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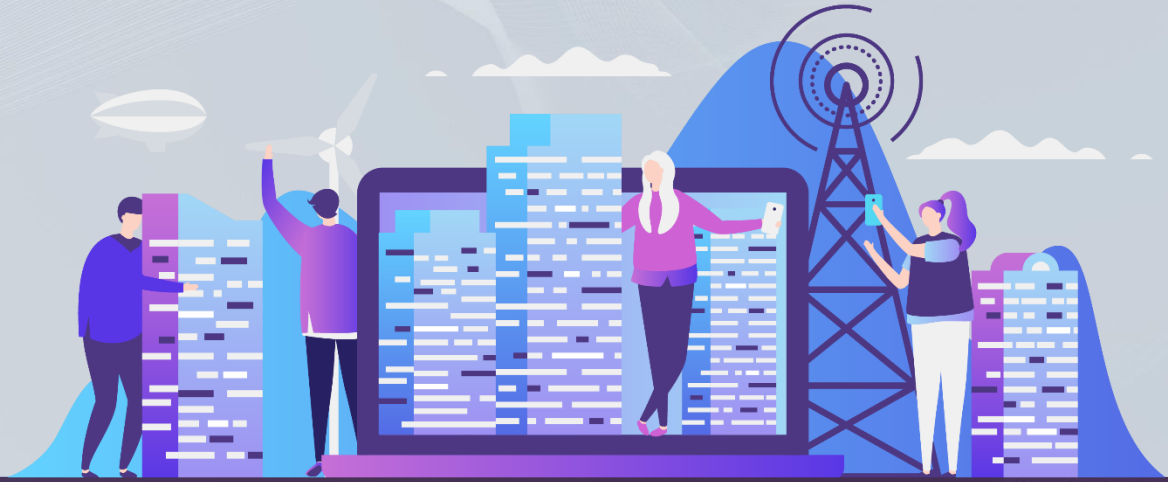
mmW RCN Workshop Panel 2: From 5G to 6G



Charlie Zhang

July 24, 2019

Thinking Beyond 5G and Plan for 6G

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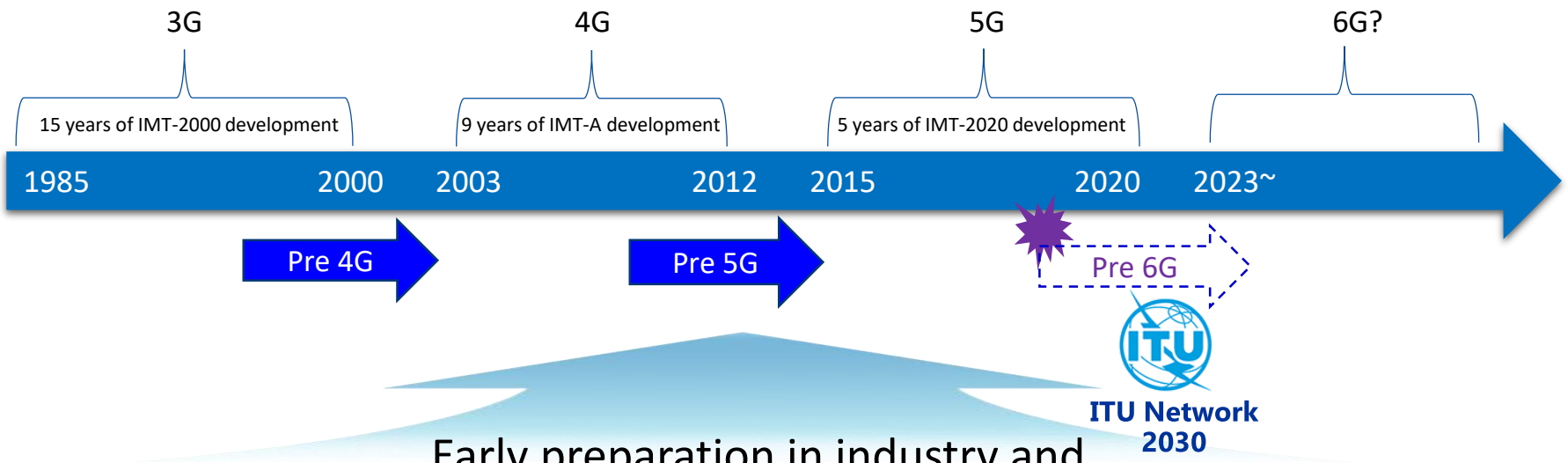
New mobile generations have appeared about every ten years

