



# No painless upgrade to 4G

The upgrade to WiMAX or LTE requires a new overlay network, not just software upgrades

By Monica Paolini

**T**he transition to 4G technologies appears ineluctable and the near universal consensus is that 4G technologies—no matter how you define the term ‘4G’, which is still a matter of debate—will all be based on OFDMA, at least in the downlink.

CDMA-based 2G and 3G still have a long life ahead of them and will continue to dominate the voice market for many years to come. No operator is in a hurry to dismantle their GSM networks to replace them with WiMAX or LTE. At the same time, the evolution of CDMA-based technologies has reached its natural end. They are not as spectrally efficient as OFDMA

technologies. Being optimised for voice services, they are not well suited to support wireless broadband connectivity. Finally the use of narrow channels limits their capacity and increases the cost-per-bit in network deployments.

What is involved in the transition to 4G is becoming a hot discussion topic, especially when vendors are in the room. Trying to diffuse worries that 4G may turn out to be a repetition of the 3G experience (long delays, high capex, few devices and, eventually, a slow adoption growth path), some vendors are marketing solutions that promise to minimise the pain of the technology upgrade.

Can software upgrades delay some of the hardware replacements? Which core network elements can be shared or re-used? Could you preserve your current platform—and presumably the vendor—to upgrade with a few, minor equipment changes (eg, change the radios only)?

These are all very important questions as operators move into more detailed planning of how to deploy new networks or how to upgrade from the existing ones. For instance, can operators that plan to move from CDMA to LTE benefit from an interim migration to HSPA? Which technology, WiMAX or LTE, is better suited for operators given their timing, market targets,

service planned and business model? The effort and costs involved in the transition has a huge impact on the operator's decision.

## More than software upgrades

The transition to WiMAX and LTE is not going to be a simple software upgrade. Some network elements can be re-purposed or shared but, in many cases, even this is not going to be cost-effective or desirable (*see adjacent figure*). In most cases operators will find that an overlay network is going to be the only suitable solution for multiple reasons:

- **Wireless interface: base stations and subscriber devices.** WiMAX and LTE use a new wireless interface that requires an entirely new radio access network and new subscriber devices. The equipment already deployed that is a target for upgrades has been in operation for some time and will often not accommodate the power requirements of OFDMA technolo-

gies supporting MIMO or beamforming. Even if the new base station models use a platform that will in the future accommodate new technologies, the ones currently deployed typically do not.

- **Spectrum.** WiMAX and LTE are almost exclusively deployed in newly acquired or unused spectrum bands. As a result, at a minimum, a new radio and new antennas (especially if moving to MIMO and/or beamforming) are required.
- **Cell locations.** Operators may need to invest in new cell towers or rent additional locations to support OFDMA technology. Using a new spectrum band limits the ability to share base station locations and cell towers. Spacing between base stations depends heavily on the technology used and spectrum frequency. Moving to a higher frequency will require a more dense concentration of base stations, other things being equal. Operators will clearly benefit from sharing as many cell locations with cellular legacy technologies as possible, but this is not going to be cost-effective and spectrally efficient as different spectrum bands are used. Furthermore, antenna size and placement vary greatly depending on the frequency used, and the target tower may not have room to accommodate the new antennas. This is rapidly becoming a major issue as the equipment deployed increases and space and permits available for the construction of new towers are limited.
- **Legacy networks.** Wisely, operators want to extract all the value they can from existing networks. 2G cellular networks have enjoyed a long life span and they are still responsible for most of operators' revenue—and even more so profit—as they are efficient at carrying voice and SMS traffic. When planning a new

WiMAX or LTE network, operators typically do not have network infrastructure to re-use.

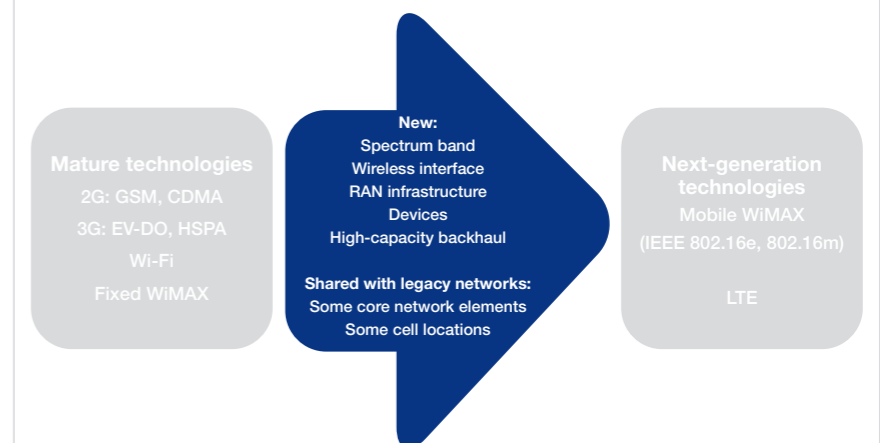
- **Core network elements.** While some elements of the network (eg, the AAA or the billing management) may be shared in some network environments, most of the core network elements need to be duplicated or replaced and this in fact will result in a more powerful but less complex IP-based core network with a flatter hierarchy.
- **Backhaul.** 3G networks are already suffering from a backhaul bottlenecks at cell sites that have a backhaul infrastructure inherited from 2G networks. OFDMA technologies like WiMAX and LTE bring a much higher capacity in the network that translates into higher volume of traffic to backhaul. Simply adding T1 connections will not suffice and operators will often need to adopt new backhaul solutions to accommodate the new traffic.

