TESTING RADIO PERFORMANCE OF IOT DEVICES IN REVERBERATION CHAMBER

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BLUETEST.se

ABOUT BLUETEST

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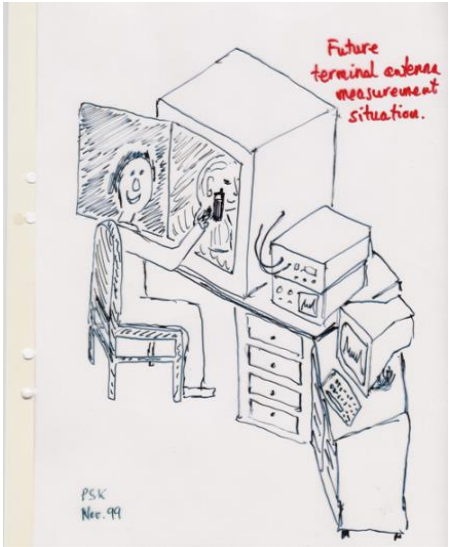


- A privately held company founded in the year 2000 by Chalmers University Professor Per-Simon Kildal
  - Head Office in Gothenburg, Sweden
- Market leader in Over-The-Air MIMO testing
  - More than 300 OTA test systems delivered since 2006
- Worldwide sales network
  - North America, China, Taiwan, Japan, Korea, India, Malaysia, Germany (Austria, Switzerland), Finland, France, Australia, Spain and Portugal.
  - Regional sales and support offices in North America and China (Beijing, Shenzhen)
- Our corporate values: Customer Focus, Team Work, Innovation & Trust

OUR CUSTOMERS

Mobile phone manufacturers
(Most of the top 10)

Mobile operators
(Asia, Europe, USA)

Test institutes

Antenna and component manufacturers

Laptop & Wi-Fi device manufacturers

Network equipment manufacturers

Universities

Automotive

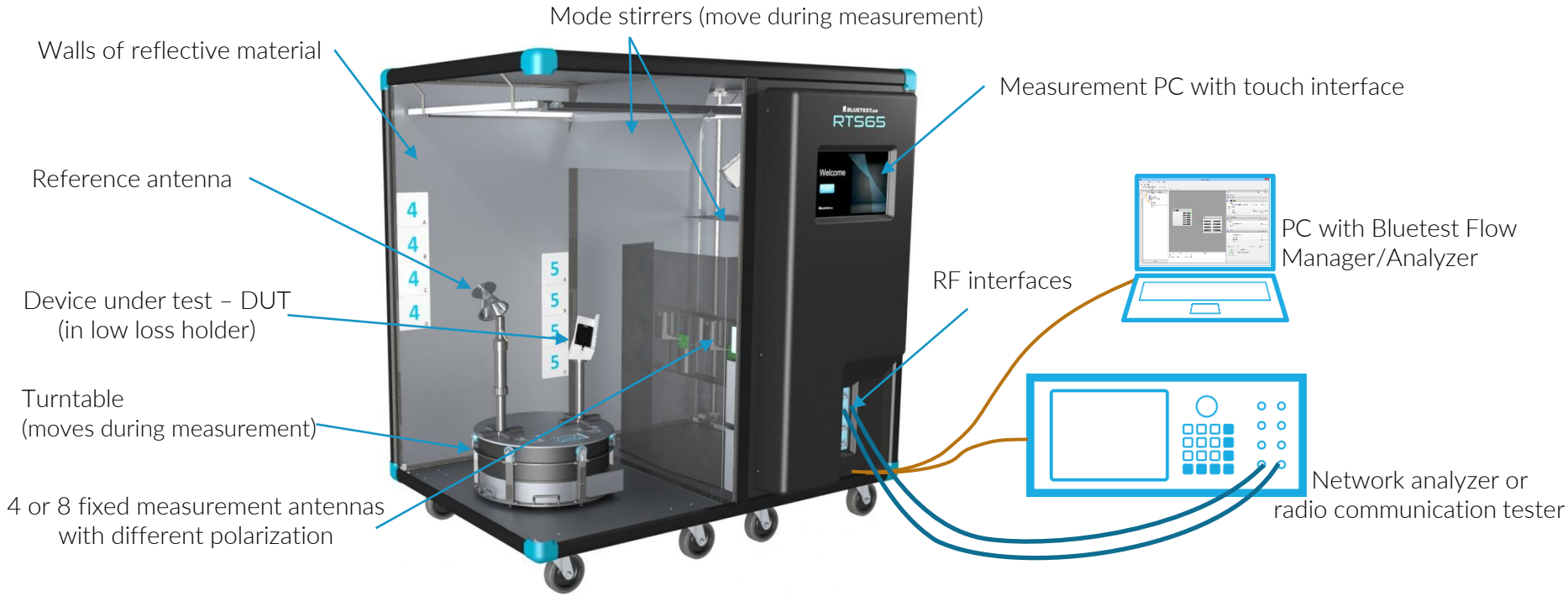
More than 300 OTA test systems delivered world wide

