NOKIA BELL LABS

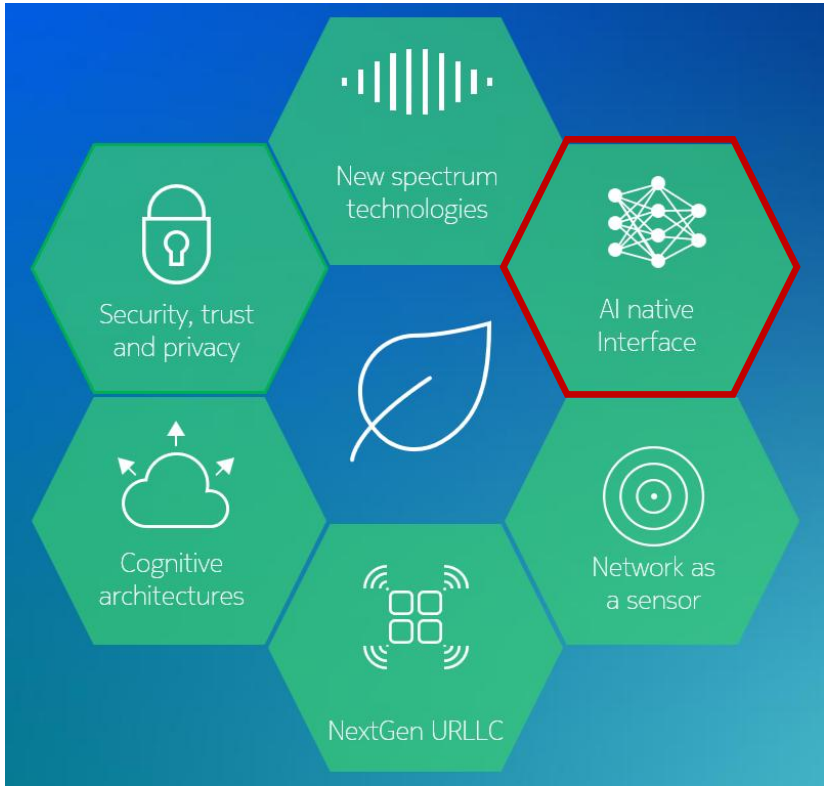
Convergence of Wireless and AI

Platform and ASIC Research Lab

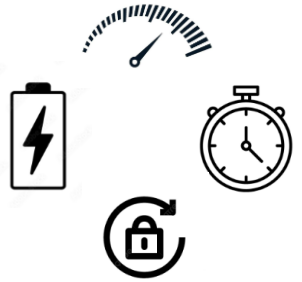
Dragan Samardzija

November 2025

6G Technologies

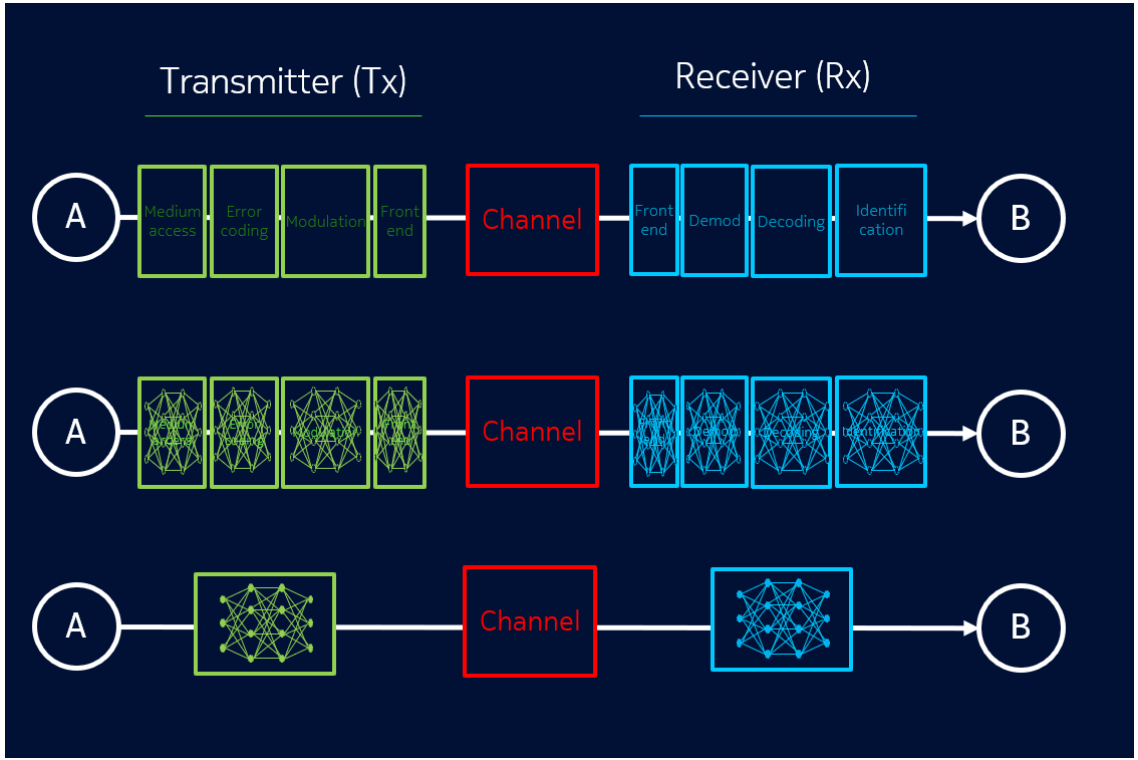


Performance

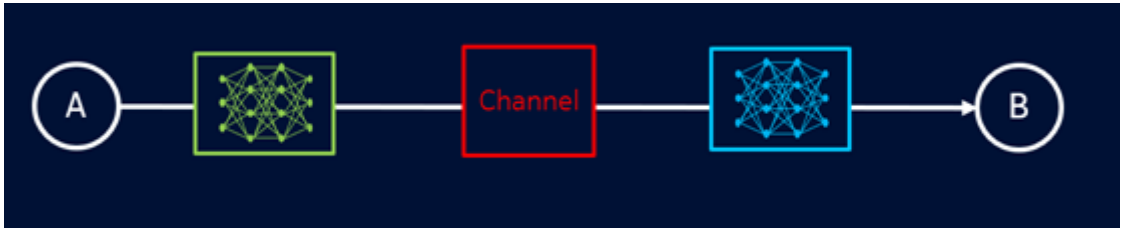


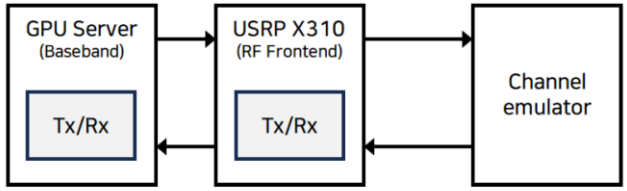
Revenue

Introduction of AI to Air Interface

