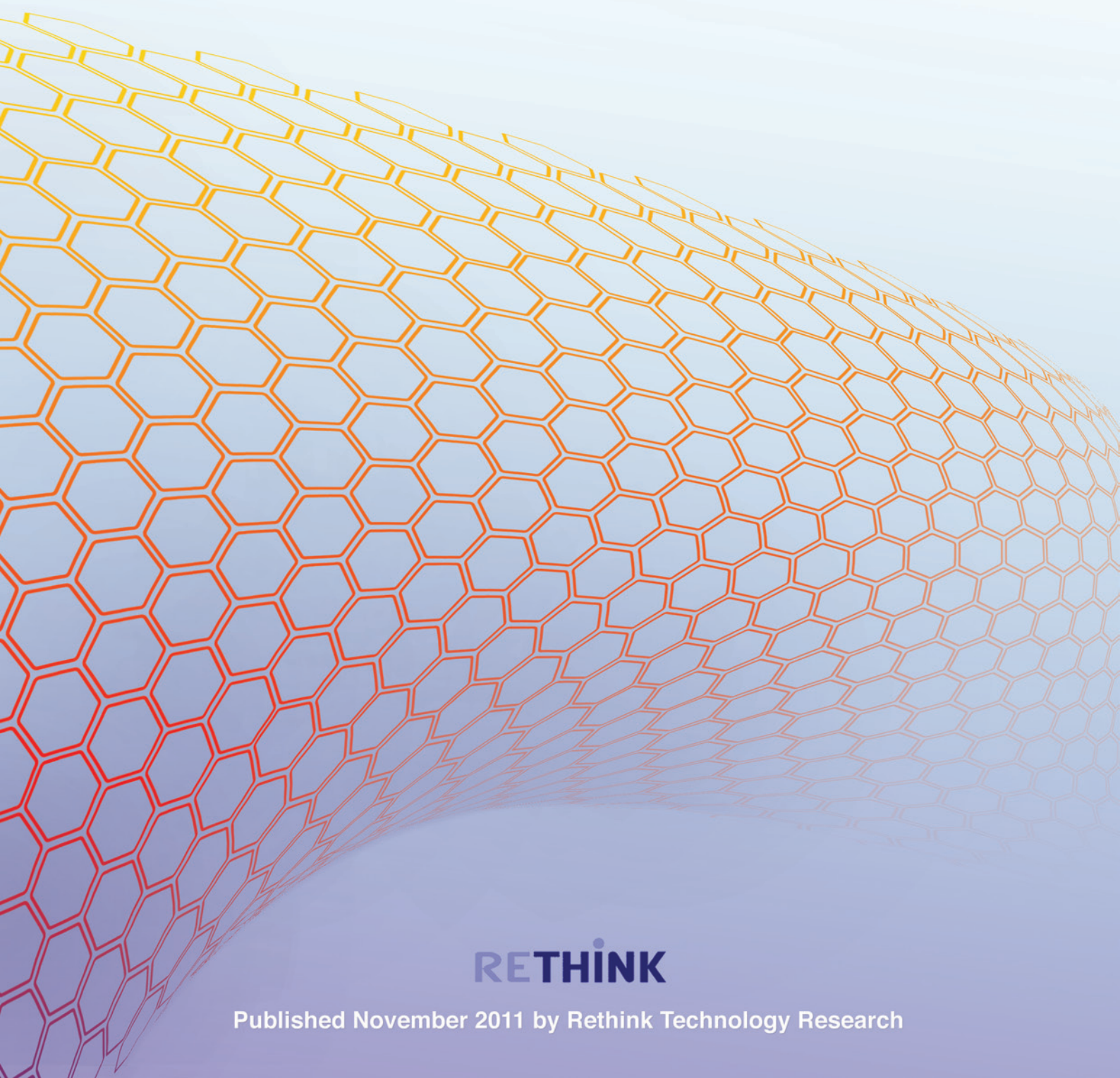


Summary Report

Coping strategies for the mobile data explosion

The incredible shrinking cell, HetNets and LTE Advanced



RETHINK

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Executive Summary

Mobile operators are frequently told they are now facing the ‘perfect storm’. They need massive extra capacity in order to support the data services and web experience users demand as a default, yet they are making dwindling returns on that investment. Some figures underpinning the nightmare:

- Mobile data traffic will increase at 70% a year in developed markets between 2011 and 2015, but mobile data revenues will increase by only 17%.
- Data is already accounting for well over 90% of a carrier’s traffic in developed markets, but only one-third or less of its ARPU.
- ARPU from data is increasing, but it is not doing so sufficiently quickly to compensate for plummeting voice revenues.
- In order to retain the same level of customers and revenues, carriers will need to invest about \$14bn in new networks worldwide between 2011 and 2015. The major investment will be upgrading the air interface to HSPA+ and, especially, LTE (Advanced), but these upgrades alone will address only 20% of the estimated additional capacity that will be needed by 2016.

The only way to sustain a profit model against this backdrop will be to reduce dramatically the cost of delivering mobile data. At the same time, new networks must not just slash the cost per Gigabyte and per Mbps, but must support massive increases in capacity, so that operators can satisfy current customers and have room for new revenue streams. Since an air interface upgrade is only 20% of the solution, new ways will have to be found to make the wireless technologies far more efficient, getting far greater mileage out of each piece of spectrum and each mobile cell.

Small cells and HetNets 2011-2015

This will mean designing networks in an entirely different way. Hallmarks of the new RAN will include:

- increasing deconstruction of the base station to distribute processing effort efficiently and reduce cost
- smaller and smaller cells, to maximize capacity by moving it closer to the user
- multiple layers of base stations within each macrocell, often using different frequencies and air interfaces within one cell to deliver more capacity
- extensive offload of macro network data to various other technologies
- flexible backhaul techniques
- new, sometimes unconventional spectrum bands and carrier aggregation
- advanced traffic management policies and tools

These add up to two key and related trends which will be the focus of this report – the distributed network and the small cell. The logical extension of these trends will be two radical network designs which will be fully enabled by LTE-Advanced – the heterogeneous network (HetNet) and the Cloud RAN. Both of these will be firmly on the cellcos' roadmaps from 2013 with the beginnings of LTE-Advanced upgrades.

This report examines the steps along that road, the key RAN technologies which will enable the new-look network, and the impact they will have on operators' capex investments, operating efficiencies and ability to support massive data explosion while remaining profitable. It includes full forecasts of operators' projected capex spend on 3G+ and 4G networks by base station form factor; air interface; and region.

Rethink Technology Research has conducted the most comprehensive study yet of what mobile operators intend to do about the 4G dilemma. It conducted an in-depth survey of over 90 operators with plans to deploy LTE and/or HSPA+ in developed or major urban markets between now and 2015. All of them also plan at least to trial LTE-Advanced by that date. They were questioned about how their infrastructure budgets will be allocated during the period of the study; how quickly they aim to move to the new standards; and which network topologies and base

station technologies they plan to adopt. In addition, the vendors and ecosystems supporting those technologies were identified and analyzed. The resulting report harnesses those carrier and OEM strategies to forecast the rise of these new technologies, and plot the shape of the future networks in LTE and LTE-Advanced.

The research found that carriers believe they have six key weapons to make their data businesses profitable despite slow ARPU growth and massive increases in data traffic:

- o Planning and deploying networks in new ways in order to boost capacity at lower cost and support new services – in particular, by using small cells and HetNets
- o New spectrum
- o A host of new charging structures, looking well beyond simple tiered pricing
- o An end to device subsidies
- o New ways of generating revenue from new devices such as tablets
- o Entirely new revenue streams harnessing the new networks

Their strategies for tariffs and subsidies have been examined in the previous Rethink report, **4G data networks – carriers’ savior or a black hole?** This report, the second in the series, looks in-depth at how operators aim to enhance capacity and quality of service with new approaches to network planning, even while radically reducing the cost of ownership and the vital ‘dollar per Gigabyte’ figure.

