IEEE 802.15 WNG
Total Radiated Power spectral density (TRP_{sd}) by JRC

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Summary of *TPR*$_{sd}$ measurement in 2023 by JRC, ISPRA

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Introduction

- **These slides present a summary of the measurement results contained in the *TRP*$_{sd}$ measurement report from the JRC in Ispra**
- **The Joint Research Centre (JRC) is part of the EU commission and supports the regulation activities in Europe**
- **"Report on Measurement Campaigns for Total Radiated Power of UltraWideBand (UWB) device to support EU RF spectrum regulation"**
  - https://publications.jrc.ec.europa.eu/repository/handle/JRC134860
- **Results should be used for the future simulation in the band extension WI in SE24**
- **Further measurements are planned in 2024**

Total Radiate Power spectral density (TRP_{sd})

- **Total Radiated Power (TRP) is a Radio Frequency (RF) engineering term used to describe the sum of all power radiated by an antenna connected to a transmitter**
- **TRP_{sd} represent the overall power emitted by a device in the given bandwidth (typically 1MHz)**
- **TRP_{sd} represents an average value for the interference potential of a device in all directions.**
  - In contrast to the e.i.r.p in dBm/MHz value which represents the worst case of the interference potential into one dedicated direction
- **For any kind of aggregated interference investigations, the TRP_{sd} value is the more appropriate value**

Definition of *TRP*$_{\mathbf{sd}}$

$$\mathrm{TRP}sd = \int_{\Theta=0}^{\pi} \int_{\Phi=0}^{2\pi} \frac{P_{\mathrm{psd},\Theta,\Phi}}{A_r} \times \mathrm{r}^2 \times \sin(\Theta)\, \mathrm{d}\Theta\, \mathrm{d}\Phi \qquad \text{(A.10)}$$

Where:

- Radiated mean power spectral density $P_{\mathrm{psd},\Theta,\Phi}$ measurement in 1 MHz (recorded) one point of the sphere depending Θ and Φ and frequency
- r is the radius of the sphere/measurement distance
- Θ is the elevation angle
- Φ is the azimuth angle
- A_r is the effective area of the receiving antenna (measurement antenna)

Reference: ETSI TR 103 750 V1.1.1

Basic measurement setup

Figure 1: Over The Air (OTA) measurement set up in the Shielded Anechoic Chamber (SAC) in full anechoic configuration.

