Flexible, Multiservice Optical Platforms: Optimize Cellular Backhaul Networks

Summary

Today's mobile carriers are incorporating more packet-based services than ever before to support emerging voice-over-IP (VoIP) and mobile data applications. As mobile users increasingly adopt IP-based music, video, and data services, cellular bandwidth requirements are growing exponentially – especially in the cellular backhaul network. Unfortunately, the design of most of today's cell sites leaves service providers with few options for increasing capacity.

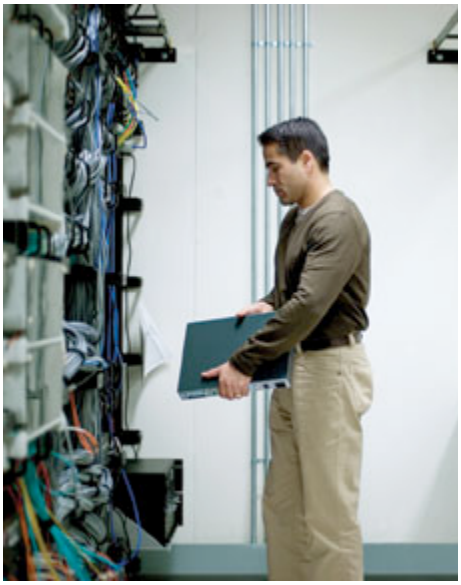
For many incumbent service providers and the wireless carriers they support, providing the reliable, high-quality user experience that customers demand means adding more copper T1 circuits between cell sites and switching offices. This strategy offers little scalability for supporting future services, and promises ever-increasing costs as the number of required T1 circuits continues to grow.

Forward-looking service providers are introducing a more efficient IP interface at the cell site using Cisco® ONS solutions. By converting cell sites to optical technologies, service providers gain a much more reliable connection and a much more scalable cell-site technology for accommodating needs over the next several years. Cisco ONS solutions support both emerging packet services and conventional T1/DS-1 traffic simultaneously, allowing carriers to scale capacity and provision IP applications much more cost-effectively.

Challenge

Growing Cellular Bandwidth Requirements

In the fiercely competitive consumer wireless market, a service provider's success often depends on its ability to bring the latest mobile services to market before the competition, and to provide a higher-quality user experience. Increasingly, high-speed mobile data, voice, and video applications are considered a core requirement for any wireless service offering. To support the growing demand for data applications, wireless carriers are transitioning from first-generation narrowband service networks to technologies that provide broadband capabilities. They are increasingly adopting strategies such as Evolution-Data Optimized (EV-DO) and High-Speed Packet Access (HSPA) technologies in third-generation (3G) wireless networks. These trends will transform wireless services in myriad ways, but there is one crucial and immediate requirement for wireless carriers and the incumbent service providers that support them: increasing capacity in the wireless backhaul network. Meeting this need, however, is no small task.



Today's Cellular Backhaul Network

Most of today's cellular sites (and their associated backhaul networks) were designed with one primary objective: to deploy new sites as quickly as possible to support the exploding demand for wireless voice services. Incumbent service providers built their core networks – and even the segment of the backhaul network that connects mobile switching offices – using high-capacity, fiber-optic connections. But when it came to the last mile of the backhaul network that links remote cell sites, wireline service providers and wireless carriers turned to the most widely available, cost-effective network connections – which almost invariably were leased copper T1 circuits. A couple T1 circuits are no longer adequate to support multimegabit services such as streaming video, which requires much more capacity. With each T1/DS-1 costing as much as US$700 each month, network expansion using T1/DS-1 results in a huge increase in recurring leased-line costs.

To cost-effectively deliver today's mobile data services, as well as the packet-based services of the future, service providers must be able to support broadband technologies such as Ethernet throughout the entire service network, and support IP interfaces at every cell site. It is imperative that the network be optimized to support high-growth, IP/Ethernet-based traffic.

Solution

Cisco ONS 15454 and 15310

Cisco's optical portfolio, with the Cisco ONS 15454 and 15310 multiservice platforms (Figure 1), provides an ideal end-to-end cell-site solution from both an access and aggregation perspective. The Cisco ONS Family helps optimize the network to deliver IP/Ethernet services while still supporting traditional TDM services. Service providers can safely invest in Cisco ONS products as they plan their future network evolution to packet transport over DWDM or dark fiber.

The Cisco ONS 15310-MA, the high-density multiservice provisioning platform available in both SONET and SDH versions, with two chassis fitting side by side in a 6-rack-unit (6RU) configuration, delivers a wide mix of service interfaces, optimal manageability, and carrier-class reliability for next-generation wireless networks. The Cisco ONS 15310-MA is designed specifically for harsh outdoor environments such as cell sites. Built to comply with the GR-3108 specification, the platform can be deployed in cabinets on or near cell towers. It can operate at very high temperatures (Industrial Temperature Rated at –40 to +65°C), as well as in environments with airborne contaminants.

