



Position Paper

Boost multimedia adoption with 4G mobile broadband

Executive summary

Mobile broadband is all about the user experience. 4G mobile broadband will provide an order of magnitude improvement in performance, total cost of ownership and number of devices supported by the network. These improvements are significant and will make 4G mobile broadband a truly disruptive and business-changing technology.

4G mobile broadband will bring more affordable services to wireless consumers, and these services will be made possible with the deployment of more efficient radio technologies. New bandwidth-hungry applications and real-time sensitive services will drive greater consumer adoption in the market; and the new generation of consumer devices and advances in current devices are driving hyperconnectivity — a state of increasing penetration where each user has multiple connected devices.

4G will be powered by a complete revolution in radio technology aimed at packing information more efficiently on the scarce and expensive air waves. High spectral efficiency is made possible with a 4G air interface technology called Orthogonal Frequency Division Multiplexing (OFDM). In addition to this,

another innovative technique that provides a killer combination for 4G wireless access is the Multiple Input Multiple Output (MIMO) antenna technology. With MIMO, the BTS has the intelligence to further boost capacity and coverage using various algorithms that take advantage of the mobile environment to provide the multi-megabit-per-second user experience. On the core network side, 4G combines many of the routing and mobility management functions to deliver a flat all-IP network architecture that enhances data performance and reduces operational costs.

Mobile operators will seize the more attractive business model, earlier time-to-market advantage, lower cost, higher

performance, more efficient delivery of multimedia applications and new revenue opportunities that 4G mobile broadband will enable.

We are on the threshold of a new era with more innovation and opportunity not witnessed in previous eras. 4G will eliminate the gap between mobile and fixed broadband. It will create revenue and cost reduction opportunities for service providers and a rich seamless experience for the end users, making wireless broadband affordable and facilitating a gamut of applications from basic voice over IP (VoIP) to bandwidth-hungry video applications in fixed or mobile environments.



The dawning of the 4G mobile broadband era

Changes are already underway with devices, applications and the marketplace.

- First, the trends are in place for an explosion of consumer devices demanding mobile broadband connections to enhance the user experience.
- Second, mobile electronics technologies continue advancing to deliver enhanced usability of Internet applications on mobile devices. These technology advancements, along with increasing parity in performance between fixed and mobile networks, are supporting a fixed to mobile migration of popular Internet applications such as VoIP, video sharing and multimedia downloading.
- Finally, the business opportunity for fixed and mobile operators is increasingly overlapping as end users are becoming accustomed to (and even demanding) service convergence.

The mobile connectivity explosion is already very apparent today in the growing number of Wi-Fi enabled devices such as Sony's Playstation PSP and Nintendo's GameBoy DS and, more recently, MP3 players and digital cameras. As users experience the ease and transportability of wireless connec-

tions, the natural evolution for these devices is to become mobile and give users even more freedom to download, and upload, and all the while staying connected wherever and whenever they desire. In this hyperconnected world, a user is at the control of their connectivity. They are not associated with just one device for one application — which, in the past, was primarily used for voice communication — but with two, three or more purpose-created devices. These devices, such as smart mobile phones, MP3 players and navigational systems, require mobile connectivity and interact with the user. They provide instant access to updated content and information, like the latest number one hit being heard on the radio, digital maps that show instant traffic information or the shortest driving path to a destination.

On the application front, there are many proven Internet applications ready for a mobile make-over. Applications like interactive online gaming could be a sticky proposition when equipped with a mobile connection. In addition, IMS-based rich voice services are on the cusp of widespread deployment requiring only a packet switched technology with a quality of service (QoS) performance equivalent to today's circuit switched network. These new networks will provide the performance and capacity

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to deliver a richer experience to the consumer by combining presence, messaging, collaboration and video telephony. Finally, video is a huge phenomenon going on in the wired world with sites like YouTube and Google video. Collectively, all viewers spent over nine thousand years watching video on YouTube last year.

