6G Journey: A critical interdependence of Chips and Connectivity

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What is 6G?

What the crowd-sourced crystal ball tells us ?

What will be the defining new application for the 6G Era?

Immersive experience/XR	**27%**
Digital-physical fusion	**25%**
Autonomous vehicles	**25%**
Co-bots & AI agents	**23%**

782 votes

New experiences…

Which of the below will be one of the defining new technologies for 6G?

AI-based networking	**51%**
Cloud-native architecture	**24%**
Satellite	**13%**
New spectrum radio	**12%**

3,119 votes

…over native-AI networks

What do you think will be the most important KPI for 6G networks?

Security and trust	**34%**
Latency & reliability	**29%**
Energy Efficiency	**20%**
Throughput & capacity	**17%**

3,126 votes

…which are safe and trustful

Nokia Bell Labs 6G vision, since 2019:

- Digital-physical fusion will liberate human potential in the 6G Era
- Powered by native-AI networks and applications
- In a (quantum) safe and trusted way

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Bringing future to live

Six key technology areas for the 6G essential infrastructure

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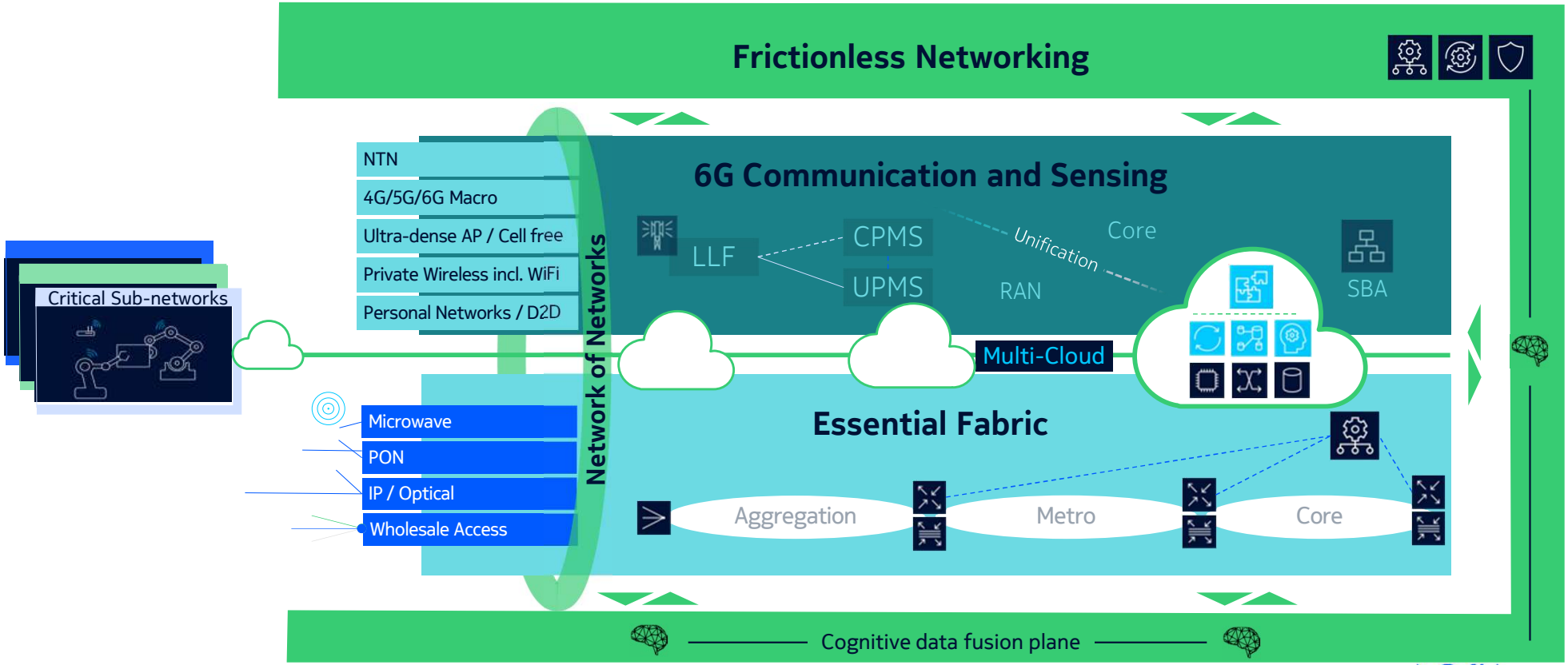
Wireless/Optical convergence in the context of 6G

