

Catching the 40G Wave

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Hunger for high-bandwidth, media-rich content is pressuring already strained service provider networks across both wireless and wireline connections. As a result, demand has increased for new, high-bandwidth network infrastructure equipment capable of supporting these applications today and into the future at decreasing costs per transmitted byte.

This article discusses the technology trends that are boosting bandwidth demand and argues that timing is key: Developers who delay in preparing for quick and painless system upgrades risk being throw off balance by, rather than catching the 40G wave, as the technology for creating blades and systems that interact at 40 Gbps arrives.

Enhancements to the open standard-based AdvancedTCA specification – as well as high-performance processor and hardware technologies – are already under way, signaling that advanced high-bandwidth transport technologies are on the near horizon. To date, mainstream markets have found few processing systems capable of reliably interacting at 40G available. However, the advent of processing blades and infrastructure capable of sustaining 40G per slot in a bladed AdvancedTCA system architecture is certain to open the door to a new performance dimension.

One thousand endpoints per person forecast

Recent forecasts from the Wireless World Research Forum project that as many as seven trillion wireless devices will be in operation by 2017 – an average of 1,000 communicating endpoints for every person on the planet. Furthermore, according to the Next Generation Mobile Network Alliance, wireless technology has responded to increasing demand by moving from peak download performance of about half a megabyte per second (Mbps) in 2004 to the 5-7 Mbps range today, as shown on Figure 1. Next-generation mobile networks are expected to nearly triple to more than 20 Mbps in the coming decade. Some mobile voice communications are also switching over to IP-based infrastructures, further inflating worldwide expectations and demand for high-speed wireless connectivity.

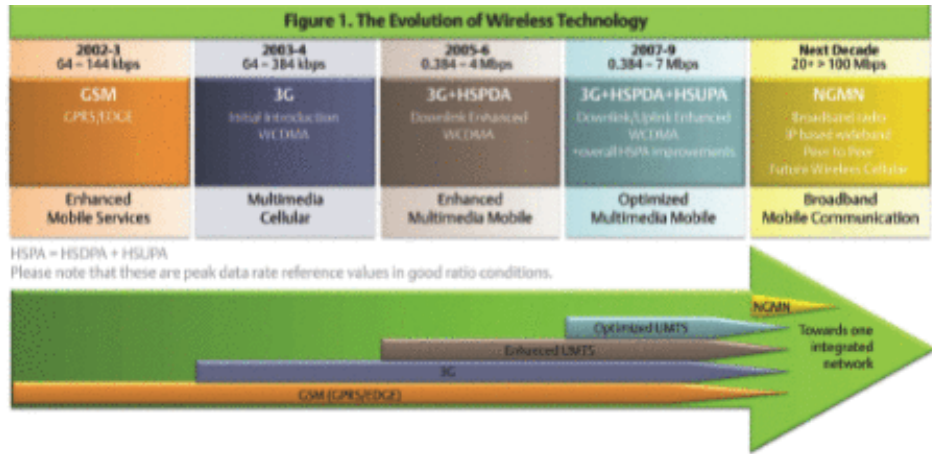


Figure 1: Since 2004 peak download performance of around half a megabyte per second (Mbps) has improved to today's 5-7 Mbps range.

A new generation of smartphones is connecting people with data in fun and useful ways

From a carrier's perspective, the Apple iPhone acted as a game changer for wireless networks. The iPhone's ease-of-use for mobile entertainment and Internet access continues to increase the traffic demand to unexpected levels. Clearly this presented an issue for most carriers, whose billing structures for mobile subscribers are traditionally flat and remain so. In response, developers created service-oriented billing structures for subscribers and providers to motivate carriers to invest in profitable new high-bandwidth networks. Identifying services, assigning bandwidth and quality according to the subscriber's individual contract, and billing are relatively new challenges, and the next-generation LTE network has zeroed in on them. These challenges demand extensive processing performance to investigate and control data traffic on the fly. From a commercial standpoint, it suggests that new small network elements operating at high bandwidths will be required to perform such tasks.

Cloudy weather and greater ROI ahead

Beyond wireless, cloud computing is another trend buoying the need for 40G. In an effort to keep up with increasing system demands between the Internet and globally dispersed corporate intranets, network-attached, high-capacity storage systems for enterprise databases are rapidly growing in size. To reduce costs, providers of streaming data and non-

telecom applications (such as on-demand video) are also seeking ways to aggregate multiple media streams for distribution. This would enable smaller infrastructures to provide more compelling services, such as High-Definition (HD) streaming, ultimately resulting in greater return-on-investment for providers.

Responsive systems are increasingly used to monitor everyday processes

A heightened interest in ambient intelligence is emerging, resulting in the creation of several wireless sensor and ID tag protocols that serve various functions, including transported goods tracking, smart building power management, and wide-area environmental sensing networks. Automobiles, for example, are embedding multiple wireless communications devices – an average of 10 per vehicle in newer models – for such things as hands-free cell phones, real-time traffic and route displays, tire pressure sensors, and live roadside assistance services such as OnStar. Nearly all these wireless nodes feed into an IP network to handle data as well as performing remote network access and management, further increasing IP bandwidth demand.

