

Unlocking sub-THz bands for future services:

the 6GTandem approach

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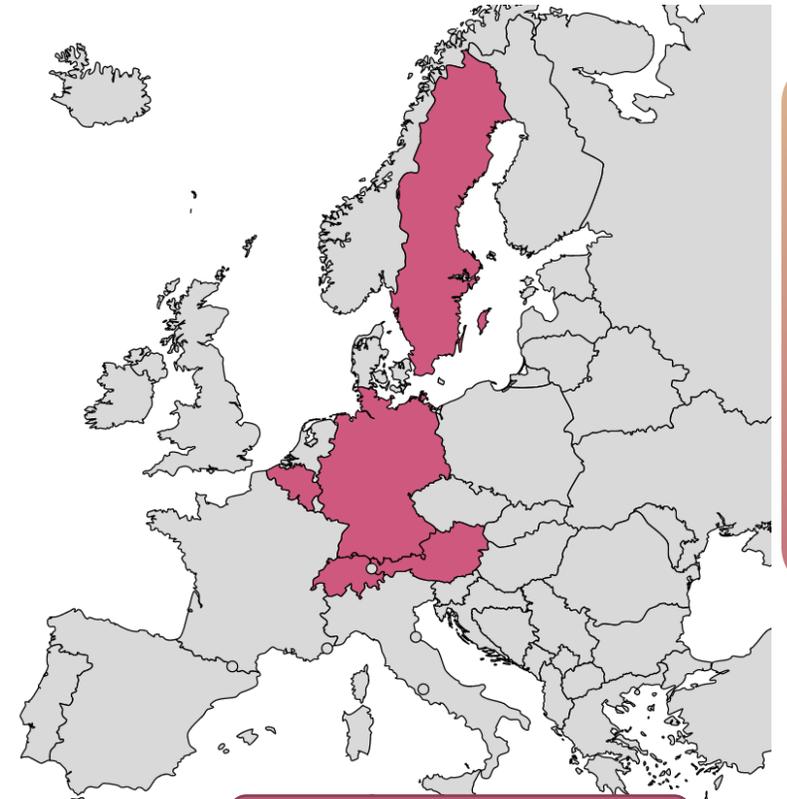
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Unlocking sub-THz bands for future services: The 6GTandem approach

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- Project facts
- What is calling for sub-THz support?
 - Use cases analyzed
 - Specifications derived
- The 6GTandem approach:
 - Dense deployment & dual-frequency concepts
 - System-HW co-design
- Plan



6GTandem partners

Project facts

- **Title:** A Dual-frequency Distributed MIMO Approach for Future 6G Applications
- **Website:** <https://horizon-6gtandem.eu/>
- **Program:** SNS-program stream B-01-02
- **Key info:** 6GTandem will co-design novel dual-frequency (sub-10 GHz & sub-THz) operation and a new highly integrated and distributed radio transceiver architecture (radio stripe) to achieve superior value with respect to energy, service availability and cost of deployment.

Addressed Verticals:

Adaptive robotized factories, warehouses, retail and logistics, Immersive entertainment for crowds of people (e.g., arenas), Human-machine interaction in care environments, hospitals, Public transportation



What is calling for sub-THz support?



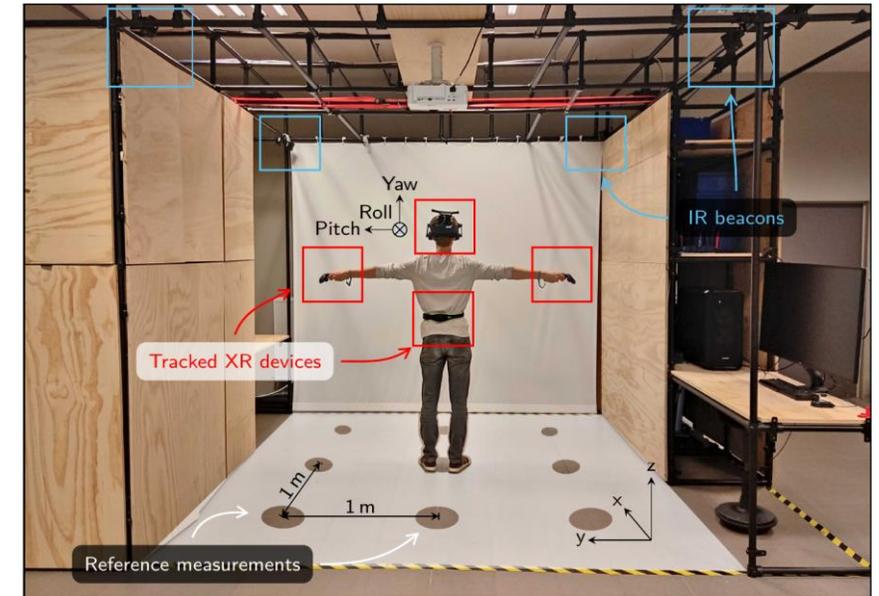
Identified Use Cases that could benefit from sub-THz

