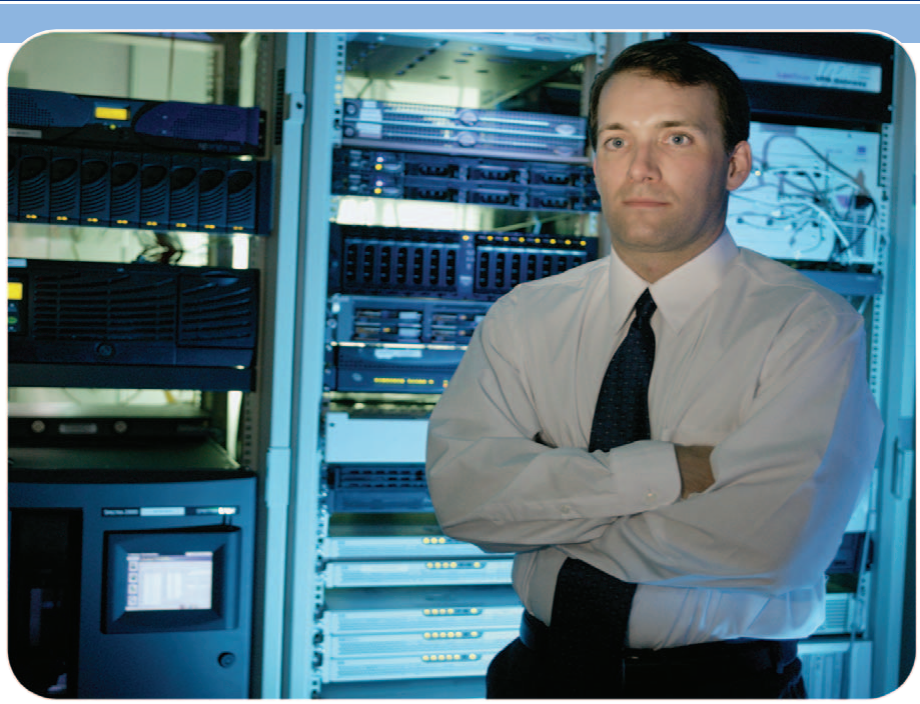


C-COR Advanced Network Architectures

Dynamically Reconfigurable Optical Networking

Application Note

Wouldn't it be great if your network adapted to exactly what you needed it to be without having to plan in advance? Or pay for a lot of expensive features on day 1?

The C-COR suite of transport products allow you to build the network you need today and evolve it into the sophisticated network of tomorrow that can support all of your services and their wide range of requirements.

The deployment of advanced customer services, like VOD, Commercial Services, Switched Digital Broadcast, and advanced internal network capabilities like regional interconnects and path protection, have led to a need for not only expanded capacity, but for a network that can adapt its connectivity to the services required.

Networks must transport information from any location to any other location and provide the quality of service (QoS) appropriate for the application.

If the total capacity of the service provided is less than that of a single 10Gbps wavelength, then it is important that the service aggregation devices in your network are able to manage the bandwidth in a manner that maximizes the number of billable services sharing the wavelength. It is also important to ensure that the bandwidth is being managed intelligently ensuring that SLAs for each service are guaranteed. The optimal and most efficient way to maximize the number of services while preserving service (or user) SLAs is by performing service aggregation on a per-service, per-user, or per-flow basis. Per-flow service or per-flow service aggregation implies that each user's traffic or service carried by the network is buffered in independent traffic queues from all other services and users. By buffering traffic in separate queues, each user's traffic or service can be independently scheduled from the rest. This allows each user's traffic to be scheduled in a manner commensurate with changing loads in the network.

The C-COR Multi-Service Packet Switch (MPS) combines multiple services on a single 10Gbps wavelength while maintaining SLAs for each service or user's traffic. The MPS performs intelligent traffic scheduling down to the service or flow level, ensuring that each and every service is scheduled at rate consistent with its peak and committed bandwidth SLA. The MPS also employs a unique closed loop feedback scheduling algorithm providing dynamic bandwidth reclamation of unused committed service bandwidth. By turning unused committed bandwidth back into the bandwidth pool, the MPS is able to boost the overall network efficiency while maintaining SLAs. The flow-based closed loop feedback scheduling algorithm performs collision avoidance, eliminating the need for store-forward buffers at downstream congestion points. Dynamic scheduling of flows such that congestion points are never over-committed yields a more efficient operation of the network minimizing end-to-end network delay and jitter and eliminating traffic loss. Per-flow scheduling also eliminates head-of-line blocking in the face of downstream congestion. Flows leaving the network prior to a downstream congestion point are not blocked by traffic having to transit the congestion point.

Traffic from individual users or services can be readily identified by any criteria from Layer 1 through Layer 4. Traffic between MPS nodes can be sent from any node to any other node. Individual services or traffic flows can be defined as either point-to-point, point-to-multipoint, E-LAN, or E-LINE. Protected, unprotected, and fractionally protected services can be implemented for different services simultaneously. Close coordination with the CMTS policy manager allows your DOCSIS customers to have end-to-end QoS not previously available.

When the capacity to be managed exceeds a single wavelength, then a highly flexible wavelength management system is required. Depending on the specific services and their relative capacities, any of a number of network architectures could be required. With its modular construction, the PLEXiS MFX can provide a network optimized for today's traffic, but which can be evolved into a fully reconfigurable network capable of sophisticated wavelength management as the capacity requires.