Setup: technical details

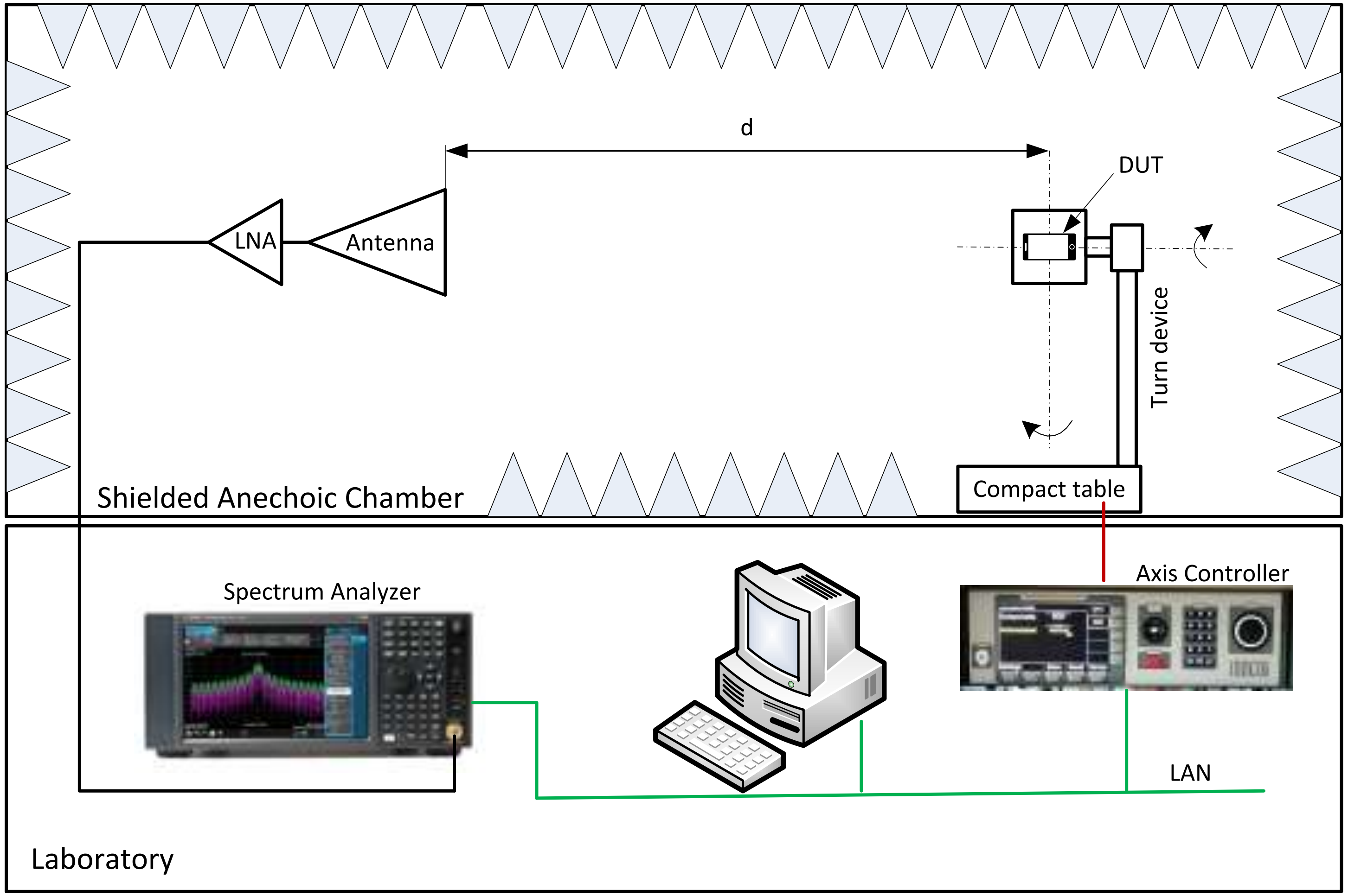

Figure 2: Measurement setup

Device under test

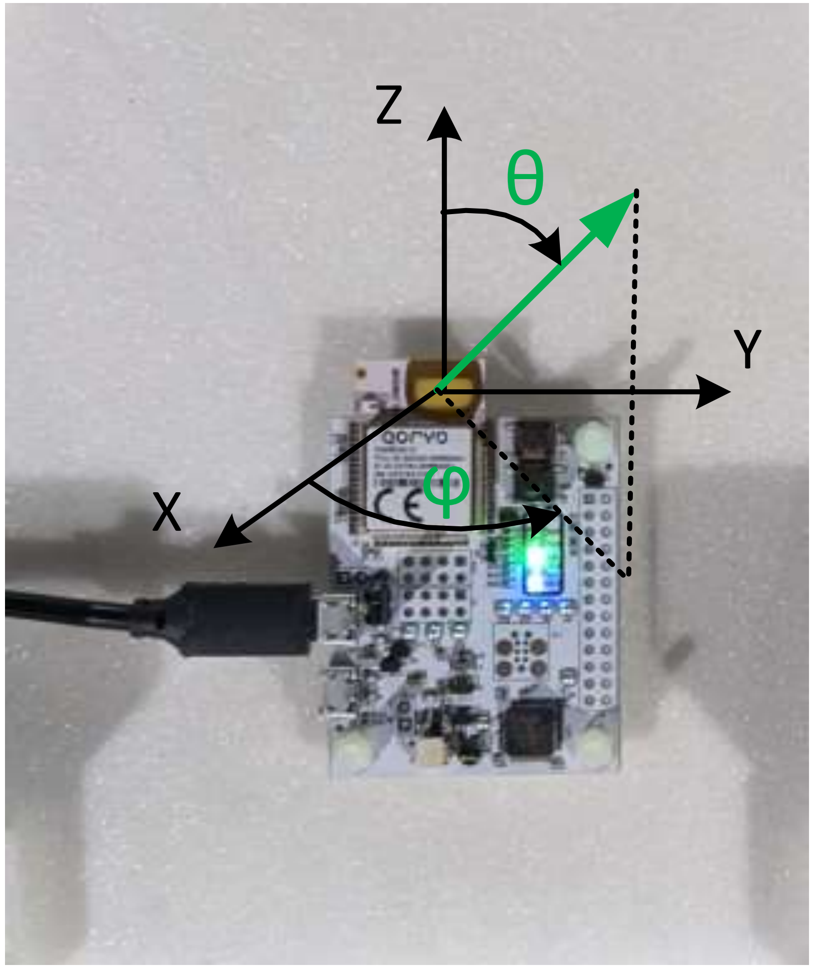

Figure 3: Coordinate system associated with the DUT