The most significant advantage of the Cisco ONS 15310-MA is the superior flexibility and scalability it provides. It supports a wide range of TDM and packet services, including OC-3 to OC-48, 28 to 168 DS-1, up to six DS-3 protected or unprotected interfaces, up to 32 fixed 10/100 TX ports, and up to 24 SFP-based 10/100/1000 ports. As a result, the platform allows for a truly evolutionary approach to changing cell-site requirements. Service providers can begin deploying OC-3 rings immediately to support multiple redundant T1 connections, and scale the circuit to support more connections as needed. As new broadband data services are introduced over time, service providers can upgrade the Cisco ONS 15310-MA to a higher-speed optical ring (OC-12 or OC-48) without changing any line cards and turn up Ethernet services. For low-density cell site locations, the Cisco ONS 15310-CL, a 1RU SONET only, provides both TDM and Ethernet services with up to OC-12 uplinks.

Figure 1. Cisco ONS Multiservice Platforms

The Cisco ONS 15310-MA positioned at a cell site is complemented by the Cisco ONS 15454 at the central office, where multiple cell sites are aggregated and transported to be handed over to Mobile Switching Center (MSC) or Radio Network Controller (RNC) sites. The Cisco ONS 15454 is a carrier-class platform capable of supporting multiservice networks with TDM, Ethernet, and dense wavelength division multiplexing (DWDM) transport capabilities. With the Cisco ONS 15454, a service provider can build a SONET/SDH-based transport and migrate to DWDM-based transport as transport bandwidth requirements grow beyond 10 Gbps. The Cisco ONS 15454 provides MEF-certified Layer 1 and Layer 2 Ethernet capabilities over SONET/SDH as well as DWDM.

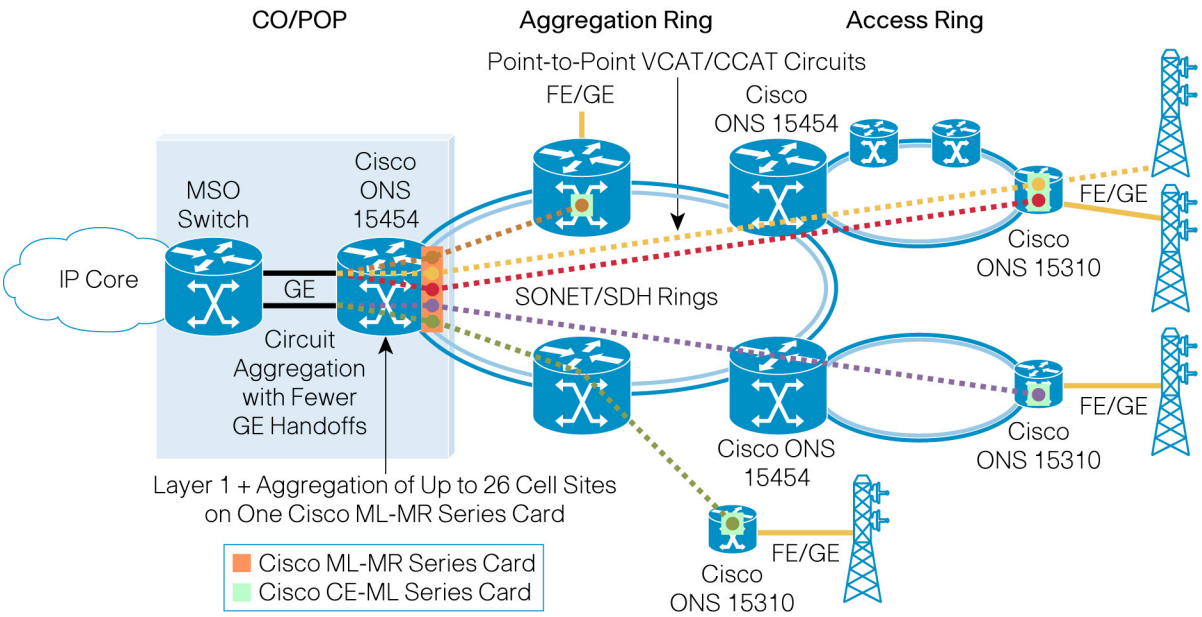
Service providers can choose Cisco ONS 15454 CE-Series Carrier Ethernet cards when their most critical requirement is supporting service-level agreements (SLAs). Or they can deploy the solution with Cisco ONS 15454 ML-Series multilayer switched Ethernet cards to support advanced IP capabilities such as oversubscription. Service providers can build a pure Layer 1 or pure Layer 2 Ethernet network solution by using either Cisco ONS 15454 CE-Series or ML-Series cards respectively at both cell sites and central office locations. While a Layer 1 approach

provides TDM-like operational simplicity, a Layer 2 approach provides flexibility in optimizing bandwidth and aggregating multiple cell sites to provide fewer handoffs at the MSC. Cisco enables service providers to realize the benefits of both approaches with a unique, standards-based Layer 1+ architectural approach (Figure 2).