Listed use case suggestions	
AR/VR/XR	UC1: Mixed Reality (MR) in industrial environments
	UC2: Professional Virtual Reality (VR) training
	UC3: Remote surgery, enabled by VR telepresence
	UC4: MR surgery
	UC5: Social XR interaction/interactive classroom
	UC6: AR-enriched events
	UC7: XR in a metro/train station
URLLC	UC8: Cooperative mobile robots & flexible manufacturing
	UC9: Digital Twin (DT) in Industrial Environments
	UC10: Position tracking of roots and UAVs
Positioning /tracking	UC11: Tracking of goods and real-time inventory
	UC12: Contact tracing and people tracking in large venues
	UC13: Location-based information transfer
	UC14: Crowd scenarios in public transportation
	UC15: Federated learning-based intelligent video surveillance for public safety in large venues
	UC16: Sub-THz radio stripe as fronthaul solution

XR Mobility Assessment:

Experimental campaign conducted for missing parameters

- Evaluation of mobility requirements for UCs 1—7
- UCs characterized by occasional rapid rotation (360 °/s)
 - Constraint 1: UE beamforming / beam steering
- Users can roam around in the environment (<6 m/s)
 - Constraint 1: Initial RU and beam selection
 - Constraint 2: Hand-off between RUs
- Possible hand and 3-rd person LoS obstruction
 - Constraint 1: High RU deployment or 5—15 dB extra link budget



Dataset available
<https://zenodo.org/records/10836884>

Use cases-Key Performance Indicators

Assumptions:

- Real-time video compression with a ratio of 1:300 (h.265) is considered. Note: **traffic volume density** and **latency** is affected by this
- Use the sub-10GHz radio for providing **reliable coverage** and the sub-THz for coping with the stringent requirements **on data rates as well as latency**.

Key take aways:

Highest **traffic volume density DL:**

768Mbps/m²

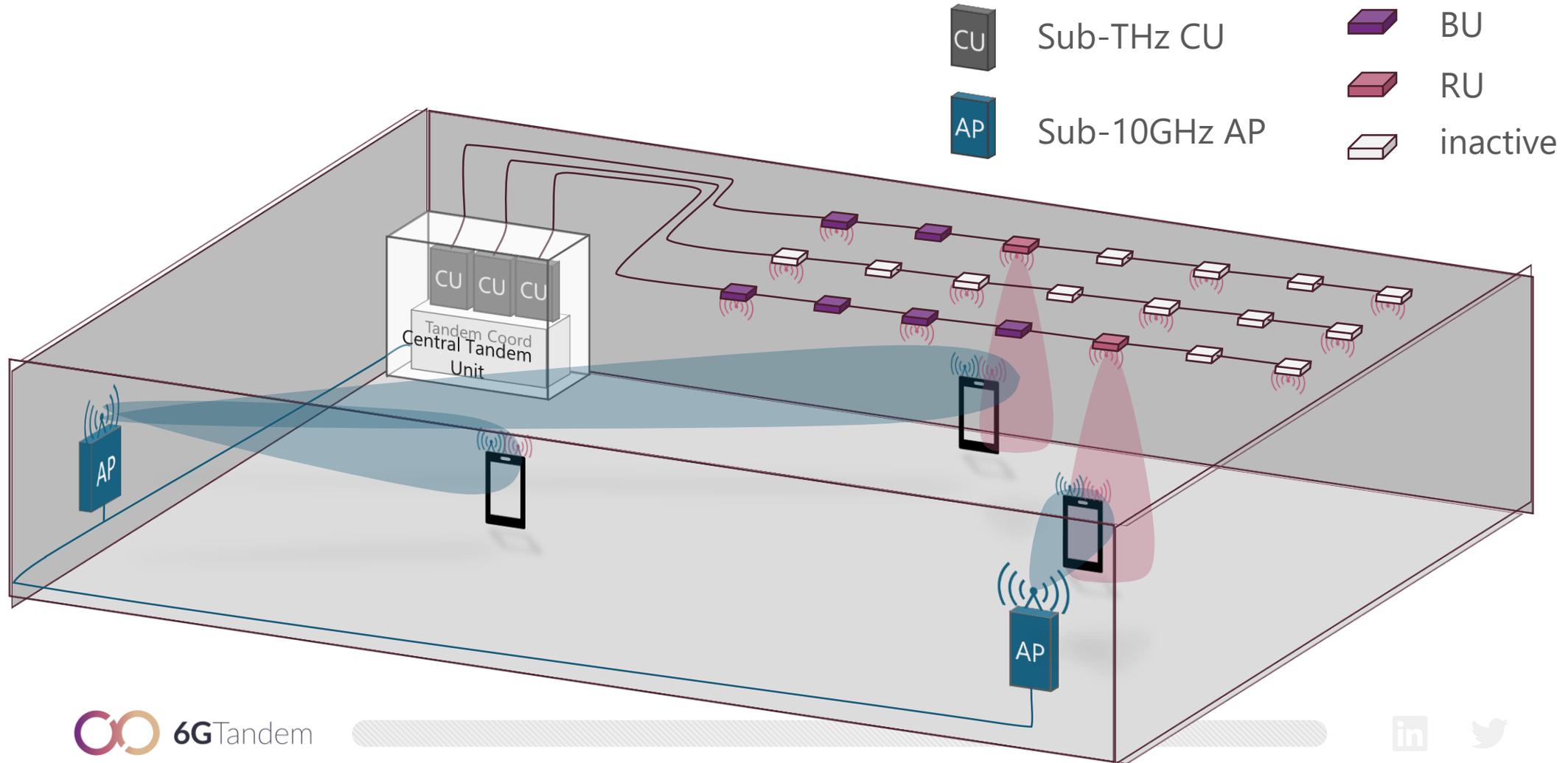
User experience data rate: few Mbps-400 Mbps

Reliability: >99.999% in automation in industry 4.0

Table 13 Summary of KPIs for all the presented use-cases

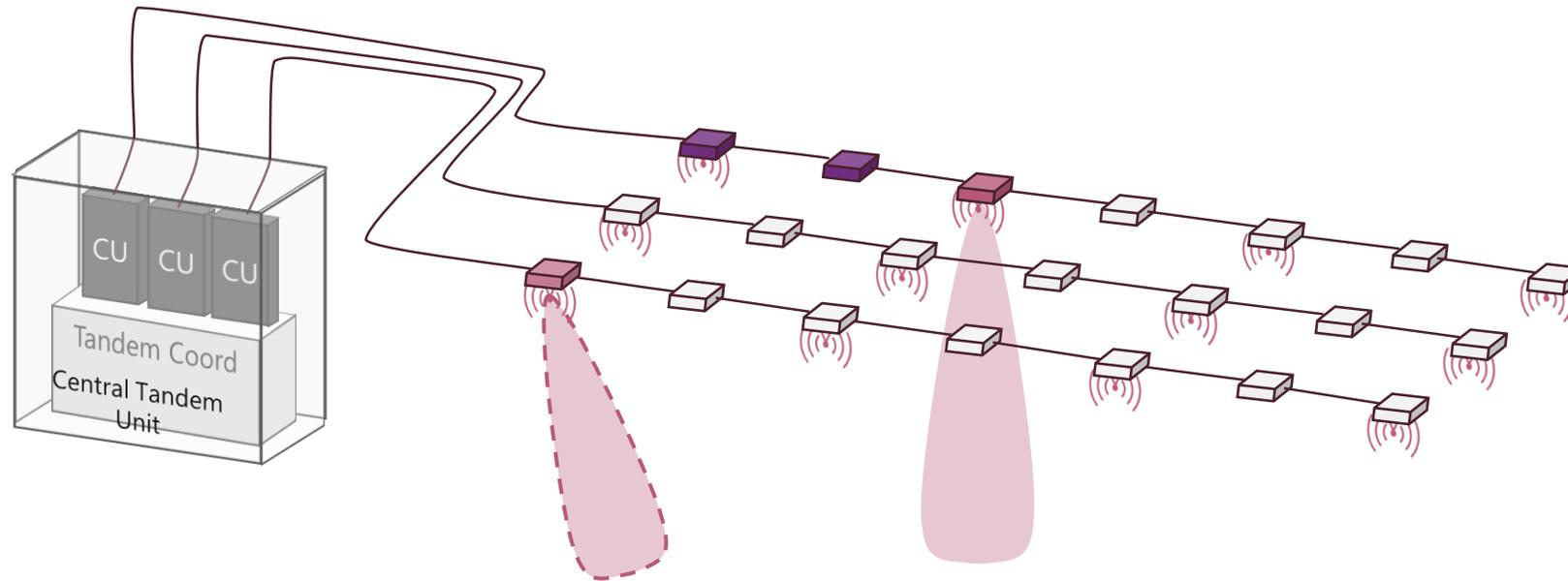
	Use case														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Traffic volume density DL (Mbps/m ²)	104	193	768	204	76	24	12	12	20	40	100	2	100	100/25	259 000
Traffic volume density UL (Mbps/m ²)	50	5	20	10	12	32	2	14	10	50	100	2	100	50/50	129 500
User density (1/m ²)	1	1	2	2	2	4	2	2	0.2	5	100	2	10	1-2	
E2E latency (ms)	6+6	6+6	6+6	6+6	9+9	8+8	8+8	<25	<10 0	10	100	100 0	100 0	2-4	600 00
Reliability (%)	99	97	99	99	97	97	97	99.9 99	99.9 99 %	99.9 999	99.9 %	99.9 %	99 %	99.9 9	99
Positioning & mapping Accuracy (cm,degree)	<5 <5°	<5 <5°	<5 <5°	<5 <5°	<5 <5°	100 <5°	100 <5°	1-5 <1°	1 <10 °	1 <10 °	1	100	50	30	
Mobility(m/s)	<6	<6	<6	<2	<6	<6	<6	<10	<10	<10	<10	<2	<2	2	