Technology development has accelerated recently especially with 5G



Early preparation in industry and academia research is the key to success

From 5G to 6G

Enhancing all interaction aspects of 5G

5G

6G

Mostly Human-Centric

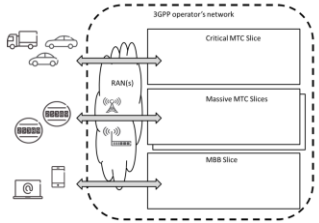
Human to Human

Human to Machine

Machine to Machine

Intelligent Machine Interaction

Network-Centric Design



Device-centric design

Converged communication & computing

Enabling of new business model

Industrial Automation

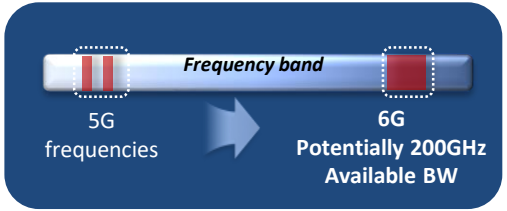
Massive real-time sensor data processing

Intelligent Transportation

5G Americas ('17.11)

Key Enabling Technologies for 6G

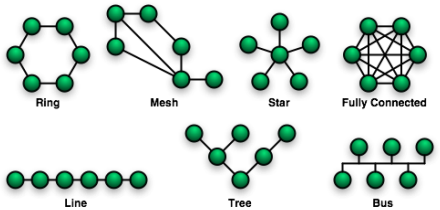
New Spectrum Opportunity



FCC Proposes to Open Spectrum Horizons for New Services & Technologies (>95GHz) Feb. 2019

- Tera Hz
- Shared Spectrum

New Cellular Topology



- Mesh Network
- Distributed MIMO

Converged Computing and Communication

Only 0 or1

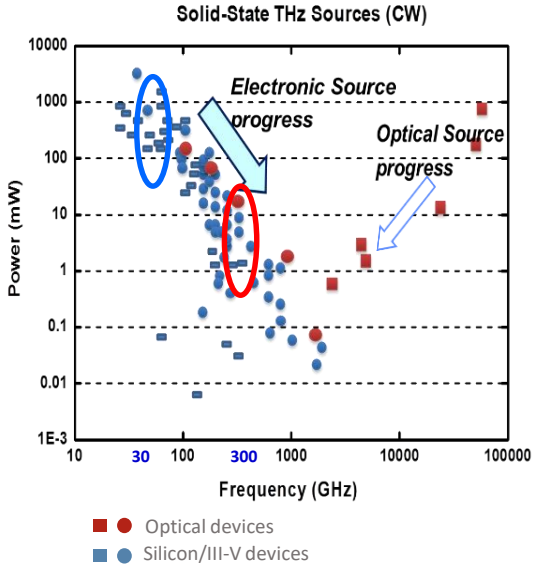
0 and 1 at once

- Quantum Computing
- AI/ML for Wireless

6G: technology & business model innovation

THz Challenges: Efficiency

- Much lower PA output power, and higher noise LNA from 28GHz to 300GHz

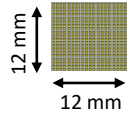


Source: Afshari, The Last Untapped Spectrum

E.g. Pout ~10mW NF>10dB @300GHz
v.s. Pout>300mW, NF: 4~5dB @28GHz

Link Budget

$$SNR_{RX} \propto \frac{N^3 \cdot P_{T1} \cdot \lambda^2}{NF \cdot BW \cdot R^2}$$



- Maintain 28GHz link distance R and SNR margin, ***10X*** throughput gain through BW increase
- Assume one antenna per RF chain, square phased array

