eSkin-ART

Human Exposure Assessment to mmWave 5G/6G Based on Electromagnetic Artificial Skin

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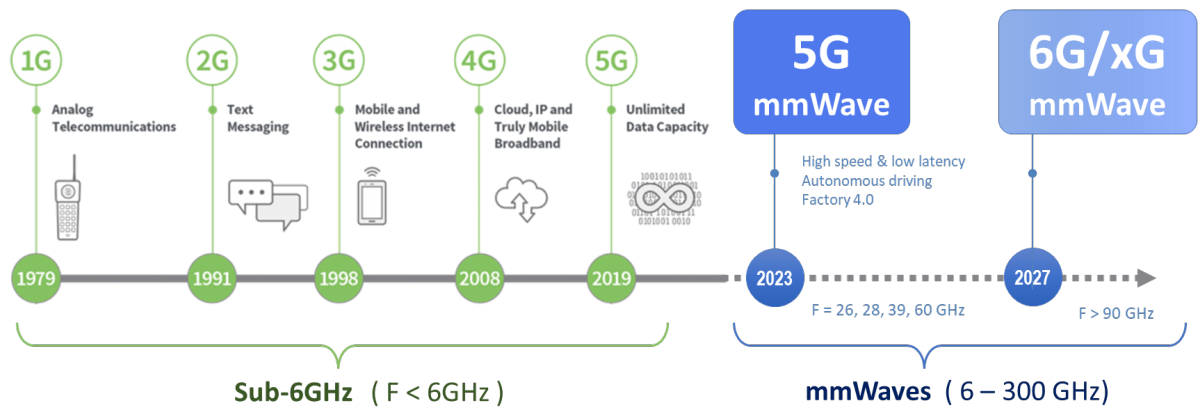
Contexte and motivation

The EM-ART project supported by Labex CominLabs in 2022 is focused on the development of the new approach for fast assessment of user exposure, addressing the challenges in terms of accurate, realistic, and fast dosimetry measurements at 5G/6G frequencies above 6 GHz. This approach is based on an innovative solid tissue-equivalent phantom design with EM scattering characteristics optimized for mmWave 5G/6G dosimetry, overcoming intrinsic limitations of existing 3G/4G dosimetry systems.

In continuation to the PoC results generated in the frame of EM-ART project, the eSkin-ART innovation action aims at moving from a laboratory prototype towards a compact integrated demonstrator.

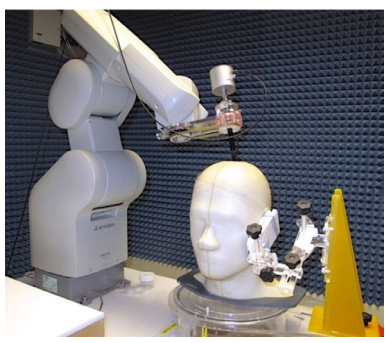
Towards mmWave 5G / xG

FR2 frequencies (26 GHz, 39 GHz, 60 GHz) are increasingly used for mmWave 5G / xG



State of the Art

Examples of dosimetry systems for user exposure compliance testing



Systems based on liquid or gel phantoms employed at frequencies < 10 GHz

Free-space measurement system operating up to 110 GHz

Evolution of regulations / standards

ICNIRP INTERNATIONAL COMMISSION ON NON-IONIZING RADIATION PROTECTION — 1998

Free-space measurements: incident power density (IDP)

2020

In-body exposure evaluation: absorbed power density (APD)

IEC — 2024-2025

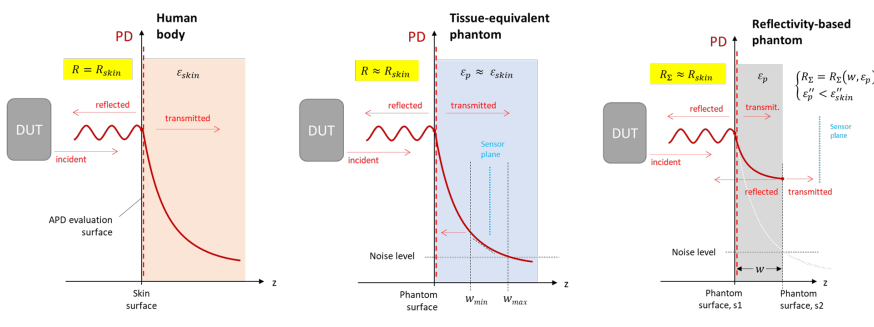
New standard for exposure evaluation > 6 GHz

Challenges and current limitations

- Existing liquid-based phantoms are not scalable to mmWaves
- Chemical waist from liquid phantoms requires disposal (environmental footprint)
- Free-space measurements do not account for antenna/body interaction
- High uncertainty associated with the use of scanning probes (transmit power drift in time)

Methodology overview

Conceptually new patented solution for user exposure and APD compliance testing > 6 GHz



Human body modelled as semi-infinite lossy dielectric medium

Tissue equivalent phantom reproduces complex dielectric permittivity of biological tissues

Reflectivity-based phantom reproduces reflection coefficient from the skin surface

From laboratory prototype towards a compact system demonstrator

Task 1. Conceptual design of the compact integrated system demonstrator prototype

Task 2. Adaptation/integration of the phantom and miniature IR camera into the demonstrator.

Task 3. Experimental validation using 5G device (e.g. smartphone) with a mmWave transceiver.