REVERBERATION CHAMBERS

AN INTRODUCTION TO BLUETEST RTS

- Reverberation Test System
  - Full 3D device performance evaluation
  - Rich Isotropic Multipath fading environment (RIMP)
- 3 chamber sizes available
  - RTS25, RTS65 & RTS95
- Up to 16 active measurement ports supporting
  - Higher order MIMO
  - LTE Advanced with LTE carrier aggregation
  - Extended channel models with external channel emulator
- Standardized
  - 3GPP TS34.114, TS37.544 & TR37.977
  - CTIA large form factor testing
- Wide range of options and accessories
- Easy DIY calibration process

THE REVERBERATION TEST SYSTEM

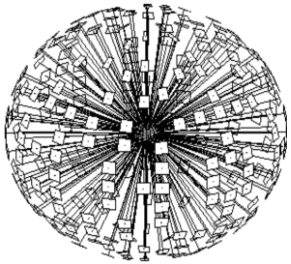


Creates a good representation of the real life radio environment (Multipath, fading, isotropic)

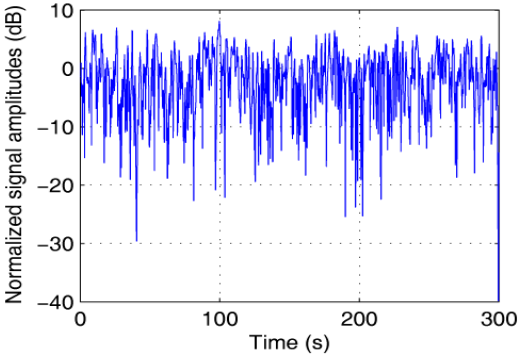
One measurement result averages hundreds of measurement samples to give an accurate and repeatable result

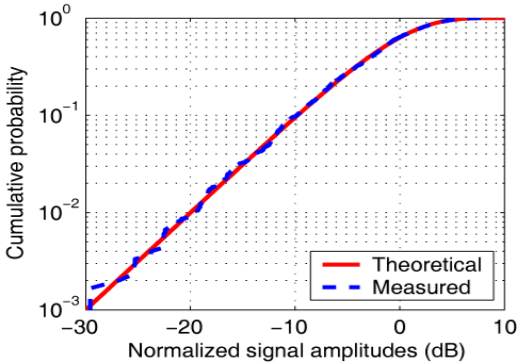
HOW DOES IT WORK?

- Creates rich isotropic and multipath fading environment (RIMP)



Uniform field environment
when averaged over large number
of independent field samples





Rayleigh faded signal transmission

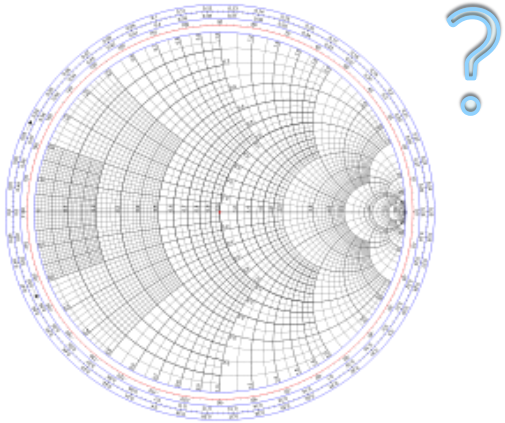
One test session consists of collecting many samples to create a stable average value

