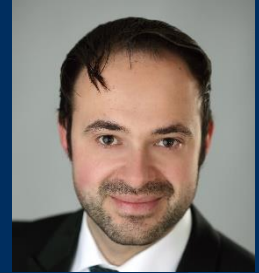


Mobile Network Testing

5G NR CODE SELECTIVE EMF MEASUREMENTS

ITU Regional Symposium for Europe and CIS on
Spectrum Management and Broadcasting

Electromagnetic Fields and 5G Implementation



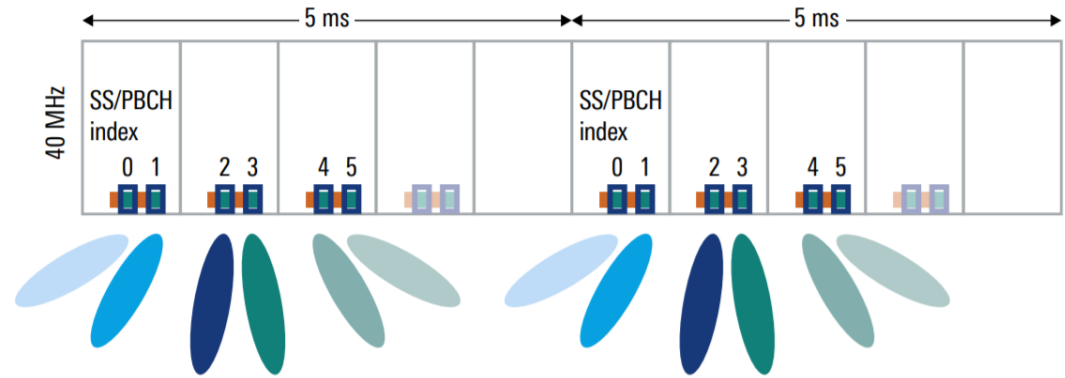
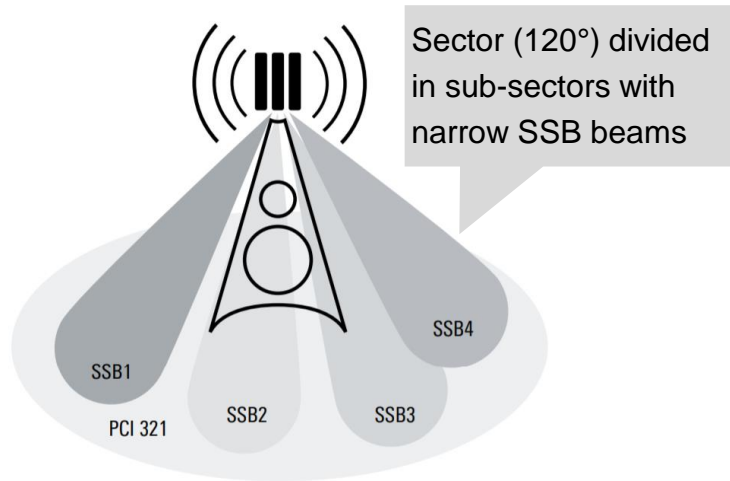
Manuel Mielke
Product Manager, Drive Test Scanners

