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Handset radiated performance testing and requirements.

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Radiated Performance-testing and requirements.

- What mobile RX and TX antenna is and how to get best results.
- Yesterday and Today of the device radiating performance testing.
- Impact of TIS and TRP on customer experience.
- What works better-sticker on the phone or human factor use during R&D in getting best results?
- Pass/Fail criteria and methods of improving mobile performance.
- What value of it for network operator?
- What new in radiated performance for the near future and testing of it.

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The purpose…

The purpose of a transmitting antenna is to project radiant energy over a given wave path in the most effective way.

The purpose of the receiving antenna is to absorb a maximum power from the passing wave field with the maximum attenuation of the noise and interference.

Different mobile antennas and phone shape factor and impact of it.

Variety of antennas is being used: whip, stub, intennas at the top, intennas at the bottom etc. Different losses due to materials and implementation.

Different handset shape factors are being used: candy bar, flip, slider, PDA and more to come. Smaller ground plane provides less current and impacts performance.

Embedded solutions is growing up rapidly.

Radiated performance testing evolution.

Five years ago-mostly conducted testing with some field test and benchmark comparison.

Three years ago-free space TRP and TIS, collection of the data for ‘Pass/Fail’ criteria.

Now-obstructed with phantom head and hand mostly in all useful phone and phantoms positions with ‘Pass/Fail’ limits.

Obstructed environment testing

Possible antenna design steps.

Successful antenna design starts with ‘dummy ‘ phone design, human factor (hold model) research, RF modeling and leads to low loss on both TX and RX in free space and obstructed environment.

Well designed antenna has free space loss of 1-3dB and another 3-4dB loss when tested in obstructed environment-with phantom head and hand.

Less successful design may start with low loss in free space and very high loss in obstructed environment due to RF power heavily oriented toward obstructed areas. Or may be high loss in free space and high loss in obstructed environment.

This may result in higher SAR, lower talk time, higher drop rate and higher cell loading factor.

Existing standards and technical limitations.

SAR-even though IS98 limit is 30dBm peak EIRP and FCC is 33dBm OEM prefer not to go over the 25dBm level at the antenna connector due to the reaching SAR limit of 1.6W/KG first.
For the triple mode phones SAR limit often being reached in AMPS, not CDMA.

Phones are getting smaller and ground plane getting smaller along with them. Ground plane is equally important in phones radiated performance.

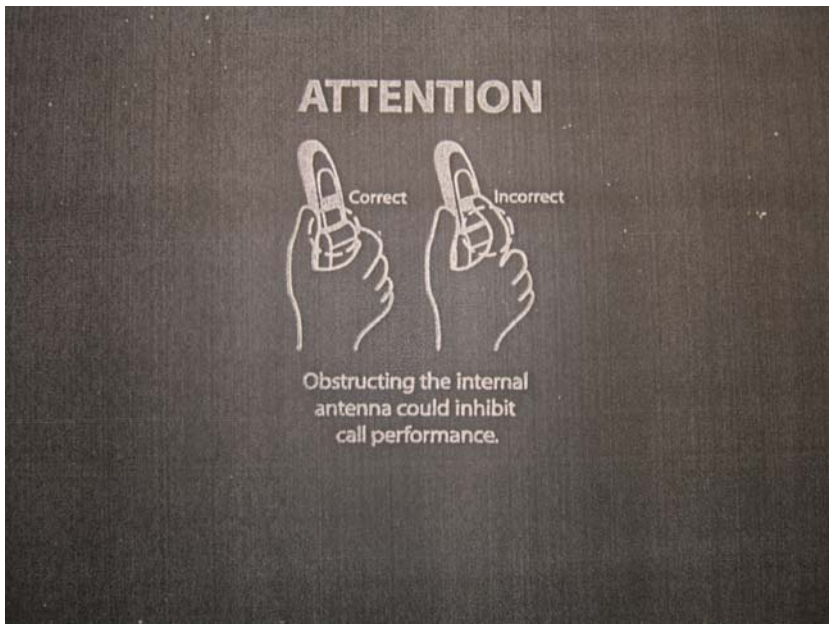
Multiband and multitechnology phones require additional circuitry, which leads to higher losses.

Wi-Fi, Bluetooth and other build in technologies may impact performance of the main RX chain.

Detuning and obstruction of the antenna by hand and head proximity leads to high losses in both TX and RX.