6GTandem dense deployment & dual-frequency concepts



Dense deployment of RUs for very high frequencies can 'embrace the propagation problem'

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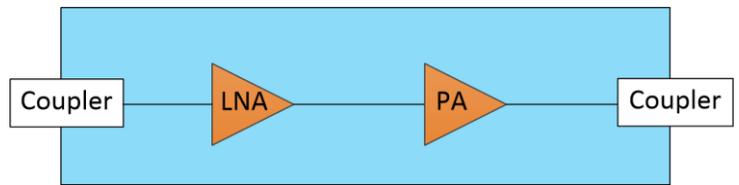


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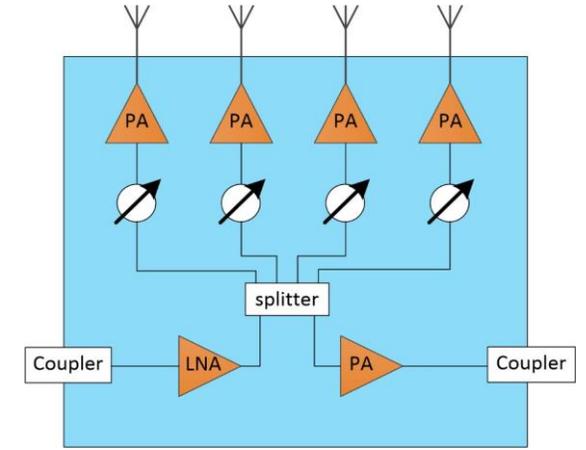