The architectural view of future networks in 2030



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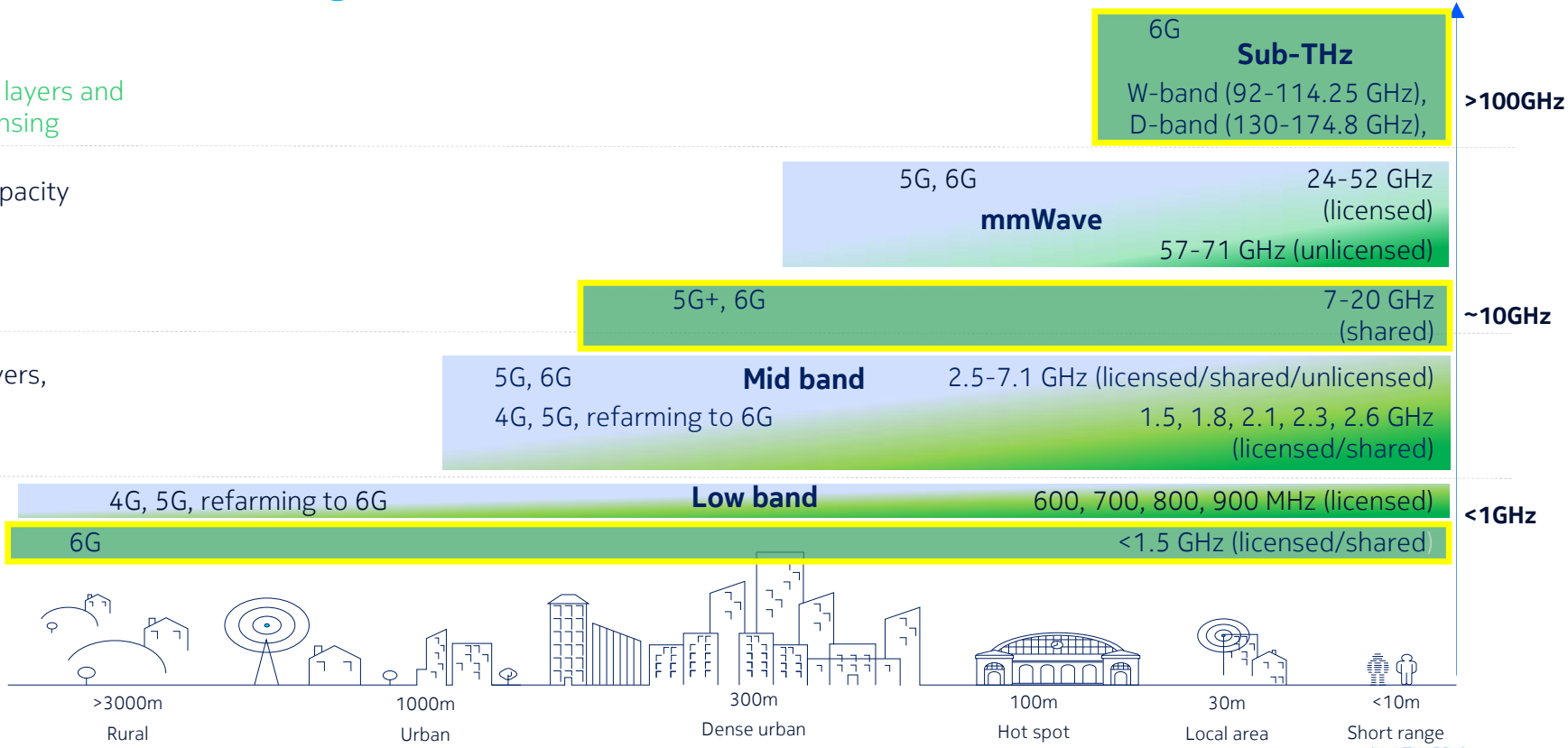
6G new spectrum technologies