Data cards performance is impacted by computer noise floor, phones by noise and harmonics of the circuitry.

‘How to’ sticker and how long is it remembered?



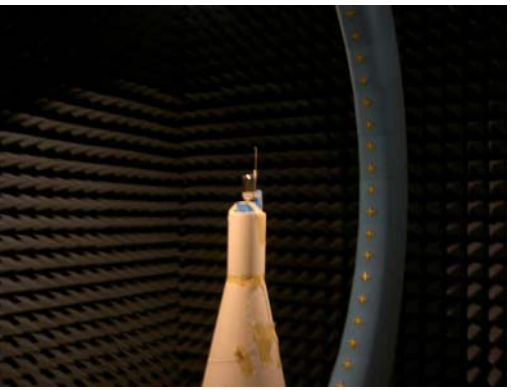
If phone was not designed around human ‘hold factor’-sticker is needed to remind how to improve performance, but it is becomes useless and forgotten basically after first battery charge.

‘Correct’-is the one used by majority of the users and must be researched before hardware design.

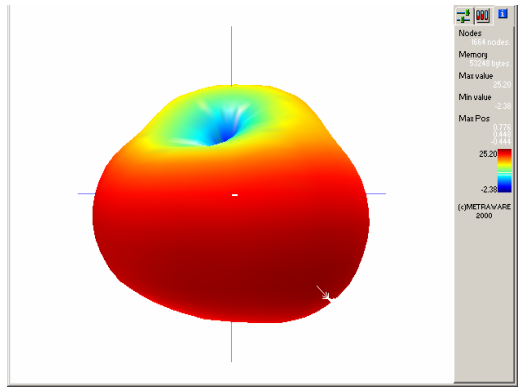
80% of the users hold phone in right hand with 15mm distance to the palm and when used as PDA-in left with 5mm spacing.

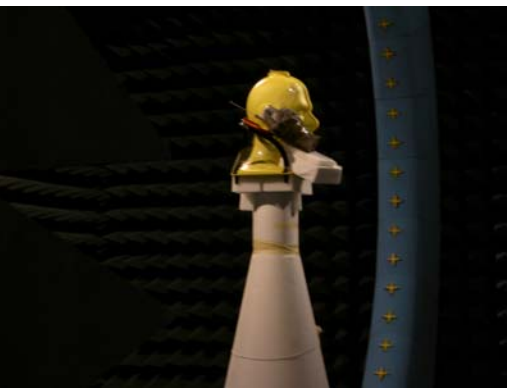
Users palm placed over antenna in ‘normal user’ positions with no extra steps to reduce detuning and blocking contributes to 10-15dBm average loss.

Free space and Obstructed performance comparison.

