Ethernet Distribution Frame

Centralized Cross-Connect System for Managing Ethernet Data Services

application note

Situation

Ethernet-based data services offer the opportunity to create differentiation, command premium pricing, and earn higher margin for such value-added data services as transparent LANs, storage area networks, and virtual private networks. Extending native 10/100Base-T and Gigabit Ethernet services across the LAN, WAN, and MAN means data services are less expensive to deploy, provision quickly, and offer exceptional reliability and security. Yet as the Ethernet distribution system grows with more routers and switches in central offices, all of these advantages can be quickly erased by a poorly designed cabling and connectivity architecture.

As service providers move from being *vendors* of T1, T3 and OC-XX data pipes to *partners* providing value-added Ethernet data services, an effective business model includes the following goals:

- Create a flexible, carrier-class Ethernet delivery system, and
- Decrease operating costs of Ethernet delivery.

Reaching these goals is contingent largely upon building the correct architecture to support Ethernet data services.

Solution

Achieving the dual requirements of lower costs and carrier-class services is possible by creating a centralized cross-connect patching system with an Ethernet Distribution Frame (EDF). An EDF provides a cross-connect field that ties together all Ethernet network elements from multiple floors of the central office (CO) or point-of-presence (POP), providing a common craft interface for performing adds, upgrades, and rearrangements on Ethernet services. In this simplified architecture, all network elements have permanent equipment cable connections that are, once terminated, never handled again. Technicians isolate elements, connect new elements, route around problems, and perform maintenance and other functions using semi-permanent patch cord connections on the front of the EDF cross-connect bay. This craft-friendly design supports cost-effective growth and change in the Ethernet distribution system.

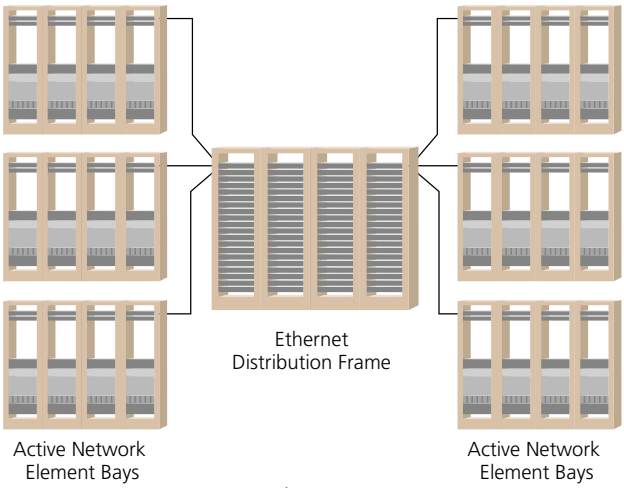

Figure 1

Ethernet Distribution Frame

Benefits

- **Lower operating costs.** As compared to direct connect or interconnect designs, the EDF cross-connect reduces the time it takes for adding cards, moving circuits, upgrading software, and performing maintenance. Factory assembled cable assemblies and patch panels reduce installation time and ensure consistent quality. In addition, this high-density interface for Ethernet distribution not only maximizes active ports but also conserves valuable floor space.
- **Improved reliability and availability.** Permanent connections protect equipment cables from daily activity that can damage cables. Moves, adds, and changes are effected on the patching field instead of on the backplanes of sensitive routing and switching equipment, enabling changes in the network without disrupting service. With the ability to isolate network segments for troubleshooting and reroute circuits through simple patching, Operations gains time for making proper repairs during regular hours instead of during night or weekend shifts.
- **Competitive advantage.** The EDF enables rapid changes to the network. Turning-up new service is accomplished by plugging in a patch cord instead of the labor-intensive task of making multiple hard-wired cable connections. As a result, cards are added to the network in minutes instead of hours, decreasing time to revenue and providing a competitive edge—faster service availability—in the marketplace.
- **Investment protection.** Unlike direct connection of Ethernet elements, the logical EDF cross-connect scales easily. As elements are added, transport methods changed, and new technologies implemented, the EDF remains constant, providing the common craft interface for managing Ethernet distribution without service disruption.