By implementing a reconfigurable optical add/drop module, as well as the building blocks of that module, the PLEXiS can implement a fully reconfigurable network on deployment, or allow a simpler network to be converted into a reconfigurable one at a future date.

Rather than requiring that one solution fits all, the PLEXiS MFX can provide the specific connectivity required by your network services. Integration of existing wavelengths onto the PLEXiS DWDM transport is easy and allows monitoring and protection of those wavelengths if desired. Existing wavelengths that are not compliant with the ITU Grid can be translated onto the grid by PLEXiS variable rate transceivers.

In the examples that follow there are two networks illustrated with their expansion capabilities. The first is a sophisticated network that can provide a hub to hub connectivity, as used for data services, and a unidirectional protected star, as might be used for broadcast video or video on demand. In the case of a banded wavelength structure, the insertion loss of a hub site can be minimized, but each service is confined to the bands that are allocated for it. The hub to hub data traffic implements wavelength reuse to minimize the number required. The star network is implemented as a broadcast and select architecture with optical protection. Capacity expansion is available in each of the wavelength service groups.

The limitation of a network using a fixed wavelength architecture is illustrated when there is a requirement for a wavelength that does not fit easily into the existing topologies. Consider, for example, a business service application that requires a bidirectional link between two hubs on the network. In addition to deploying the new transceivers at the two hubs, the intervening hub must be visited to manually configure the wavelength to patch through that site. If the service is to be protected, then all of the hubs on the ring must be visited to manually configure the chassis.

In the second example, the same wavelength topologies are supported (hub to hub data service and a protected video star), but the network is built using a reconfigurable optical add/drop architecture (ROADM). In fact, using the modular nature of the PLEXiS platform, the earlier fixed example can be migrated into the ROADM based transport without interrupting traffic, as the service requires.

Utilizing the reconfigurable nature of the ROADM, the new business service can be deployed by connecting the new transceivers to the network, and then all intervening sites can be controlled remotely to provide the proper wavelength paths through the network.

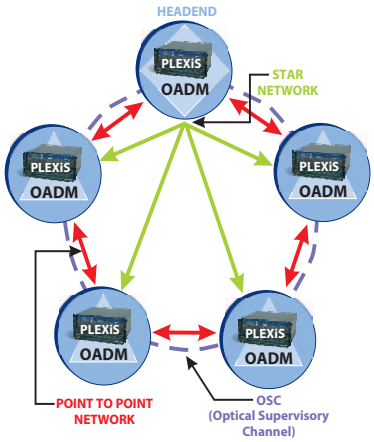
Other broadcast and select architectures that can provide any wavelength anywhere are possible, but do not allow wavelength reuse. These networks have the lowest cost and parts count.

Any of the discussed network topologies can be implemented using the modular PLEXiS MFX transport system. The management of the network is provided by the Crystal stand-alone management system, or as a plug-in to the CorView network manager. If an independent management network is not already in place, an optical service channel (OSC) can be installed in the PLEXiS chassis. The OSC can be deployed at 1510 nm or 1310 nm depending on the desires of the customer.

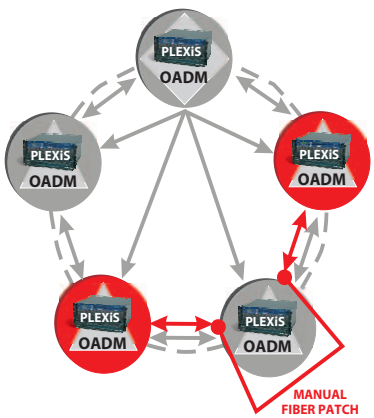
Examples

Example 1

Simultaneous carriage of unidirectional broadcast and select traffic and wavelength reuse in a data network using a fixed wavelength architecture. Addition of services that depart from the existing topology require manual installation of jumpers to reconfigure the network.

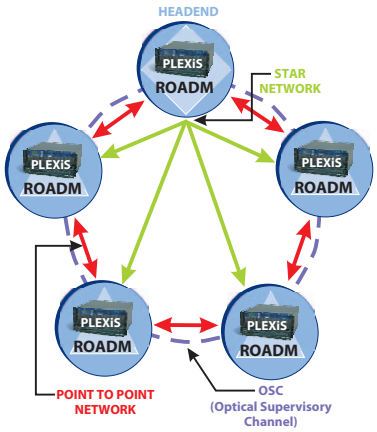


Manual Service Expansion (Example 1)

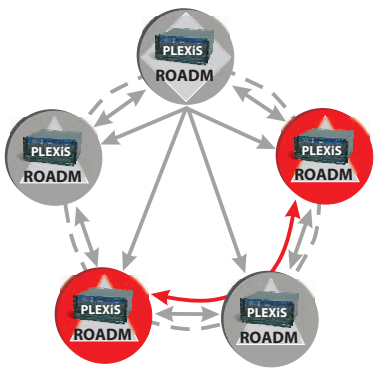


Example 2

The same network services deployed using ROADMs allow each new wavelength to follow its own topology, without having to physically visit each intervening hub site. Banded solutions are still possible, and the wavelength plan can be scaled from as few as 8 wavelengths to as many as 40, while still only visiting the service endpoints.



Remote Service Expansion (Example 2)



As additional features are integrated into the PLEXiS product line, its modular nature allows your network to keep up, incorporating the latest technology in tunable transmitters, dynamic wavelength control, and advanced network monitoring.

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