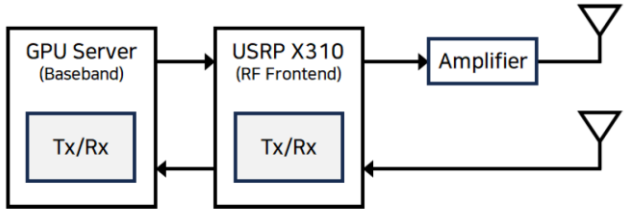


6G AI-native Air Interface

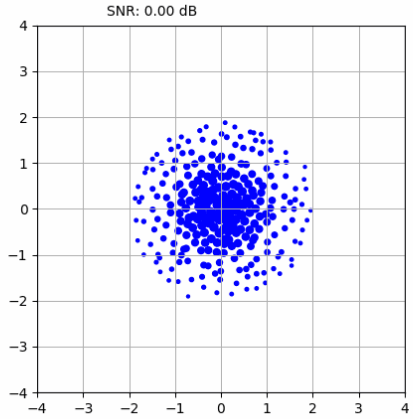




(a)



(b)



Press Releases

November 17, 2025

NTT DOCOMO Achieves Successful Outdoor Trial of AI-Driven Wireless Interface Toward 6G

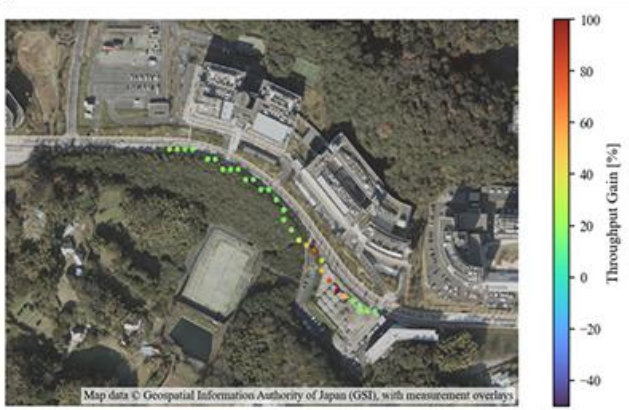
— Throughput improved by up to 100% under real-world outdoor conditions —