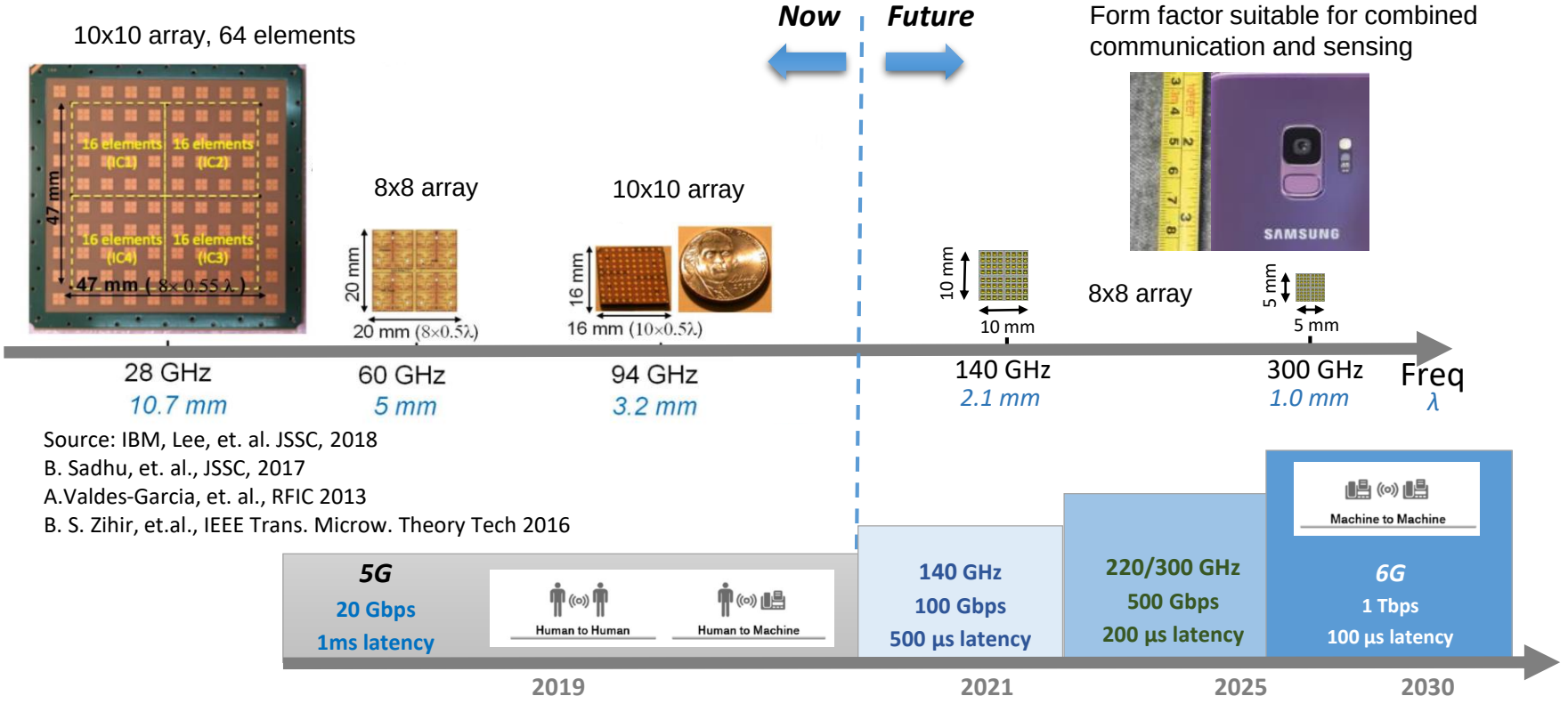
	300GHz v.s. 28GHz
P_{T1}	1/30
NF	4X
BW	10X
λ	1/10
N	**50X**

R: link distance
P_{T1}: Tx output power per chain
NF: Rx noise factor
BW: bandwidth
λ: wavelength
N: **# of transceivers**

- E.g. **8** TRx at 28GHz ≈ **400** TRx at 300GHz
- Cost/power prohibitive phased array

New systems, BF architecture, devices needed

THz for 6G Roadmap



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Thank you!