Mobile broadband will enable ubiquitous access to services that drive network convergence. Fixed and wireless operators will find themselves competing and/or partnering with each other to deliver the simplicity and transparency their customers will demand when accessing applications and services regardless of place or time. The deployments of the IMS Voice Call Continuity (VCC) solution are evidence of this industry trend where integrated operators deliver seamless voice service experience for the end users across location and access technology. (With the IMS VCC service, an end-user equipped with a dual mode cellular/Wi-Fi device can seamlessly move from a circuit switched call in cellular coverage to a packet switched call in Wi-Fi coverage.) An operator with converged network solutions can differentiate itself with bundled services to deliver end users the value of a common point interface for self-provision and personalization.

To compete effectively in this new mobile broadband era, a new paradigm on the choice for the radio technology and network architecture is necessary to get the capacity, performance and right cost structure critical for staying profitable while supporting the order of magnitude increase in connections, traffic and performance expectations. OFDM and MIMO have proven to be the most cost-effective air interface solutions that will also deliver the scalability required for mobile broadband performance enhancement for years to come.

All roads lead to OFDM-MIMO

OFDM is an extremely successful radio access technology that is ideal for high data rate communications. It is currently deployed in a number of wireless and wireline applications including broadcast (Digital Audio Broadcast or DAB, and Digital Video Broadcast or DVB), wireless WLAN (IEEE 802.11a and IEEE 802.11g) and WiMAX (IEEE 802.16), and Asynchronous Digital Subscriber Loop (ADSL/ADSL2+). OFDM has proven, as indicated by these extensive applications, to be an extremely scalable and spectrally efficient technology for wireless broadband data communications. It is widely accepted as the basis for the air-interface technology necessary to meet the requirements of 4G mobile networks.

MIMO is an advanced antenna system technology that employs multiple transmitting and receiving antennas to substantially enhance the data capacity over the air interface. MIMO processing exploits spatial multiplexing that allows different data streams to be transmitted simultaneously from the different transmit antennas to increase the end user data rate and mobile network's throughput. It can also use space-time coding to map the same data source onto multiple transmit antennas that can extend the coverage of the cell.

Together OFDM and MIMO will deliver, on average, up to five times the performance enhancement over existing 3G technologies. This next-generation wireless technology can deliver a peak throughput of well over 100 Mbps, and with future upgrades, can enable performance over 1 Gbps.

While throughput performance can mostly be addressed with the choice of the air interface technology, enhancing data latency, critical for delay-sensitive and real-time applications, requires changes in the network architecture. The network will be flatter with only two types of network elements to reduce the number of router connections that the user data package will have to traverse. IP networking will be leveraged to get the routing efficiency and cost scale benefits. As a result, network delay will be reduced to less than 20ms — up to three times the enhancement over today's 3G technologies.

Nortel is paving the 4G path

Thanks to its tremendous experience in deploying over 300 wireless networks in all leading cellular technologies, Nortel has gained the critical expertise and know-how to deliver networks that fulfill operators' most stringent requirements with a lower total cost of ownership. Nortel's 4G access solutions will provide best-in-class coverage and capacity and

deliver the level of performance and spectrum efficiency at an order of magnitude higher than current 3G solutions. Nortel leverages a common carrier-grade core network solution across all leading broadband access technologies to simplify inter-working and support services convergence. Nortel's time-to-market leadership strategy includes early co-development relationships with mobile chipset vendors that accelerate interoperability testing with device manufacturers to ensure the availability of a complete 4G ecosystem.

Nortel began investing in OFDM and MIMO in 1998 in anticipation of their adoption in mobility networks. Since then, the company has numerous patents on file and has demonstrated OFDM-MIMO commercial benefits and feasibility to more than 100 customers worldwide. As an example, Nortel performed the world's first live-air LTE (Long Term Evolution) with Collaborative MIMO demonstration at the 2007 3GSM World Congress. Nortel continues to leverage its OFDM-MIMO investment and experience across 3GPP LTE, 3GPP2 UMB and WiMAX to achieve maximum synergies across these advanced wireless network product lines.