Print Like Post

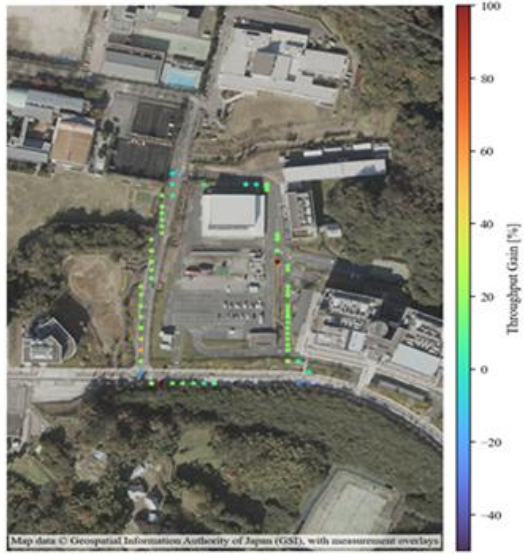
TOKYO, JAPAN, November 17, 2025 --- NTT DOCOMO, INC. announced today that they have successfully conducted the world's first outdoor demonstration using real-time transceiver systems with AI-powered wireless technology for sixth-generation (6G) mobile communications. The demonstration was carried out in collaboration with NTT, Inc. ("NTT"), Nokia Bell Labs., and SK Telecom Co., Ltd. ("SK Telecom"). Field trials took place at three locations in Yokosuka City, Kanagawa Prefecture, and confirmed that the use of AI improved throughput (transmission speed) by up to 100% compared with conventional non-AI-based methods under the same environmental conditions, effectively doubling the communication speed.

3GPP TSG RAN WG1 Meeting #123
Dallas, US, Nov. 17th – 21st, 2025

Agenda item:	**11.6**
Title:	**Discussion on AI/ML in 6GR air interface**
Source:	**SK Telecom, [Nokia, NTT Docomo] …**
Document for:	**Discussion**

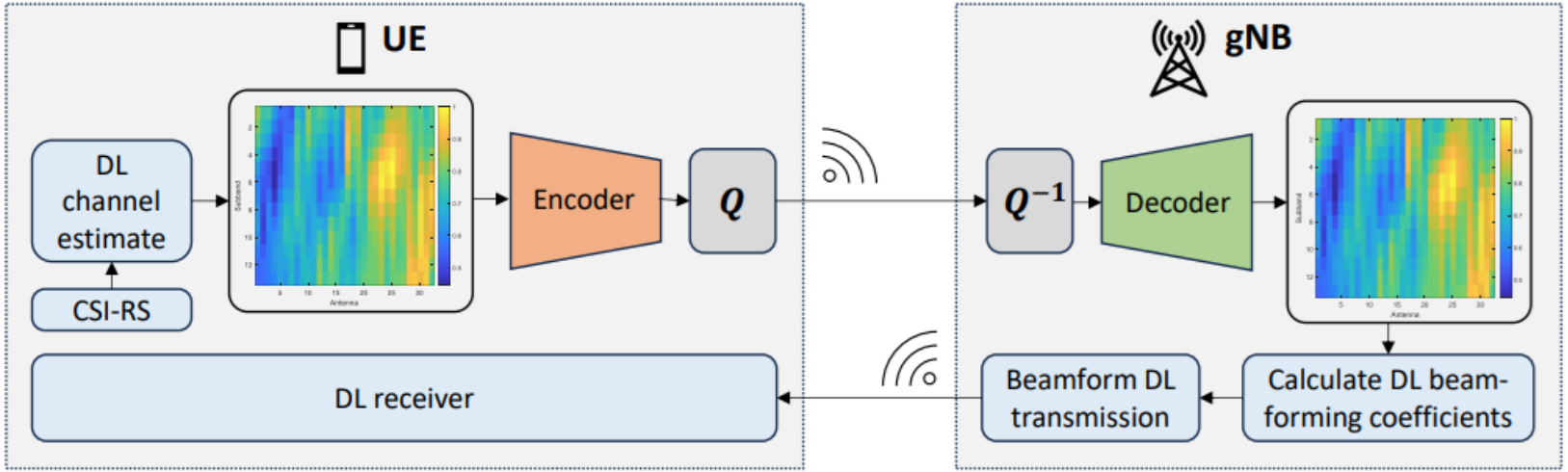


Throughput Gain



Throughput Gain

6G ML-based CSI Compression



Qualcomm

NOKIA

Key goals and milestones

1. Interoperability between the QC encoder and Nokia decoder
2. Lower the UL overhead due to the CSI feedback compression
3. Increase DL rates due to more advanced spatial precoding

