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the wireline transport of choice. If you're not a new operator and you have existing facilities, "the biggest problem is Ethernet is not available to most of the cell sites because most of the transport providers only offer Ethernet over fiber and fiber's not there," said Michael Howard, principal analyst/co-founder of Infonetics Research.

That, said Mike Emmendorfer, senior director of solution architecture and strategy for cable equipment vendor Arris, gives his cable customers a leg up in the backhaul competition.

"The MSOs have built extensive fiber infrastructure throughout the

Pseudowire also offers the degree of reliability operators are seeking ... for a price.

communities where (wireless) base stations are. They will then extend that fiber infrastructure to those base stations and light up some of their existing technologies that they've used for years to support commercial services: SONET or optical Ethernet or EPON (Ethernet Passive Optical Network). Most of the MSOs are going to be moving to optical Ethernet and eventually EPON because EPON is going to be a very efficient manner to deliver cellular backhaul services," Emmendorfer said.

Whatever the case and whatever the play, the consensus is that Ethernet is here to stay. ●

Migrating SONET/SDH to Packet-Based Networks for Mobile Backhaul

BY SULTAN DAWOOD, MARKETING VICE-CHAIR AND MEMBER OF THE BOARD OF DIRECTORS, BROADBAND FORUM

► Many mobile service providers are in the process of adapting their Regional Area Networks (RAN) to incorporate innovative, high-speed data services. These new services include third- and fourth-generation (3G and 4G) High-Speed Packet Access (HSPA), WiMAX, and Code Division Multiple Access (CDMA) Single Carrier Evolved Data Optimized (1xEV-DO). The popularity of email, Internet and intranet access, and video sharing on mobile devices is putting pressure on the existing circuit-switched RAN infrastructures of mobile service providers.

Studies have shown that several mobile service providers on different continents see data traffic comprising 30 percent of all traffic in 2008 and expect it to be 50 percent of their traffic by 2010. These same providers anticipate the need to provide 25 Mbps of bandwidth for urban mobile customers by 2010. As the volume of such bandwidth-intensive traffic grows, the costs for RAN backhaul grow correspondingly, lowering the average revenue per user (ARPU). Adapting traditional circuit-switched transport architectures to support these new

data services is proving cumbersome and expensive. Indeed, the average revenue per megabit for data service is far lower than for traditional voice and text messaging but consumers are demanding mobile broadband services at affordable prices. To meet these needs, mobile service providers are looking for alternative ways to scale bandwidth in the RAN while reducing their growing operating expenses.

RAN backhaul is one of the last areas of the mobile operator's infrastructure not yet redesigned to efficiently handle IP broadband traffic. By migrating to Carrier Ethernet and Multi-Protocol Label Switching (MPLS) for RAN backhaul, mobile service providers with leased or owned SONET/Synchronous Digital Hierarchy (SDH) protocol network infrastructures can:

- Save money in the near and long term using packet-switched instead of circuit-switched connections
- Simplify their operations
- More easily scale their networks
- Increase available bandwidth and add flexibility to bandwidth usage



- Maintain high security, reliability, and availability
- Quickly deploy next-generation IP applications with Pseudowires

By migrating from SONET/SDH to Carrier Ethernet technology in the RAN, mobile service providers can save between 25 to 40 percent in backhaul costs over a five-year period while increasing speeds up to 10 Gbps. For mobile service providers, the cost and efficiency benefits are immediate. For those providers that own their SONET/SDH infrastructures, the efficiency benefits from increasing bandwidth and more easily deploying 3G and 4G services can be realized right away. Capital expense savings are realized in the longer term from reduced transmission costs and enhanced profit margins, market share, and competitiveness.

The RAN is a major area of expense because mobile service

The RAN is currently dominated by circuit switched SONET/SDH technology, an always-on transport that is more expensive per bit than Ethernet traffic.



Sultan Dawood

providers typically have hundreds or thousands of cell sites, and upgrading gear and increasing bandwidth makes these the most expensive parts of the network. Transmission costs account for approximately 19 percent of the overall cost of delivering data to an end user in today's 2G and 3G networks, according to 2007 estimates by Unstrung Insider. But with backhaul architectures based on leased lines, these costs could increase to 80 percent of operating expenses as cell sites are upgraded to their maximum capacities with current architectures. Reducing this

cost is vital to a provider's long-term financial stability as traffic volumes grow and ARPU declines.

The RAN is currently dominated by circuit switched SONET/SDH technology, an always-on transport that is more expensive per bit than Ethernet traffic. By redesigning the RAN to provide packet transport end-to-end, mobile service providers can eliminate the extra layers in the network. As voice traffic migrates to IP transport based on Session Initiation Protocol (SIP), IP/MPLS technology makes it easier to provision, scale, and manage these services. Moving to Carrier Ethernet in the RAN brings sizeable cost efficiencies to mobile service providers

with no loss of network performance, stability, or manageability. By using Pseudowires—which are MPLS virtual circuit "tunnels"—mobile service providers can aggregate and transport TDM, IP, Ethernet, and ATM traffic as well as clock synchronization from the RAN to the network core. The solution increases bandwidth available for backhaul and other services by an order of magnitude but at one-tenth of the cost per bit when compared to T1 and E1 service. Additionally, IP/MPLS in the RAN brings intelligent features such as

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Wireless is There When There's No Fiber

BY FIERCETELECOM

▶ Even with a world full of contrarians, you would be hard pressed to find anyone who disputes that Ethernet-over-fiber is probably the best transport method for the heavy load of IP-based data straining today's wireless backhaul networks.

