



RTT TECHNOLOGY TOPIC

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Specification ,simulation, spectral and shareholder value - why data sheets only tell part of the story

The Oxford Dictionary defines specification as the act of identifying something precisely or of stating a precise requirement.

In this month's Technology Topic we look at the strengths and weaknesses of RF performance specification and the impact this has, or should have, on LTE economic modelling and LTE economic value.

Specification of component and user device performance provides an adequate guide to 'isolated' performance but a poor guide to 'included in a design' performance.

Network economic modelling needs to be based on actual not relative numbers. If there is a known difference between the two then the economic model can be adjusted. If the difference is unknown or unquantified then the modelling is invalid.

This month's Technology Topic sets out to quantify the difference between specified and actual performance, the financial significance of the difference and whether the difference is increasing or decreasing over time.

Read on

The Dark Art of Specification

Most of us have noticed that the fuel consumption figures quoted for cars is not representative of the fuel consumption experienced in normal driving conditions.

Our (very dull) family economy car has a specified extra urban fuel consumption of 64 miles per gallon. We have never bettered 50 miles per gallon in day to day out of town driving.

The reason for this is that the consumption measurements have been made in ideal rather than representative conditions. Many other quoted performance figures such as acceleration are equally hard to achieve.

Performance specification is part of the dark art of salesmanship and relatively harmless if treated with circumspection but should not be used as the basis of economic calculation (in this case how much petrol the car will use).

In the wireless broadband industry we use specifications to define RF component performance and user device and base station performance.

The RF performance specifications of components such as filters and amplifiers and switches are measured in ideally matched (50 ohm) conditions.

Apparently similar devices can exhibit large differences in specified performance. Two SAW filters could for example have a 15 dB difference in Out of Band attenuation. The better performing filter will however probably have poorer performance on other parameters, for example further away from the band edge or in-band ripple.

In this example a judgement on relative performance can only be made if all measurable parameters for each device and the impact of those parameters on the user and other geographically and spectrally proximate users are compared.

Similarly the specification of an individual component only provides a partial indication of the overall performance of the function that the component is expected to perform. A switch for example will have a quoted insertion loss but the overall system loss of the switch function will be a composite of the switch and the paths to which it is connected.

This is often described as implementation loss, the difference between the theoretical performance of the individual components required for the function and the overall performance of those components when combined together.

Individual component performance and system performance also needs to be specified over temperature and time, particularly for parameters such as frequency stability, for example resonators used in oscillator circuits. Stability also needs to be qualified against other factors such as noise and spurious signal energy.

These functions then have to be combined within a user device, for example an LTE smartphone. This will need to meet a conformance specification which includes parameters such as receive sensitivity, transmitted output power and power mask in the frequency and time domain.

A prudent design team would add 5 to 7 dB of margin over and above this conformance specification to account for component and batch to batch variations on the production line in order to minimize factory rework cost.

The equally dark art of system performance simulation

The conformance specification is used as the basis for the link budget assumptions that are then used to calculate network capacity and coverage.

The problem with this is that conformance tests are done in the conducted domain which means that test equipment is directly connected to the antenna port.

The measurements therefore fail to take into account real life antenna losses including detuning caused by hand capacitance effects.

A more accurate assessment of performance can be made by measuring user devices in an anechoic chamber. This is expensive and time consuming but will often reveal compromised performance of the order of several dB of total isotropic sensitivity (TIS) and transmitted radiated power (TRP) when compared to the conformance specification.

The impact on spectral value

It is therefore not valid to use specification sheets to infer system level performance and it can be equally misleading to use device conformance specifications as the basis for network economic calculations based on an inferred and over optimistic link budget. Specification sheets are merely a starting point.

As the LTE band/technology mix becomes increasingly complex, component and product conformance specification becomes an increasingly less reliable guide to system level performance. This needs to be accommodated within ROI economic models and generally would suggest that spectral value is lower than unadjusted models would imply.

Summary and the impact on operator and infrastructure vendor shareholder value

Specification sheets provide an adequate guide to relative performance but a poor guide to actual performance.

Specification sheets can be used to predict or simulate system level performance but a significant implementation loss should be assumed.

At user device level there is a significant (several dB) difference between conformance specifications measured in the conducted domain (direct at the antenna port) and measurements conducted in an anechoic chamber. The anechoic chamber provides a far from perfect reconstruction of the real world but is significantly closer than a conducted domain test. Link budgets use conformance specifications and these link budgets are then used as the basis of economic modelling and investment justification.

This means that real life network performance can be significantly worse than expected. A new lightly loaded network will mask this effect as noise levels will be low but as loading increases, capacity and coverage will fall off faster than expected when compared to sales oriented simulations. Return on investment will therefore be lower than the investment return simulations have suggested. This needs to be reflected in operator equity and spectral asset valuation.

One answer for the operator is to move performance risk to the infrastructure vendor. The difficulty here is that European and US infrastructure vendors (Motorola, NSN and Ericsson) have lost the intimate visibility to present and future user device performance that they once had. This is not the case for the present wave of Chinese infrastructure vendors including ZTE and Huawei.

Risk is acceptable if it can be measured and managed. Integrated vendors developing infrastructure products **and** user devices have visibility to both ends of the RF link budget and therefore can take informed performance risk analysed decisions.

Bit players with a partial product offering are disadvantaged.

The European and US shareholder and investment communities involved in infrastructure companies that insisted that user device product divisions should be sold to maximise short term shareholder value would be well advised to reflect on the longer term economic loss that they have unwittingly created.

Marathon time again

This is the 188th technology topic

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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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