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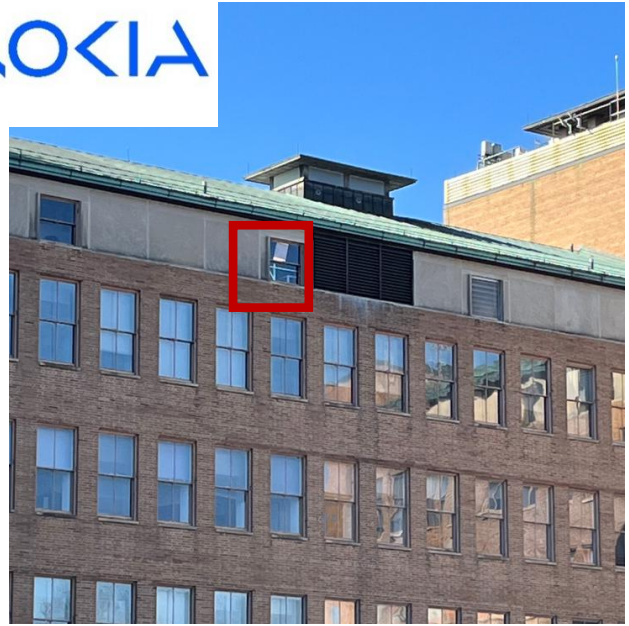
Qualcomm

NOKIA



DL throughput gain evaluation of the ML-based CSI feedback compression PoC.

Test location (see Fig. 3)	Line of sight (LOS)							Non line of sight (NLOS)			Average
	L1	*L2*	*L3*	*L4*	*L5*	*L6*	*L7*	*N1*	*N2*	*N3*	
Indoor model	50.30%	95.60%	61.90%	76.60%	74.30%	39.10%	70.50%	39.60%	96.10%	61.10%	66.51%
Outdoor model	41.60%	83.10%	65.30%	57.90%	69.00%	30.40%	67.90%	47.50%	100.40%	54.90%	61.80%
Mixed model	50.30%	94.70%	65.70%	77.30%	86.90%	39.10%	72.10%	28.40%	96.40%	64.20%	67.51%

IEEE

MWC Barcelona

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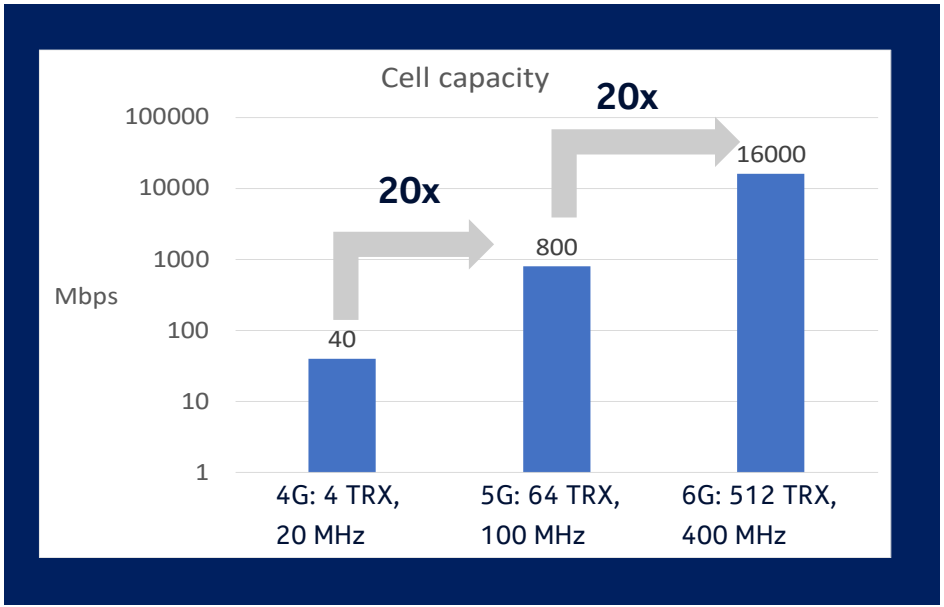
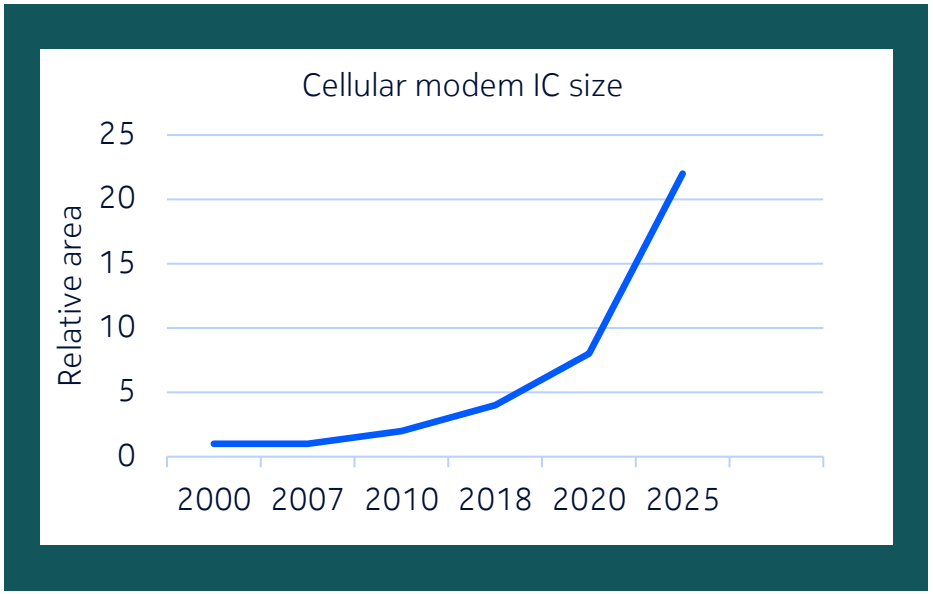
Compute Challenge
Radio Access





