Better Backhaul
The Service and Infrastructure Transition to Ethernet

A Brave New World of Mobile Applications

Today, the mobile phone is hardly a phone. It is a device as powerful and application-rich as the computer laptops that sit upon our kitchen tables. Subscribers to mobile services are rapidly expanding their typical application usage patterns from a small percentage of their daily voice calls made while out of the home or office to nearly all of their daily calls. Have you ever found yourself at your desk talking on your mobile device while using your desk phone as only a clock? Data usage on mobile devices is really evolving. Only a short while ago a person was using their mobile device to look up a few compressed web pages, WAP-based sports scores, weather forecasts or play a rudimentary game of online poker or checkers on their mobile device. Today, with advanced mobile appliances, we are now mobile gamers using our devices to enjoy latency sensitive multi-player games seen previously only on portable gaming consoles. Some of us send and receive hundreds of emails daily while others view streaming video to enjoy sports highlights or upload content to video sharing websites via their mobile device.
ADTRAN offers a solution that allows an operator to migrate their access from copper and TDM to fibre and Ethernet.

Cell Site Access Needs To Keep Pace

To enable this advancement of next-generation mobile applications and deliver the full value of mobility, wireless service providers are migrating their networks to support highly efficient Radio Frequency (RF) standards. These 4G standards such as Long-Term Evolution (LTE) and Worldwide Interoperability for Microwave Access (WiMAX) are beginning to be deployed, as the next step beyond today’s 3G mobile technologies. These new 4G technologies will allow many times the bandwidth to be supported; as much as 100Mbps speeds will be supported. The existing circuit-based backhaul architectures that have served mobile backhaul networks well in the past are beginning to be the detriment to the overall subscriber Quality of Experience (QoE). For example, web page downloads are slower than they were last year, and video is jerky. The same advanced mobile applications that led to new subscriber adds and increased revenue per user cannot be allowed because of a network capacity bottleneck. In the end, the bottleneck can be the cause of expensive subscriber churn or slow the uptake of next year’s differentiated mobile services.

Optimising The Backhaul

For mobile carriers, the largest network expense is backhaul. Now, more than ever, operators are looking for ways to reduce transport costs in the backhaul network by more efficiently utilising bandwidth and optimising their network for support of multiple technologies. As the cost of backhauling traffic continues to rise, the need to drive down costs continues to be the central focus of operators. The conversion to an Ethernet-based IP-enabled network architecture is inevitable. This will occur not only to handle an increase in new applications and mobile users, but to drive down the rapidly rising cost of backhaul. What specifically do we mean by the term backhaul? An example of the backhaul network is illustrated in Figure 1. Note that the backhaul portion of the network can use any number of high-speed connections. Examples of backhaul connections are microwave, fibre, DSL, or any of a number of other connection technologies.
Legacy Services Transition to All-packet Mobile Backhaul

Mobile broadband networks are driving a transformation to IP and Ethernet with the deployment of new technologies—Long-term Evolution (LTE), High Speed Packet Access (HSPA), Next Generation Networking (NGN) and IP Multimedia Subsystems (IMS). The access network between Ethernet edge and IP core must keep pace or become a quality of service bottleneck, and the main component of a growing operational expenditure.

Service providers, focused on delivery of new revenue streams, are introducing new network capabilities and applications. The associated bandwidth growth is best served with Ethernet. As mobile operators invest in new Ethernet networks to support this growth, they must continue to support TDM services for their established mobile networks such as traditional GSM- or CDMA-based mobile services.

These legacy technologies typically enable comprehensive coverage for the operator’s customer base and a vital source of ongoing revenue to be supported. However, during this typically extended period of overlap and transition, an important consideration is the operation and maintenance of two disparate networks—one IP/Ethernet and the other TDM-based.

Circuit emulation services (CES) offer TDM connectivity over packet-switched networks (CESoPSN). These solutions allow operators to effectively grow new packet-based services and support revenue streams from legacy services without expensive upgrades to the existing mobile network. The CES or pseudowire creates a circuit within the packet network providing the appropriate voice service prioritisation and TDM timing preservation even as network conditions change.
Solution Summary

ADTRAN proposes a versatile Carrier Ethernet access solution to meet the needs of a multi-access next-generation mobile backhaul network. The solution consists of an aggregation component that either resides in the mobile telephone switching office, and/or a hub site, and a cell site gateway component for the actual service delivery. The ADTRAN Total Access 5000 (TA5000) is a chassis-based platform providing flexible, scalable interfaces to the Evolved Packet Core (EPC) and Metro Ethernet Network (MEN). At the cell site is a high-performance termination device that delivers intelligent Ethernet service; this is the ADTRAN NetVanta 8000 Series Ethernet over Fibre network termination unit (NTU). This overall solution delivers QoS-based Ethernet services in addition to T1/E1 Circuit Emulation Services (CES) and a robust clock recovery mechanism that is delivered over packet-based access.
Fibre provides the flexibility to reach the greatest distances and provides the added benefits of resiliency and protection. Today, fibre is the lesser deployed of the three implementations and has the highest price tag, making it cost prohibitive for many operators. Some operators are willing to accept the high price tag in favor of the benefits fibre affords their networks to extend reach and offer higher-bandwidth capabilities.