Measurement procedure

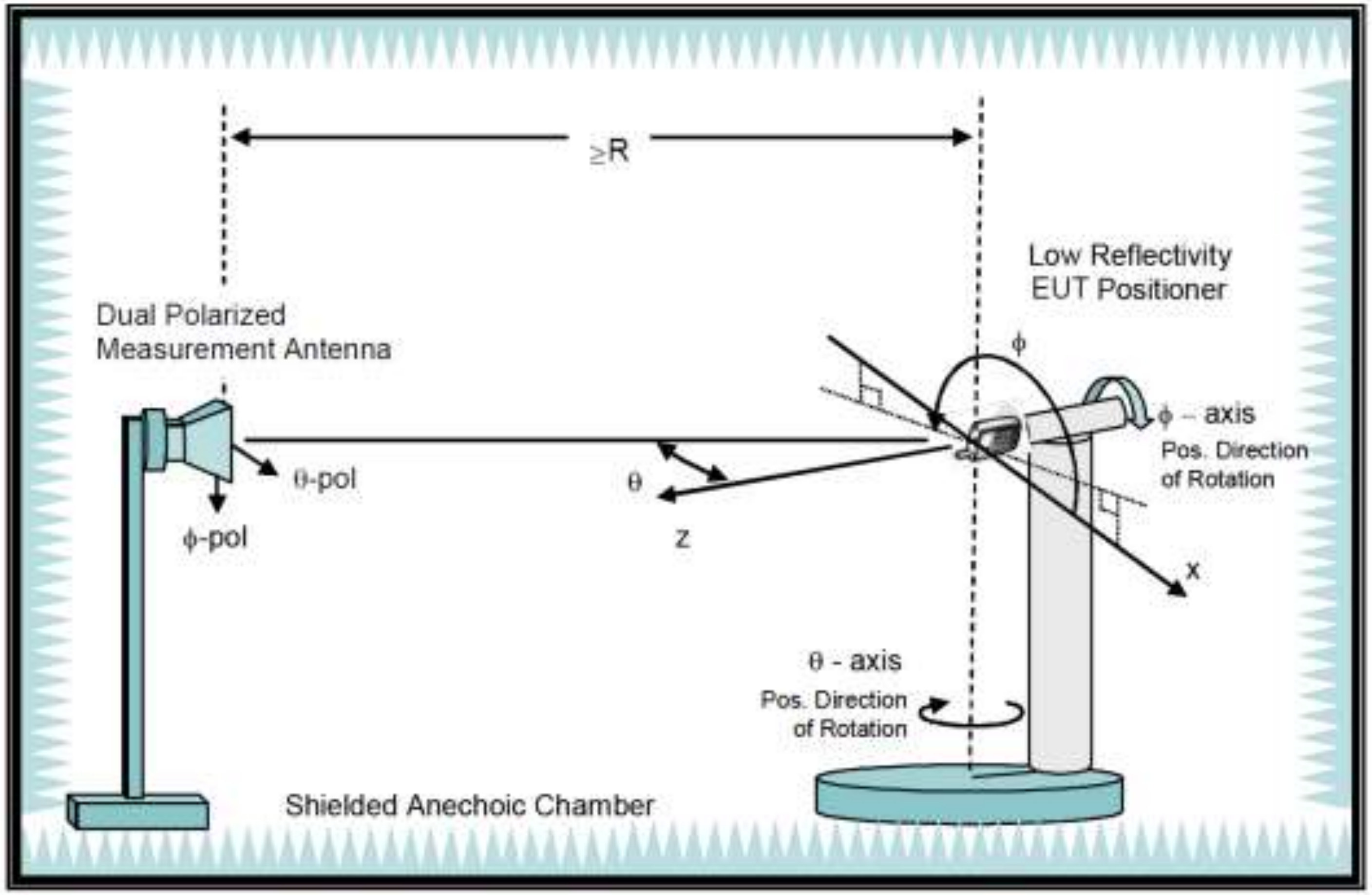

Figure 4: Typical setup for a combined-axes system as shown in Appendix A of the CTIA test plan [4].