6G Massive MIMO: **>5000 TOPS** at **<100 W**

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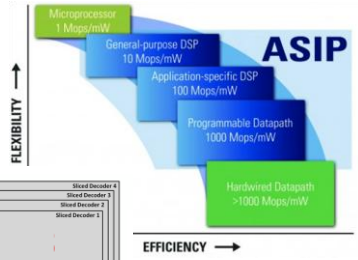
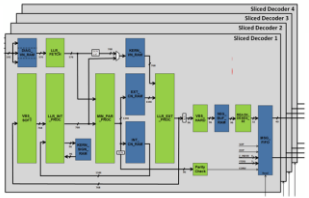
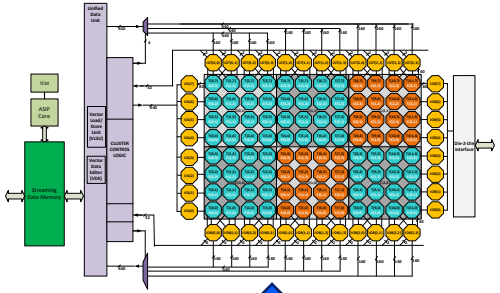
Flexibility vs. Performance Optimization

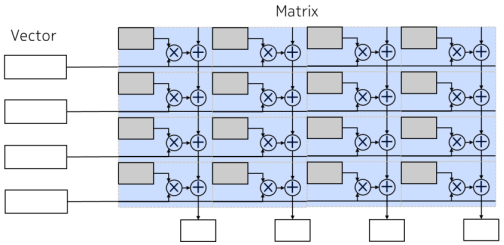




Massive Parallelization for MIMO Wavefront Processing

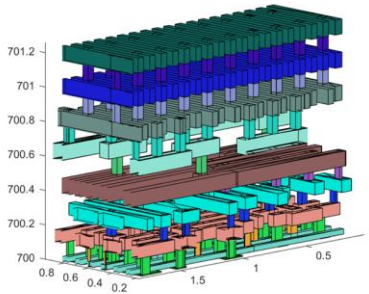


Taking Down Memory Wall for AI and MIMO Compute in Memory

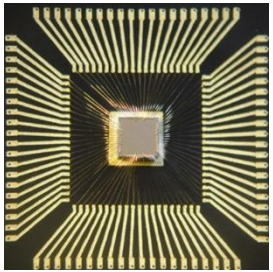


Algorithm-HW Co-design
Mico-architectures
Physical-level
Beyond Digital CMOS

Deep IC Design for Ultra-low Power Analog/Digital Compute