Small cells and HetNets 2011-2015

Key findings:

- LTE will see rapid uptake but HSPA+ will remain the most important focus of capex investment throughout the period. However, the new network will accommodate a more diverse range of air interfaces than in the past, and most operators surveyed will combine 3G, LTE, Wi-Fi and a TDD technology by 2015 and, by then, will also be starting to incorporate LTE-Advanced.
- Migration to LTE-Advanced will be the most rapid standards upgrade in wireless history, driven by the data deluge, software upgradeability, flexible infrastructure platforms, and heavy activity by the device ecosystem.
- The dominant base station form factor throughout the period, for new deployment, will be the distributed unit with remote radio head and, increasingly, a highly integrated antenna and radio. The baseband processor will be separated and in some cases, especially among major Asian carriers, this activity will be centralized in the cloud.

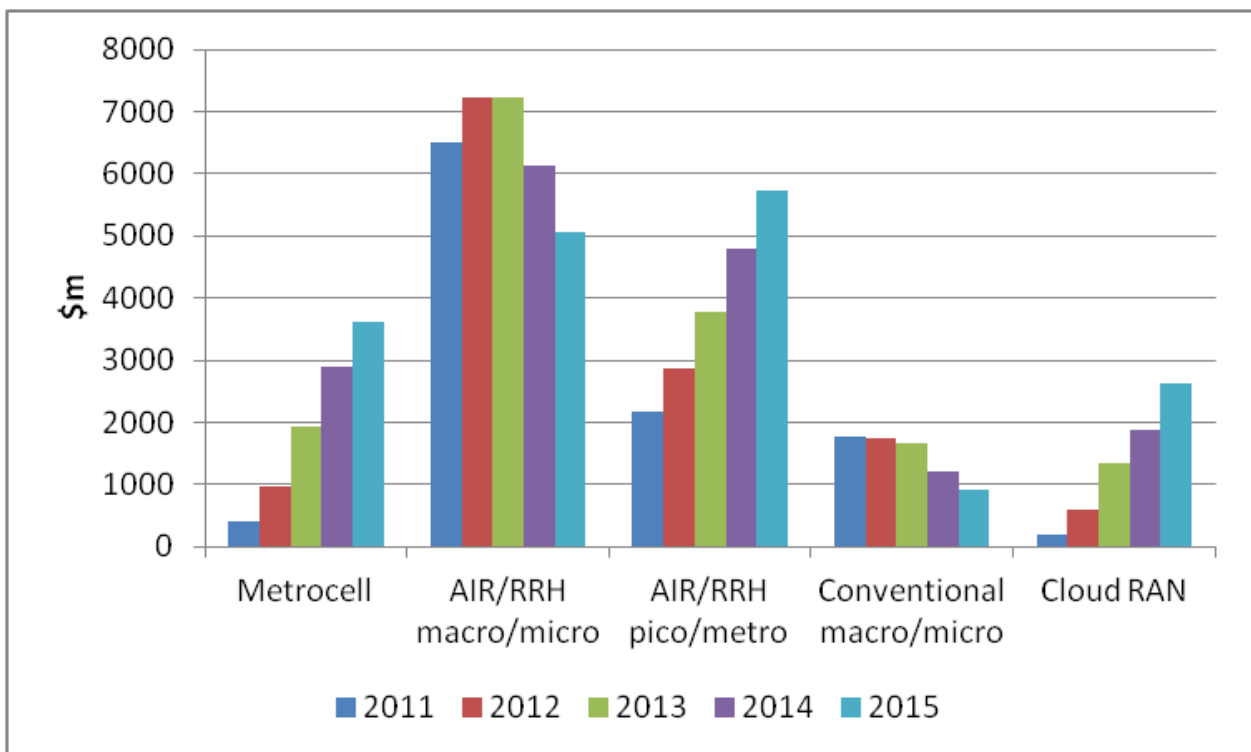


Fig1. Carrier investment in different base station formats to 2015.

