

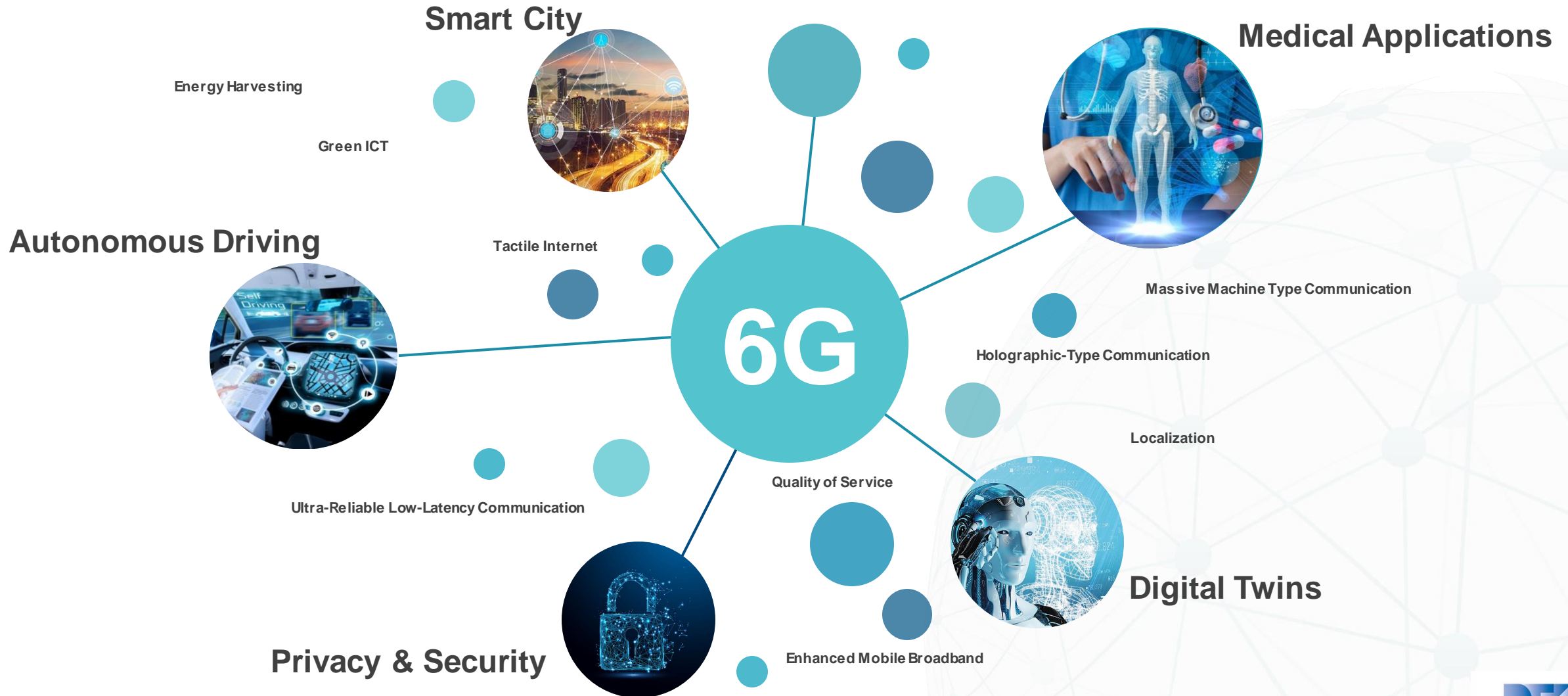
Towards the Sixth Generation (6G) Wireless Systems: Thoughts on Physical Layer Security

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The Sixth Generation (6G) Wireless Systems



6G Enabling Technologies

Distributed Processing

Radio Access Networks are already part of the 5G development; this will be the standard in 6G



(Sub) THz communication

High frequencies enable wider bandwidth, localization and sensing



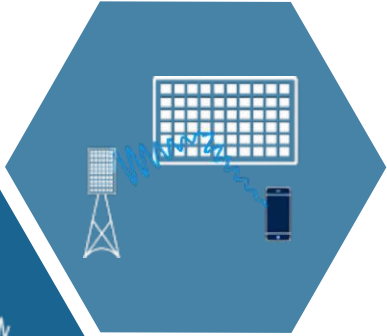
Artificial Intelligence

AI and ML are currently applied for network management and orchestration; In 6G it will influence every block of the signal processing chain