Test-chips to De-risk and Drive Foundry-related Innovations



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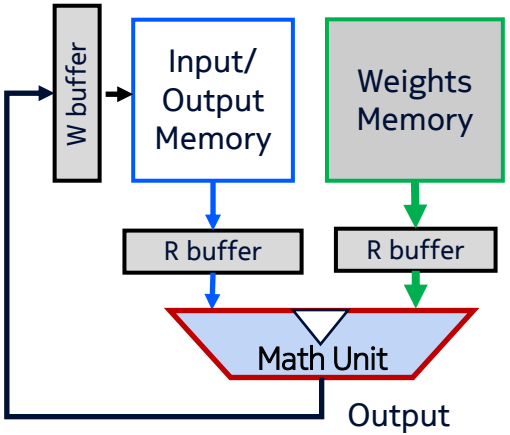
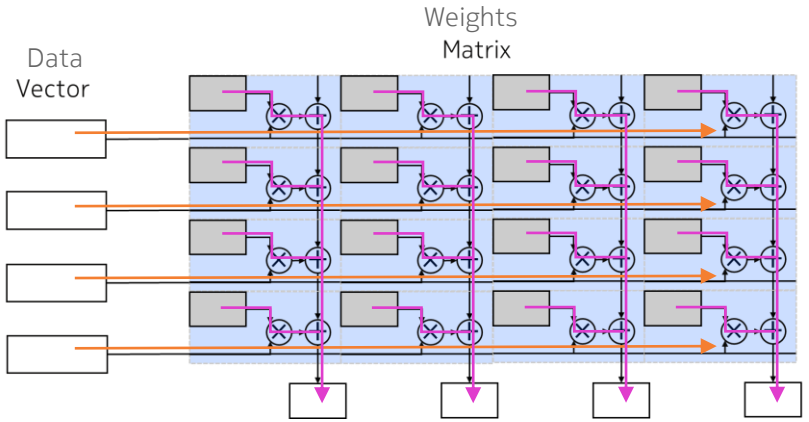
From Conventional Processor to Compute-in-Memory

Vector-Matrix Multiplication

Conventional



Compute-In-Memory



10 -100x more TOPS/W

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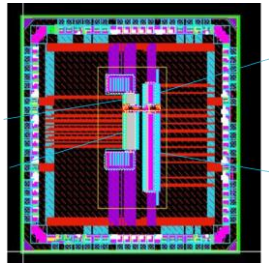
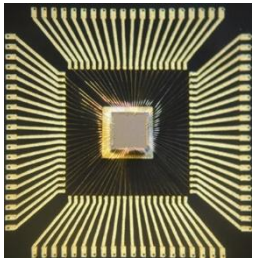
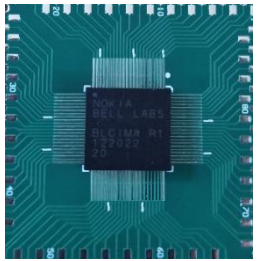
Test Chip

Global Foundries 22FDX

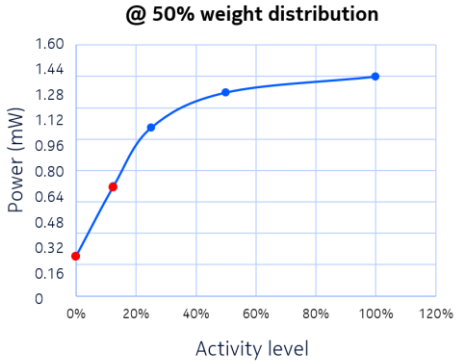
*Synthesized with 22FDX 8T CSC28SL 104nm Standard Cell Lib





