6G Global R&D Collaboration Activities

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In the presentation, I introduce our 6G global R&D collaboration activities with **Fraunhofer Heinrich Hertz Institute (HHI)** in terms of **Full Duplex Radio** and **Sub-Terahertz Radio** technologies.

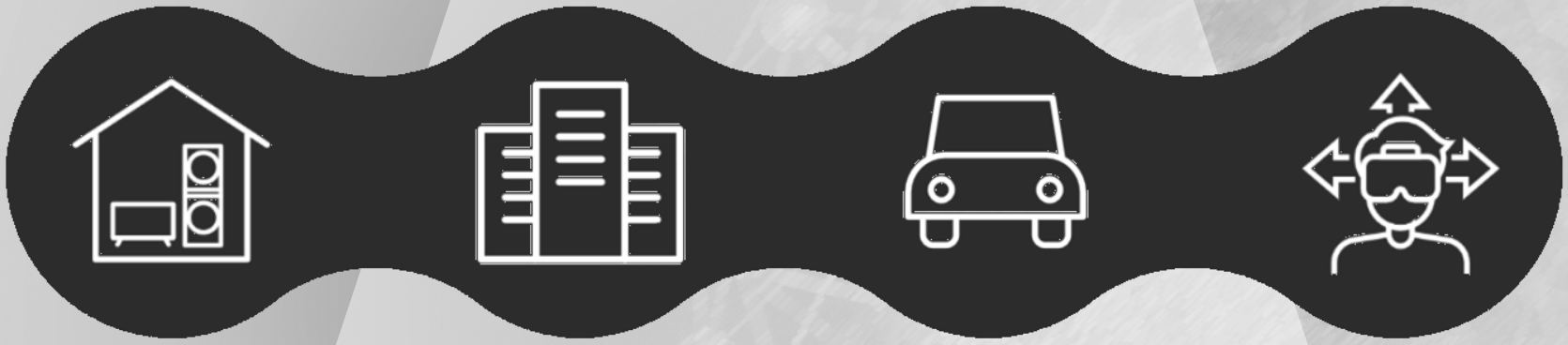
For Full Duplex Radio, we collaborate the **establishment and leading of a global interest-group activity** to get technical consensus on use cases for advanced duplexing and relevant transceiver architecture also including technical promotion and standard proposals.

For Sub-Terahertz Radio, we collaborate the **exploratory R&D for Sub-THz frontend devices and beamforming solutions, and their PoCs** to resolve the challenges on the application for mobile communication.

LG Electronics 6G Tech Vision (1/2)

Future Business Vision

Smart Life Solution Company



Home | Commercial (Inc. office/factory) | Mobility | Virtual Space

Connected AI Everywhere

Aerial 3D-coverage Support

Hyper-immersive Media Communication

Empowered by 6G

LG Electronics 6G Tech Vision (2/2)

Focused 6G Enabling Technologies / R&D Roadmap

Radio Technologies

New Spectrum Utilization	Terahertz Radio / Dynamic spectrum sharing
Enhanced Spectral Efficiency	Full duplex radio / AI-native air interface / Ultra massive MIMO / New waveform & coding
Radio Coverage Improvement	3D radio coverage (NTN) / Reconfigurable intelligent surface (RIS)
Radio Solution Convergence	Joint comm. & sensing (JCAS) / mobile OWC

Network Architectures & Solutions

Flexible Network Architecture	New network topology / Seamless mobility / Evolved distributed cloud & computing
Secure & Green Networks	PQC & Homomorphic cryptography / Network energy saving

2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 | 2029 | 2030~

Exploration & advanced R&D on 6G enabling technologies

Global standardization

Commercialization

LG-KAIST 6G Research Center Foundation

Fraunhofer HHI/IAF 6G Collaboration Start

6G Grand Summit 2022 Main Hosting

LG 6G Tech Festa & 6G Grand Summit 2023 osting

LGE's Advanced R&D Story on Full Duplex Radio

Focus on in-device & network interference cancellation/mitigation technologies realizing duplexing flexibility

