Measurement principle for code-selective measurement of 5G

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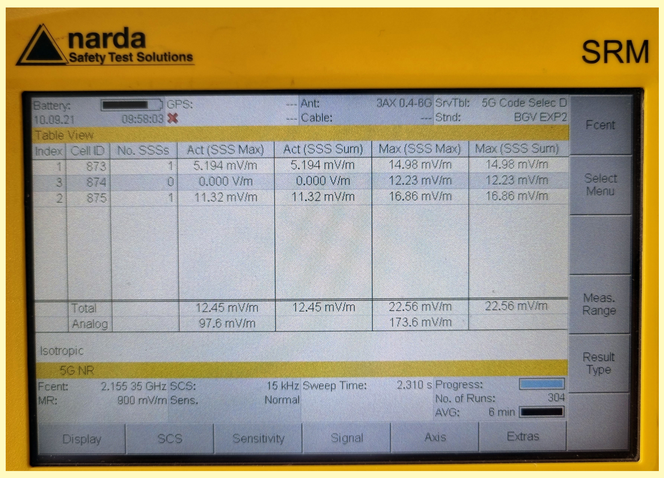
Introduction

5G is the mobile communications standard for the future. Germany and many other European and non-European countries require electromagnetic field (EMF) immission evaluations that are based on the maximum state of the system, for example when approving new transmitting equipment. The aim is to always determine the worst case or maximum possible field strength to which persons can be exposed. If this value is below the applicable permitted limit value, the equipment can be approved and operated safely and in any situation without any concerns.

Measuring concept

The measurement method is based on determination of the radiated field strength of the secondary signaling signals (SSS) in the broadcast channel (PBCH) of the downlink.



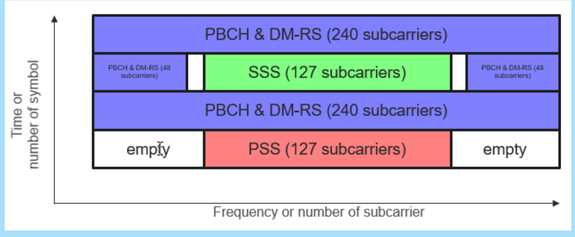
Advantages of the code selective measurement:

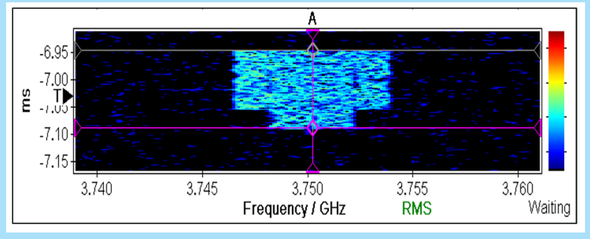
- It is independent of the cell load, so it can be performed at any time without the need for on-site participation by the system operator.
- It also works with beamforming antennas, which are more often used for 5G systems.
- It can distinguish between different segment antennas, which enables evaluation of individual segment antennas right up to the sum of all the cellphone stations.
- The measurement is unaffected by the cellphone system uplink signals. This is important when TDD systems are employed, which is the major technology used for 5G NR.

Structure of SS/PBCH block

PSS (red) and SSS (green) are signals inside the physical broadcast channel (SS/PBCH) block

- The entire block is 240 subcarriers broad and 4 symbols long
- PSS and SSS are 127 subcarriers broad and 1 symbol long





Measurement bandwidths

The bandwidth of the SS/PBCH block and the SSS signal are defined as follows:

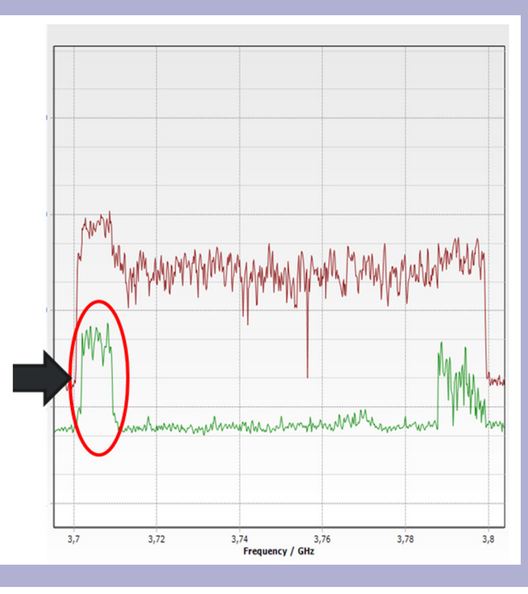
- SS/PBCH block has a bandwidth of 240 x Δf
- The SSS signal bandwidth is 127x Δf
  The subcarrier spacing of the PBCH block “Δf” can have the following values for carrier frequencies ≤ 6 GHz:
- 15 kHz, 30 kHz
  This results in the following bandwidths:

