RTT TECHNOLOGY TOPIC
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Small Cell Hard Sell

Our April technology topic discussed the limitations of system performance simulations based on LTE user device specification data sheets, highlighting the difference between measurements taken in ideal conditions and practical real world performance.

We also highlighted the difference between conformance test results measured directly from the antenna port of an LTE user device and performance measured in an anechoic chamber and pointed out that link budgets based on conformance specification result in over optimistic economic modelling with the result that spectrum is worth less than the economic models suggest.

One answer for the operator is to move network performance risk to the infrastructure vendor but European and US vendors no longer have control over user device performance which means that performance linked investment risk is potentially unknown, generally underestimated and only obvious when a network becomes loaded with users.

The user device is however only one end of the link and a true economic picture can only be obtained when user device **and** base station performance are fully taken into account.

This month's technology topic takes a look at base station performance and suggests that while larger micro and macro base stations can be relatively easily performance optimized, it will be harder to obtain good and consistent performance from small cell LTE access points.

There are also scale economy issues that need to be resolved. This combination of performance and cost risk means that the economic models showing the asserted benefits of network densification should be treated with caution.

Read on

The performance challenge of small form factor LTE base stations

The assumption is sometimes made that small LTE base stations defined as indoor or outdoor pico cells have a similar performance requirement to user devices on the basis that they have similar power outputs (of the order of +23 dBm).

This ignores the obvious difference that a handset is supporting one user and other adjacent users will be some distance away.

The major RF design challenge within a user device is keeping the locally generated RF power out of the receive path. The two paths are separated by the duplex spacing, for example 45 MHz at 900 MHz

A base station needs to support multiple users on adjacent channels. On the receive path, even in a small room or outdoor space, the receiver will have to manage a wider dynamic range of wanted and unwanted received energy. There is also a requirement to separate out the transmit path of one user for example at the top end of the lower duplex from the receive path of another user at the bottom end of the upper duplex. These two users will be separated by the duplex gap, for example 10 MHz at 900 MHz rather than the duplex spacing.

In present Pico cells this problem is mitigated by supporting only one operator. This means in practice that only one duplex pair of channels will be supported within a pass band, for example a

10 MHz channel pair within a 35 MHz by 35 MHz pass band at 900 MHz

This however limits the market appeal of Pico cells both for domestic markets where parents and children may have contracts with different operators and business markets where employees bring their own devices to work which means that multi operator support is required.

In a larger form factor base station this can be accommodated both by physical filtering (cavity resonators rather than acoustic filters for example) and a high dynamic range wide bit width A to D and D to A signal processor down converting and up converting the whole of the pass band with digital filtering applied to provide channel to channel selectivity.

Again the assumption may be made that this should also be possible in small form factor pico cells particularly as this is already applied in WiFi transceivers. However the dynamic range requirements of WiFi are lower than LTE.

Low power LTE can mean anything between low power 5 to 10 watt cells for dense urban capacity or coverage extension in rural areas, indoor 250 mW for dense urban capacity or 100 mW to 1 W for indoor coverage. Each of these requirements requires a differently optimized front end.

The pass band bandwidth ratio of WiFi (80 MHz TDD at 2400 MHz for example) is also less challenging that many/most of the present and proposed LTE FDD and TDD pass bands.

Additional the RF designer at least theoretically should be accommodating forty four different LTE FDD/TDD pass bands (increasing by the day) rather than the two WiFi TDD pass bands at 2.4 GHz and 5 GHz.

This means that the pass band signal processor in an extended multi band LTE small cell will be expensive and probably too hot to accommodate in a small form factor with limited heat sinking opportunities. This in turn causes frequency instability in the resonator and filter functions.

There are also an almost infinite number of inter band carrier aggregation options being introduced in the present LTE and LTE Advanced standards process implying an equivalently infinite amount of second, third and fifth order intermodulation products.

It is therefore hard to see how integrated WiFi and LTE access points with anything other than compromised LTE RF performance are going to be realized with present RF architectures and components.

In terms of cost, the Pico cell/small cell community reference markets where unit sales of >one million units have either been achieved or are anticipated.

These addressable markets are however two orders of magnitude smaller than the annual smart phone market and represent a more difficult and hence risky design challenge.

This is coupled with an expectation than the devices will be delivered at WiFi access point price levels, at least one order of magnitude lower than any presently plausible LTE price point.

It can therefore be confidently asserted that multi band multi operator low cost high performance LTE/WiFi Pico cells will take longer to come to market than present vendor market announcements suggest.

In practice this undermines the economic modelling assumptions being about in building LTE and Pico cell and small cell based outdoor network densification.

LTE relays and repeaters may provide a partial solution (see January 2014 Technology Topic Mobile Networks http://www.rttonline.com/tt/TT2014_001.pdf) but it is hard to avoid the conclusion that LTE network economic improvements are more likely to be achieved by outside to inside LTE

coverage from micro cells and macro cells combined with WiFi indoor and outdoor access rather than indoor LTE.

Pico cell small cell LTE is a hard sell better avoided.

Marathon time again

This is the 189th technology topic
http://www.rttonline.com/sitemap.html

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http://uk.virginmoneygiving.com/fundraiser-web/fundraiser/showFundraiserProfilePage.action?userUrl=portcullisrunningforRACC&isTeam=true

This raises money for adults with learning difficulties and disabilities (400 students) at our local Adult Community College.

http://www.portcullistrust.org.uk/
http://www.racc.ac.uk/events
We are aiming for a sub four hour time this year though the hills can be a bit of a problem.
https://www.facebook.com/pages/Running-for-RACC-Richmond-Park-Marathon-May-18-2014/354049631378032

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