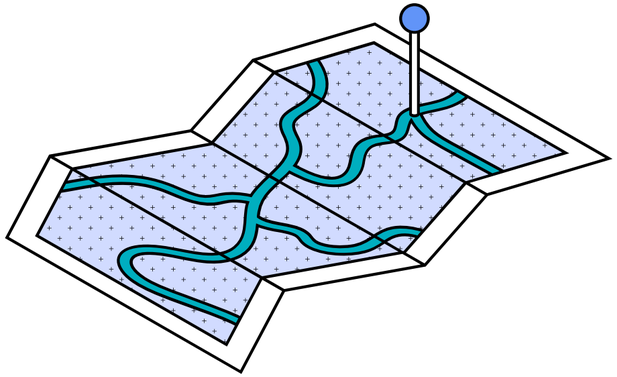
Leading Technologies in 6G



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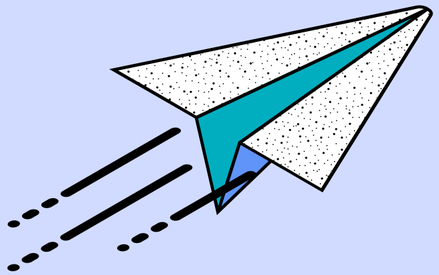
1G	2G	3G	4G	5G
1980s	1990s	2000s	2010s	Current
Basic voice service	Voice service, SMS, and MMS	Voice with data, SMS, MMS, video calls, Internet access, mobile TV	Voice with data, SMS, MMS, Internet access, video calls, mobile TV HD, cloud computing	Voice with data, SMS, MMS, Internet access, video calls, mobile TV HD, cloud computing, and the Internet of Things

Agenda



- Introduction
- Technologies
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  - Intelligent Surfaces
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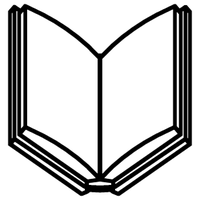