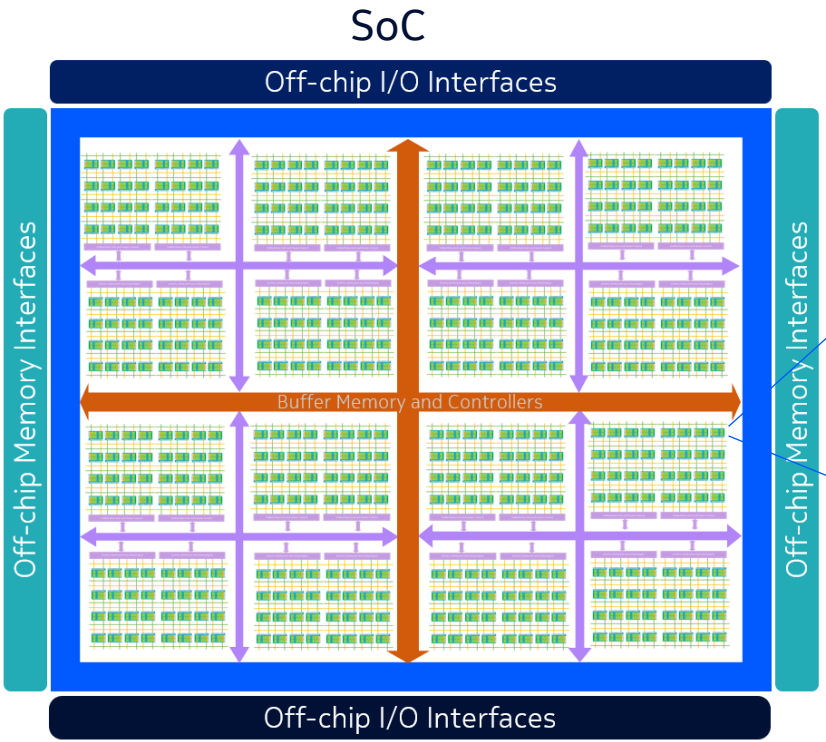


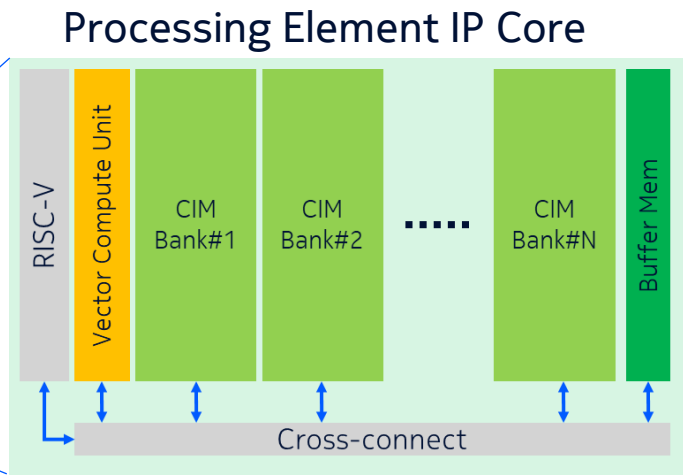
CIM Type	SNPS Std. Cell & SRAM*	BL D-CIM	BL A-CIM
Input precision	8	1-8 (extendable)	8
Weights precision	8	4/8/12/16	8
Area (μm^2)	101,706	27,552	12,996
Operating clock (MHz)	1000	400	800
Latency (ns)	10	22.5 (8b/8b)	10.01
Power (mW)	90.4	1.92	0.82
Throughput (GOPS)	256	91.7	185.42
Energy efficiency (TOPS/W)	2.83	47.7 (8b/8b)	226.1
Area efficiency (TOPS/mm^2)	2.52	3.33	14.27