Overall R&D Activity History

R&D Focus

- Realization of throughput increase, coverage enhancement, and latency reduction through the various advanced duplexing schemes
- Support of synergetic integration with MIMO performance & operability in the miniaturized frontend/antenna condition
- Optimized transceiver operation for integrated sensing and communication

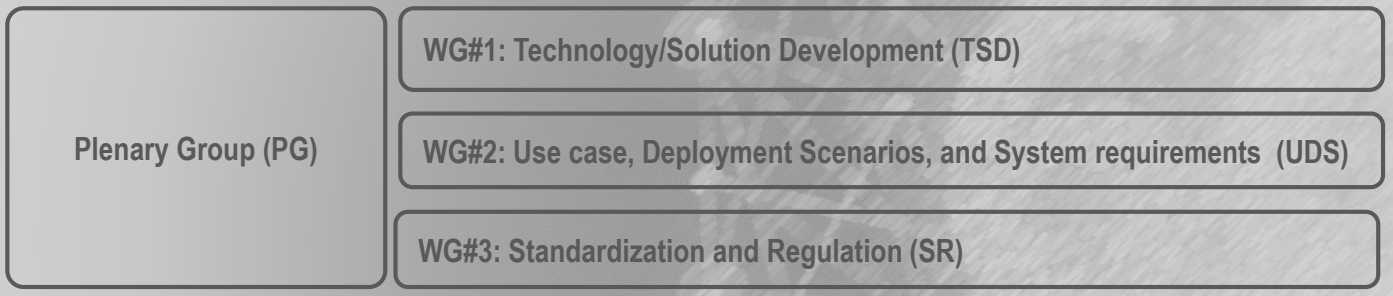
Target Spectrums

- Brand new sub-6GHz & upper-mid band spectrum (primary focus)
- Low-band re-farming spectrum (operator demand)

Collaborative Leading of Global Technical Consensus
FDR-IG (Full Duplex Radio–Interest Group) Activities

Overall of FDR-IG activities

- Activity initiation with kick-off workshop(@US, San Diego) at Dec. 2017
- Organization – Plenary Group & 3 Working Groups



- Steering Roles – Technical investigation & study / Global technology promotion / Standard proposals

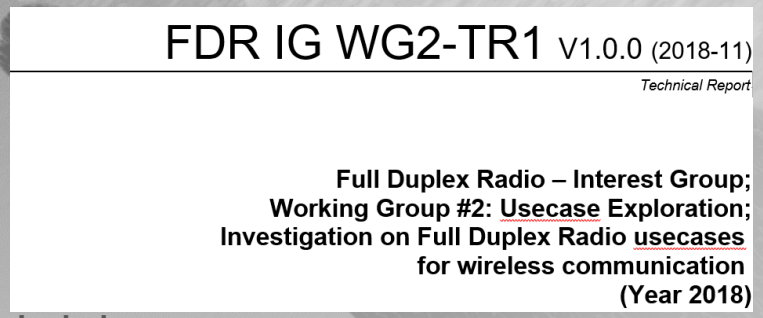
Representative Outcomes


FDR IG WG1-TR1 V1.0.0 (2018-11)

Technical Report

Full Duplex Radio – Interest Group;
Working Group #1: Technologies;
Enabling techniques for Full-Duplex Radio in wireless communication networks
(Year 2018)

Includes:
- Reference transceiver architecture & potential solutions


FDR IG WG2-TR1 V1.0.0 (2018-11)

Technical Report

Full Duplex Radio – Interest Group;
Working Group #2: Usecase Exploration;
Investigation on Full Duplex Radio usecases for wireless communication
(Year 2018)

Includes:
- Total 18 use case scenarios based on full duplex and flexible duplex(incl. XDD) operations & system requirements