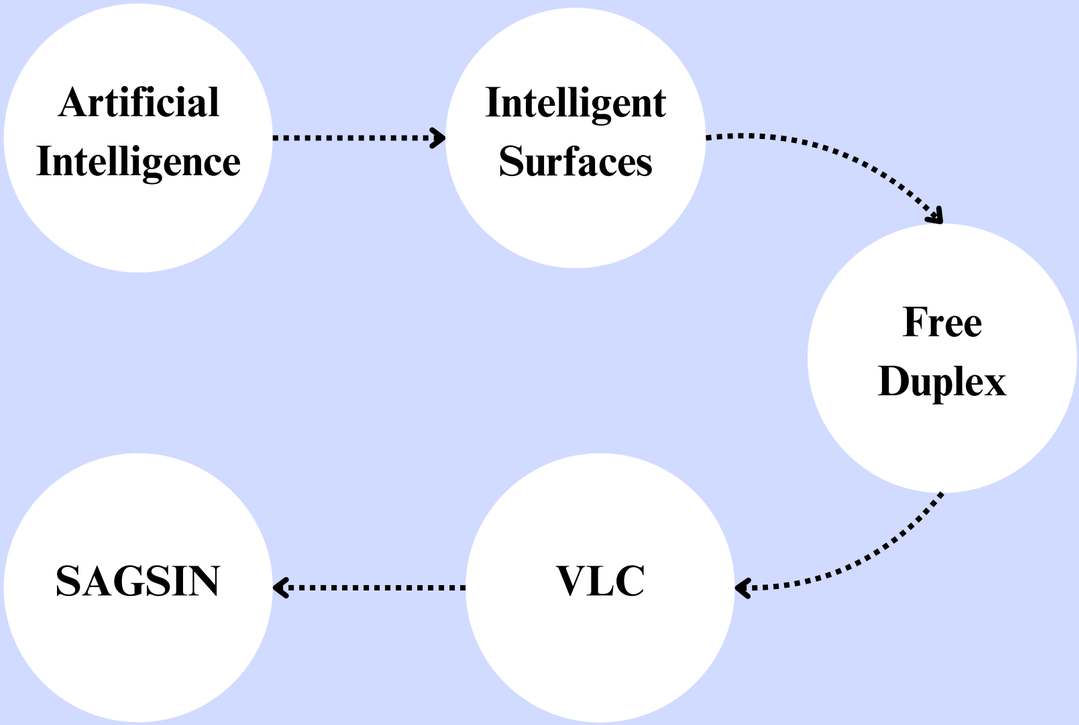
Introduction

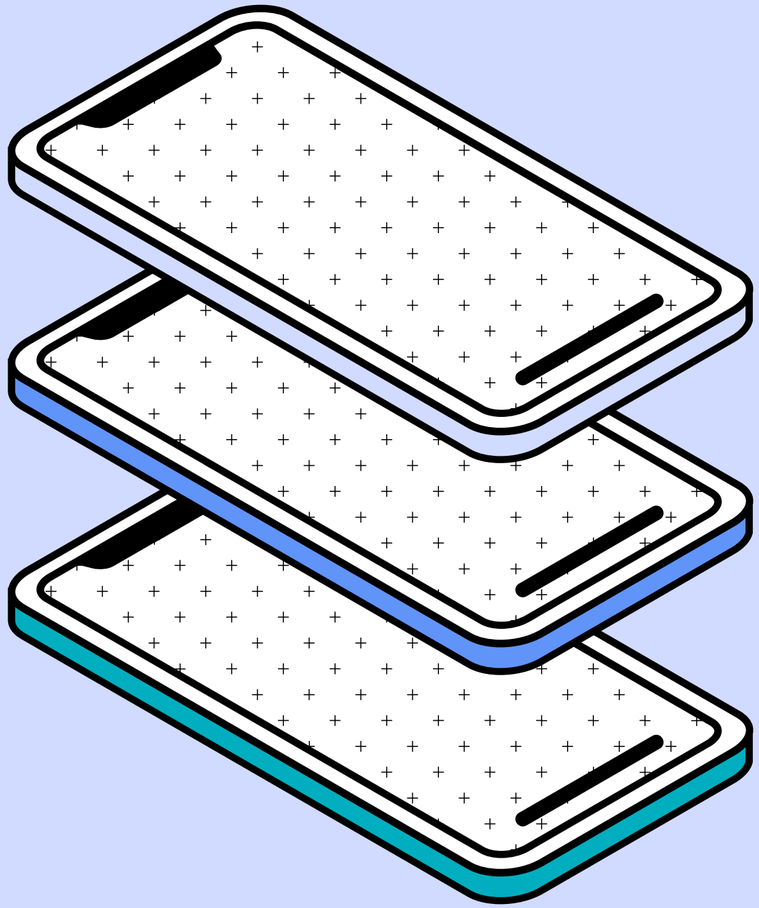
- Data-centric intelligent systems
- Haptic Internet-based telemedicine
- Stricter requirement & better QoS & broader coverage

Requirements	6G
Service types	MBRLLC/mURLLC/HCS/MPS
Service level	Tactile
Device types	Smart implants/ CRAS/ XR and BCI equipment/ Sensors and DLT devices
Jitters	1 μsec
Individual data rate	100 Gbps
Peak DL data rate	$\geq$ 1 Tbps
Latency	0.1 msec
Mobility	up to 1000 km/h
Reliability	up to 99.99999%
Frequency bands	- sub-THz band - Non-RF, e.g, optical, VLC, laser $\cdots$
Multiplexing	Smart OFDMA plus IM
Power consumption	Ultra low
Processing delay	$\leq$ 10ns
Maximum rate	100Gb s^{-1}
Security and privacy	Very high
Network orientation	Service-centric
Wireless power transfer/ Wireless charging	Support (BS to devices power transfer)
Smart city components	Integrated
Autonomous V2X	Fully
Localization precision	1 cm on 3D

TABLE 1: Requirements and Features of 6G

Technologies



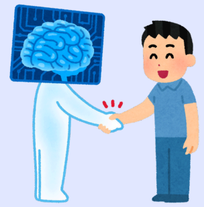


Artificial Intelligence

Making 6G a Revolutionary Leap in Wireless Communication

Federated Learning

- training data remaining distributed at clients
- protect data owners' privacy
- moving from a centralized cloud-based model to the decentralized devices base
- edge computing



Explainable Artificial Intelligence

- autonomous driving and remote surgery
- building trust between humans and machines
- PYH and MAC layers
- methods : visualization with case studies, hypothesis testing, and didactic statements