There are some welcome advantages in comparison to the evolution from 2G to 3G. Most vendors are working on modular base station form factors that provide operators with increased flexibility in the future to upgrade their networks. Operators can also gradually increase the size of the transmission channels as they gain more spectrum allocations within the same band or gradually migrate from one technology to another. The increasing availability of microcells, picocells and femtocells also widens the choice in network architecture, and it is likely to bring higher network efficiency and capacity, along with cost reductions.

## Backward compatibility?

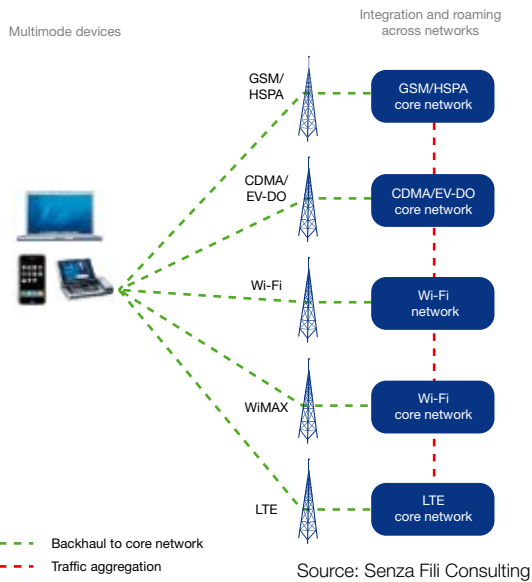
The move to 4G is going to be disruptive, regardless of the technology—WiMAX or →

## 4G upgrade requirements



Source: Senza Fili Consulting

## Multimode device roaming



LTE—selected. The new wireless interfaces and IP core bring a much-improved cost framework and spectral efficiency, but the downside is that there will be no backward compatibility within the RAN between 2G/3G and OFDMA technologies.

But this does not mean that WiMAX and LTE networks will operate in isolation from cellular, wifi or wireline networks. In fact, much more so than in the past, there will be closer integration across multiple technologies, as no single technology can single-handedly address the demand for subscribers to have both voice and broadband data services available everywhere on any device they own.

The integration will not happen in the RAN, but within the subscriber devices and the core networks. Increasingly, devices will support

multiple wireless interfaces that allow subscribers to connect to the best network available, based on their preferences, operator's policy, and coverage. At the other end, interworking and roaming will be increasingly common among networks as a way to provide better domestic and international coverage and to increase the efficiency in the use of network resources.

### Overlay network integration

There is no dominant upgrade path to 4G technologies. Different operators are pursuing different plans, which are based on:

- **Current and expected traffic demand.** This is rapidly changing as individual traffic levels have started to grow faster with the wider

availability of data-friendly devices like the iPhone, and of off-deck applications.

- **Existing infrastructure and its upgradability.** Operators are trying to extract as much value as possible from their 3G networks by upgrading to HSPA. Upgrades to HSPA+ in many cases are not cost effective as they require significant equipment upgrades to accommodate MIMO, as Darren McQueen, vice president of wireless broadband access technologies at Motorola, points out. In this case, a WiMAX or LTE overlay network may be more cost-effective. For many 2G cellular operators a transition to 3G ahead of the upgrade to WiMAX or LTE may be difficult to justify in terms of cost and efficient use of spectrum. Leapfrogging 3G may give 2G operators the

opportunity to be among the first to deploy OFDMA technology, and move earlier to a leaner IP core network.

- **Spectrum and funding availability.** In many markets WiMAX and LTE spectrum in the 2.5-2.7GHz band has not yet been assigned and many operators welcome this as it gives them more time to prepare to move to 4G. Funding limitations both due to the current financial environment and to the recent huge—and unprofitable so far—investments in 3G are likely to push deployments further out in the future.

These factors will determine which technology operators will adopt and when. The costs and efforts required to upgrade from a 2G or 3G network to WiMAX or LTE are largely the same. There are “no profound differences” according to Jim Orr, principal technical architect at Fujitsu.

The different choices among operators mostly stem from their requirements. LTE is based on a standard developed mostly by 2G and 3G cellular operators and vendors to provide them with a path to OFDMA. The WiMAX standard was developed by a broader ecosystem that also included IT and, more specifically, wifi vendors, which have provided the momentum to bring the flat all-IP architecture to mobile communications.

Operators that choose WiMAX have the opportunity to be among the first to operate an IP mobile network and will be able to roll out their network sooner, as LTE equipment is still not commercially available. But in either case, the transition to OFDMA will require the introduction of new radio equipment, devices and a new core network. □

*Monica Paolini is the founder and president of Senza Fili Consulting and can be contacted at [monica.paolini@senzafiliconsulting.com](mailto:monica.paolini@senzafiliconsulting.com). Senza Fili Consulting provides expert advisory services on wireless data technologies and services.*

## WiMAX attraction for greenfield operators

Greenfield operators do not have to worry about a legacy infrastructure that has to be integrated with the new OFDMA networks and can enjoy more flexibility. At the same time, many greenfield operators are actively working with cellular operators on roaming arrangements that will provide WiMAX operators wider coverage, especially during the deployment stage.

The earlier availability makes WiMAX the obvious choice in the short term for many greenfield operators. Even in the long term, however, we expect greenfield operators to prefer WiMAX as its ecosystem is more closely aligned with their business models as aggressive new entrants trying to secure a sizable market share with better performance, wider choice of devices and more affordable prices before incumbent operators enter the market with their 4G networks.