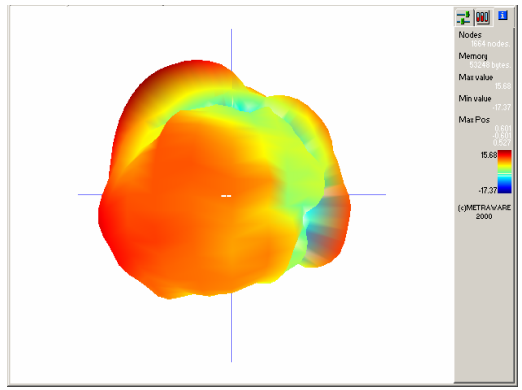


+20dBm





+11dBm



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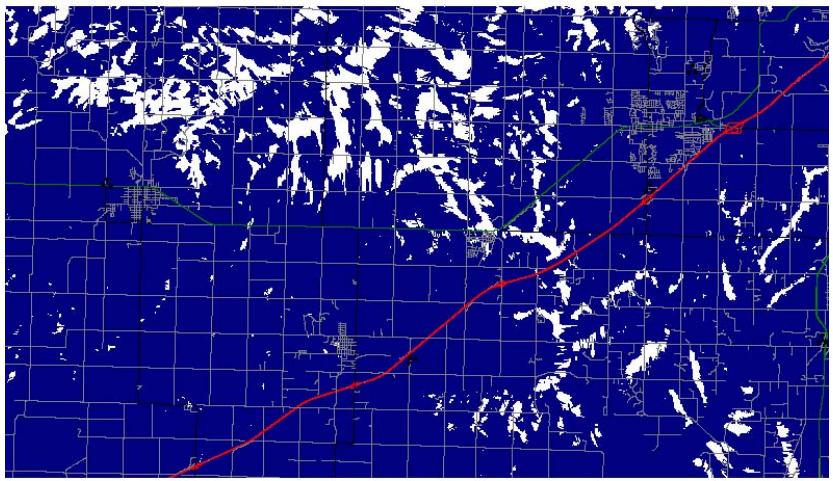
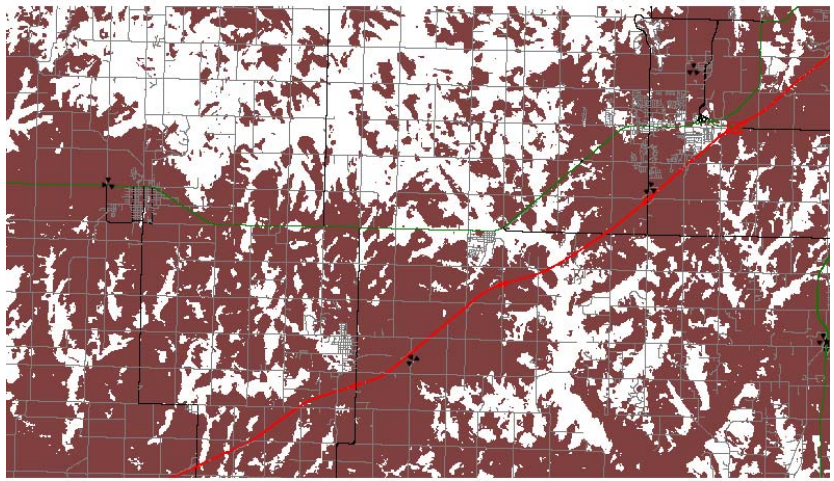
Were 10dB takes us?

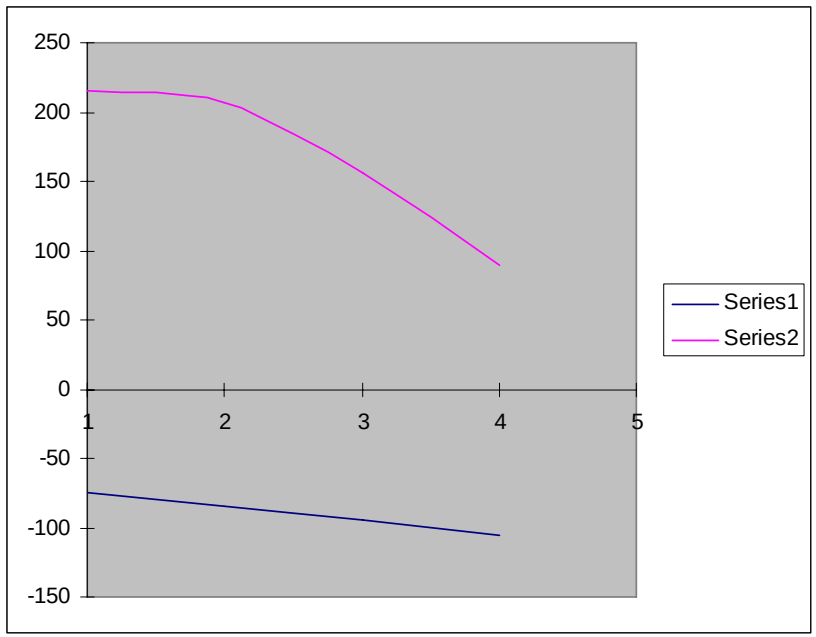




10dB palm or ‘in pocket’ loss contributes to significant service area shrinkage while idle on common channel.

RX Sensitivity impact on data throughput.

Data Throughput (Kbytes/s)
Band Class 1:
[-75dBM] = 215.45
[-85dBM] = 206.60
[-95dBM] = 170.06
[-105dBM] = 90.93
Band Class 0:
[-75dBM] = 216.12
[-85dBM] = 207.75
[-95dBM] = 155.86
[-105dBM] = 89.9