IOT RADIO CHALLENGES

RADIO DESIGN

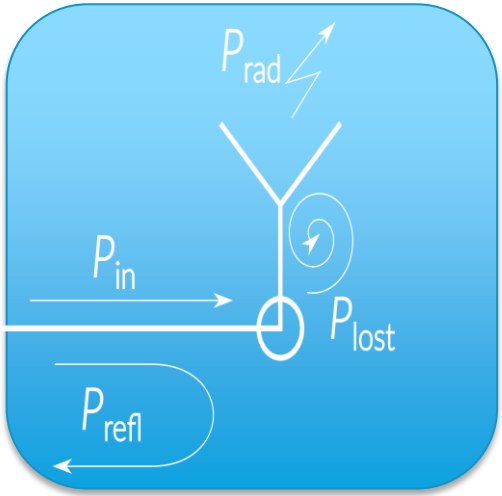
Typical Approach for IOT device

1. Core function focus
   - Laundry Machine – wash clothes well
   - Camera – take great pictures
   - Vending Machine – sell stuff conveniently
2. Buy IOT radio module and antenna
3. Integrate into IOT device



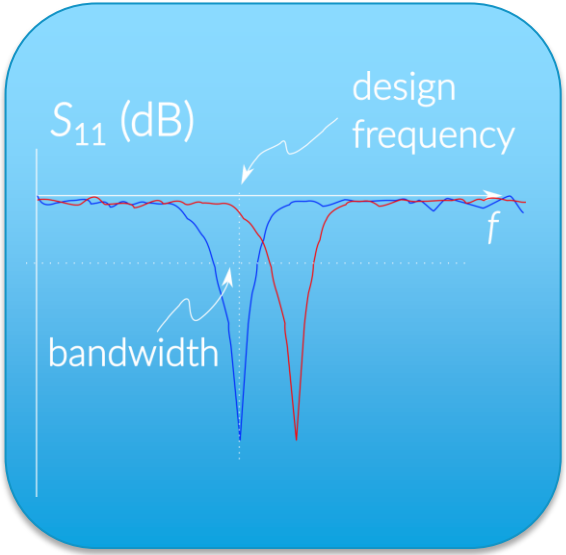
WHAT CAN GO WRONG?

- Antennas
  - Casing can absorb most of radiation
  - Antenna can detune
  - Poor diversity/reliability
- Receiver
  - Device electronics can ruin receiver sensitivity
  - Multiple radios can interfere with each other



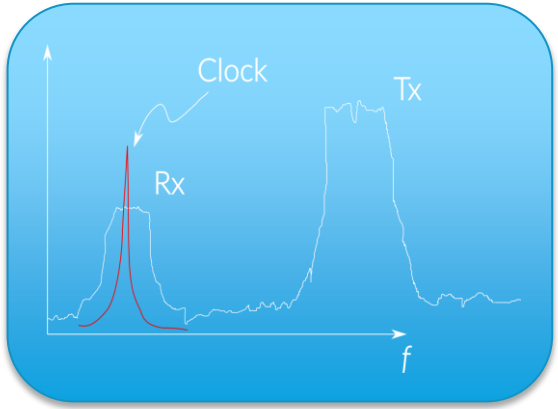
ANTENNA PLACEMENT PROBLEMS

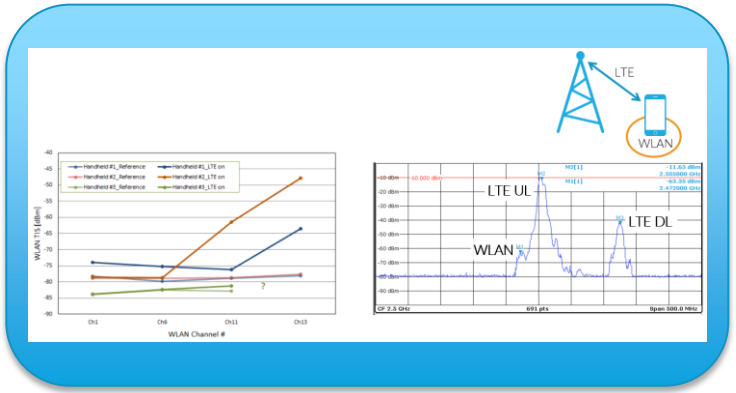
- Antennas
  - convert radio waves propagating in free space to signals propagating on transmission lines
  - and vice versa
- Antennas interact strongly with their surroundings
- A bad location can impact performance
  - Absorb radiation or detune antenna



RECEIVE PROBLEMS

- Electronics inside device can generate signals that interfere with received signal
- If multiple radios are used – the transmitter of one radio can interfere with receiver of another





WHAT SHALL I MEASURE?

