On the leading edge

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New mobile networks will have a dramatic impact on sites and planning, reports Caroline Gabriel

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Forecasting the future in mobile telecoms is becoming an increasingly challenging game. The huge range of uses for a handset could hardly have been anticipated a decade ago, and as mobile phones morph into high-powered computers, so the technologies to support those data-greedy devices have had to evolve rapidly to keep up ? and to keep operators' heads above water. Already we are on the edge of the next big shift for mobile networks ? the emergence of the 'internet of everything', where almost anything, from a smoke alarm to a pet or even a human, is directly connected to the internet via a wireless connection and a simple browser.

These changes add up to vast amounts of data transmitted over wireless networks ? Cisco's latest estimates are for an 11-fold rise in mobile data traffic between 2013 and 2018, with almost 70% of that accounted for by video. The sheer weight of traffic, coupled with users' rising expectations of high-quality and ubiquitous availability, have driven the operators to build increasingly powerful, fast and dense networks.

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There are various ways that a mobile carrier can make its network capable of carrying huge amounts of broadband data, and most are being harnessed by the UK mobile network operators, like their counterparts around the world, in
various combinations. The first step for most is to upgrade at least part of the network from 3G to long term evolution (LTE), which brings full Internet Protocol support; data rates currently peak at 300Mbps, but are set to rise far higher; and more efficient use of spectrum. The UK has seen all 4 of its operators launch 4G services, starting with EE in 2012, gaining an advantage when it was allowed to roll out LTE in its existing GSM spectrum, while its rivals had to wait for last February's auction of new airwaves.

But an LTE upgrade on its own delivers just 15% of the required additional capacity in most scenarios, so operators need to use many other complementary techniques to achieve that 11-fold capacity increase.

These include conventional enhancements ? equipping additional sectors and smarter antennas on the towers. But something more dramatic is also needed, because the other pressure is to lower the cost of deploying and running these new networks.

New approaches

Europe's operators face competitive markets, high debt levels in many cases, and consumers who want more data for less money. There is a significant imbalance between the investment needed to support rising mobile traffic, and the revenues that can be clawed back. By Rethink's calculations, global investment in additional capacity will be higher than the extra revenues generated until 2017, if operators continue to build networks in the same way.

That has turned attention to new types of networks that may deliver data capacity at far lower cost ? and which will entail significant new approaches to mobile telecoms sites and network planning.

There are 3 important new approaches, which may often be complementary: small cells, carrier WiFi and Cloud-RAN. All will require large numbers of new sites, far closer to the ground than traditional towers and high rooftops. Low roofs, lamp posts and the sides of buildings will become common locations for base stations and antennas, leading to new planning pressures for operators and potential new directions for site owners and operators. In the UK, for instance, Arqiva has set up small cell and WiFi activities to extend its wireless infrastructure management business into the new world.

- Small cells have largely been deployed indoors so far, to improve signal quality in homes or offices, but over the next few years operators in many countries plan to roll out public access versions, many in the street. The aim is to create a separate layer of small base stations, below the existing tower-level macro network, which would provide significant additional data capacity and fill in coverage gaps. Because the base stations cover only a small area (about 100m in urban zones), they can support highly targeted capacity and even location-aware services (such as alerting users to a nearby restaurant by SMS, when they venture into the cell). The operators believe that the equipment will reduce the cost of delivering data capacity because it will be low cost and standardised (similar to WiFi access points) and largely self-managing, reducing maintenance cost. Those cost arguments are still unproven, but are essential for the business case to work.
- Also contributing to operators' ability to deliver high data capacity at low cost is WiFi. Operators already offload heavy-duty or less valuable data (e.g. YouTube sessions by pay-as-you-go teenagers) to nearby WiFi hotspots, but technology is evolving to allow them to make WiFi an integral part of their networks. For instance, the HotSpot 2.0 standard allows handset users to transfer seamlessly between cellular and WiFi without having to sign in, and base stations are emerging that combine WiFi and 3G or 4G in a single low-cost box, all controllable by the carrier's software. This is a way to add significant wireless capacity using low cost equipment and free spectrum (although there are still issues with service quality in unlicensed frequencies).
- The third new approach is Cloud-RAN, which is at a more experimental stage but is proving of high interest to many operators. This involves centralising the digital processing functions of base stations on large servers. This pool of processing capability then serves hundreds of sites, which are themselves made up of low-cost, low-power equipment ? a radio/antenna unit that can be the size of a large book. This means the 'clever' resources of the network can be shared flexibly where required, while the operator can greatly reduce the cost of equipping the sites itself, allowing it to deploy huge numbers to achieve dense coverage. Cloud-RAN, therefore, needs large numbers of new sites, just like small cells. The difference is that small cells retain the processing power and intelligence locally.

There are still many barriers to these approaches, many of them connected to the sites themselves. Increasingly, operators know they do not just need large numbers of sites, but the right sites to deliver optimal quality at greatest efficiency. Signal quality, and the resulting quality of experience for customers, is hard to achieve when there may be

hundreds of base stations in close proximity (some from rival operators), so prevention of interference is critical. That relies on clever tools, but also on having the best locations. However, even when the most desirable roof or billboard is identified, it may not have readily available backhaul links or power supply.

Sharing and outsourcing

Complexities of planning and installation, and the need to scale up to large numbers of cells, are driving operator interest in 2 trends, which will also affect sites. One is to share their networks, to reduce interference and cut costs. Carriers are increasingly keen to share elements of their macro networks, as seen in the joint ventures between Vodafone and O2, and between EE and 3UK. It is logical that this would extend to small cells, although one significant barrier needs to be overcome (this year, according to many vendors) ? developing a small cell base station that can support more than 1 operator's network.

The other trend is to outsource the planning, site acquisition and backhaul provision for their small cells, or even to entrust the entire network to a third-party provider. Some telecoms infrastructure companies and cable operators ? such as Virgin Media and Colt Telecom ? are already developing these 'Small cell as a service' offerings.

Conclusion

Overall, then, mobile technology is moving towards a world where there will be far more sites, supporting a wide variety of equipment form factors. Power will shift to companies that own desirable urban locations (outdoors and indoors) and/or fibre or cable for backhaul.

The tower-based sites will not go away. Although there will be impact from network sharing, most carriers will still add more macro sites to support their LTE roll-outs, with small cells providing additional capacity when that macro layer is stretched to the limit of the latest antenna advances.

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These new network topologies are in their infancy. This year will see UK operators trialling public small cells and making increasing use of WiFi, but it will be late 2015 and beyond before most operators outside Japan, Korea and China have commercial networks with hundreds or thousands of cells. Also, outside those pace-setting countries, Cloud-RAN is unlikely to be deployed on a wide scale until 2016 and later.

The catalyst for mass deployment is likely to be adoption of the next wave of LTE standards, LTE-Advanced, which includes several technologies that make it simpler to support huge numbers of cells. In particular, it standardises some important technologies for self-organising cells and for interference prevention. Some elements of LTE-Advanced are already creeping into the networks of operators such as EE, and they will help to ease the transition to the new networks.

Of course, the pace of change never lets up and users' hunger for more data will soon outrun the progress of LTE. Already, operators and vendors are studying the next

generation of mobile technology, naturally dubbed 5G, which is expected to become commercial around 2020 and will feature even smaller cells, higher spectrum bands, and another sea-change in the way networks are planned and rolled out.

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