Other key enabling technologies which Nortel is actively researching include light-weight antenna systems, cell-site cable reduction and high efficiency linear power amplifier technologies which all contribute to lowering the total cost of ownership from which the 4G mobile broadband operator benefits when deploying OFDM-MIMO based networks.

On the core network side, Nortel will provide an access-agnostic core network solution with embedded security, QoS management intelligence at the services edge and built-in carrier-grade reliability. In addition, Nortel's VoIP core and IMS application solutions lead the industry in IMS-compliant implementations in the market. The access-aware network also allows content providers,

OFDM-MIMO is the basis for all 4G technologies

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developers and service providers to deliver content more easily and effectively by eliminating the need for different schemes and codes for each service or application. As a proof point, Nortel has successfully completed more than 110 IMS IOT projects/test fest events with developers, service providers and other vendors in the last two years while Nortel's IMS-ready solution is equipping more than 100 networks in the world.

For early success in 4G, Nortel understands that a holistic ecosystem needs to be in place. Towards that strategic vision, Nortel is establishing a presence in Taiwan to leverage early co-development and testing with 4G chipset vendors that will help accelerate interoperability testing timelines with device vendors and ensure product compliance and early availability to the market. This is one of the many proof points of Nortel's leadership that contributes to the establishment of a broad network of suppliers who are all driven by a common early time-to-market vision.

The hype is becoming reality

The mobile broadband era begins with mobile WiMAX in 2007, when new entrants and existing network operators begin to differentiate their service offer-

ings with the deployments of a true mobile broadband solution. New entrants are taking advantage of both a clean network that has no legacy dependencies and the capabilities of WiMAX to deliver truly disruptive services and claim market share. Cable and wireline operators are looking at last mile applications and expansion to deliver quadruple play (broadband data, video, voice and mobility). Existing cellular operators see the potential in the time-to-market advantage with performance leadership and capacity WiMAX can offer. Above all, the compelling reason for WiMAX is the open ecosystem nature and proliferation of new generation devices. Consumers are no longer tethered to handsets as the only mobile device but their world expands to all consumer electronic devices, be it home or car appliances, gaming consoles or MP3 players.

By 2008, Ultra Mobile Broadband (UMB) and Long Term Evolution (LTE) access technologies and ecosystems will join the scene supporting trial systems. The 4G deployment domino effect will unfold by 2009 with early adopters leveraging LTE and UMB to create differentiations and maintain market leaderships. The early arrivals of such technologies will also present

enormous opportunities for existing 2G wireless operators — giving them an evolution path that leapfrogs 3G directly to 4G. After all, one of the major reasons why these operators would still stay on 2G is because of a lack of a compelling business opportunity with 3G. On the other hand, 4G total cost of ownership can be 70 percent lower than 3G; and that alone is a convincing value proposition for these operators looking to stay profitable in the long term.

The all-wireless broadband era is quickly approaching. Operators armed with a 4G leadership vision now can change the game and come out ahead. Nortel will deliver the network solutions along with the service and device ecosystems to support the early time-to-market strategies of its customers. The company will leverage its technology leadership in OFDM-MIMO and core network solutions across all 4G technologies to deliver superior solutions with simplicity in operations and carrier-grade reliability, for an overall superior value to customers. Last but not least, Nortel's IMS core complements the 4G leadership to ensure the richest and most open service delivery platform for the operator.

Are you ready for mobile broadband?

Nortel is a recognized leader in delivering communications capabilities that enhance the human experience, ignite and power global commerce, and secure and protect the world's most critical information. Our next-generation technologies, for both service providers and enterprises, span access and core networks, support multimedia and business-critical applications, and help eliminate today's barriers to efficiency, speed and performance by simplifying networks and connecting people with information. Nortel does business in more than 150 countries. For more information, visit Nortel on the Web at www.nortel.com.

For more information, contact your Nortel representative, or call 1-800-4 NORTEL or 1-800-466-7835 from anywhere in North America.

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