Telecom Technology That Works For You

Utility Network Specialists

Telecom Infrastructure Overview
From RFL Communications plc

RFL Communications plc www.rflcomms.co.uk

A simplified overview of MPLS/TDM systems

BT are transforming their existing TDM network to an IP (Internet protocol), broadband system. This is an ambitious project that requires the co-ordination and integration of new access, backbone and management systems.

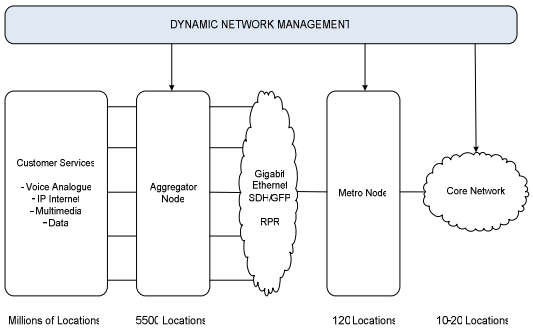
The key driver is to simplify the delivery of high-bandwidth multimedia converged services. Once implemented, BT expects to make an annual saving in operating costs of £1bn.

Whilst existing access fibre and copper will remain, the core hardware infrastructure will be replaced. The architecture assumes that even the most basic voice services will be supported as VoIP

Access nodes will be installed in 5,500 nationwide exchanges. These nodes aggregate voice (in IP format) circuits, internet and data onto the backbone. For an initial period traditional analogue and X.21 presentations will be available but adapted into a format suitable for connection with the access nodes. These traditional 64Kbit/s TDM services will be allocated 384Kbit/s of bandwidth in order to reduce latency issues.

Aggregated data will be passed from the access node to a **Metro node**. These will be installed in 20 digital exchanges located within major towns and cities.
Metro nodes have the task of routing and prioritising the packets of data. Metro nodes also referred to as **Core nodes** provide a fluid platform routing data streams around link failures, congestion and bottlenecks. The technologies deployed that facilitate this are Internet Protocol/**Multi-Protocol Label Switching**, IP/MPLS.

Figure 1: Telco MPLS Network

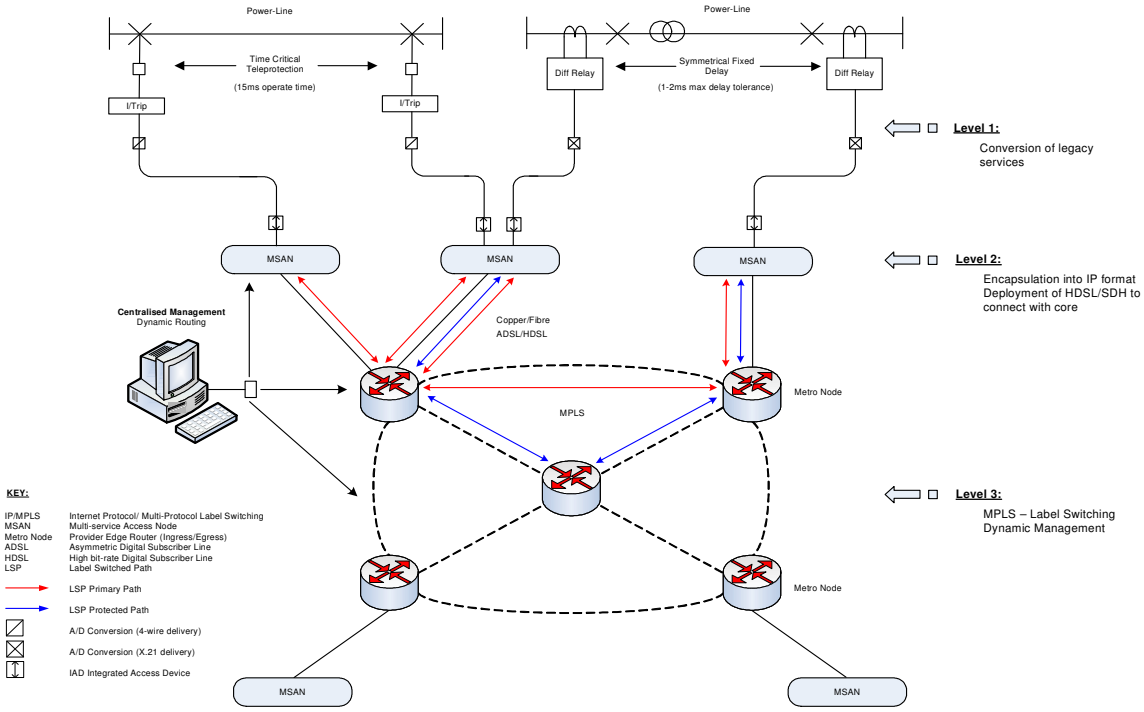


MPLS is the mechanism used to set up a network path for identifiable packets of multiple protocol data through an IP based network. It works by giving packets of data a label that can be used by routing hardware to identify the **Label Switched Path** from a pre-determined forwarding table, LSP. The forwarding table provides information on the next physical link to be used, along with applying a new label for the next recipient node. The new label will consider the type of services being carried and the destination of other data to be inserted into the new packet.

Essentially, each hop is connection orientated with data routed along pre-configured labelled paths. Data is aggregated dependent on destination and "forwarding equivalence class". This creates several layers of labels identifiable by the network routers.