Small cells and HetNet 2011-2015

- As a complementary strategy, there will be a sharp increase in investment in integrated metrocells, which place the whole miniaturized base station on a system-on-chip for dense metrozone deployments at low cost and using commodity backhaul. These two key trends will shape the highly distributed HetNet of LTE-Advanced.
- Smart antenna strategies will be increasingly important to generate the maximum data rates and capacity from the new base stations, especially AAS and MIMO technologies, though there is considerable caution about taking the latter beyond 4x4 configurations.
- In unit terms, integrated metrocell shipments will overtake those of conventional base stations (of all sizes), in 2014 and by the end of 2015 metrocell shipments will exceed the total installed base of traditional BTS.

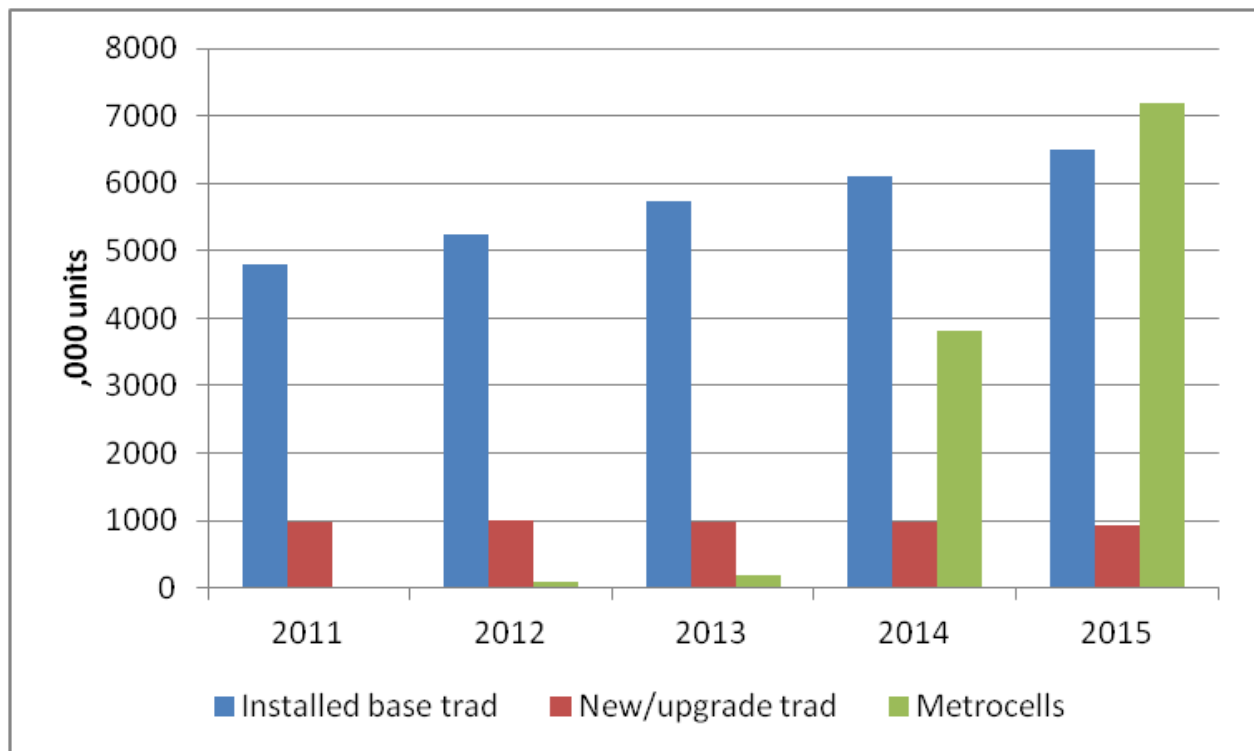


Fig 2. Shipments of metrocells and picocells, compared to those of traditional macro/micro base stations.

