RTT TECHNOLOGY TOPIC
December 2012

How far does it go mate?
Rural LTE

About 2000 years ago some indigenous Northern Australians decided that they needed a more efficient way of talking to each other than just shouting a lot. Blowing into a long cylindrical piece of bamboo proved to be just what was needed and seriously useful fun – the dawn of the didgeridoo.

http://www.ididj.com.au/theDidjeridu/timeline.html

The way you can tell that your didgeridoo is better than everyone else's didgeridoo is to blow into it and find out how far the sound goes.

So naturally when an Australian goes in to buy a 'Next G' mobile phone from a Telstra shop the first question is 'how far does it go mate?

And the answer is on the box.

Telstra tests phones in the laboratory and if they perform well they go off for a drive in the outback for some comparative testing.

If the phone works beyond the edge of the operator's coverage map it gets a blue tick – it really is that simple and we might well ask why other operators don't do the same.

http://www.telstra.com.au/mobile-phones/coverage-networks/our-coverage/mobile-broadband/

http://www.telstra.com.au/mobile-phones/coverage-networks/our-coverage/maximise-coverage/#blue

We have all got used to our phones working more or less anywhere at least for voice and text but getting decent data rates anywhere other than close in to a cell site is more problematic.

Few of us would think about checking whether the phone we are buying has good radio performance and actually we have no way of finding out until we start using the device and then we blame the network not the phone.

This would not matter if all phones worked equally well but they don't. They all meet a basic conformance standard but the conformance tests don't recreate real life conditions.

Most new phones including LTE phones are 'uplink limited'. This means that the data rates and data

reach (the distance from a base station where you can still get a data link) are constrained by the ability of the device to generate RF energy efficiently (the job done by the RF amplifier) and couple that RF energy efficiently into the antenna (the job of the matching circuits).

Techniques such as envelope tracking help to improve RF amplifier efficiency and digital capacitors are now used to deliver more efficient (adaptive) matching but mechanical design constraints mean that overall efficiency can still be disappointingly low.

One solution is to use external antennas. Telstra list three options for in car use and caravanning either using a co-linear (broom stick) antenna or panel antenna with a patch cable into the antenna port of the modem or smart phone (assuming it has an antenna port).

http://www.telstra.com.au/mobile-phones/youtube-videos/camping-caravanning/

The other option is to increase the power available.

LTE transceivers with two watts (33 dBm) of transmit power will be available for the Band 14 LTE **P**ublic **P**rotection and **D**isaster **R**elief market in the US and could potentially be realised in other LTE bands either for PPDR or for enhanced rural broadband coverage or potentially both.

The additional 10 dB of power (2 watts rather than 200 milliwatts) has to be produced efficiently, matched efficiently and filtered efficiently to avoid receiver desensitisation. There is not much point in improving uplink performance if downlink performance gets worse.

Band 14 LTE radios for the US market are presently specified to support Band 14 (reverse duplex 758 to 768 and 788 to 798 MHz) with roaming to Verizon Band 13 LTE (reverse duplex 746 to 756 and 777 to 787 MHz) and Verizon Band 5 EVDO, the US 850 band. The radios have Wi Fi as well.

Adding high power LTE to these devices is however a non-trivial design task and particularly challenging if low cost SAW filters are used. The overall transceiver design is likely to be complex and expensive.

This implies a need to amortise development and manufacturing cost across US and rest of the world markets. However most of Region 1 (Europe and Africa), Region 3 (Asia) and a large part of Region 2 (Latin America) will not be adopting the US 700 MHz band plan. Alternatives include deploying high power LTE into the E850 band either in Band 26 (extending the existing 850 band down to 814 MHz) or Band 27 (extending the existing 850 band down to 806 MHz). This would replace or supplement existing specialist radio networks but only works for countries that have legacy 850 networks and definitely does not work for countries deploying LTE 800 into Band 20 (reverse duplex 791 to 821 MHz and 832 to 862 MHz).It is therefore going to be difficult to achieve market scale in any of these bands.

A longer term alternative could be to attempt to realise a global allocation of LTE in the UHF band (380 to 470 MHz) integrated with present TETRA and Tetrapol allocations.

There are other alternatives including new higher power low earth orbit, medium earth orbit and geostationary satellite constellations at L band or S band adjacent to Band 1(LTE/satellite hybrids).

Present satellite systems now support a range of small form factor terminals. They are the best and often only option for very remote areas and their performance (data rates) will increase as satellite power outputs increase over time but high power LTE delivered from a relatively small number of dominant macro sites using spectrum below 1 GHz could fill many of the spaces in between. Amortising research, development costs across PPDR and commercial devices would however be hugely beneficial. It will be a pity if a failure to coordinate regulatory and industrial policy frustrates this opportunity.

Resources

To buy a didgeridoo (festive aboriginal present)
http://www.didgeridoostore.com/soundsrhythms.html

Works in rural areas, may cause adjacent channel interference in dense urban environments

More about
Envelope tracking (RF PA efficiency)
http://www.makingtelecomswork.com/resources.html

High power LTE standards (Agilent presentation)
3GPP LTE Standards Update: Release 11, 12 and Beyond

LTE PPDR (Motorola product offer)
http://www.motorola.com/Business/US-N/Business+Product+and+Services/Public+Safety+LTE/VML700-US-EN

LTE PPDR in the UHF band 380-470 MHz (Alcatel Lucent Product Offer)
http://enterprise.alcatel-lucent.com/elqNow/elqRedir.htm?ref=http://enterprise.alcatel-lucent.com/includes/doclinkPostElog.cfm?id=21581

Present and future generation Low Earth Orbit (LEO) satellite constellations
Iridium
http://www.iridium.com/
Globalstar
http://www.globalstar.com

Present and future Geostationary satellite constellations
Inmarsat BGAN
http://www.inmarsat.com/services/BGAN
Inmarsat hand held devices
http://www.satphone.co.uk/hardware/isatphone-pro?gclid=CNHL3dmI77MCFczHtAodejQAaw

S band/Band 1 LTE satellite and terrestrial networks
http://solarismobile.com

Dual mode terrestrial/satellite terminals
http://www.satphone.co.uk/networks/thuraya?gclid=CPOahqiJ77MCFW_KtAodyVoAAw

LTE/TV coexistence
https://connect.innovateuk.org/c/document_library/get_file?folderId=865485&name=DLFE-43459.pdf

Ends
Rural fixed and mobile broad band is one of the topics addressed in RTT's fourth book '**Making Telecoms Work- from technical innovation to commercial success'** available from the **RTT book shop.**

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 although as you can tell we sometimes stray into more philosophic territory. There are over 130 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