The radio stripe building blocks

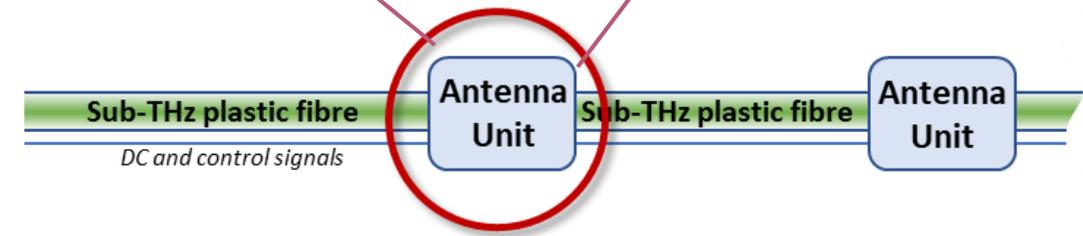
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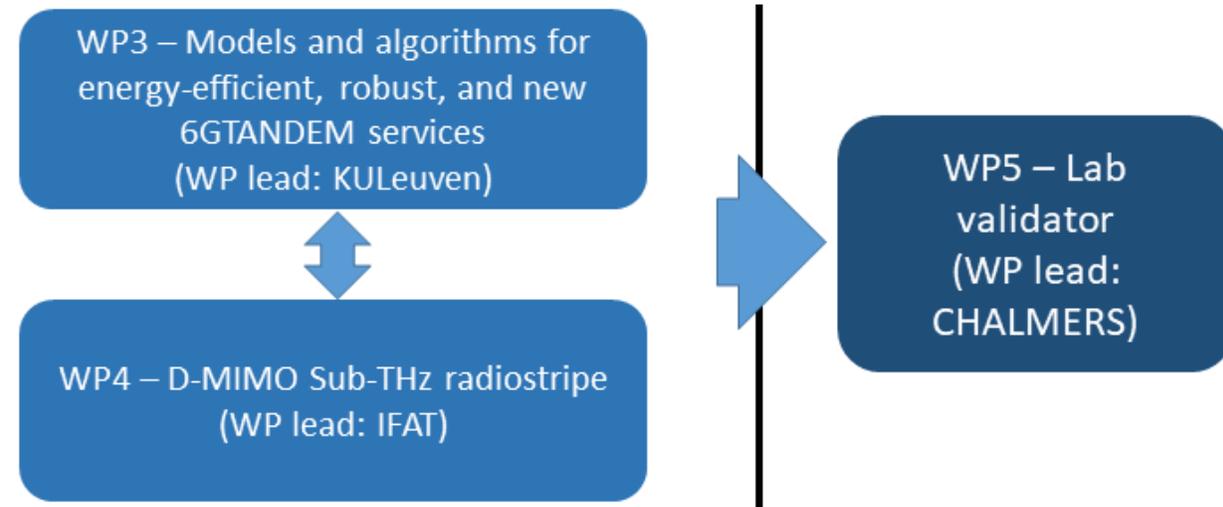
Booster unit (BU)



Radio unit (RU)