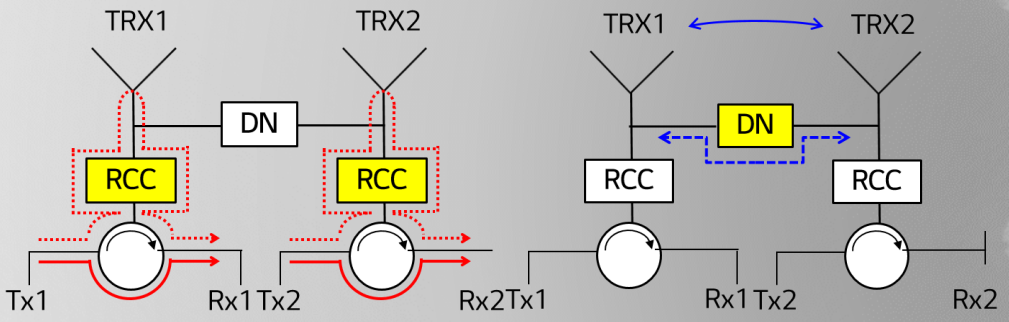
Following In-house R&D Activities

Stimulated by FDR-IG technical outcomes and activities

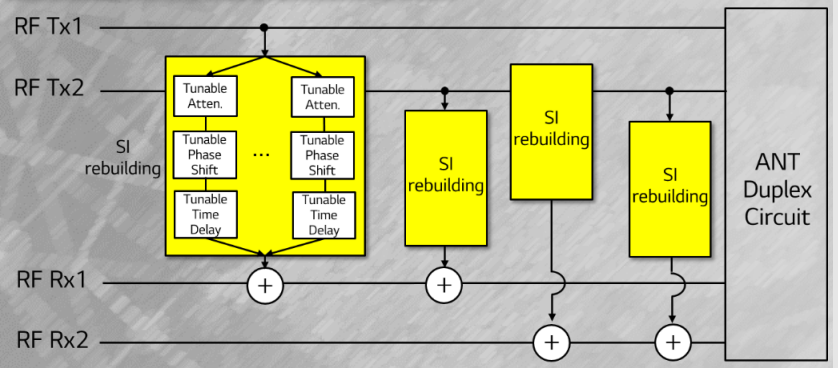
Transceiver Solution Development

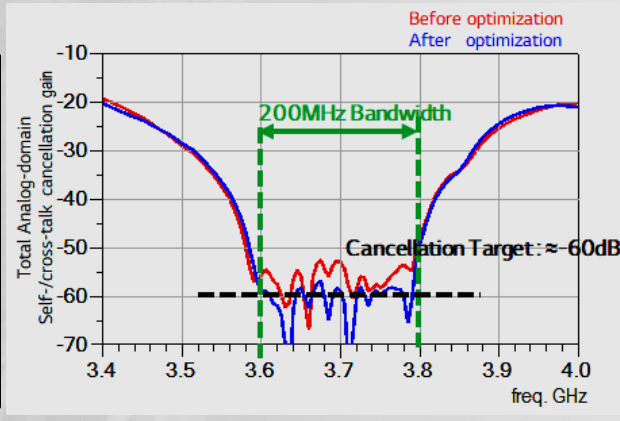
- Wideband analog self-interference cancellation solution for a MIMO full-duplex transceiver (Tx/Rx shared physical antenna condition)

Antenna-domain SI cancellation



RF-domain SI cancellation





Partnership-based Platform Development & Test/Demo

- A global operator-NW vendor partnership FDR platform development & test/demonstration (`18.3~`20.9)
  - For gNB full-duplex/UE half-duplex and gNB/UE full-duplex scenarios
- An operator partnership FDR platform development & test/demonstration (`21)
  - For 200MHz self-inference cancellation performance and cross-link interference impact

LGE's Vision and R&D Activities for Sub-Terahertz Radio

Sub-THz radio transmission technologies for the spectrum range of 100~200GHz

R&D Motivation

- High data rate support for hyper-immersive media communication
- Wider BW radio-pipe provisioning against next-term mobile traffic avalanche