ROHDE & SCHWARZ

Make ideas real



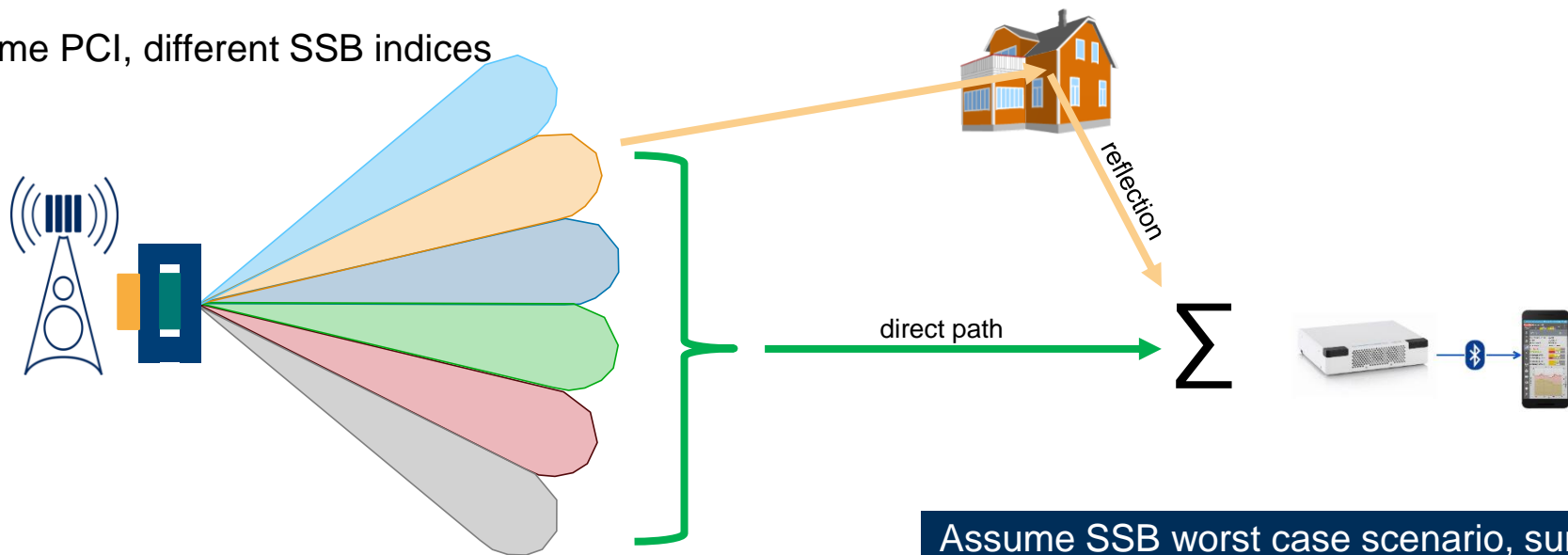
5G CODE-SELECTIVE METHOD – MEASUREMENTS ON SSB



- ▶ 5G NR uses beamforming to overcome the path loss for synchronization (SSBs) and data signals
- ▶ Intelligent antenna arrays create very narrow but high-gain beams to focus the power on a certain area to increase SINR and received power
- ▶ This can create field strength hotspots in the very narrow main lobes of the beams

STEP 1: SUM UP ALL SSBs

Same PCI, different SSB indices



Assume SSB worst case scenario, sum all SSB power and multipath receptions

$$E_{i,max}^{SSS(RE)} = \max \left(\sqrt{\sum_j (E_{i,j}^{SSS(RE)})^2} \right)$$

Source: METAS

STEP 2: APPLY EXTRAPOLATION FACTORS

▶ Extrapolation of SSB power to full 5G NR carrier spectrum (like in LTE)

SSBs have a **bandwidth of 3.6 or 7.2 MHz** in FR1 depending on the subcarrier spacing. The **total bandwidth** of 5G NR carrier can vary from 5 to 100 MHz.

- Factor from operators or to be determined by a mobile phone attached to the network

▶ Beam / gain offset between SSB and data beams

It is expected, that **UE specific data beams have a smaller beamwidth and / or more power compared to SSB beams** to further increase the SINR.

- Corresponding data by network operators or infrastructure suppliers

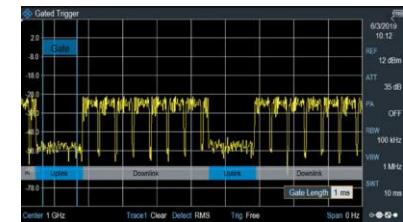
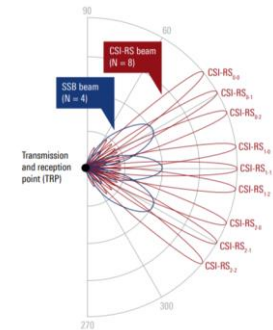
▶ Uplink and downlink relation factor in TDD

In TDD networks, **the relation between UL and DL** significantly affects the radiated power by the gNodeB. In case of more UL slots, the radiated power decreases.

