement for low latency, and specifically low asymmetrical delay in the network. The problem is that packet-based networks do not always provide the conditions required for best practice operation.

Therefore there is a critical need to adequately test the components in the network to ensure that they perform predictably and safely in a variety of network configurations and conditions. Calnex have been helping organisations in the power industry for a many years. In the following section we will look at a couple of examples of how they have been doing this.

Case study 1 – Teleprotection test

A leading manufacturer of power grid components recognised that they needed to test their devices to validate their performance in a variety of different "real-world" conditions. Their end customers are the Utilities companies who needed to have confidence that these products worked under different conditions representative of their networks.
(A view of the test design is shown in the diagram below.)

In this case the test involved multiple devices under test all on separate VLANs. The test could be run on all streams simultaneously. They were also able to change impairment values (rates of delay, % drop, etc.) as well as turn on/off throughout the test. Traffic generators were able to validate metrics at either side to ensure the accuracy of the test. Ultimately this proved performance of the devices in a range of scenarios in a pre-production environment but under real world conditions, offsetting any risk of underperformance when the devices were deployed into a live network.



Case study 2 - Network capacity planning

Another example of testing using impairment involved a North American Utility who was building a data network overlay on their power grid. Historically they based the decision to replace infrastructure purely on age of components. They wanted to test to see if they could understand the stress points in their network and therefore make better decisions around how they replaced elements in the network. The test involved modelling sections of the network and injecting captures of real network traffic into the virtual links. Additional traffic could be injected to create congestion, and links could be throttled and broken. Routing protocols determined how best to flow the traffic and the system monitored to see if capacity was being exceeded. Investment into new infrastructure involved millions of dollars at a time. With better insight the organisation was able to not waste investment into replacing infrastructure that didn't need it and spend it correctly where it was.

About Calnex SNE

Calnex SNE is a highly flexible solution for both network emulation and network simulation. Whether you want to emulate point to point links, simulate complex data-centers with multiple gateways or extract out analytical information on video systems, with the Calnex SNE you can build your network in seconds.

And because every network and project requirement is different – depending on factors such as location, connectivity,quality of service, number of services and
the applications being used across it –reaching beyond simple delay, jitter and bandwidth emulation is essential for any business.

Further, Calnex SNE offers a multi-user, multi-port environment. Each user can be allocated a pair of ports, or a number of ports, and can password protect these ports for their own exclusive use. This ensures a very cost effective and flexible means of providing test resources to a team or department.

"The Calnex SNE provides industry-leading flexibility in building and modelling these complex real-life systems enabling you to simulate networks and emulate the real world conditions under which applications and platforms need to perform."

About Calnex

Founded in 2006, Calnex is the world-leader in test and measurement solutions for synchronization and wide-area network emulation. Headquartered in Linlithgow, Scotland, with sites around the globe, Calnex was named the 2015 winner of the Queen's Award for Enterprise for International Trade, the UK's highest accolade for business success. Calnex's SNE Network Emulator is a multi-port, multi-user test solution. It emulates WAN links, and simulates complex data center and telecom infrastructure. The SNE provides comprehensive testing with higher ports counts to allow users to test with real-world network conditions in the lab, enabling issues to be found and resolved in existing networks, and potential issues in new networks to be fixed prior to the network, service or equipment going live.

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