Band options for a new generation



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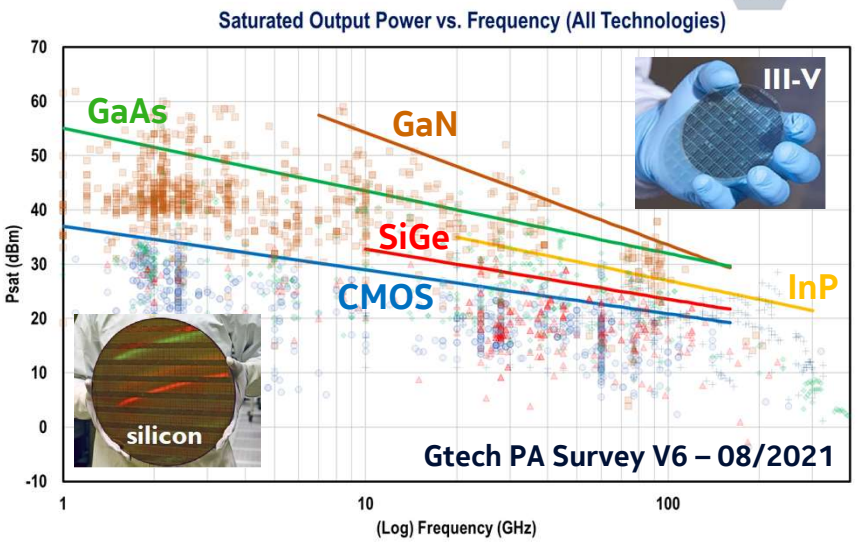
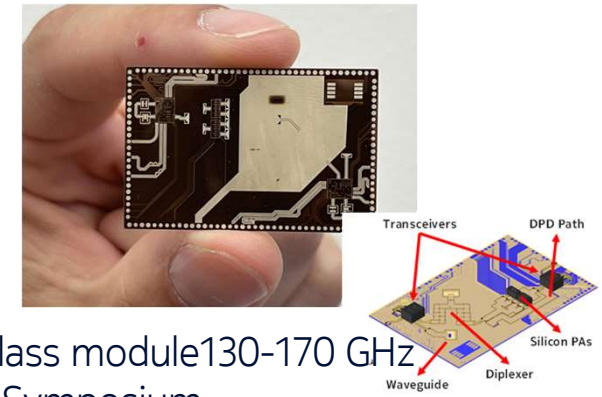
6G new spectrum technologies

…. And there is still exciting research in wireless

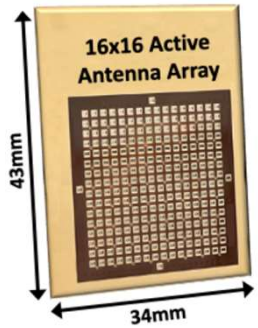
Analog and Mixed Signal Circuits

- Analog circuits **do not follow Moore's scaling laws** for size, DC power or performance.
- The analog industry has seen **strong consolidation** and a trend towards **higher integration** of functions especially in consumer applications
- Use of **III-V technologies** (GaN, GaAs and InP) enables higher frequency operation, lower noise and higher output power and efficiency for PA's
- Future trend is monolithic or wafer-scale integration of III-V devices with scaled CMOS (**InP & GaN on Si**) enabling optimal analog-digital SoC's





Radio-on-glass module130-170 GHz
*2022 RFIC Symposium



256-element D-Band array
*2022 ISSCC

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Solving the Extreme Connectivity equation