Implementation

Creating a craft-friendly, low-cost Ethernet distribution system fully rated for Gigabit Ethernet consists of the following products:

Ethernet Distribution Frame, providing the central location for cross-connecting all Ethernet network elements in a CO or POP with semi-permanent connections. Each EDF consists of the following ADC equipment:

- 19" UEF zone 4 rack
- Glide Cable Management system, consisting of vertical cable managers installed on the sides each rack as well as upper and lower crossover troughs
- 5800 series Category 5e patch panels, RJ45/RJ21x, providing up to 864 available Ethernet ports per 7' rack
- 6000 series Category 5e patch cords for creating semi-permanent cross-connections

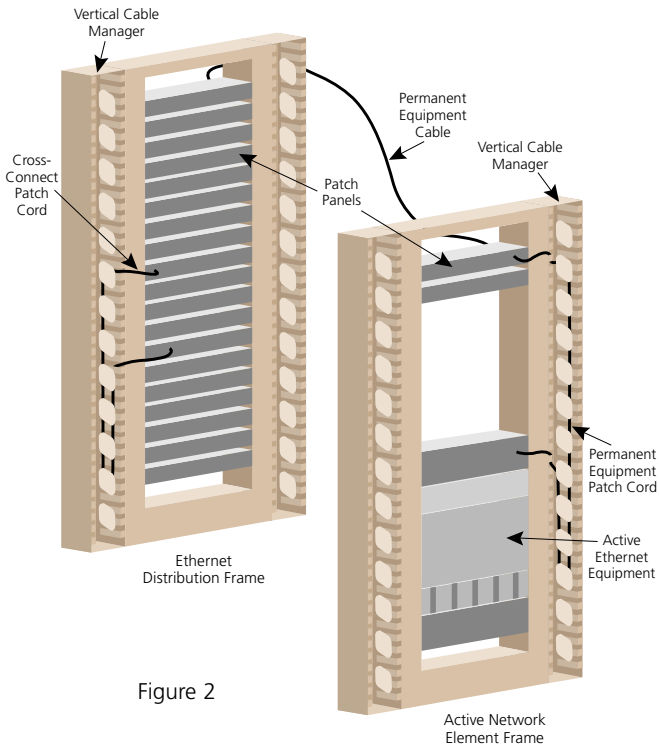

Figure 2

Active Network Element Frame
houses both active equipment and one or two distribution panels. It provides permanent connections from active Ethernet equipment to distribution panels and from distribution panels to the EDF.

- 19" UEF zone 4 rack
- Glide Cable Management system, consisting of vertical cable managers installed on the sides each rack as well as an upper crossover trough
- One or two 5800 series Category 5e patch panels, RJ45/RJ21x, mounted at the top of each bay with active network elements mounted below
- 6000 series Category 5e patch cords for making permanent RJ45 connections between Ethernet equipment and distribution patch panels at the top of the bay

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Permanent Equipment Cables, providing permanent connections between the EDF and distribution panels in each Active Network Element Frame.

- Factory terminated and tested RJ21x 24-pair Category 5e cable assemblies, up to 90 meters in length

Media Converters, providing E/O and O/E conversion for distances greater than 100 meters between active equipment. May also be used for interoffice transport, for transport to customer premises, and for interface with Ethernet network elements that require fiber optic interfaces.

- Rack mount, high-density design of 16 ports in 1 RU, mounted in or adjacent to EDF and active equipment bays

Fiber Cable Management, for termination, splice, and storage of fibers where media conversion occurs.

- Rack mount FL2000 panels, wall mount FL2000 boxes, or high-density Fiber Management Trays panels, all with integrated cable management that connect and protect fibers

Power Distribution, for protection of critical active equipment such as routers and switches in the Ethernet distribution system.

- PowerWorx power distribution products include options for suppression of power line noise, uninterrupted power, and fusing for multiple amperage equipment from a single rack unit design—all with NEBS Level 3 certification and a lifetime warranty

