NAME : BRUNO PERALTA
COUNTRY : SPAIN
REGISTRATION NUMBER: 6272

GROUP REF.: 11052
PREF. SUBJECT: 3
QUESTION N°: 3.5

Question 3.5*: As packet-switched networks are becoming increasingly adopted as the main technology for power utilities' telecommunications networks, describe some challenges in preventing the adoption of a fully packet switched network for utilities.*

Whenever a utility decides to deploy a packet-switched network as its main (or unique) telecommunication network, many challenges should be taking into account specially because most of these projects involves the migration from some other legacy networks, which it's a challenge itself.

A deep strategic analysis, from a holistic point of view must be considered paying special attention to continuity of the current services, specially the critical ones (line protections). It's important to review the legacy interfaces of the operational services in order to avoid additional investments as well as migration restrictions.
The availability and reliability of the critical services is one, if not the most, important challenge to be considered. Most of the projects involve the migration from a TDM network to IP technology. Related to protection line services, it's important to analyze the requirements of these services (delay, jitter and path symmetry among others) bearing in mind that packet-switched networks were designed for telecommunication operators whose main problems are related with capacity and the optimization of the network itself for providing services to many customers, whereas utilities are concerned mainly about availability of the critical services.

Another relevant challenge is the design to transport and distribute frequency, phase and time synchronization from a synchronization clock hierarchy to substations. The protocol used in all nodes of the network for distributing accuracy time and frequency is IEEE 1588V2 Telecom profile. This profile allows timing accuracy <1 microsecond with a high stability when the network links or nodes failure. This performance is suitable in the digital substation applications such as synchro phasors, sampled values and current differential line protection. This service is quite relevant thinking in terms of the evolution of the services related to the digital substation.

In case the new network was deployed in parallel with the TDM network, the lack of optical fiber needed for the links must be considered. There're active and passive solutions to solve this problem, but it's important to have in mind that the availability of both networks will depend on this implementation.

The life cycle of the new technologies (where the packet-switched networks are located) are quite short compared to energy assets. Typically, the amortization period of energy assets is 20 years, whereas new technologies become less than 10 years. This fact forces, among other things, to shorten the period of deployment of these projects, which becomes a challenge itself. To guarantee the continuity of the equipment for, at least, 10-12 years, is something that must be considered when reviewing the different technical and economic offers.

The interconnection with third parties (some others TSOs, DSOs…) is something to be considered. The circuit-switched networks (SDH, PDH…) are quite simple to interconnect due to the limited alternatives to do so (STM-n, E1/T1, 64 Kbps…). When migrating to a packet-switched network, the technical alternatives to interconnect networks multiply and some other aspects must be considered, as well as cybersecurity among others. This becomes especially relevant in the case of TSOs because their power lines are connected to the DSO's ones for voltage transformation, therefore, the exchange of information in between the TSO and the DSO is quite common.

When talking about services, there is a clear difference between the IP/ethernet ones, and the TDM ones. For the first group, the migration should be quite smooth because the transportation of this type of services in a packet-switch network is very natural. In fact, not only the interfaces are implemented, but also there're many tools (Virtual Private Networks) that can help to achieve the migration. On the other hand, TDM services will have to be emulated through the packet-switch network. To do so, in the case of MPLS networks create virtual transport tunnels, also called LSPs (Label Switched Paths), that are used to forward customer data across the entire network with high availability, reliability and performance. The route or path for each tunnel can be defined automatically by the used IGP (Interior Gateway Protocol) routing protocol. The path can also be subject to constraints imposed by the operator if MPLS-TE (Traffic Engineering Extensions for MPLS) is enabled. Even, the path can be defined statically and manually by the operator. The use of one method or another for the establishment of the transport tunnel depends on the service to be provided. Thus, for example, the communication for current differential protection uses RSVP-TE tunnels and the path is defined manually by the operator.

Using traffic engineering tools enables to manage some other constraints that could be relevant for providing services like the bandwidth or the maximum delay of the services provided.
The migration of the services is very relevant; therefore, a deep analysis and a good strategy must be considered before the beginning of this task. The main aspect to bear in mind is the chance to have both networks (the old one, and the new one to be deployed) in parallel. This is a key point because it facilitates a lot the whole migration process and the backup in case the migration was not running fine. Another strategy that could be implemented is to use both networks for providing a service. This can be done in the case there are two physical interfaces for the same service, and it allows to compare the performance of both networks.

Implementing a packet-switch network in a utility also implies a deep cultural change. Most of the TDM networks were deployed 20 or 25 years ago, therefore the procedures and the knowledge of the technology is quite deep in the O&M and engineering departments. The learning cycle that must be planned is key in order to ensure the success of the project. Many concepts or terms will have to be updated, especially those related with circuits. In some cases, the feeling of lack of control can be present, therefore a good learning plan must be considered.