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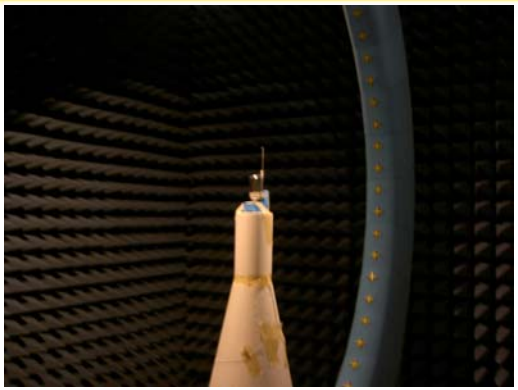
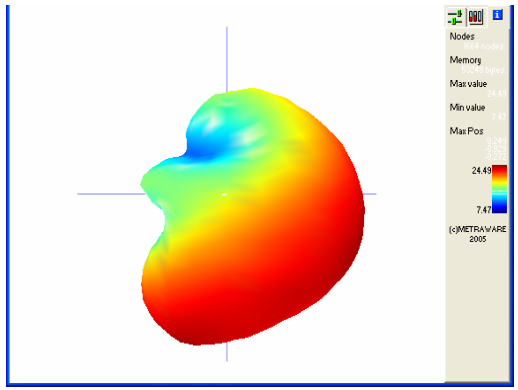
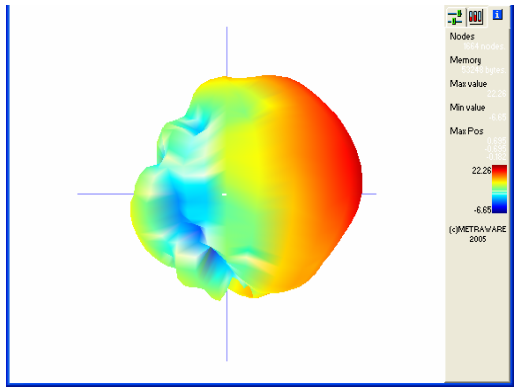