TYPES OF MEASUREMENTS

- Passive measurements - Measure on only the antenna
  - Antenna efficiency
    - How much power is lost inside the antenna and never reach the air
  - Diversity gain
    - Separation between antennas
- Active measurements – Measure radio + antenna performance
  - Transmitted output power (TRP)
  - Receiver sensitivity (TIS)
  - Data throughput vs signal strength
- Miscellaneous
  - Co-existence
    - Interference between wireless standards
  - Spurious emission

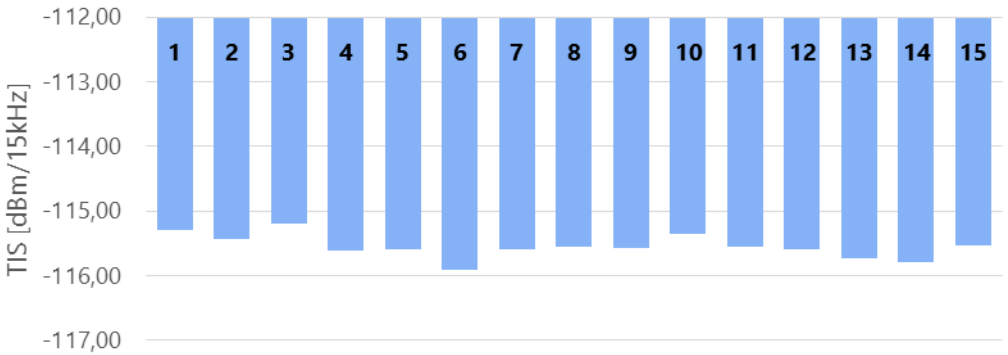
HOW TO USE THE MEASUREMENTS

- Evaluate performance difference between chipsets or modules
  - For example very large difference between good and not so good WLAN chipsets
- Evaluate performance difference between antennas
  - Is the low cost antenna as good as the more expensive one
  - Can I select a smaller antenna and maintain good enough performance
- Optimize antenna location
- Optimize antenna cover/radome material
- Early measurements ensure good design solutions and avoid late unpleasant surprises

HOW CAN I MEASURE?

EXPECTATIONS ON TEST RESULTS

- It shall be possible to repeat the measurement and get the same result
  - In different locations with different units of equipment
  - At different times of the day
- Lab environment preferred over unpredictable real life environment



Repeatability testing on receiver sensitivity
Results within +/-0.5dB = OK

WLAN EXAMPLE: REAL WORLD VS LAB

- Downlink IP data throughput measurements
  - Domestic house in countryside
    - Far away from other interfering WLAN sources
  - Measured with Bluetest TTS11 WLAN throughput tester
  - Several positions and devices evaluated

