RTT TECHNOLOGY TOPIC
January 2014

Mobile Networks

In our December 2013 Technology Topic, Low Cost LTE, we argued the case for taking a long term (50 year) view of investment returns from emerging markets, referencing the drinks industry in Nigeria and Chinese investment in the Tanzania to Zambia railway (in 1965) as two presently relevant examples.

A European operator a couple of days later pointed out that even in developed countries, operating margins are too low to support the infrastructure investment needed to support data growth. This is particularly true of markets with four or five operators. Even with network sharing, the combination of high back haul costs, highly priced spectrum and site costs makes it difficult to achieve a sustainable business.

Site costs are particularly problematic and the problem is increasing over time.

Rural sites are a problem because individual arrangements have to be negotiated with farmers and land owners. Investment in concrete and towers means that it is prohibitively expensive to move even if rents are escalated. Urban sites are a problem for similar reasons but with additional access and maintenance cost, for example inaccessible roof top installations. Buying space from a mast/tower company is administratively simpler but still expensive with a limited choice of sites or alternative options – the ransom pricing problem.

There are however a number of commercial and technical developments which could potentially reduce these costs.

An emerging opportunity is the extension of present site sharing. A quick glance at a large macro site provides an overview of present physical sharing arrangements with TV broadcast at the top of the tower, two way radio wherever there happens to be some space and a cascade of cellular sector antennas.

The cellular antennas can and often are shared between multiple operators using an antenna sharing combiner.

http://www.radiodesign.eu/productsASC.php

And or multiple technologies are multiplexed on to a single antenna

http://www.radiodesign.eu/productsTSC.php

The assumption here is that this minimises the additional site cost incurred when implementing LTE in to re-farmed spectrum.

Tower/mast providers are also anticipating the introduction of smart metering as a new tenant opportunity.

http://www.arqiva.com/our-views/smart-metering-the-next-big-switch-over

The impact of this could be that site space becomes even scarcer which would mean rents would increase or it could mean that the additional income stream would improve site amortisation allowing rental costs to reduce – either outcome is possible though cost reduction is only likely in markets where competitive choice is either already available or imposed.

Other alternatives to terrestrial sites include low orbit, medium orbit, high orbit or geostationary

orbit satellites.

On December 9th a Russian rocket launched from Kazakhstan carried Inmarsat's latest six ton I-5 F1 satellite towards a geostationary orbit where it will generate 15 kilowatts of RF power from multiple steerable antennas (maximising the downlink and uplink link budget).

This is enough to support data rates of up 50 Mbps to fixed and portable devices. The satellite works in Ka band and can switch between civilian bands (27.5- 31 GHz uplink, 17.7 to 21.2 GHz downlink) and military bands (30 to 31 GHz uplink, 20.2 to 21.2 GHz downlink and is part of a $1.6 billion service platform upgrade.

http://www.inmarsat.com/news/successful-launch-first-global-xpress-satellite/

Early 2015 will also see the launch of the first of the next generation of Iridium low earth (low latency) satellites.

http://www.iridium.com/about/IridiumNEXT.aspx

Inmarsat and Iridium are both able to amortize launch and operational cost across multiple civilian and military payloads including sensing applications. The economics of these new satellite systems can therefore be attractive particularly for rural areas and or for delivering on demand capacity as and where required.

However satellites cannot compete with terrestrial sites in terms of flux density and it is hard to deliver acceptable indoor coverage without an external antenna. It is of course possible to improve link budgets with user device dish antennas particularly if accurately pointed but this is only beneficial to portable or fixed devices. Satellite systems cannot therefore be considered as direct economic replacements for terrestrial networks supporting mobile users. The same caveats apply to balloon or plane based platforms though these can at least be brought back to earth and repaired.

Terrestrial LTE relays might be a better short term bet.

These were introduced into 3GPP Release 8 with additional specification work included in Release 10. The specifications include amplify and forward relays also known as repeaters. These amplify whatever they receive including noise and interference so are best used to improve coverage in areas blocked by buildings and hills. They are similar in concept to TV broadcast repeaters (though have to receive as well as transmit). The other option is for the relay to decode the transmission stream and then re-encode, re-modulate and transmit. These are useful in low signal to noise conditions but introduce additional delay, greater than a one millisecond LTE sub frame.

Frustratingly there is no support for relay cell to cell handover in Release 10 so mobile relay functionality is not supported.

This is a pity because mobile relays could be potentially useful.

One obvious application is a more optimised version of in train communications.

At present when you connect your computer to a train Wi Fi system it will be routed to an on board modem which is in practice four of five phones and four or five SIM cards in a box all of which support data connections with a different operator. The assumption is that there will usually be at least one cell site visible at any one time. These systems work rather better than you might expect.

The East Coast inter City service in the UK is one example

http://www.icomera.com/solutions/east-coast-uk/

First Great Western is another.

http://nomad-digital.com/first-great-western-chooses-nomad-major-wifi-expansion-plans/

A mobile LTE relay would perform the same function but could be more efficient though would similarly benefit from supporting multiple operator connections.

The standards effort required is not that huge and could borrow extensively from the direct mode work items included in Release 12.

http://www.3gpp.org/news-events/3gpp-news/1455-Public-Safety

This then opens up the additional opportunity to deploy mobile base stations with in band backhaul.

Truck mounted base stations have existed from the late 1980's and are widely used to provide event or incident coverage. However they are designed to work when stationary.

Mobile base stations would do what it says on the tin – they would work when moving.

This would mean that LTE base stations could be installed on buses, tubes and trains.

The advantages include conveniently available power, no landlords and an incentive to use public transport if you want a faster data connection.

A truly mobile network.

Resources

LTE relays and repeaters are covered in the updated second edition of 4G LTE Advanced for Mobile Broadband written by Ericsson Researchers Erik Dahlman, Stefan Parkvall and Johan Skold.

Additional background detail can be found in a new book by Sassan Ahmadi, LTE Advanced, A Practical Systems Approach to Understanding 3GPP LTE Releases 10 and 11 Radio Access Technologies.

Both books are available from Elsevier Academic Press and are available from the **RTT book shop.**

Post script – the addiction and dependency model (again)

Our comments in December linked the telecoms industry to the drinks industry on the basis that both industries were driven by a reliance on addiction and dependency. Actually the original analogy made an equivalently awkward link with the tobacco industry.

10% of the Chinese government's income, a smoke fuelled £60 billion pounds, comes from the consumption of 2.6 trillion cigarettes per year, a market managed by the state owned tobacco monopoly run by the younger brother of the Chinese premier who also runs the Ministry for Public Health. Smoking related deaths are known to cause at least a million deaths per year in China and are expected to triple by 2030 potentially equalling Chairman Mao's proud death toll. It does of course have the benefit of reducing pension costs and makes the telecommunications industry look positively saintly.

About RTT Technology Topics

RTT Technology Topics reflect areas of research that we are presently working on. We aim to

introduce new terminology and new ideas to help inform present and future technology, engineering, market and business decisions. The first technology topic (on GPRS design) was produced in August 1998.
http://www.rttonline.com/tt/TT1998_008.pdf

15 years on there are over 180 technology topics **archived on the RTT web site.**
Do pass these Technology Topics and related links on to your colleagues, encourage them to join our **Subscriber List** and respond with comments.

Contact RTT
RTT, the **Jane Zweig Group** and **The Mobile World** are presently working on a number of research and forecasting projects in the mobile broadband, two way radio, satellite and broadcasting industry.

If you would like more information on this work then please contact **geoff@rttonline.com** **00 44 208 744 3163**