The entire system is fluid and centrally managed in order to manage bottlenecks, congestion and link failures

Figure 2: Implementing Protection over IP/MPLS



Power Utility Telecom requirements

Protection & Control – Issues with IP

The issues most utilities face is that most current protection and control systems rely on the availability of TDM services. Unlike investment in office LAN/WAN products the majority of substation equipment has an operational life of between 10 and 15 Years. An onerous approvals process is needed to prove their reliability, typically meaning the time from the launch of a new protection product to wide-scale deployment takes Years rather than Months.

Whilst in its infancy protection manufacturers have considered and accommodated the deployment of IP for control and interrogation of substation Intelligent Electronic Devices, IED's, within the IEC61850 standards. However, little attention has been given to sub-station to sub-station communication requirements for trip and restraint commands between protection relays. As a consequence most modern communicating relays still require either a VF 4-Wire or synchronous 64Kbit/s symmetrical channel.

The immediate challenges faced when deploying relays over a PTT circuit include:

1. Interface adaptation
Adapting the presentation of a relay communication interface into a format suitable for the latest telecom access equipment introduces distortion. This impacts the reliability of the relays and can cause mal-operations.

This is frequently compounded as xDSL technology is used to increase bandwidth on copper circuits within the telecom operator's network.

2. Circuit Provisioning
Modern networks struggle to provide fixed delay TDM connections. This is as a consequence of their inherent ability to dynamically re-route to avoid failures, congestion and bottlenecks within the telecom network.

3. Relay Re-Synchronisation Times

Modern protection relay algorithms typically need to re-synch following any communications link switching activity. A particularly fluid network such as an IP/MPLS network could therefore lower the availability of the protection scheme.

Re-synch times whilst variable can be as high as one minute.

Telecom Network Availability Vs Protection System Availability

Consideration has been given to calculating a representative availability time for a modern telecom network and its possible impact on protection schemes.

Using a telecom network availability figure of 99.999%, network outage time can be calculated as being 315 seconds per annum.

By considering the dynamic routing ability of most networks to avoid connection failures and congestion, it can be assumed the 315 seconds is a consequence of switching delays.
If each switch causes a 60millisecond loss of data and we divide 315/0.06, this implies a total of 5,236 network switches occur per annum.

Protection relays sensitive to any interruptions take longer to re-synchronise, typically 30 seconds. If we take the number of switch interruptions as being 5,236 and re-synch time as 30 seconds, this gives a protection scheme outage time of 43.5 hours per annum.

In summary, a seemingly high telecom network availability figure does not necessarily ensure the same for the protection system operating over it.

Emerging Requirements

Information available from modern sub-station devices can offer increased efficiency in the way the overall network is managed. Most plant is able to collate information on its current state and provide statistics that help define maintenance requirements. This in turn provides benefits in the form of increased efficiency in dealing with transient faults and long term maintenance strategies.

These emerging applications when coupled with access control, video surveillance and remote networking connections for field based engineers, favour the deployment of modern IP based infrastructures.

Summary

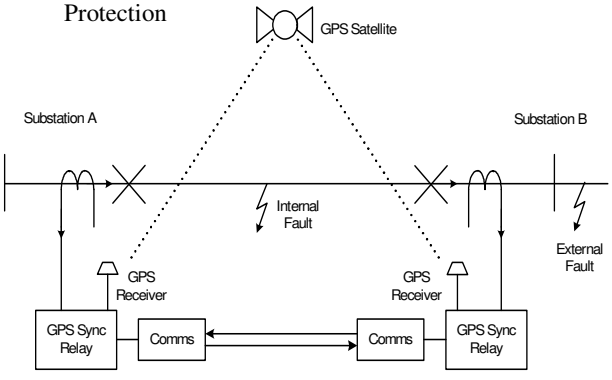
Modern protection relays weren't designed to provide reliable operation over the IP networks currently being deployed. Removing issues associated with asymmetric time delays relies upon GPS and only tackles part of the problem.

The benefits of introducing WAN/IP services into the sub-station can't however be ignored and when considered against the potential for increased operational efficiencies in how the power network is controlled and maintained has merit.

Implementing a private network able to accommodate both TDM and emerging IP standards enables power utilities to retain total control of their assets.

With careful management it is possible to build a modern infrastructure without compromising legacy protection and SCADA services.

Figure 3: Applying GPS Timing to Differential Protection



RFL Communications: Utility network Specialists

RFL are a specialist supplier of telecom products and turnkey systems to power utilities across Europe and the Middle East. Through active participation in solving problems associated with the migration of protection and control systems from analogue to digital services, RFL have a grasp of the technologies deployed, their pitfalls and more importantly how they can be resolved.

RFL can address the immediate operational requirements of a power utility without compromising the ability to deliver the emerging and future IP requirements. Consideration is given to time sensitive protection relays relied upon to protect overhead lines and main electrical plant, identifying and isolating faults within milliseconds. Circuits are provisioned and managed to provide protection engineers with a predictable fault resilient conduit for the most onerous of protection schemes.

RFL technologies Include:

- PDH Access Multiplexer equipment
- SDH STM-1/4/16 equipment
- Ruggedised networking products complying with IEC61850
- Power Line carrier
- Microwave radio

Products are supported with the technical expertise to deliver complete fibre, radio and power line carrier turnkey systems.

Is it financially viable?

By offering a platform that supports the immediate and emerging communication requirements, initial capital outlay can be justified and equipment protected against obsolescence.

In the longer term, by taking control of the telecom assets OPEX can be significantly reduced. New applications for CCTV, access control and remote server connections can be provided at a fraction of the cost of a leased line service.

Figure 4: Fully Integrated IP and TDM Utility Telecom Solution