Intelligent Surfaces

- made of electromagnetic (EM) material
- electronically controlled
- reflection coefficients
- not require a specific energy source
- low-cost & lightweight
- optimization problems consumes a lot of time and hardware resources
- complex CSI with large number of IRS elements

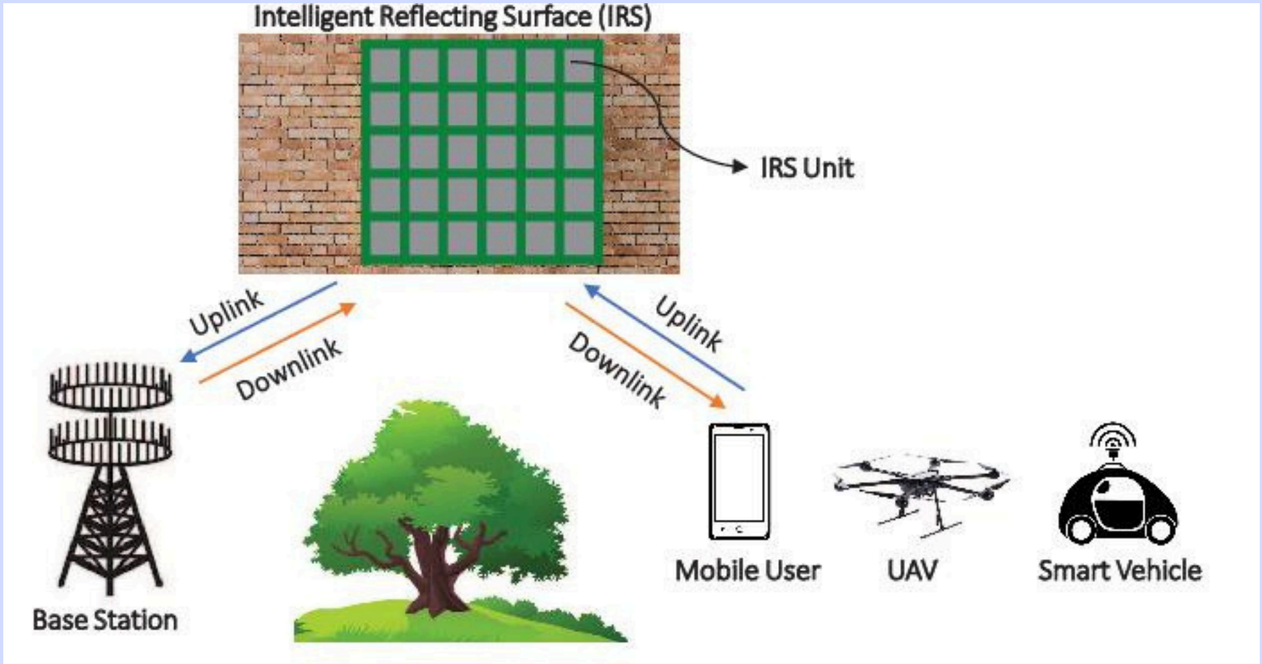


Fig.1: Intelligent Surface Application

Free Duplex

- optimal spectrum resources usage
- Flexible Duplex vs FDD & TDD
- double current efficiency
- transmit and receive in the same frequency band