Progressing HW-system co-design: inter-dependencies

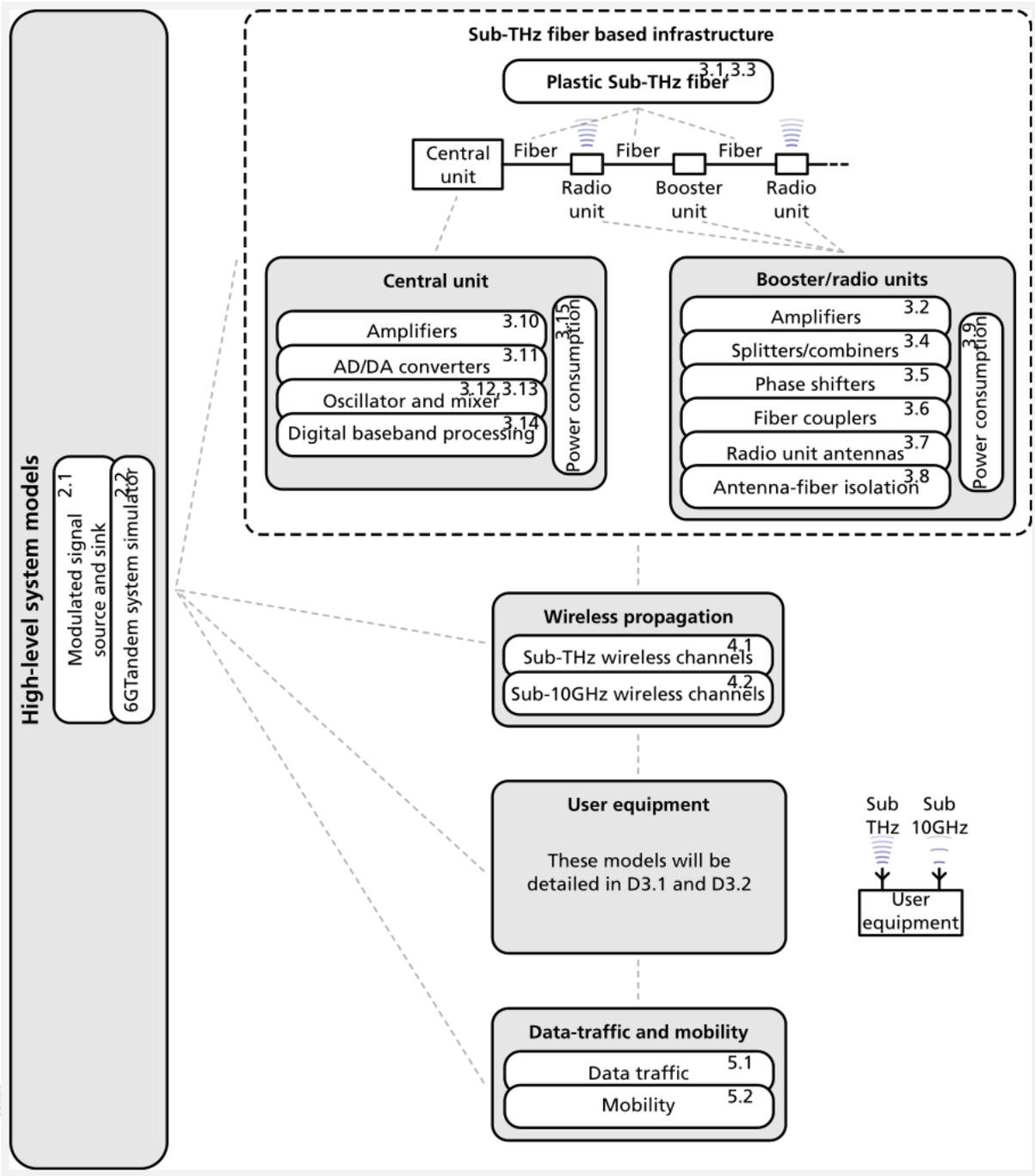
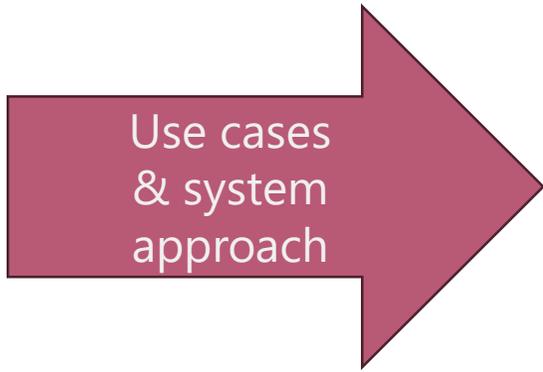


System design requires models/parameters of HW (PMF and components)

HW design/implementation long cycle, needs steering from system-level

→ Approach:

- Initial guestimates for HW data, models and parameters planned to update regularly
- Early planning and risk management for validation integrating new hardware



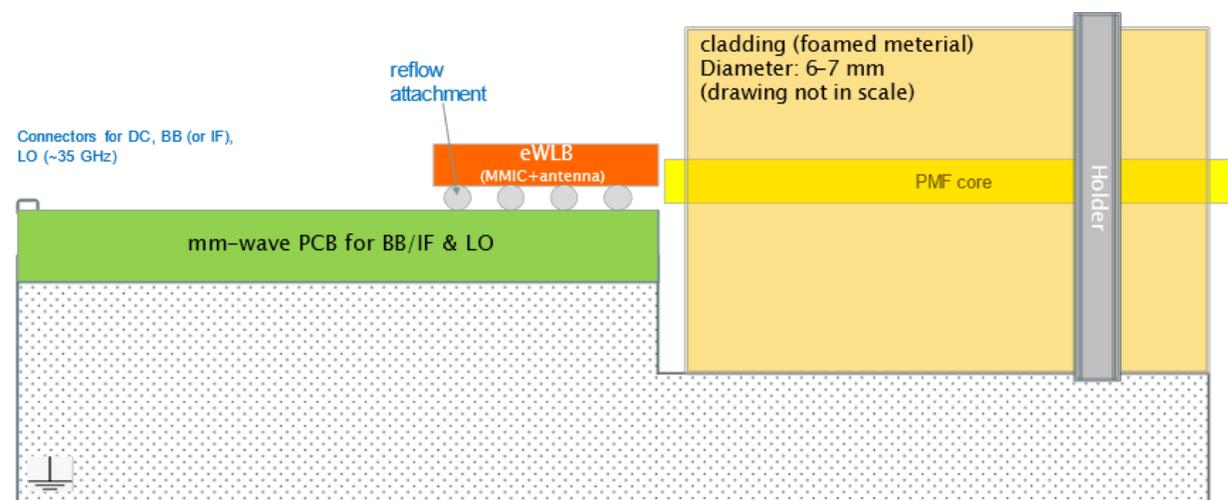
Hardware solutions: circuits and modules in progress