But, "it's not a black-and-white world where we're going to say

every tower in the world is going to be fiber. There's going to be a lot of copper but the percentage of fiber is going to go up and the percentage of copper is going to go down pretty significantly over the next five years," said Tom Huegerich, vice president of global fiber for ADC.

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Traffic Engineering and Fast Reroute throughout the network. Mobile service providers can make use of the existing MPLS infrastructure while extending the packet-based core already deployed out to the edge of the network as well as take advantage of the highest levels of traffic grooming and network management, QoS, and the ability to assign classes of service.

With SONET/SDH equipment vendors aware of the progression of more services to IP and the growing bandwidth demands with multimedia applications, SONET/SDH equipment is migrating to packet based transport based on MPLS. Many mobile service providers are proactively revamping their RAN backhaul to cost-effectively migrate their hub-and-spoke network architectures to a meshed network edge, with IP/MPLS Layer 3 routing intelligence moving

throughout the network from core to cell site. A single combined network, using MPLS both in the core and RAN, can simplify operations and lower operational expenses. By using a standards-based MPLS Pseudowire solution, additional bandwidth can easily and flexibly be added to cell sites and aggregation sites as needed.

To facilitate this migration, the Broadband Forum is actively developing specifications for the application and deployment of IP/MPLS technology in the converged network. New work is underway addressing MPLS in Mobile Backhaul networks, MPLS in Carrier Ethernet networks and respective certification test specifications for both efforts. For more information about these important initiatives, check out <http://www.broadband-forum.org/technical/technicalwip.php>.

The collapse of backhaul technologies onto a single IP/MPLS network results in reduced operating costs, rapid provisioning of bandwidth to support new services and service growth, seamless support of 2G/3G/4G radio technology, and the ability to take advantage of alternative transport media (such as Ethernet and DSL) for additional cost savings. The Broadband Forum will continue to do all we can to make this transition as seamless and effective as possible to ensure industry growth and network convergence success.

Sultan Dawood is a member of the Broadband Forum's Board of Directors and has expertise in developing IP/MPLS and Packet Transport technologies and solutions. Sultan earned his Bachelor of Science degree in Electrical Engineering from Old Dominion University in Norfolk, Virginia. ●

Bridging the Synchronization Gap

Maintaining reliable network sync while migrating backhaul networks to all-IP

▶ The migration of mobile backhaul networks from TDM to all-IP will be implemented from the edge to the core, but it will not be a step change. Rather, a gradual evolutionary approach will be needed because TDM-based voice and data services are not going away any time soon. High quality voice services must be maintained, while gracefully introducing new packet-based network transport architectures that can be scaled up as data demand increases.

As mobile operators worldwide grapple with the evolution of their backhaul network to all-IP, a key issue will be how to maintain accurate, cost-effective and reliable synchronization. The current suite of packet-based solutions such as Synchronous Ethernet (SyncE) and IEEE 1588v2 requires operators to make a relatively risky leap to one or a combination of these new and unproven technologies. This "Sync Gap" between TDM and packet network clock sync methods calls for other solutions that retain

carrier-class sync simultaneous with the ongoing evolution of the transport network.

DECOUPLING SYNC FROM TRANSPORT NETWORK MIGRATION

Hybrid TDM + Ethernet transport networks provide operators with a low-risk solution to migrate their backhaul to all-IP over time. A similar approach is needed to allow operators to decouple sync from transport evolution and ideally to maintain their trusted TDM sync architecture over an all-packet transport network. This will enable operators to introduce all-packet transport today and keep the comfort, reliability and security of their proven TDM-based synchronization.

SAVING ON BACKHAUL PAYLOAD CAPACITY

Current methods for distributing synchronization throughout the network rely on reserving an entire T1/E1 per base station, reducing bandwidth available for customer traffic. This does not sound like much, but when you consider the demand placed on the backhaul network to support sync distribution to thousands of base stations, this can amount to literally Gigabits of aggregate backhaul capacity reserved for sync. When you also consider that many operators (particularly in the

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U.S.) have to lease this capacity on copper T1s, the overall cost of sync distribution can literally run into the millions of dollars per year.

DISTRIBUTED SYNCHRONIZATION OVER MICROWAVE BACKHAUL

Harris Stratex Networks recently introduced a new Distributed Sync™ functionality on its Eclipse Packet Node microwave backhaul platform. This patent-pending feature provides TDM-like clock synchronization over hybrid TDM/packet or packet-only microwave backhaul networks, without requiring any valuable backhaul payload bandwidth.

Distributed Sync complements the new standards-based solutions and enables operators to delay moving to these IP-based schemes until after their network migration to IP transport is well progressed or even complete. Distributed Sync offers a standard, primary reference clock-traceable output at the base station over a multi-hop, nodal backhaul network, even in an all-IP environment where no TDM transport capability is available.

Distributed Sync enables mobile operators to reduce the risk and cost of network migration by decoupling synchronization from transport network evolution to all-IP and maintain the comfort, reliability and security of their proven TDM-based synchronization. ●



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