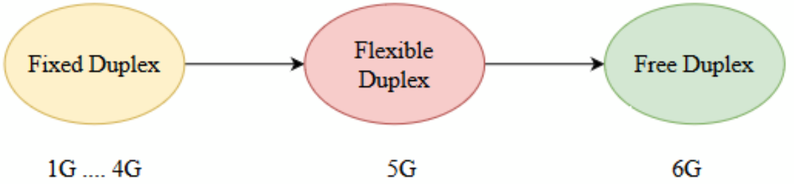


Fig.2: Evolution of Duplex Techniques

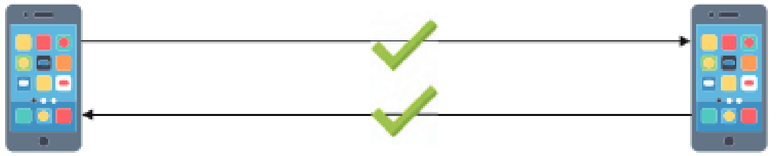


Fig.3: Full-Duplex

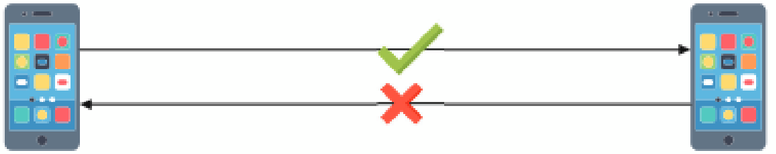
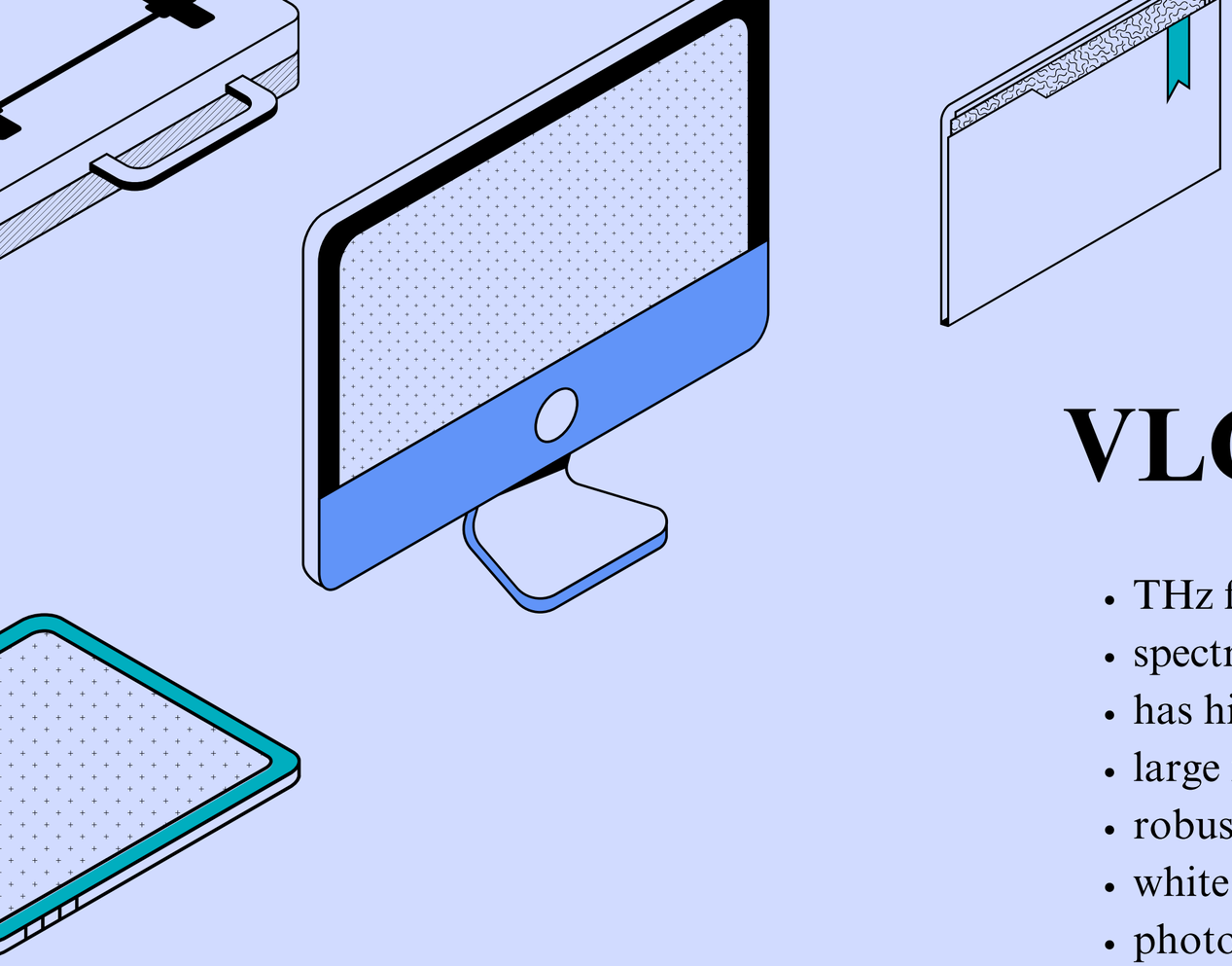


Fig.4: Half- Duplex



VLC

- THz frequencies
- spectral congestion
- has high data rates
- large frequency spectrum
- robustness against interferenc
- white laser diodes or light-emitting diodes
- photodetectors
- 100Gbps
- indoor / underwater / underground
- no application-specific integrated circuits for VLC baseband processing