Circuits:

- D-band Tx/Rx
- Switches
- Phase shifters
- amplifiers
- Power detector
- Splitter /combiner

Circuits to be packaged:

- TX and RX for PMF links
- Amplifiers for RU
- Integrated antenna with PA, TX/RX

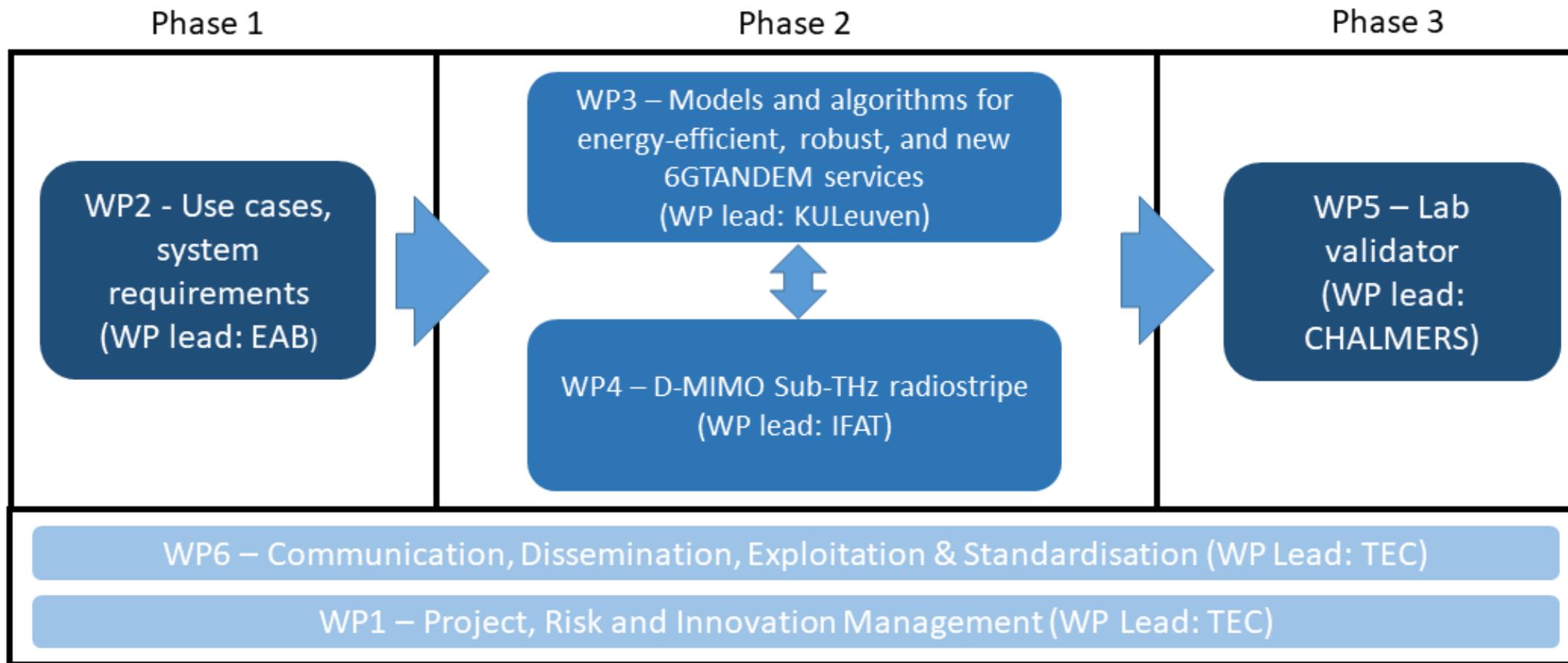


Next steps:

- Integration - PCB design
- Characterization
- Re-design

The 6GTandem plan

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If you need further information, please contact the coordinator:

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