Supporting up to 80 Gbps of bidirectional I/O

As bandwidth demand rises, many equipment providers are being faced with a need to develop new generations of equipment to process the increased traffic. Those already using the AdvancedTCA architecture have found a solution in existing multicore computing technologies, helping them bridge today's infrastructure with some of the next-generation bandwidth demands. While many advanced packet processing devices are already employing multi-core designs with as many as 64 cores on a chip, next-generation general-purpose or server-class processors (such as the latest Intel Xeon processors) are also designed with multiple processor cores.

By using multicore technology, greater bandwidth can be achieved via a single chassis or even a single blade, combining data and control planes to simplify scalability as the subscriber base grows. Next-generation processing technology will offer much higher performance. For example, a well-designed AdvancedTCA blade that can support two of these multicore CPU chips can generate enough processing power to support up to 80 Gbps of bidirectional I/O to other network elements.

High-speed AdvancedTCA shelves

This new dimension of performance is driving the AdvancedTCA community to upgrade the bandwidth of the AdvancedTCA internal network. Fully redundant 40G Ethernet to each payload blade in the AdvancedTCA system is in its final stage of standardization. This boosts the headroom for data processing toward 1000 Gbps per AdvancedTCA shelf. Shelves with new high-speed backplanes have been shipping now for over a year, while network and payload blades are being developed, and all are interoperable with currently shipping 1G and 10G payloads.

Luck favors the prepared infrastructure

While a full transition to a 40G infrastructure may be a year or more away, it is critical that equipment developers begin planning for its adoption now. Recent analysis indicates that AdvancedTCA systems can start upgrading to 40G operation as soon as late 2010 to mid 2011, with payload blades serving as the final link in the chain of availability. While developers and customers will instinctively hold back to avoid the expense of upgrading too soon, they risk allowing competitors to leapfrog ahead in offering new features and functionality once 40G payload blades become a standard offering.

Of paramount importance is the adoption of 40G-ready platforms

For service providers to utilize the new, higher-speed blades in their systems as soon as they become available, it is critical that they already have AdvancedTCA shelves in place with backplanes capable of supporting 40G data rates. With this fact in mind, many network equipment providers are beginning to offer solutions that meet current specifications, yet are forward compatible. This enables service providers to continue using existing blade technologies with confidence that their infrastructure will be able to reliably handle higher data rate blades when they become more widely available.

Expansion avenues

Network equipment providers also must be able to address a wide range of customer needs with their AdvancedTCA designs. System size and capacity need to match the initial deployment requirement to help minimize capital investment during the economic recovery. Systems should also be scalable to readily handle capacity growth as the customer base

increases and as service offerings evolve. While some of this capacity growth will occur with the move to 40G, the system should also offer other expansion avenues.

Having access to compatible platform cores in a variety of sizes gives network equipment providers a clear expansion avenue, with most elements of an AdvancedTCA platform core essentially unaffected by the platform's size. Individual blades, the operating system, and application software, for instance, behave in the same way whether there are two slots in a system or twenty. This size indifference makes the development effort needed to integrate and verify a system design essentially "re-usable" when creating a range of system offerings. The lessons learned and debugging results of the first system development effort directly apply to the scaled version when working from compatible platform bases.

As proof of this concept, Emerson Network Power has addressed this need for design scalability in its Centellis series of Platform Core products. Current offerings include a two-slot platform core for small system installations (Centellis 2000, Figure 2) and a 14-slot version for larger systems (Centellis 4440, Figure 3). Intermediate system sizes are achievable by using multiple Centellis 2000 systems in a single rack.