Δf	**0,015 MHz**	**0,030 MHz**
SS/PBCH	3,600 MHz	7,200 MHz
SSS	1,905 MHz	3,810 MHz

SS/PBCH Frequency

In contrast to 4G, 5G synchronization SS/PBCH can be shifted individually by the operator inside the frequency band. If frequency of the synchronization is unknown, it has to be located by a spectrum measurement or automatically by the measurement device.

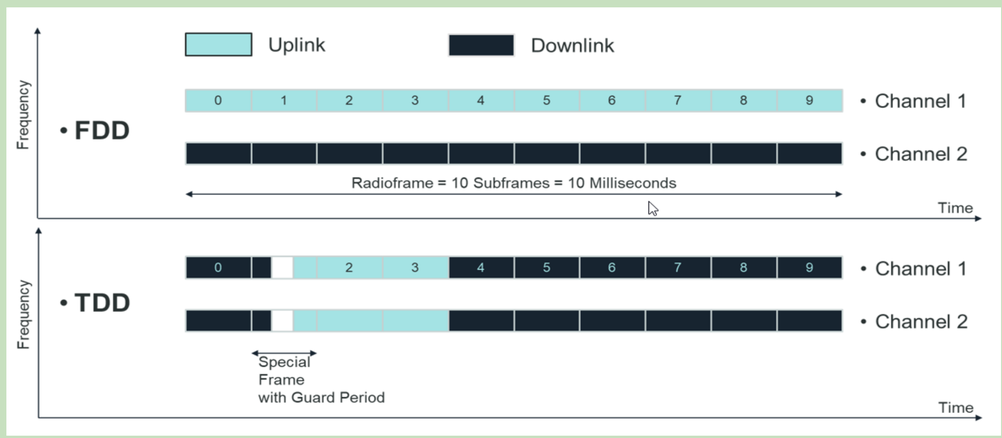
E.g.: 100 MHz bandwidth system with synchronization at lower edge of spectrum



TDD vs. FDD

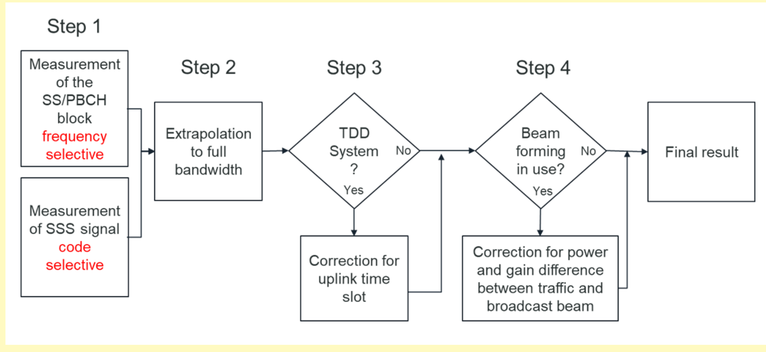
Most base stations are expected to use TDD, in which uplink and downlink are multiplexed over time slots.

- This improves the utilization of the available frequency spectrum.
- Since often more data is required for the downlink than for the uplink, TDD allows additionally the data rate to be adjusted accordingly via the number of timeslots.



Extrapolation

For the extrapolation of 5G signals several parameters have to be considered due to the use of TDD and beam forming. Even though there will be different extrapolation methods depending on the country, which differ slightly from each other, the basic principle can be described as follows:



Summary

With a spectrum analyzer, selective measurements can be performed and different services can be distinguished from each other. 5G signals in general can also be measured. If a certain 5G signal source should be measured, a code-selective measurement is required. This is also the basis for an extrapolation to the maximum load. Often regulators require extrapolation to the maximum load and comparison of this result with the local standard. This ensures that the exposure will not exceed the permitted limits and make the result independent from day and time when the measurement was taken.

References

On The Assessment of Human Exposure to Electromagnetic Fields Transmitted by 5G NR Base Stations (Health Physics: April 23, 2019 - Volume Publish Ahead of Print - Issue – p) Helmut Keller, Narda Safety Test Solutions GmbH
https://journals.lww.com/health-physics/Abstract/publishahead/On_The_Assessment_of_Human_Exposure_to.99882.aspx

Health Physics Abstract

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