Example 3D radiation pattern

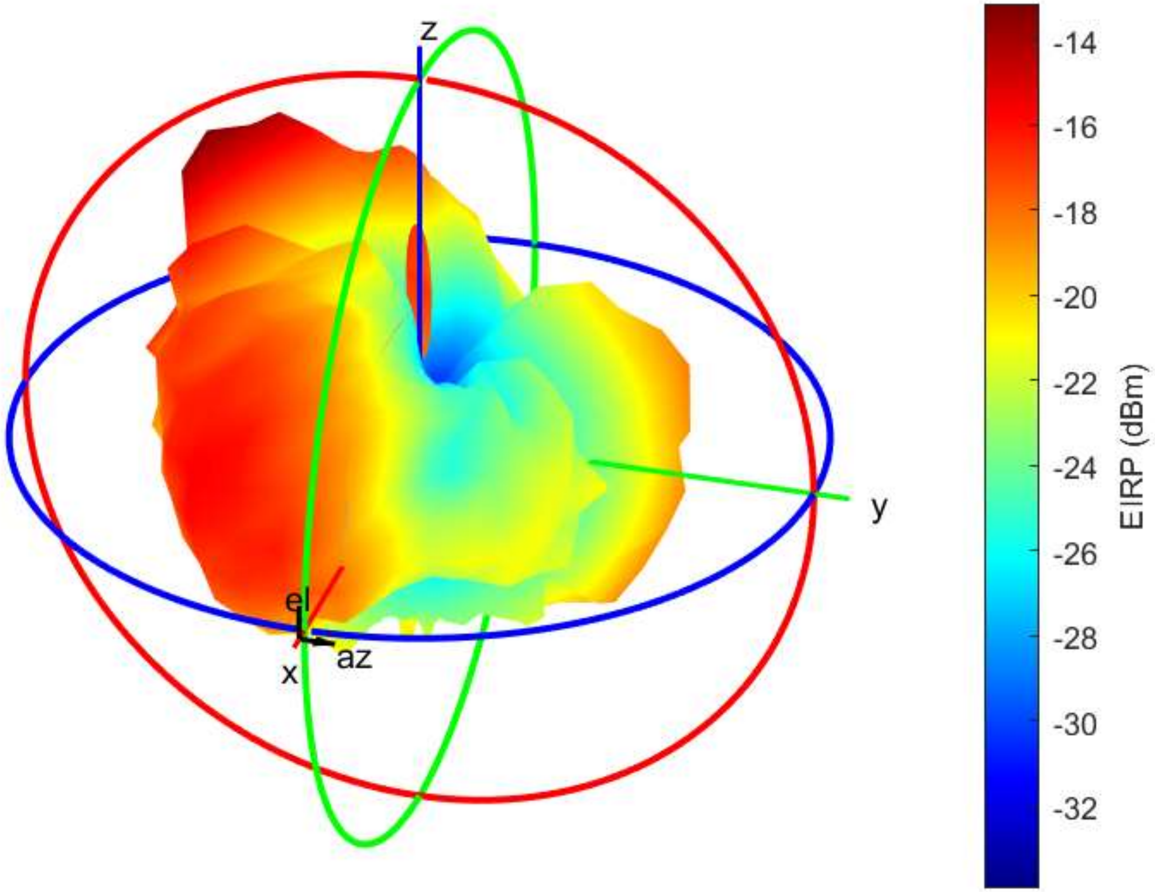

Figure 13: Example of 3D radiation pattern

Measurement results

Table 9: Measurement results

UWB channel	Distance (m)	EIRP (dBm)	$EIRP_{SD}$ (dBm/MHz)	TRP (dBm)	TRP_{SD} (dBm/MHz)
5	1	-13.15	-38.25	-20.16	-45.57
9	1	-13.3	-38.11	-19.72	-45.28
5	3	-12.93	-37.95	-19.9	-45.2

Some comments to measurements

- **Duty Cycle of the device has been set to the maximum possible without changing the default power settings leading to a slightly higher TX power**
  - Maximum mean e.i.r.p. > - 41.3dBm/MHz
  - Not fully conform to regulation
  - Simplification of measurements and increased measurement accuracy
- **In all channels the TRP_{sd} levels are significantly below the maximum mean e.i.r.p. value**
- **More directive antennas or absorbing material will increase the difference between maximum mean e.i.r.p. and TRP_{sd}**
- **Assumption of fully omnidirectional emissions is very worst case and not realistic**

Summary and outlook

- **Slides presented a summary of the JRC TRP_{sd} measurements**
- **An isolated UWB device reaches an TRP_{sd} level which is 7dB below the maximum mean e.i.r.p. value**
  - -48.3dBm/MHz (TRP_{sd}) versus -41.3dBm/MHz (maximum e.i.r.p.), mitigating factor of 7dB
- **Additional gains can be assumed in real deployment scenarios for**
  - Body worn devices
  - Fixed installed access point with directive antennas
  - Wall mounted device
- **Additional measurements to confirm this assumptions are planned**
- **Future regulation should include maximum mean e.i.r.p. value and TRP_{sd}**
- **More details: https://publications.jrc.ec.europa.eu/repository/handle/JRC134860**

Acknowledgment

- **This presentation is based on the work of the Joint research Centre of the EU commission in Ispra**

- **The author of the reports are**
    - Gianmarco Baldini
    - Jean-Marc Chareau
    - Fausto Bonavitacola