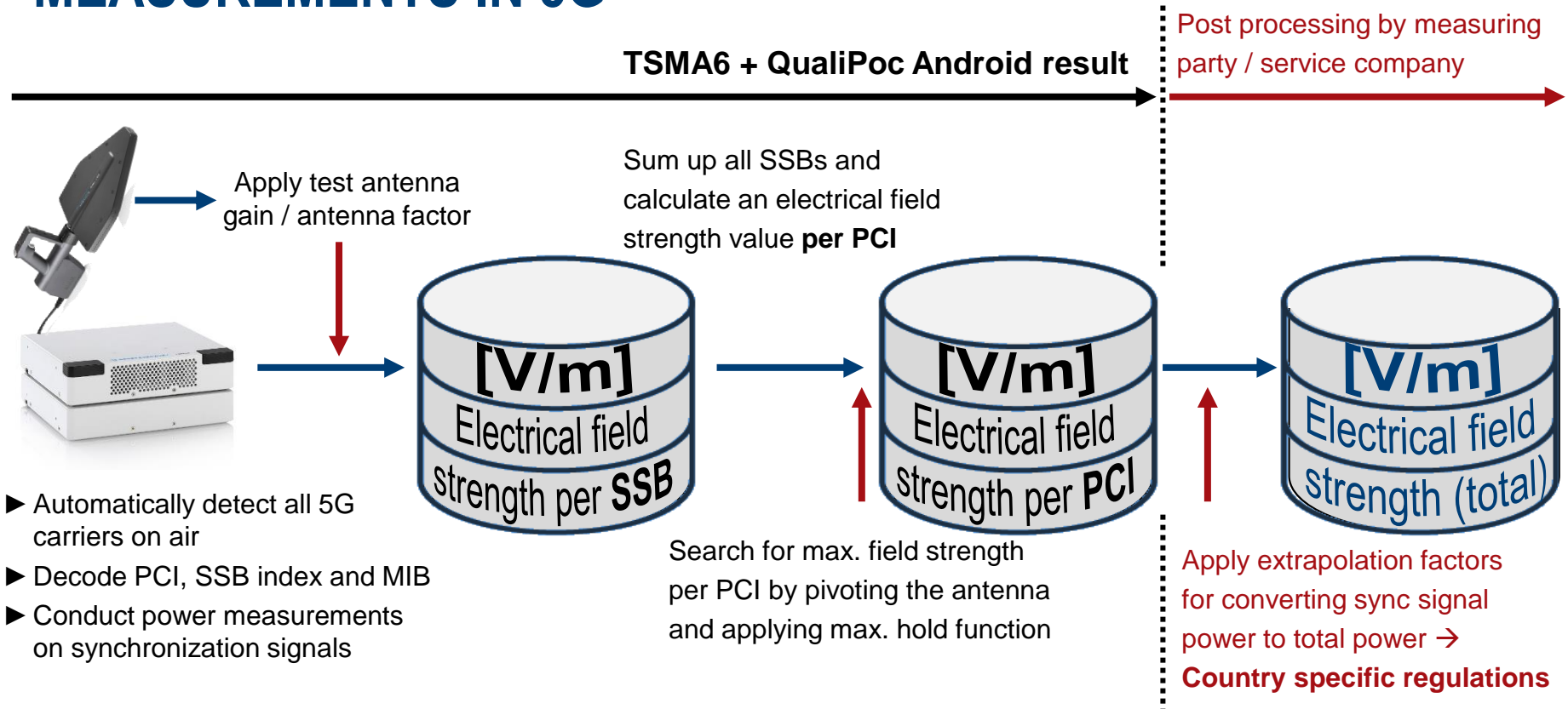
- The relation factor depends on the network configuration (from operators)



Total carrier



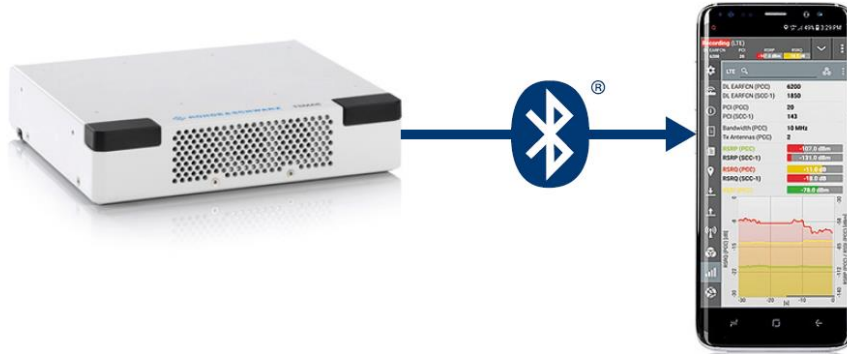
MEASUREMENT PROCEDURE OF CODE-SELECTIVE EMF MEASUREMENTS IN 5G



- ▶ Automatically detect all 5G carriers on air
- ▶ Decode PCI, SSB index and MIB
- ▶ Conduct power measurements on synchronization signals

MEASUREMENT SETUP

R&S® TSMA6 WITH QualiPoc Android



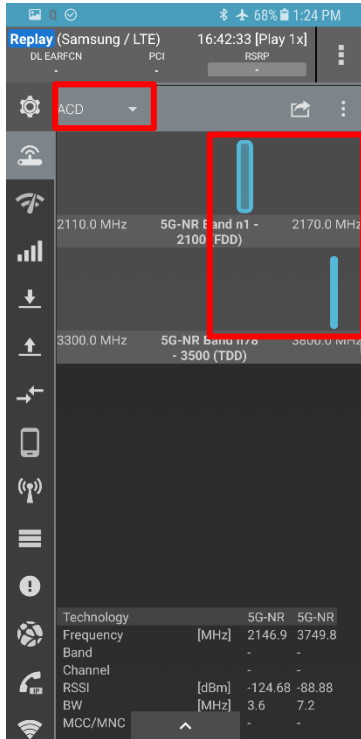
TSMA6 (passive scanning receiver + PC)