EXAMPLE : REAL WORLD

- Downlink IP data throughput measurements
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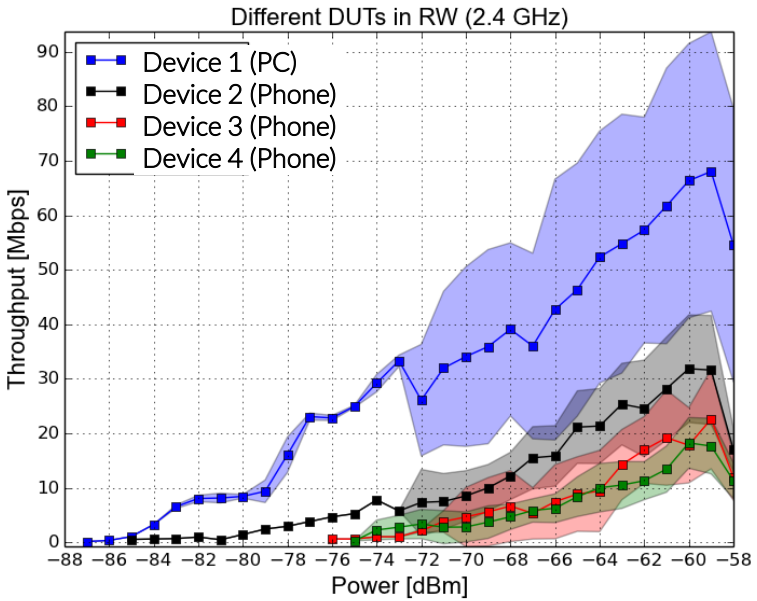
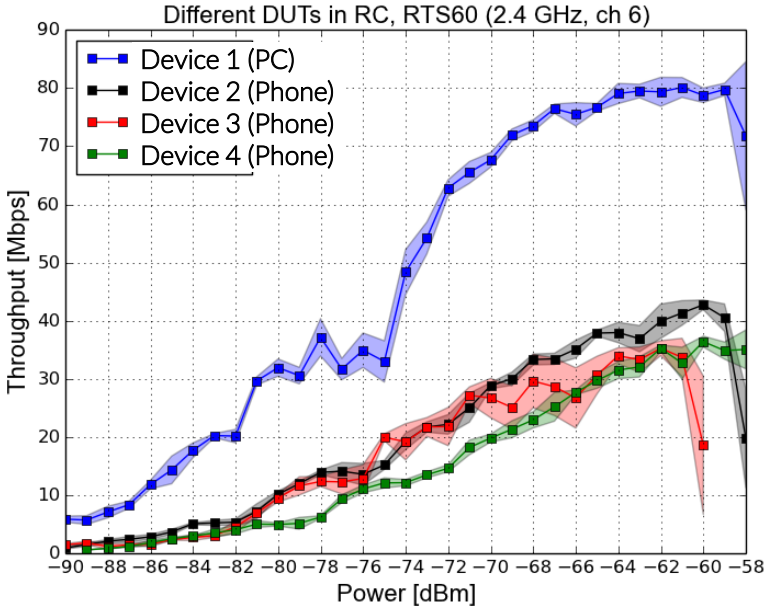
REAL WORLD VS RTS ENVIRONMENT



Power levels normalized between environments to make comparison easier



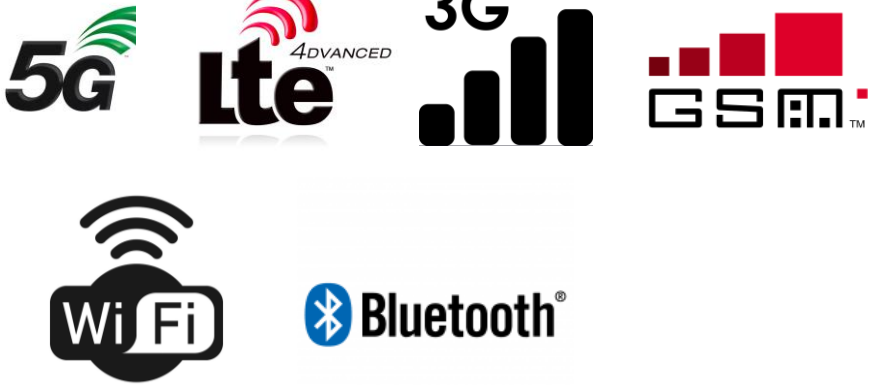
- Data throughput in the real-world environment
  - The curves are the average values of all the throughput measurements (3 different positions and repetitions)
  - Power levels below -74dBm represented by fewer measurements
  - The shadow areas show the standard deviation

- Data throughput in the RTS
  - The curve for each DUT is an average value of several throughput measurements
  - The shadow areas show the standard deviation

WHAT CAN I MEASURE IN REVERBERATION CHAMBER

RADIO STANDARDS

- Signaling Instrument
  - Mobile Standards
    - 5G / 4G /3G /2G
    - Cat M1
    - NB-IoT
  - Wifi, Bluetooth
- Other tests – Talk with us
  - Lora
  - Sigfox



EXAMPLE DEVICES TESTED IN RC

- Cell phones
- Tablets
- Laptops
- Coffe makers
- Laundry Machines
- TVs
- Video Game Consoles
- Automotive Antennas
- Body worn devices

THANKS