Target Applications

- Indoor/outdoor hot-spots






- Sidelinks & mesh networks


- Fixed/mobile(given trajectory) wireless backhaul links

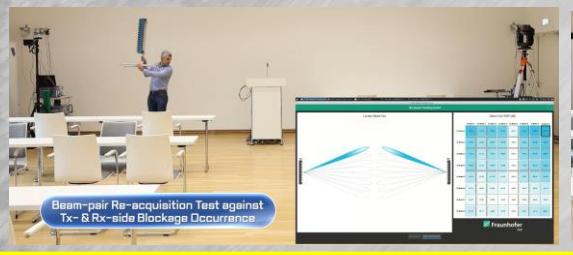

Proposed Spectrum Allocation

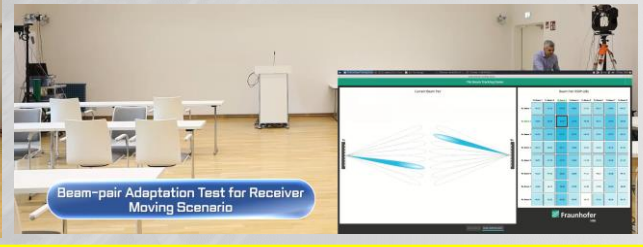
- On-demand based licensed spectrum allocation according to services & locations similar to that of private 5G

R&D Activities

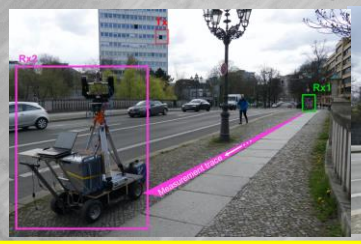
Collaboration Activities

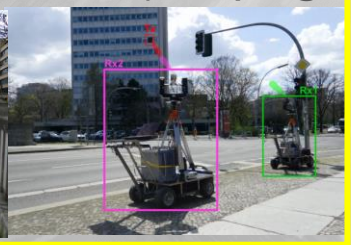
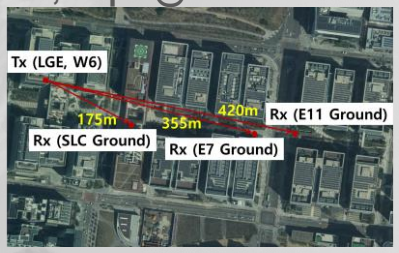
- Indoor adaptive beamforming OTA test (`22. Sept. @ Berlin)





- Outdoor beamforming OTA test (`23. April @ Berlin; Sept. @ LG Science Partk)



- Outdoor Roof2Roof & Ground2Ground OTA test (`23. Sept. @ LG Science Park)

Collaborative R&D Project with Fraunhofer HHI & IAF

Core Sub-THz frontend device/module R&D and its PoCs

R&D Target

- **Exploration of break-through Sub-THz frontend technologies** getting over 'THz-Gap' dilemma and extremely high propagation & insertion loss
- **New adaptive beamforming solution** supporting indoor & outdoor mobile communication

R&D Approaches

Today

Step #1

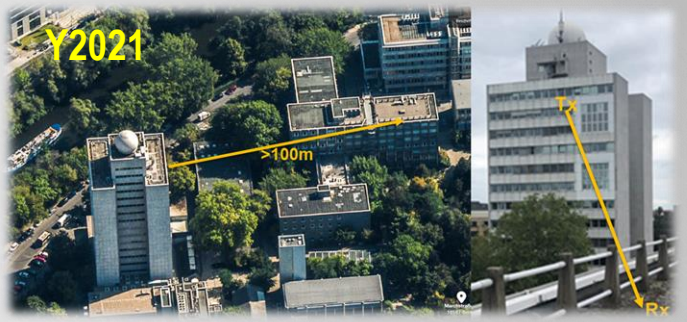
- High power PA MMIC
- Beamforming module (metal-housing form for PoC)

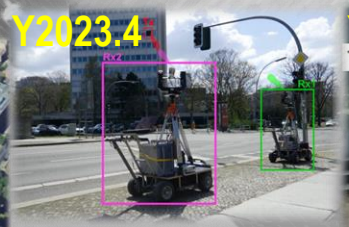
Step #2

- Core frontend MMICs – PA / LNA / active S/W
- On-substrate beamforming FE package

Step #3

- Enhanced frontend MMICs – PA / LNA / S/W / UP/DWN converters
- IC-capable full sub-array FE package





Following In-house R&D Activities

LG Science Park Sub-THz OTA Outdoor Test/Demo (`23.9)

Thank You!

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