Reconfigurable Intelligent Surfaces

RISs are planar surfaces/arrays of passive reflecting elements capable of “reconfiguring” the wireless propagation environment



Ultra - massive MIMO

Wavelengths will become shorter: opening the possibility of integrating more antenna elements



Visible Light Communication

VLC is part of the optical wireless communication technology



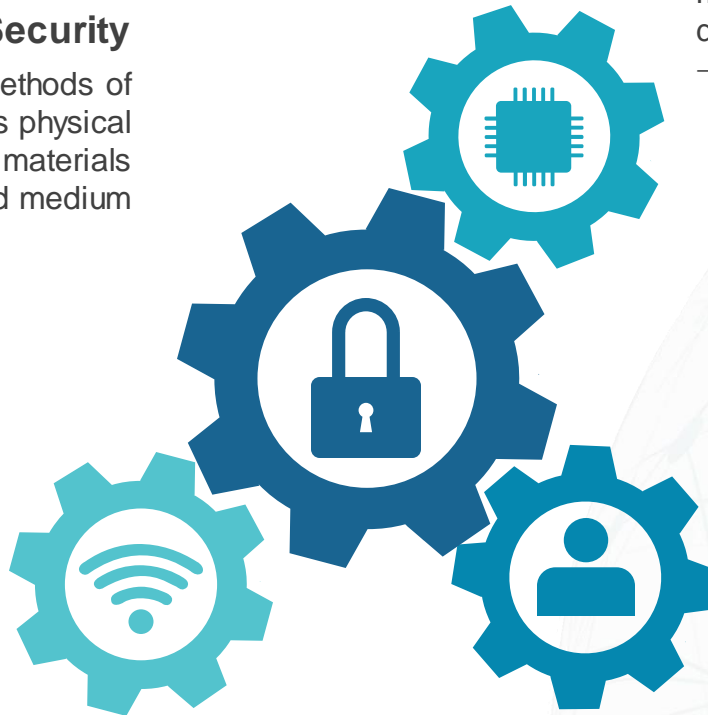
Physical Layer Security

Physical Layer Security

PhySec comprises several methods of how to utilize various physical characteristics of different materials and medium

Channel - PUFs

Channel PUFs use characteristics of electromagnetic waves and exploiting the randomness of a wireless channel.



Physically Unclonable Functions (PUFs)

PUFs use electronic properties of components, manufacturing-related and uninfluenceable deviations of semiconductor circuits
→ *Silicon PUFs*

Human - PUFs

Biometric identification is based on physiological, biological and behavioral characteristics of humans.