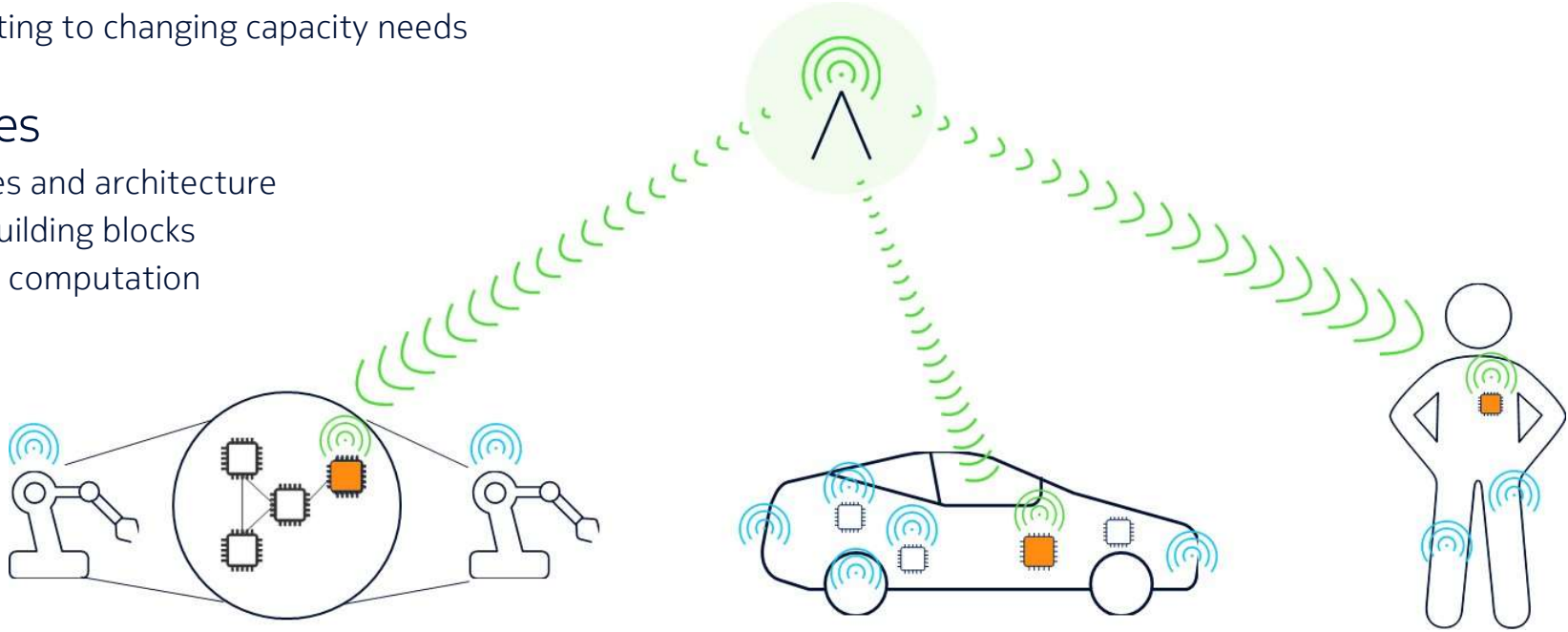
Flexibility and Low Power

Processor-based approach - ASIPs

- Programmable accelerator IP – adapting to changing standards
- Baseband functions – adapting to changing algorithms
- Scalable SoC – adapting to changing capacity needs

Enabling technologies

- Memory technologies and architecture
- Low-power digital building blocks
- Analog-mixed signal computation



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6G: Access, Sensing and Intelligence at Scale

Disruptive Chips to unleash all the potential

Consumers and home

Enterprises

mmWave / THz

Fixed Wireless Access

mid-band

xPON

Access Network

Anyhaul

Edge Cloud

IP & Optical

Centralized Cloud

- Baseband and radio digital IP
- PON line termination
- Machine learning

- Switching and routing
- Optics DSP

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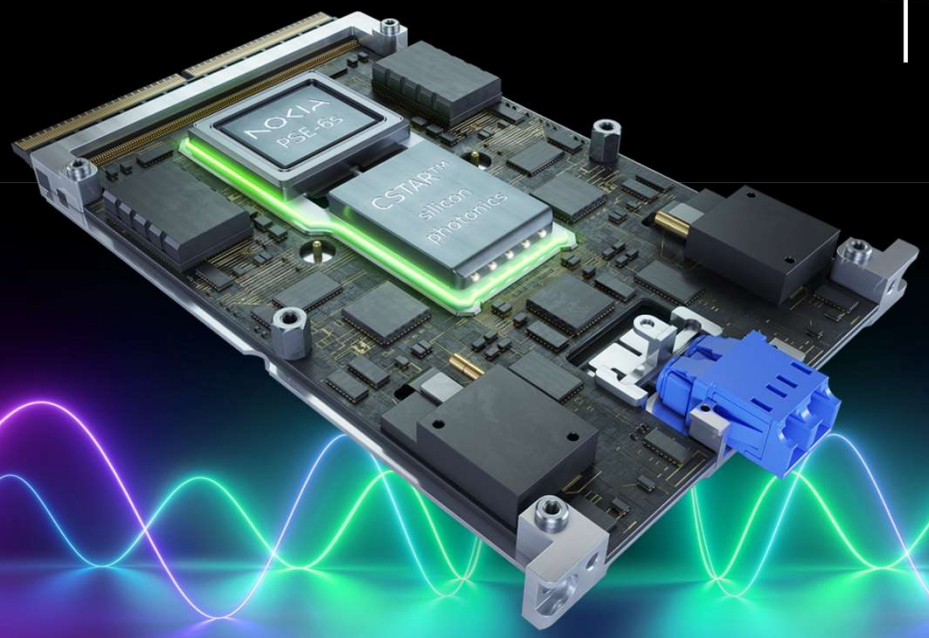
Nokia PSE-6 super-coherent



The next frontier in coherent optics

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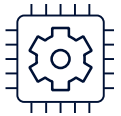
Sovereignty and Supply chain