The copper bonding solution may be implemented for a variety of deployment types. Copper pairs may be bonded together to provide greater throughput rates using advanced DSL transmission. Backhaul providers are able to realise the best cost benefit and utilise existing infrastructure. When utilising DSL technologies, copper bonding offers many of the attributes of fibre Ethernet—high bandwidth, extended reach, enhanced environmental protection, and resilient solutions are available. Also, copper bonding can be implemented on existing facilities for a fraction of the cost of fibre.

Fibre Ethernet

Wireline networks have been utilising Ethernet and IP for years. Ethernet is a proven technology and in wireline networks the shift to an all-Ethernet, IP-enabled network with both IP-based voice and data is now a proven network topology. With the increase in high-speed packet data applications in mobile networks, and the trend toward mobile devices as the primary communication device for many individuals today, it makes sense that the conversion of mobile networks to IP will occur rapidly over the next several years. To support the new network, a next-generation product set that provides support for IP-optimised services while addressing support for existing and legacy services can help operators migrate to IP confidently. This also allows them to reap the benefits of new operational efficiencies, reliable performance, multiservice configuration flexibility, and lower costs.

Circuit Bonding

While this is one of the most expensive Ethernet options, it also has the greatest coverage. It takes advantage of the legacy network of DS1 and DS3 circuits commonly found everywhere in traditional networks.

Copper Bonding

The current evolution to 4G is driving the need for an all packet-based network. IP base stations supporting 3G/4G, WiMAX and LTE are requiring operators to select equipment today that will meet both their current and future needs. Providing support for existing services while augmenting the network or fully transitioning base-stations to IP in the next few years means purchasing equipment for sites today that could realistically have a short life unless vendor equipment is designed to accommodate the conversion to a fully packet-based network.

A New Network

Evolving Solutions
Hence, service providers are searching for technologies that provide lower-cost and more effective ways to meet the demand for bandwidth capacity while lowering both Capex and Opex. Ethernet is the answer.

Cost Benefits

For many copper-fed cell sites today, operators need to integrate a platform into their network that supports IP services without requiring them to forklift upgrade to expensive fibre infrastructure. Ethernet provided over DSL like SHDSL and bonded ADSL2+ can support the growth in asymmetric traffic while making the most of existing infrastructure. Many cell sites remain copper-fed today and will be for many years. Therefore, the use of technologies like Ethernet in the First Mile (EFM) to bond copper are providing an interim way to take advantage of the cost benefits associated with Ethernet, while using existing infrastructure in areas where higher bandwidths are needed but fibre is nonexistent or cost prohibitive.

The fact is, Ethernet is appealing. Ethernet is a better backhaul technology, not only because it can be supported by a number of infrastructures, but also because it is more cost effective than other alternatives. While the number of mobile subscribers continues to grow, the unproportional demand for bandwidth along with fierce competition in the market is driving down the ARPU, making cost containment and cost reduction a necessity. Hence, service providers are searching for technologies that provide lower-cost and more effective ways to meet the demand for bandwidth capacity while lowering both Capex and Opex. Ethernet is the answer.

A vendor that can deliver a scalable platform with carrier-grade features and an architecture that supports both legacy and Carrier Ethernet applications is the best fit for new installations or network upgrades.

Carrier Ethernet provides an economical solution to meet ever-increasing bandwidth requirements and leverages the current move to packet-based networks within wireline infrastructures. Other benefits include simplified management and streamlined operations and in the face of rising backhaul costs. While many technologies have a proportional cost increase with bandwidth, Ethernet only measures a slight cost increase with large gains in bandwidth. Ethernet also provides virtually unlimited scalability and ubiquity, unmatched support with full SLA enforcement and OAM capabilities. This provides for a smooth transition from legacy to next-generation services.

Service providers have several carrier-class Ethernet implementation to choose from based on their existing network typology. The three most common are circuit bonding, fibre Ethernet and copper bonding.

So, what conclusion can we draw from this? Much work is still in progress on the definition and use of Ethernet and Carrier Ethernet in an all-packet mobile backhaul world. Today, the backhaul landscape is actively changing to keep up with user demand for data. Mobile networks that were originally built for voice communications are now being optimised for data applications. This is putting a strain on the mobile backhaul network. Operators are in dire straits for an efficient means of delivering bandwidth to the cell site. With the introduction of carrier-class Ethernet technologies, now operators can take advantage of the existing copper and fibre facilities to achieve the highest traffic carrying capacity utilisation of their embedded investment and provide a network migration path toward an all-packet network.
ADTRAN is an ISO 9001, ISO 14001, and a TL 9000 certified supplier.