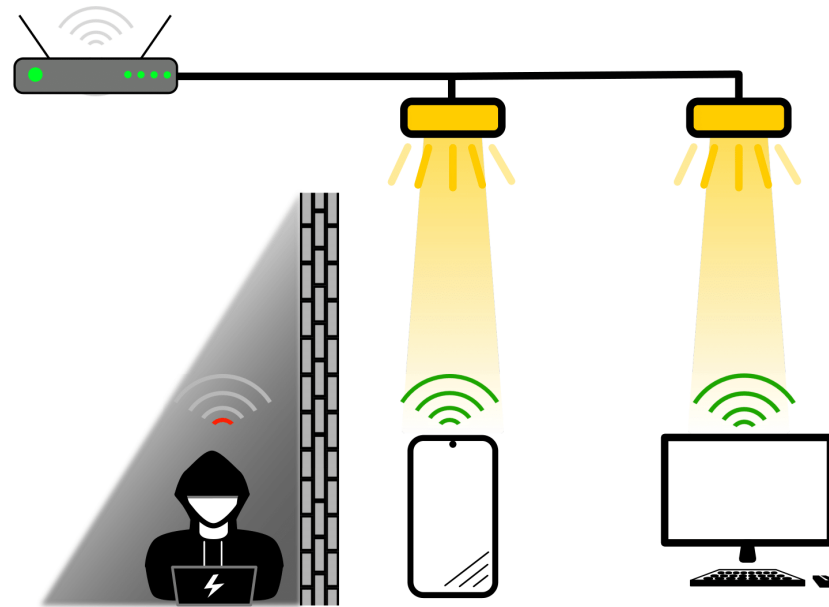
Visible Light Communication VLC

Features & Characteristics

visible light

Structure

LED as transmitter, air as transmission medium and a photo diode as receiver



Advantages

LoS communication, range limitation and wall constraint

outdoor applications

High transmission rate, ultra-high bandwidth

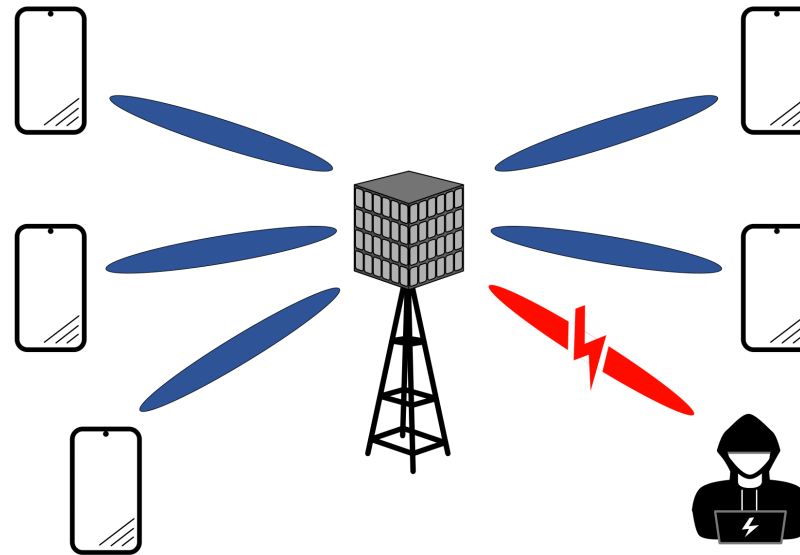
Ultra-Massive MIMO

Features & Characteristics

Higher frequencies
→ Smaller wavelengths

Advantages

More antenna elements on the same physical space
→ more users are served



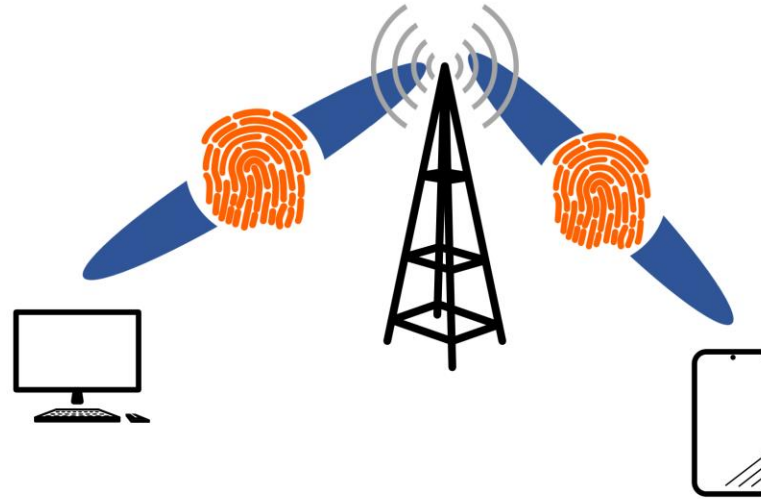
Advantages

More antenna elements
→ tighter beams
→ lower eavesdropping chance

Link Integrity Monitoring

Physical Layer Characteristics:

Received Signal Strength Indicator (RSSI),
Channel Impulse Response (CIR), angle of arrival



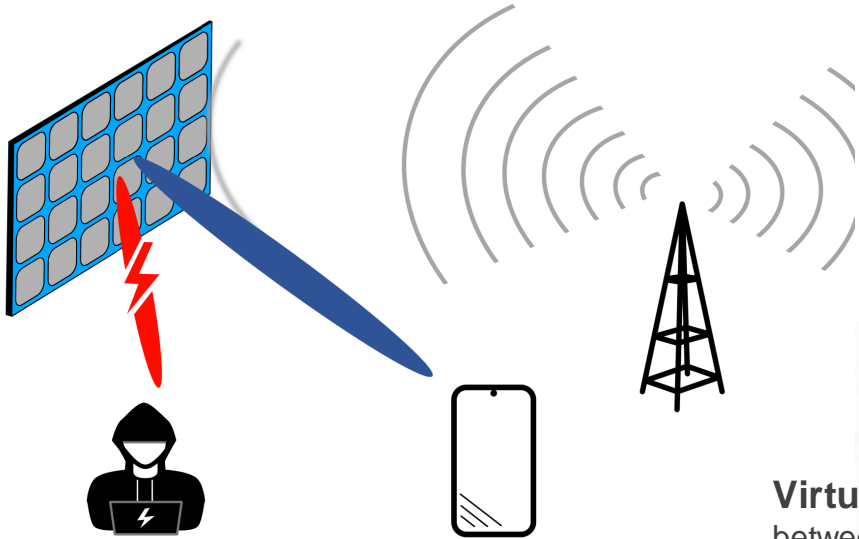
Result
Counterfeiting mitigation

Comparison to cryptographic certificates
and Message Authentication Codes (MAC)

