The Age of the THz 6G vision to connect the worlds and expand human experience

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## The past, present, and future



Wireless and het-cloud driven future for ecosystem and use case expansion

## Communications in the 6G era – the foundation for the future





Augment our THz intelligence Knowledge systems Create & consume new digital worlds Control the automatons Human Machine Interface

6G to expand the human experience across physical, digital and biological worlds

## Mixed reality telepresence Be anywhere, anytime, any way you want



#### Multiple streams of data

#### Spatial computing

#### Synchronization



## Mixed reality co-design





## Six key technologies for 6G



## The new 6G requirements





## Expanding to THz spectrum



### D band: 140 GHz to 180 GHz

#### Waveform design for 100s of Gbps

#### Higher output power

RFIC / Transceiver Design

Antenna array

Channel modeling

## Massive MIMO challenge



#### Advanced Signal Processing Platforms & Algorithms Increase spatial multiplexing efficiency

Low-cost/Low-power Radios/Arrays Scale to very large arrays

**Flexible Radios/Arrays** Multi-band, large bandwidth, waveform agnostic

Invisible Arrays Integrate into infrastructure

## 6G network creating a sixth sense





### Communication and sensing co-design

- Waveform multiplexing
- Resource allocation
- Beam sweeping
- CSI based sensing using AI/ML
- Algorithms for identification of objects

### High precision localization in NLOS



## Nokia leads the EU 6G flagship project Hexa-X



- Hexa-X is a flagship research initiative from the European Commission, with strong participation of major industry and academia stakeholders in Europe, to develop the foundation and contribute to industry consensus leading beyond 5G to 6G.
- The focus is on structuring, framing, and developing technology for connectivity needs in the 2030 timeframe, as a first step towards realizing 6G.
- It aims to develop key technology enablers in the areas of
  - fundamentally new radio access technologies at high frequencies and high-resolution localization and sensing;
  - connected intelligence though Al-driven air interface and governance for future networks, and
  - 6G architectural enablers for network disaggregation and dynamic dependability.





#### 6G Hexa-X vision to frame our joint agenda of research

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## 6G related resources

- Webpage: Nokia Bell Labs 6G era research page ٠
- White Paper: Communications in the 6G Era ٠
- Webpage: <u>Hexa-X official website</u> ٠
- Blog: <u>6G technology leadership in the US</u> ٠
- Webpage: Nokia Bell Labs 5G standards and research ٠ leadership



#### How we envision the 6G era.

The rise of the autmented human

networks will help us navigate that information, helping us make befor decisions while automating the mundane tasks of life.