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- Wi-Fi access points, public access metrocells and indoor femtocells will all play a significant role in the rising trend for carriers to offload traffic from their macro networks. By 2015 about three-quarters of traffic will be offloaded to one of these targets.
- Offload will become more effective as better integration evolves between the 3GPP and Wi-Fi networks through initiatives like Hotspot 2.0. This will eventually result in the flexible HetNet, where a layer of low power small cells, as well as Wi-Fi access points, can coexist within a macrocell, with traffic and signals passing between all three.

Small cells and HetNets 2011-2015

- The new network will give rise to a new ecosystem of vendors and component suppliers. In the metrocell market, system-on-chip and base station designers will converge from the classic BTS, the indoor femtocell and the Wlan markets, sparking a wave of consolidation and shake-out during the period of the study as the traditional players seek to hold onto their markets and enrich their offerings via acquisition or exclusive OEM deals. Companies which supply base station elements such as antennas and remote radio heads to the OEMs will become far more strategic to them, and will also start to influence the carriers' choices directly.
- Operators name backhaul as one of the top three most critical issues when they consider a small cell or HetNet strategy. There is an urgent need to reduce the cost of backhaul in order to make it suited to supporting large numbers of small cells, which will bring technologies such as point-to-multipoint, millimeter wave and fully integrated backhaul units into play.

The advanced facilities for HetNet and self-organizing small cells will be the greatest drivers of LTE-Advanced uptake, and in developed and urban markets, will prompt a more rapid upgrade cycle than was seen in any previous mobile generation. Carrier interest in LTE-Advanced is not primarily because it may finally enable 'true 4G' data rates, with peaks of 1Gbps while stationary, as defined by the ITU. Their focus is more on the way that Advanced bakes the new way of building mobile data networks – small cells, HetNets, carrier aggregation and so on – more deeply into the standard than current 3GPP specs. They are hoping that techniques which they have started to use in HSPA and LTE to improve their cost efficiencies and capacity, will be simpler and cheaper to achieve in Advanced. The biggest contributor to the business impact of LTE-A, by a runaway margin, will be small cells/HetNet, believe the operators - 35% selected this as the most important aspect of LTE-A for the commercial model.

This will drive a high level of investment in LTE-A by 2015 when it will near the \$900m capex mark, in a total LTE RAN infrastructure segment worth about \$7.5bn worldwide by then.

The research base:

This report provides a real world and detailed insight into how carriers plan to make money from their 4G investments by planning their networks in entirely new ways. It probes real build-out plans that are being drawn up now, and uses that data to forecast spending on key infrastructure categories and different air interfaces.

Unless otherwise stated, the data in the report is taken from a survey conducted in the third quarter of 2011. This covered a research base of senior strategists and executive decision makers in over 90 tier one mobile or converged operators in North America, Europe, Japan, Korea, China, Singapore, Hong Kong, Brazil and Australia. For some broader conclusions about global trends, the survey was extended to Rethink's wider research base of over 200 tier one and two mobile or converged operators around the world.

Who should buy this report?

Every business involved in the cellular industry needs to plan their LTE and LTE Advanced strategy. Operators need ideas to challenge their traditional suppliers, equipment and device suppliers must demonstrate they have a strategy to help operators through the coming data explosion. Every other cellular player needs to take advantage of the improvements in data capability, and be ready for it at the right time. This report is mostly for wireless operators but will deliver benefit to device manufacturers, apps suppliers, content owners, components makers, device and content distributors, as well as the financial community.

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Contact details:

CEO: Peter White

peter@rethinkresearch.biz

Tel: +44 (0)1590 624530 Mobile: +44 (0)7734 037414

Rethink Technology Research Ltd

1 Wide Lane Close, Brockenhurst, Hampshire SO42 7TU, UK

Research director: Caroline Gabriel

caroline@rethinkresearch.biz

Tel: +44 (0)207 403 3292

Sales:

Call Geoff Chown on Mobile: +44 (0) 77816 327626

Email: geoff@rethinkresearch.biz