- ▶ **Passive, calibrated receiver with highest achievable accuracy** ([V/m] is a linear value!)
- ▶ Automatically detect 5G NR PCIs / SSBs
- ▶ Decode and measure the received power of SSBs (beams) of all detected PCIs

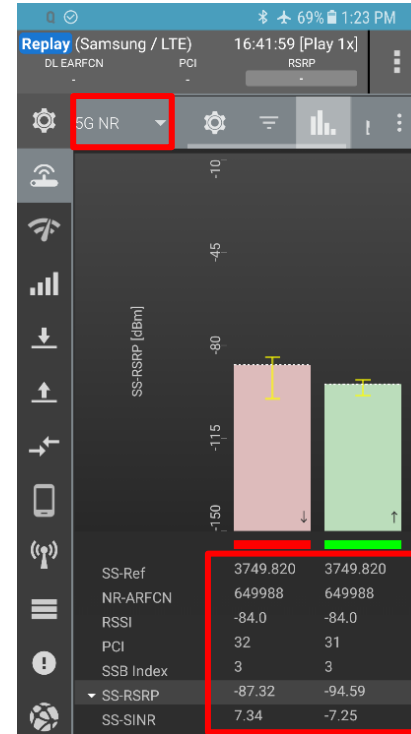
QualiPoc Android connected via Bluetooth

- ▶ **Android® app for smartphones or tablets for UE-based and scanner-based measurements**
- ▶ Compute and display electrical field strength [mV/m] over all 5G NR SSBs
- ▶ Set max. hold data points
- ▶ Export measured / calculated values

OVERVIEW - DETECTING AND CONDUCTING POWER MEASUREMENTS ON 5G NR CARRIERS

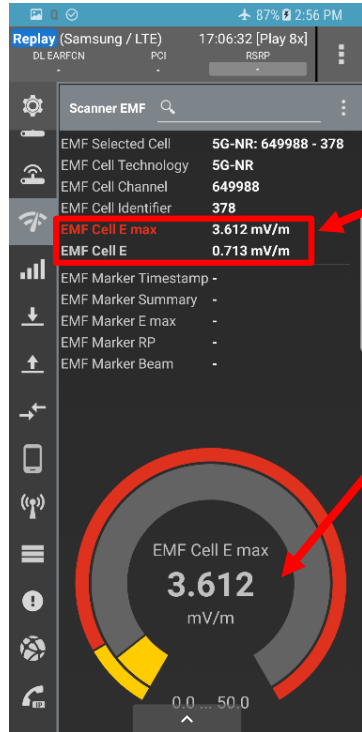


Two 5G NR SSBs detected by Automatic Channel Detection Feature (ACD)



PCI / SSB based Power and SINR measurements

OVERVIEW - SEARCHING THE MAXIMUM AND FINISHING THE MEASUREMENT



EMF [mV/m] per PCI
Max. hold and
Current value

EMF per PCI
Max. hold

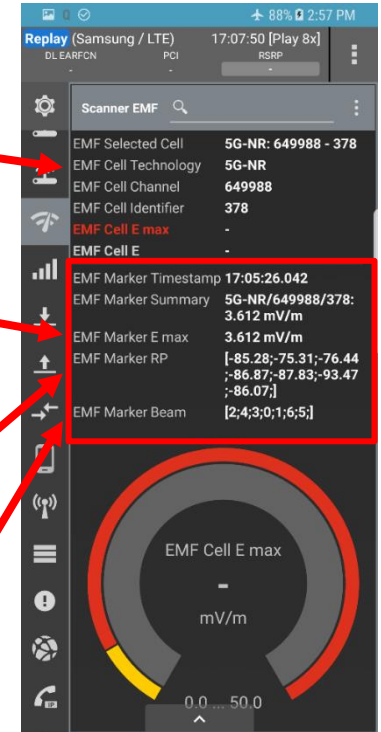
▶ The measurement data can be exported as a .csv file for further post-processing

Cell specific identifiers

Max. field strength per cell (over all SSBs)

Considered power levels per SSB for EMF measurement

Considered SSBs for EMF measurement



THANKS!