Design Issues

- All cable assemblies, patch cords, and patch panels should be rated Category 5, 5e, or 6 to ensure Gigabit Ethernet performance, per EIA/TIA 568-B.1 standards for LAN cabling. While Gigabit Ethernet is designed to run on Category 5, Category 5e and Category 6 cables and components are preferred for new build-outs.
- Cabling distance between active network elements should be no more than 100 meters, which includes both permanent cables and semi-permanent patch cords. Patch cord length should be less than 10 meters due to attenuation from stranded cable. Distances greater than 100 meters require optical transport and media conversion at both the EDF and active bays.
- Due to TIA standards that limit the proximity of connection points, limit the number of passive connection points between active equipment to four with length between EDF and active equipment of at least 15 meters to minimize electrical interaction between patch panels.
- Proper routing, management, and protection of cables and patch cords in both the EDF and active element bays is essential for carrier-class reliability and availability. A system of vertical cable managers with integrated slack managers not only offers proper management of cables, but also provides increased bay density as compared to systems using horizontal cable managers. Vertical cable managers should be sized 8 inches wide, except for inter-rack applications that require 10- or 12-inch widths.
- Select a standard patch cord length of less than 10 meters for the EDF and use slack managers in vertical cable managers for routing and storage of extra cable lengths (see Figures 3 and 4). This ensures that the cross-connect is easy to administer while providing protection for patch cords.
- Choose pre-connectorized patch panels with RJ45 interfaces on the front and RJ21x interfaces on the rear. Punchdown connectors (110) are reliable, but take more time to install and are prone to installation errors such as cross wiring that disable ports. Gold-on-gold contacts between modular interfaces on patch panels are pre-assembled cable assemblies ensure reliable and consistent performance.

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- Where E/O conversion is required, media converters should feature clear separation of optical, electrical, and power supply cables to ensure system reliability. Distributed power architecture is also preferred for improved performance, reliability, and system availability. Built-in intelligence enables time saving in installation and troubleshooting with full view of UTP and optical link integrity from one end of the circuit.
- System reliability depends upon proper management of fiber cables. Fiber panels and boxes should include removable angled retainers as well as integrated splicing and slack storage. In addition, single circuit access to fibers provides improved system reliability and availability by reducing the chance for damage to adjacent fibers during routine maintenance of individual fibers.

Conclusion

Earning customers for value-added data services requires innovative offerings, a competitive price, and superior reliability and availability. Extending native Ethernet across the LAN, WAN, and MAN opens the door for new data services. However, building an infrastructure that keeps operating costs low while providing exceptional reliability and 99.999% availability requires a centralized cross-connect EDF designed to manage growth and change without disrupting service.

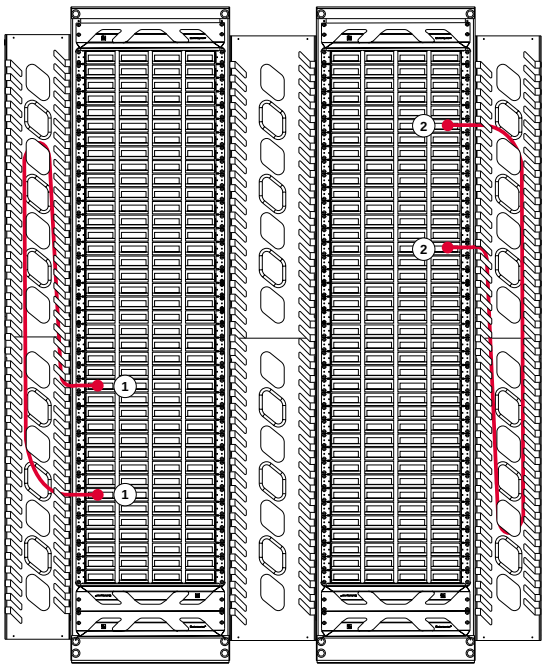

Figure 3. Connect ports to the same side of the same EDF cross-connect bay using vertical cable managers with slack managers for handling extra cable lengths.

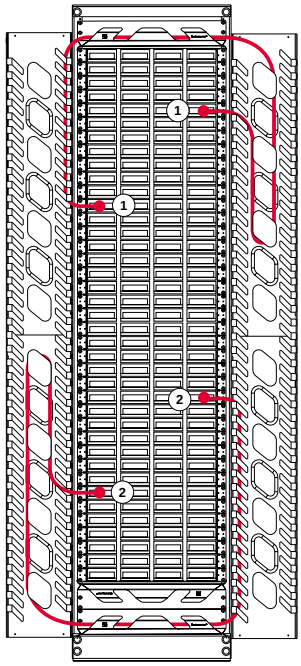

Figure 4. Upper and lower crossover managers with vertical cable managers enable connection of ports on opposite sides of the EDF cross-connect bay.

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