RF Exposure Procedures

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TCB Workshop

November 2019

Federal Communications Commission
Office of Engineering and Technology
Laboratory Division

(Editorial changes – marked in red - made after the presentation to fix errors)

Overview

- SPLSR Hotspot Combination
- Dongles with External Swivel Antennas
- Hall Effect/G-Sensors for laptops/tablets
- Portable WPT Applications
- mmWave Scan Requirements

SPLSR Hotspot Combination

- Modern devices with small form factors have an increasing number of transmitters in close proximity
  - Many devices have 10+ transmitters
- SPLSR procedure outlined in FCC KDB Publication 447498 D01 is required to be used very often
- SPLSR procedure is inherently conservative

SPLSR Hotspot Combination

- For devices whose simultaneous SAR is > 1.6 W/kg and who do not meet the SPLSR criteria, enlarged zoom scan/volume scan procedure is available
- This procedure can be quite time consuming, especially for devices where antennas are spatially separated
- Often needed only because one co-located antenna pair does not meet SPLSR

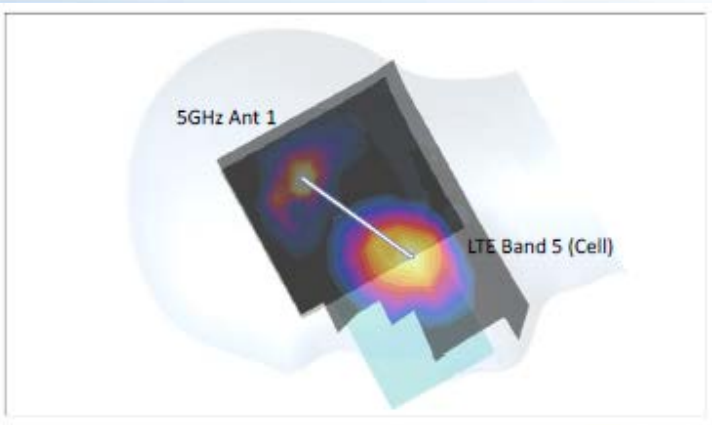
SPLSR Hotspot Combination

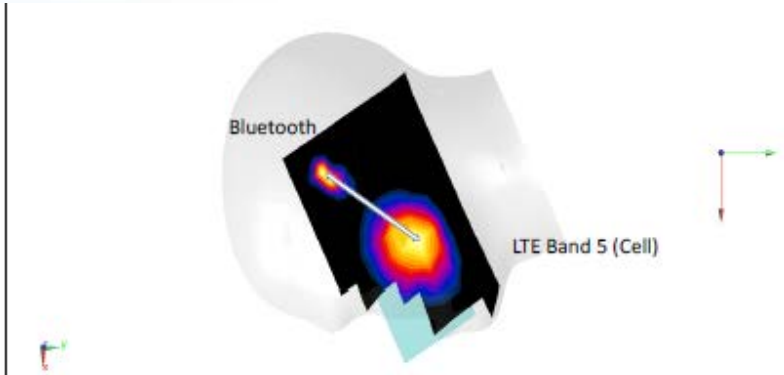
- Hybrid SPLSR and enlarged zoom scan/volume scan approach now being considered
- Will require a Lab KDB Inquiry and a PAG
- Can only be applied when simultaneous transmission SAR is > 1.6 W/kg, it does not meet SPLSR criteria, and antenna pair is co-located
- Test Procedure
  - Perform enlarged zoom scan/volume scan on the co-located antenna pair to determine 1g/10g aggregate SAR
  - Apply SPLSR procedure for the spatially separated antenna and aggregate SAR distribution of the co-located antenna pair

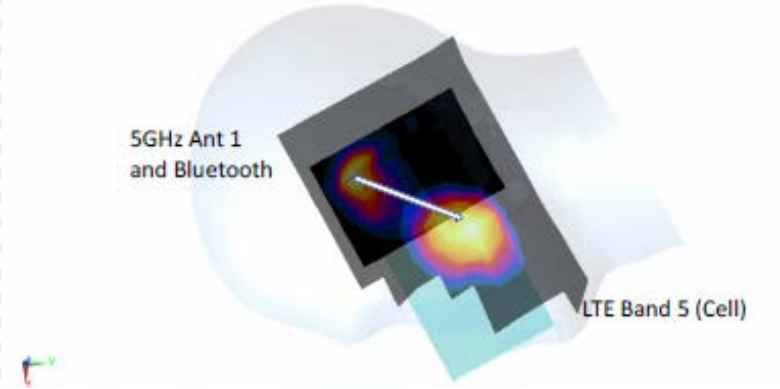
SPLSR Hotspot Combination

- What is meant by antenna co-location?
  - Antennas are not significantly spatially separated
  - Depends on device form factor and antenna implementation
  - SAR distributions overlap
    - Exact parameters for overlap are not yet defined
  - Will be assessed on a case by case basis
- This is preliminary guidance, subject to change