SAGSIN

- multi wireless communication system
- terrestrial experiencing explosive growth in number of users
- satellite / UAV / terrestrial / maritime communication networks
- IoT / big data / cloud computing

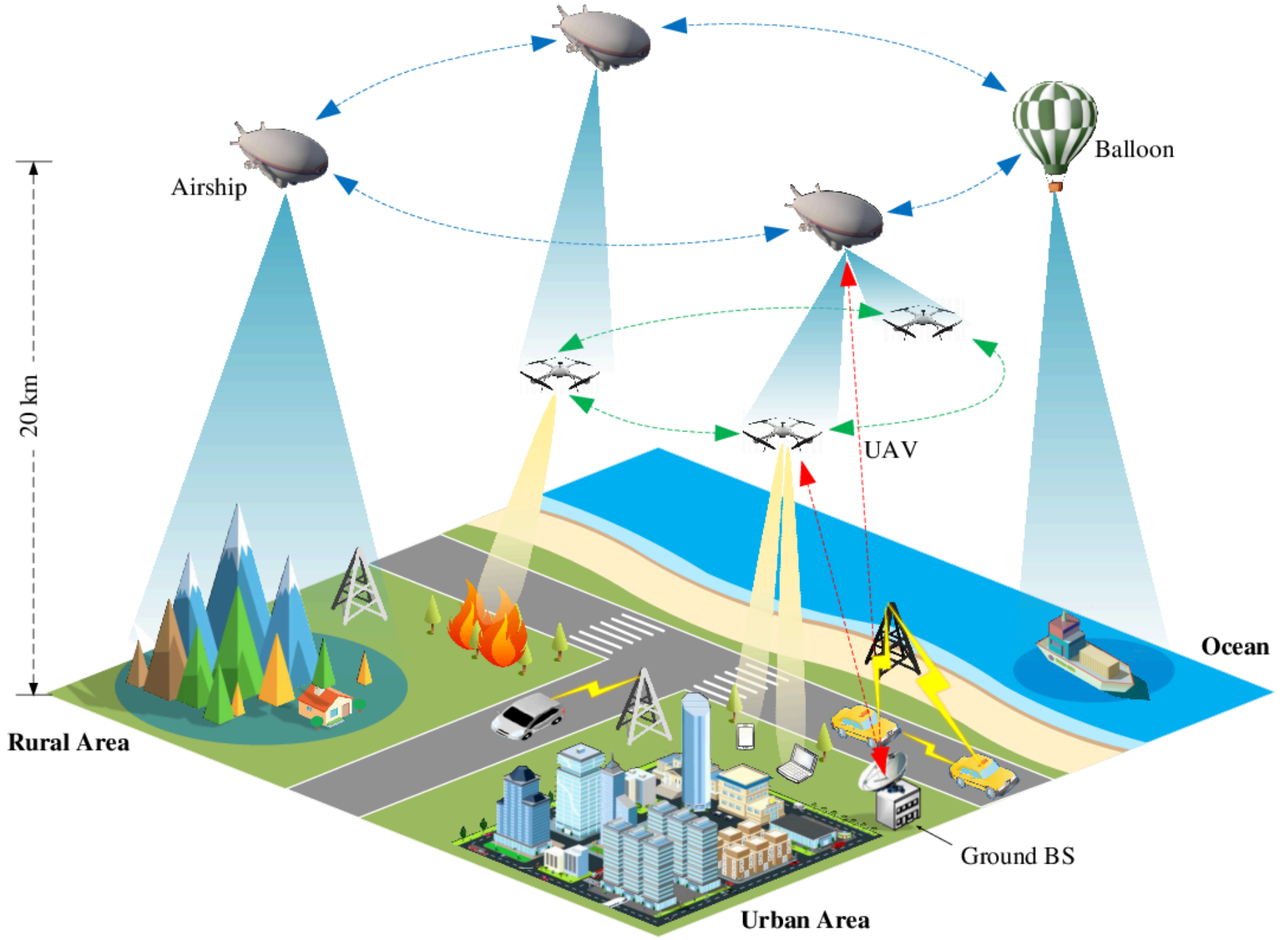


Fig.5: SAGSIN

Conclusion