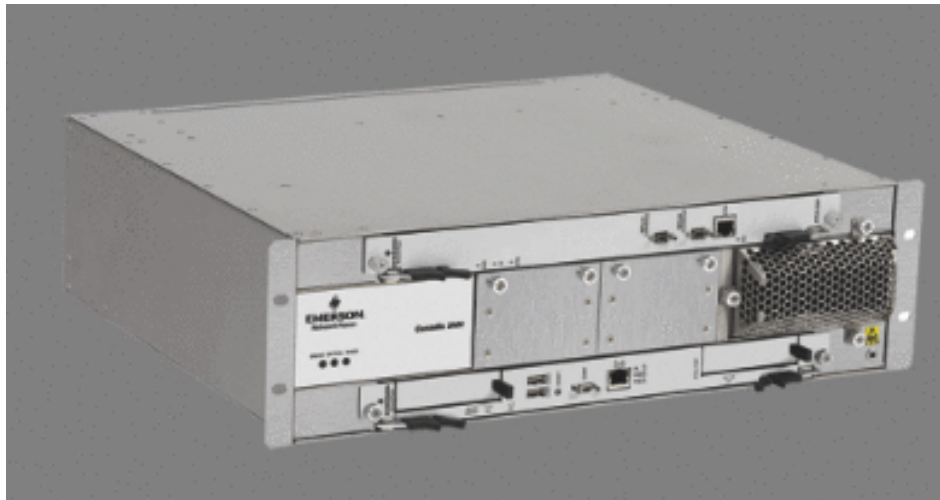


Figure 2: The two-slot Centellis 2000 AdvancedTCA Platform Core

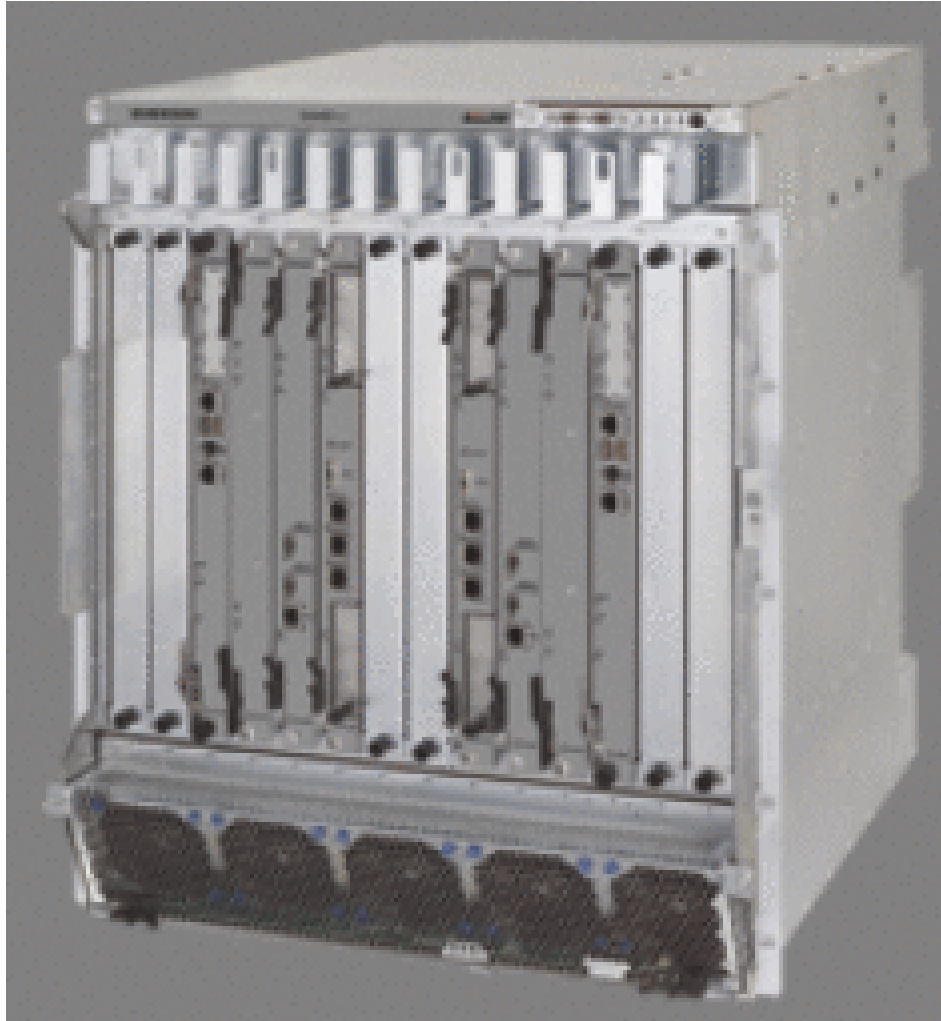


Figure 3: The 14-slot Centellis 4440 AdvancedTCA Platform Core

The needs of individual endpoint nodes and the number of nodes installed, along with the proliferation of wireless nodes, are feeding bandwidth demand. And bigger demand is increasing the requirement on throughput per network element. Cost and space constraints, meanwhile, call for network elements to shrink their physical size and price per packet handled. This reduction can only be achieved by increasing the processor performance and I/O bandwidth that individual blades can offer.

The 40G future is clear

It is certain that as customer demand for high-bandwidth services continues to increase,

AdvancedTCA systems will ultimately be forced to move from 1G and 10G operation to the next logical step: 40G. Component-level technologies are already preparing for the future, with next-generation multicore processors with the I/O and computing capacity that projected data traffic will demand. Developers of switching and packet-processing silicon are also preparing for the transition, with 40G blades as close as a year away from commercial availability.

With a 40G future looming low on the horizon, network equipment providers are well positioned to help their service provider customers prepare today by delivering systems that will allow quick and easy speed upgrades through simple blade replacement. By taking steps to ensure that a compatible infrastructure is in place, equipment and service providers will be able to experience the smoothest possible migration to 40G with minimal investment in time and cost.

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