SPLSR Hotspot Combination







Dongle with External Swivel Antennas

- General guidance for dongles can be found in FCC KDB Publication 447498 D02
- For Dongles with a single external Swivel antenna the following guidance should be applied:
  - Test the Horizontal Up and Horizontal Down positions of the dongle with the antenna connected in straight mode at a 5mm distance to the SAR phantom.
  - The testing of the antenna tip is not necessary.
  - If the two measured SAR levels are similar, then additionally test the Horizontal Up position with the antenna connected at 90 degrees, perpendicular to the phantom (antenna pointing down and away from the phantom).
  - A 5mm separation distance to the phantom would again apply. With these 3 test positions, SAR testing conditions for this dongle will be satisfied unless the following occurs:
  - If the SAR levels for the Horizontal Up and Horizontal Down positions of the dongle in antenna straight mode are not similar, then the dipole antenna is not symmetrical and the Vertical Front and Vertical Back positions in antenna straight mode also need to be tested at a 5mm distance to the SAR phantom.
- If the dongle has multiple, independent swivel antennas, the guidance above should be applied to each antenna

Hall Effect and Gravity Sensor Guidance

- FCC KDB Publication 616217 D04 provides detailed guidance on capacitive proximity sensors
- Not much guidance provided for other types of sensors including infrared, motion, or gravity sensors in KDB publications
- Hall Effect and gravity sensors are becoming increasingly prevalent in laptops and tablets, especially for convertible laptops/tablets that switch modes (laptop, to stand mode, to tent mode, to tablet mode)
- These sensors are often used to trigger power reduction based on the particular use mode
- This power reduction occurs when the lid angle reaches a certain value

Hall Effect and Gravity Sensor Guidance

- The following guidance should be applied to laptops/tablets that use Hall Effect or gravity sensors to detect lid angle for the purpose of power reduction
  - With the lid is in closed mode (0 degrees), open the screen in 10 degree steps until laptop mode is obtained
  - Lower the screen 5 degrees. Closed mode should be reobtained. If not keep lowering in 5 degree steps.
  - Open the screen in 1 degree steps until laptop mode is reobtained
  - Continue opening the screen in 1 degree steps until at least 5 degrees past where laptop mode was obtained
  - Then continue opening the screen in 10 degree steps until tablet mode is obtained
  - Power measurements should be taken at each step
  - Reverse this procedure going from tablet mode back down to closed mode
- Depending on triggering mechanism the degree steps may need to be varied to confirm mechanism operation
- Hall Effect and G-Sensors will still require a PAG

Portable WPT Applications

- Seeing an increased number of non-mobile WPT applications
- Primarily small size, in-vehicle applications installed in armrest, center console, or attached to air conditioning vent
  - Installation conditions can have a significant impact on potential RF Exposure
- Typically similar in size, shape, power (< 15 W) and function to desktop WPT devices

Portable WPT Applications

- Due to low transmission frequency SAR measurement not applicable
- Measurements difficult due to varying probe sizes, shapes and probe perturbation of measurement at short measurement distances
- Numerical modeling and/or simulation is a viable option but can be burdensome and time-consuming
  - Varying installation conditions make numerical modeling extremely complex
- Low power (<15 W) make potential for RF Exposure low

Portable WPT Applications

- For portable devices that do not physically attach to phone, desktop WPT testing guidance from FCC KDB 680106 D01 (see October 2018 TCB Workshop slides)
- For low-power (<15W), in-vehicle applications perform H-field measurements for each edge/top surface of the host/client pair at every 2 cm, starting from as close as possible out to 10 cm
  - May not be possible if probe has very large measurement head
- If measurements are < 10% respective limit, no additional testing is necessary. If not, submit a KDB Inquiry
- Preliminary guidance, subject to change

mmWave Scan Requirements

- Initial mmWave measurement guidance given at April 2019 TCB Workshop
- Guidance allowed for test reduction based on several factors including maximum measured PD, modulation, bandwidth, etc.
- Time-Averaged PD may allow for even more significant test reduction beyond April 2019 TCB workshop guidance

mmWave Scan Requirements

- mmWave measurements still take a significant amount of time
- April 2019 TCB workshop slides mentioned fields at the measurement region boundary should be ~20-30 dB below the peaks
- Further studies have revealed this may be overly conservative, increasing the required scan size and test time
- Smaller area scan sizes, with lower field difference between the boundary and peak will be considered on a case-by-case basis

Questions?

Thank You!