Flexible, Cost-Effective Aggregation and Transport

The Layer 1+ model is a centralized management architecture where cell-site Ethernet ports are an extension of an intelligent aggregator at the hub site. This approach reduces capital expenditures (CapEx) because cell sites utilize low-cost Cisco ONS 15310 CE-Series cards and central offices aggregate utilizing flexible Cisco ONS 15454 ML-MR Series cards. The Ethernet traffic from each cell site is backhauled with high-order or low-order virtually concatenated (VCAT) point-to-point circuits to the central office, where the traffic is aggregated and separated using remote Ethernet ports or customer-based VLAN marking and lookup. The Layer 1+ architecture allows wireless carriers to aggregate up to 26 cell sites at the hub into fewer Gigabit Ethernet (single or multiple) handoffs of aggregated traffic to a mobile switching office. Alternative pure Layer 1 solutions require up to 26 times the Gigabit Ethernet port handoffs both on optical and mobile switching office aggregators.

Figure 2. Layer 1+ Ethernet Aggregation



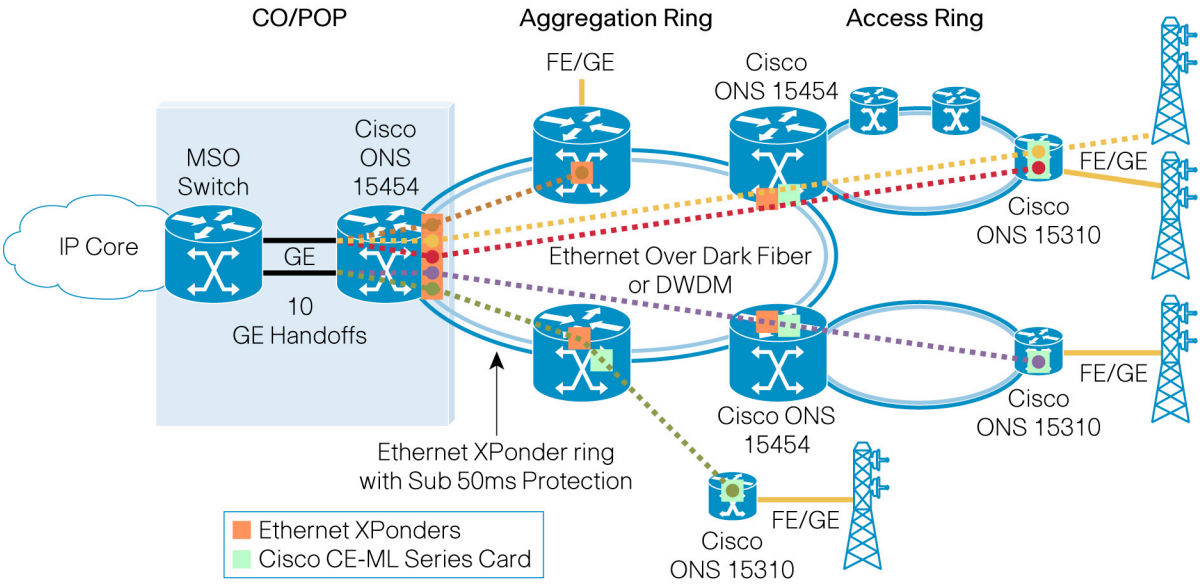
Both Ethernet services and advanced quality of service (QoS) capabilities on Cisco ONS products are Metro Ethernet Forum (MEF) certified (MEF9 and MEF14 certifications).

In metro areas, a cell-site deployment becomes a point of presence where other business customers can also be serviced. Both the Cisco ONS 15454 and 15310-MA, with superior GIgabit Ethernet density compared to other platforms of their size and type, provide a compelling solution to pick up other customers in the vicinity of the cell site or central office, thereby enabling new revenue streams. The Cisco ONS 15310-MA also provides industry-leading T1/DS-1 density; however, the majority of underlying business traffic on DS-1/DS-3 service lines is actually Ethernet packets. As end customers migrate to Ethernet-based WAN interfaces, Cisco ONS products are already optimized to provide high-density Ethernet services natively or over SONET/SDH with the same SLAs as TDM services.

The Cisco ONS 15454 provides investment protection for migration to packet-based transport architectures. By adding Cisco ONS 15454 Gigabit Ethernet XPonder line cards (see Figure 3), customers can migrate the core rings to Ethernet-based rings with little to no impact to Cisco ONS 15310-MA access rings. The Cisco XPonder product line, with its current hardware and future software enhancements, is capable of supporting native TDM services as

well as Ethernet over copper based on SFP optics. With a strategic focus on the XPonder cards, Cisco gives its customers the capability to bring Ethernet transport all the way to the cell site using current and future Ethernet transport architectures.

Figure 3. Packet Transport Aggregation Architecture



Conclusion

Wireline service providers and wireless carriers recognize that the future of mobile services lies with broadband data applications. To cost-effectively deliver the emerging applications that wireless customers will demand, providers and carriers must optimize their networks for high-bandwidth transport throughout the backhaul network and to IP interfaces at the cell site. Cisco ONS Family solutions are architected to help you build a scalable and cost-optimized aggregation network encompassing a large number of cell sites.

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