Reconfigurable Intelligent Surfaces RIS

Features & Characteristics

narrow beams and unique fingerprints



Security Threats

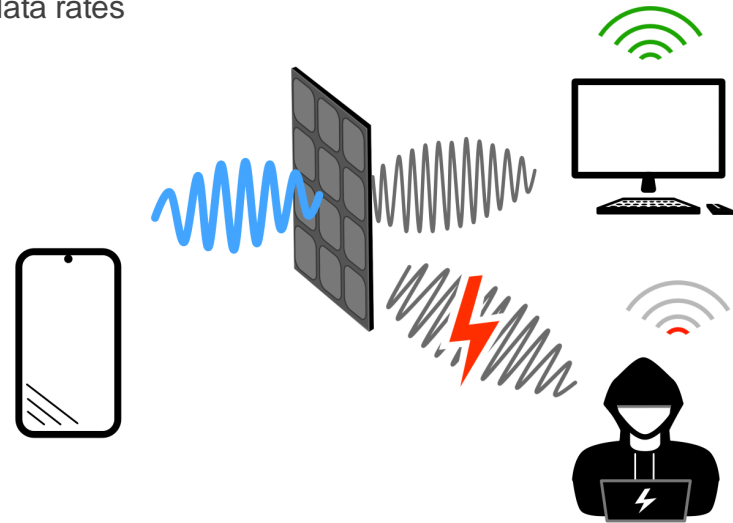
jamming attacks and information leakage

Virtual Line of Sight (LoS)

between the source and the destination

Sub Terahertz Communication THz

Higher Frequency Bands
higher bandwidth and data rates
Accurate positioning



Secret Key Generation
Relies on channel variation

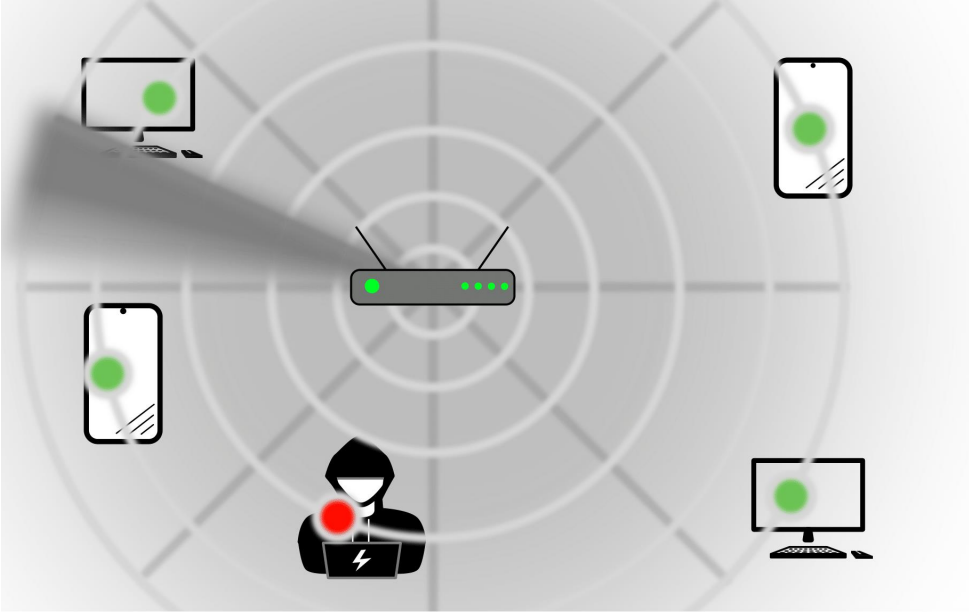
Higher Randomness
Higher entropy

Localization and Sensing

Accurate Localization

In higher frequency bands

Location Information
as security parameters



Sensing Applications

Passive and active

Use-Cases

health monitoring and autonomous driving

Conclusion & Future Work

- Highlighting research areas for the Sixth Generation Wireless Systems
 - Introducing "our" view of Physical Layer Security
 - Discussing how 6G can/will contribute to Physical Layer Security
- Implementation of the technologies in test setups



THANK YOU

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