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Latency in mission critical hybrid network

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Migration from TDM based network technologies towards to packet based technologies has started in the telecommunication networks of power utilities. Telecommunication networks are used for digital communication in transmission and distribution grids and as well as in connections between protection devices. There are several motivations behind the shift from TDM to packet based technologies. One of them is upgrading to the next generation technology when the life cycle of the currently used equipment comes to an end. Life cycle of the TDM based primary multiplexers and other equipment has been very long, more than 15-20 years. But at some point the well served equipment needs to be replaced. Another driver for the migration are changes in supported services and applications. When applications change to packet based IP technologies, taking packet based transmission networks without encapsulations into use could be feasible. Capacity requirements for all telecommunications networks are expected to grow in future. Packet based transmission is more cost efficient than TDM when higher bandwidth is required. Sometimes there is also an interest to migrate information network services and process control under one single network. This saves operational costs of the network.

Using TDM and packet technologies in parallel with so called hybrid nodes helps flexible transformation from TDM to packet based technologies. Today next generation hybrid nodes can support TDM and packet based technologies in the same node. The user can select the optimal transmission for each service. For example, the protection can use TDM cross connection matrix and transmission, and IP video surveillance cameras can use native packet transmission. But it is the old TDM based services that can be problematic. They might be connected to a packet based transmission with circuit emulation technology, but network operators do not recommend any changes to reliable operating systems following the saying “if it ain’t broke, don’t fix it”!

Using two transmission technologies at the same time will raise new questions to be answered. How to choose services connected to packet based transmission and what services have to remain in TDM based transmission? Most of the services in power utility telecommunications networks are very critical and there are very high availability requirements. But also requirements for latency are tight because of teleprotection service. What is benefit of using native transmission latency critical services without emulation or encapsulations? This technical paper gives answers to these important questions based on the experience over networks and latency measurement with different technologies.

Latency measurement can demonstrate differences between technologies. Possible encapsulation or emulation adds latency compared to the native transmission. Emulation is used for TDM based data transmitted over packet networks and encapsulation is used for transmission of packet data over TDM networks. Measurement results show when emulation or encapsulation can be used and when native transmission is required. Also possible benefits of using higher line rates can be interpreted from the latency results.