Chips shortage revealed a fragile supply chain

The long-term success of European digital industry will depend on how Europe can secure its presence in the overall value chain

- EU's capability to capture its strengths on digital infrastructure and industry verticals
- Catalyse research, and innovate in the microelectronics/Photonics domains
- Eventually build a full strategic value chain

However, European digital autonomy does not mean to control all elements of the entire value chain

- Focus on controlling essential parts by mastering advanced and competitive technologies including critical chips design capabilities to lower the cost and support growing the talent pipeline & skills
- Meanwhile ensuring mutual dependencies between different regions (trusted partners)

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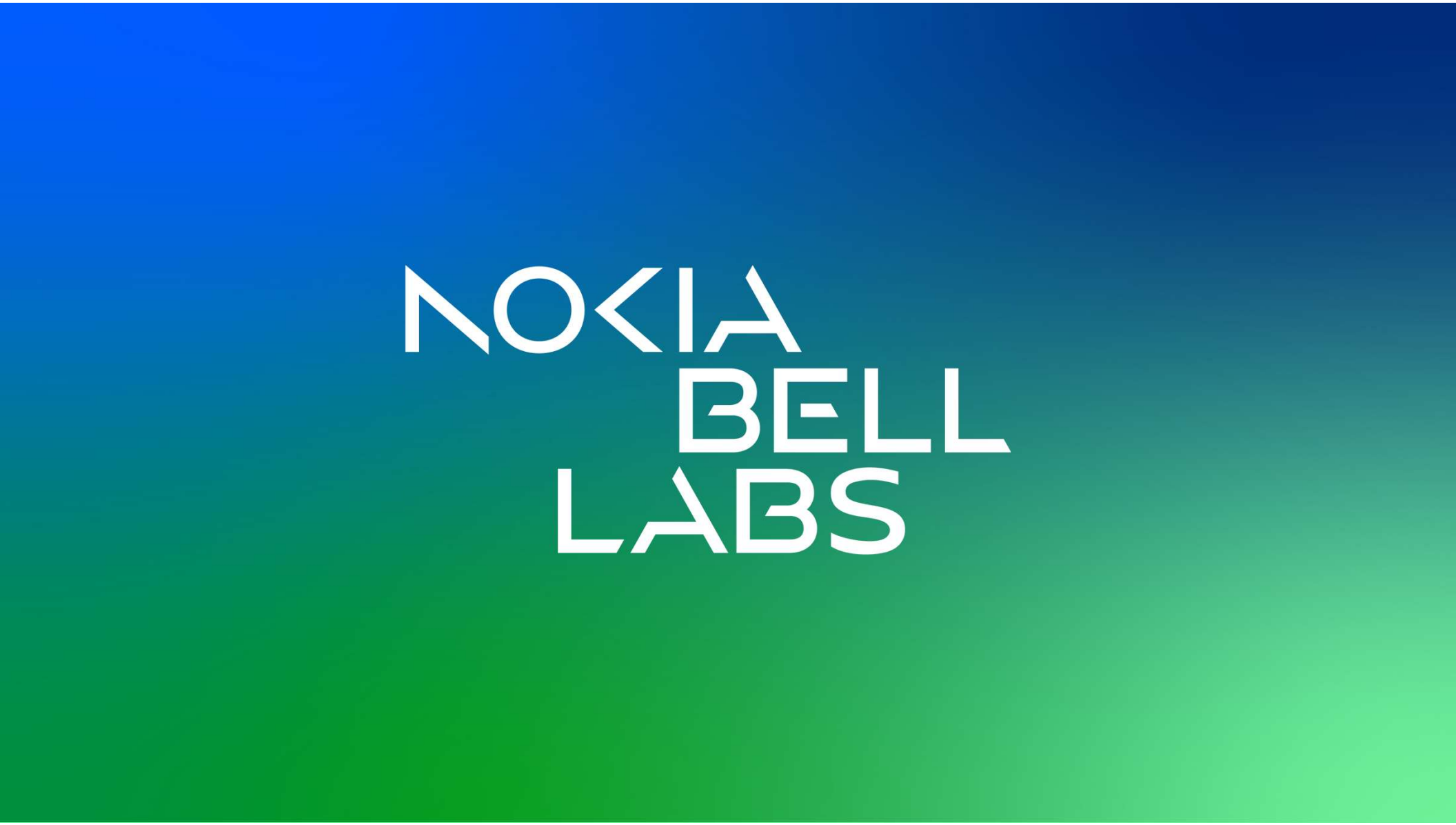
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