+20.5dBm



+15.5dBm



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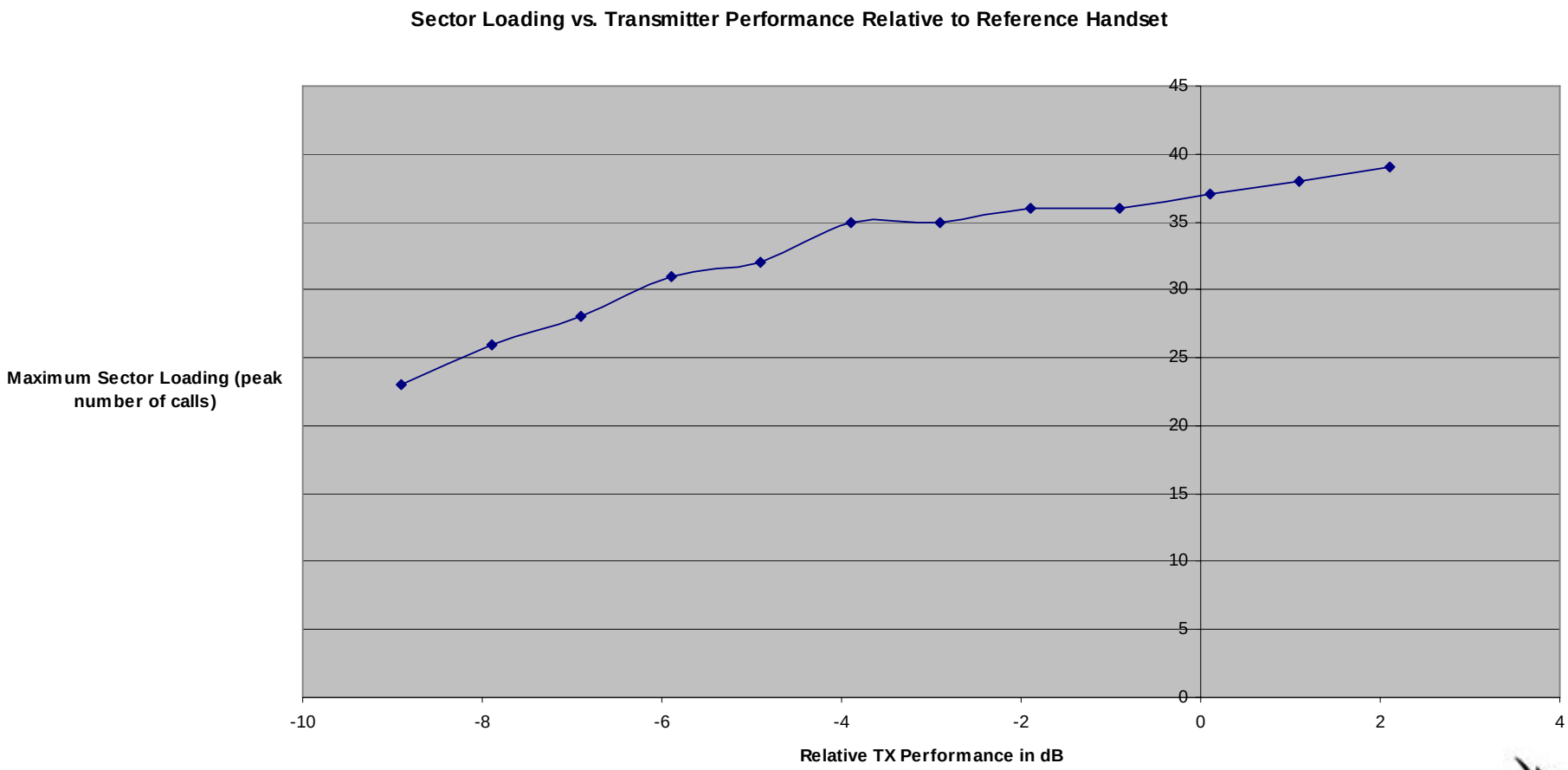
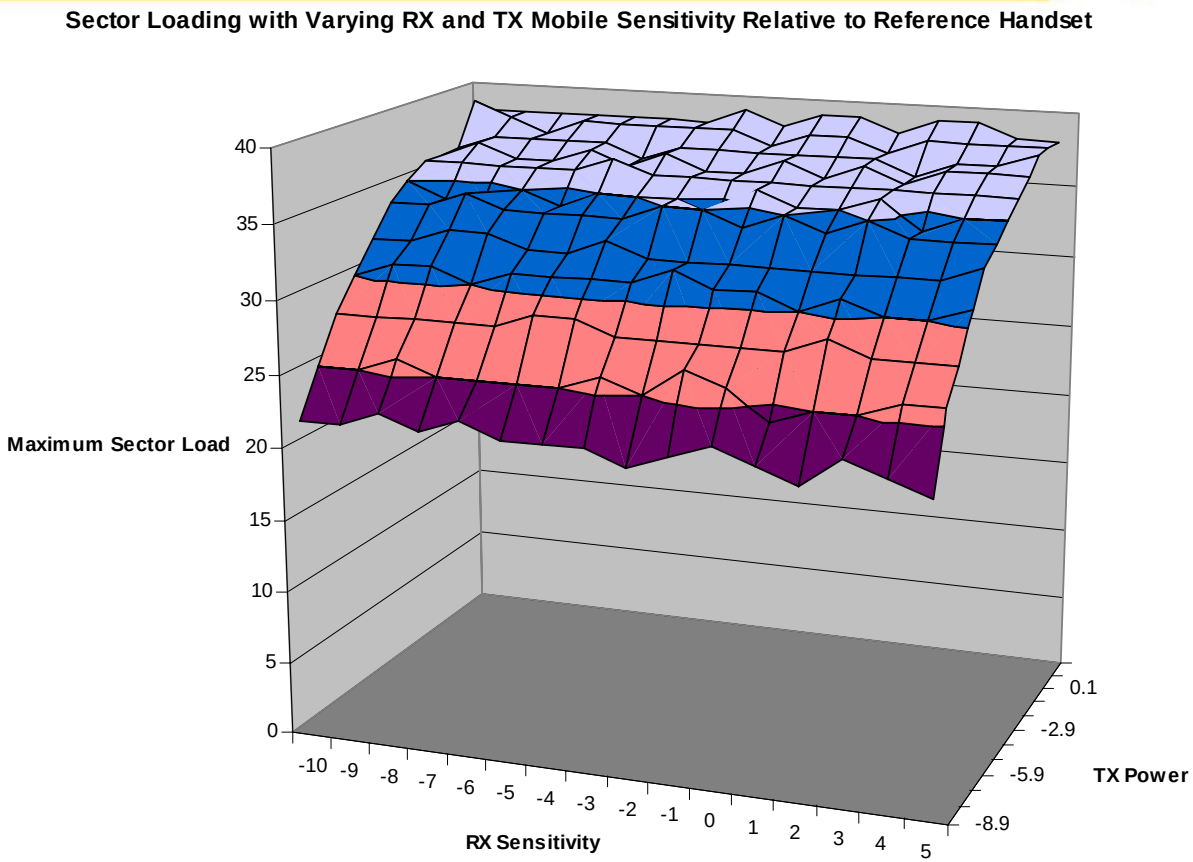
Sector load vs. Mobile TX power.