6G and AI Inference

Compute-in-Memory Digital Design



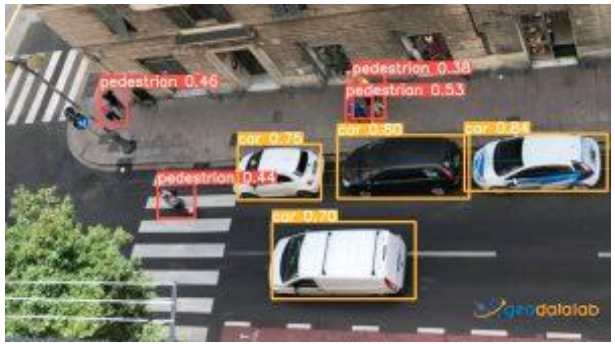


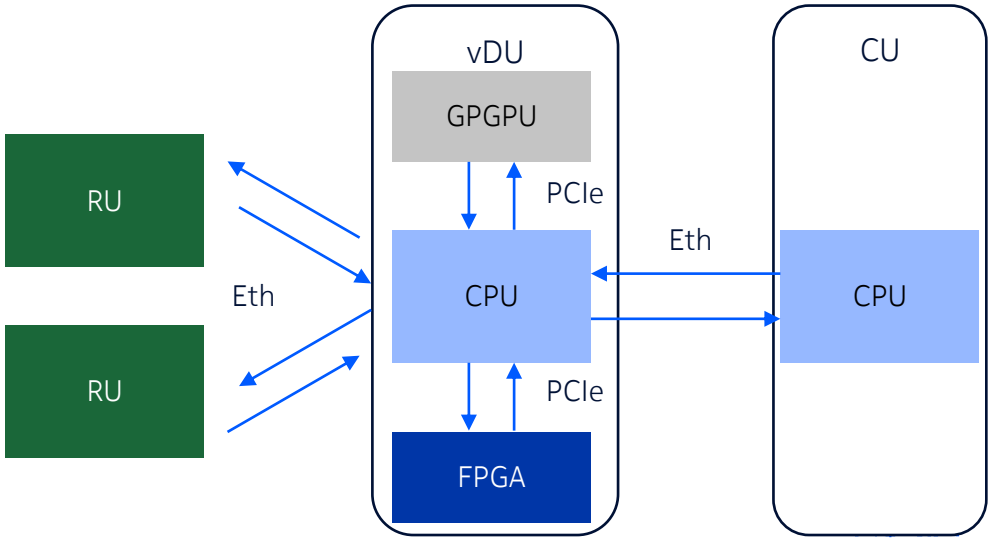
Bell Labs COTS Platform

- **General purpose server + BL software platform**
- Flexible-pipeline, real time execution
- Intel Xeon processor + accelerators (GPU and/or FPGA)
- Adaptable to various PoC scenarios in realistic environments
- Support for any split-point

10 GBPS on Nvidia A100

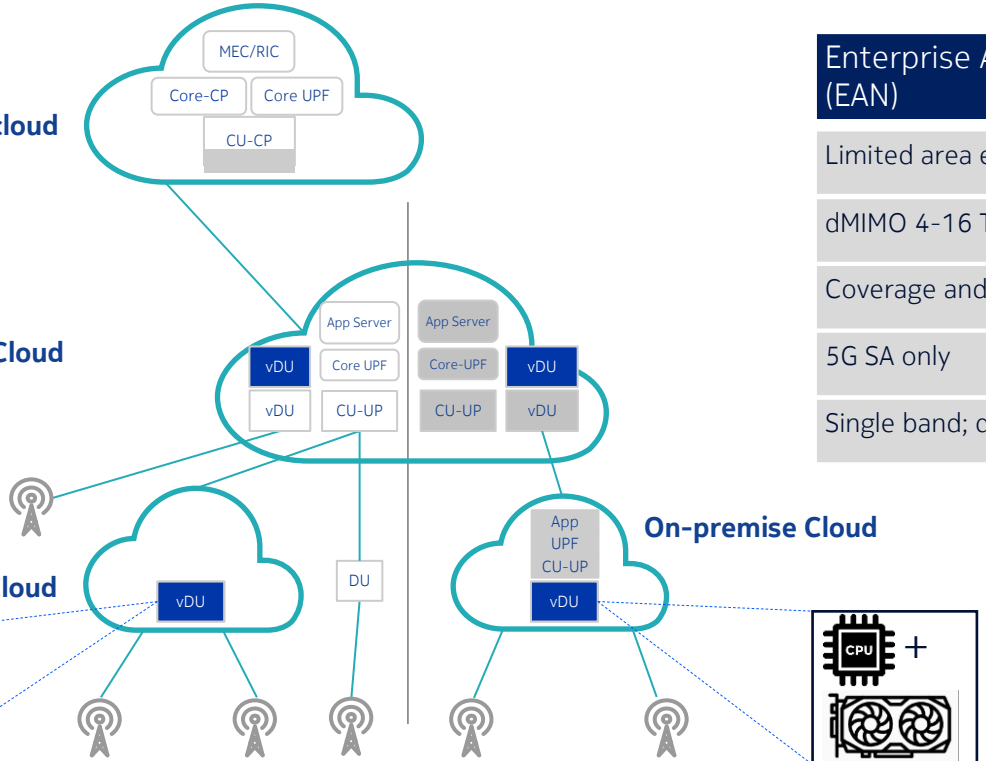
RAN and non-RAN on Common Platform





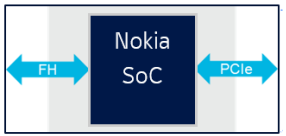
Wide Area and Private Enterprise Wireless Network

Wide Area Network (WAN)
Nationwide
High-power mMIMO
Full-featured solution
4G + 5G NSA + 5G SA
Multiband FDD + TDD



Enterprise Area Network (EAN)
Limited area enterprise
dMIMO 4-16 TRX MIMO
Coverage and reliability
5G SA only
Single band; dedicated

Powered by RAN-NIC



Powered by CPU/GPU

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NOKIA
Connecting People


NOKIA
Connecting
Intelligence