TIS TRP impact on sector capacity.

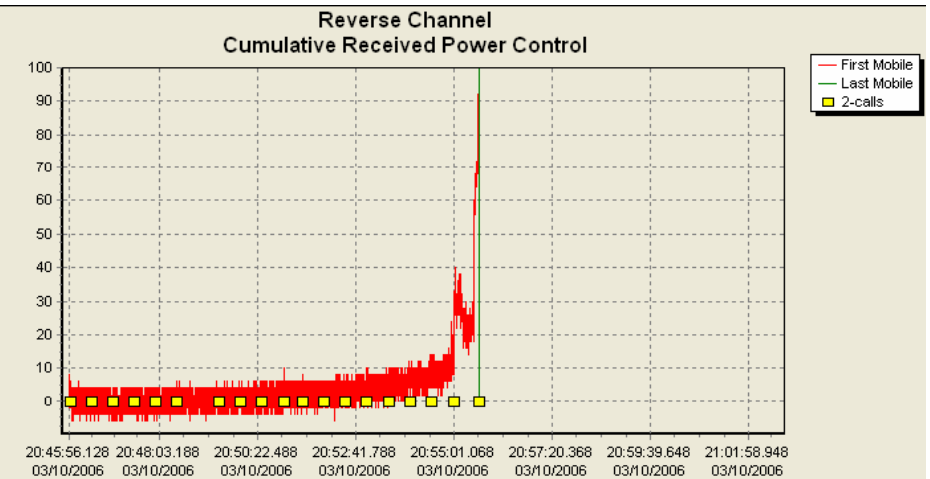


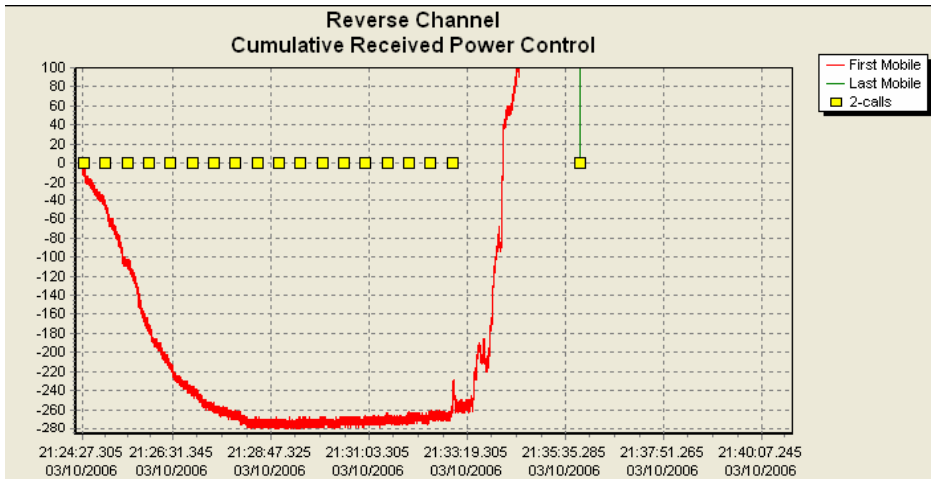
Test Results

Mobile transmit power alone has a greater impact than transmit power due to reverse link interference: 22 calls vs. 36 calls.

At this point we think that forward link is orthogonal, were reverse link is quasi-orthogonal and may interfere with other mobile signal at the base station RX input.

Cumulative power control picture for mobile with weak and strong TX.





Mobile with higher TX dynamic range reacts better to power control and results in less FER on reverse link which allows BTS to adjust outer loop set point lower and eventually drive reverse power down resulting in less interference to other mobiles.

Development of the Cell load calculator based on TRP and TIS.

Use TRP and TIS values in Cell Load Calculator to calculate impact.

Calibrated model will allow to come up with composite cell loading number and Draw Pass/Fail criteria based on both values and real network behind it.

Calculator also will be used to estimate RX and TX Diversity benefits and some Other unique cases.

Future developments...

Heavy use of the phantoms in field test to simulate ‘real live’ usage.

RX Diversity measurements made using OTA antenna chamber.

GPS and CDMA OTA chamber performance.

Wi-Fi, BT and CDMA influence on each other.

WiMax

Q&A

Questions and Answers

Thank you!