Large scale computations for 5G & 6G

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5G

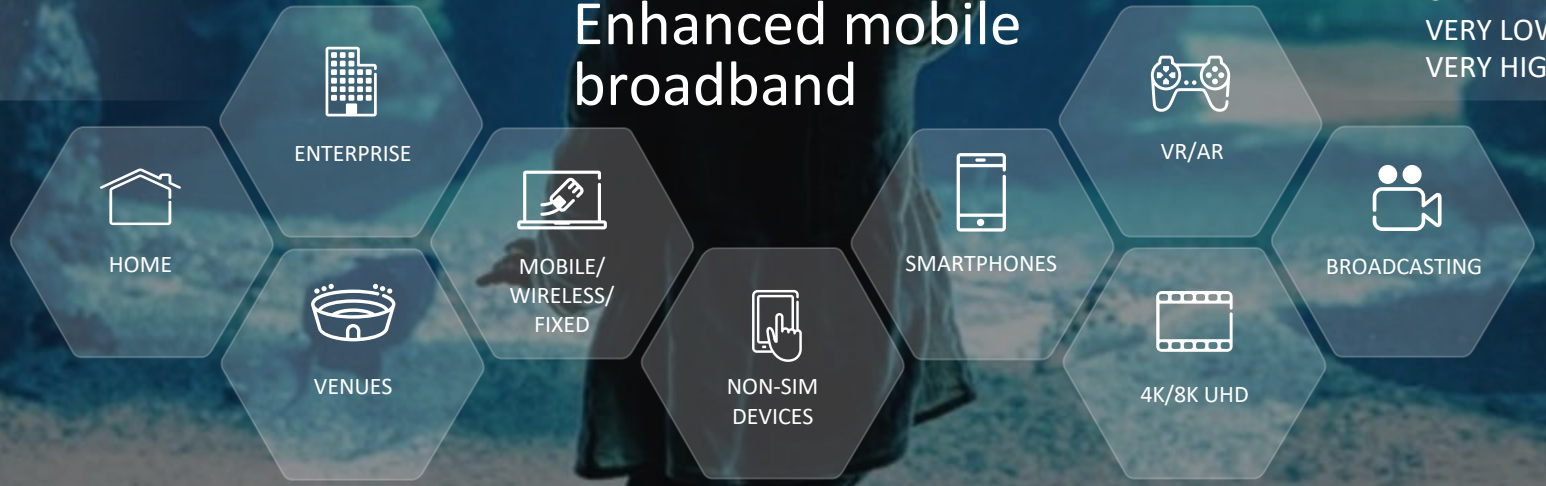
Massive communication

Critical communication

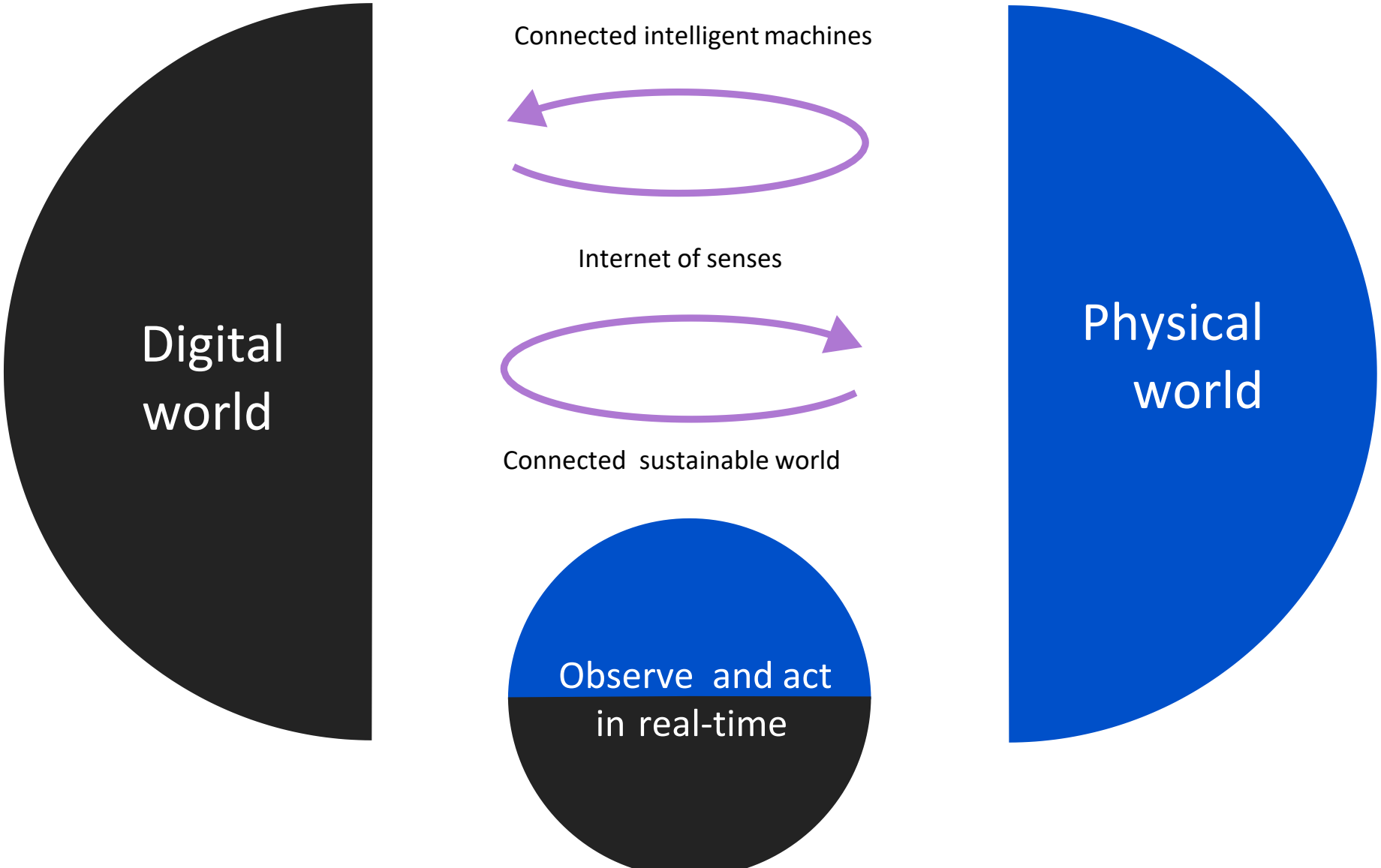
LOW COST, LOW ENERGY
SMALL DATA VOLUMES
MASSIVE NUMBERS

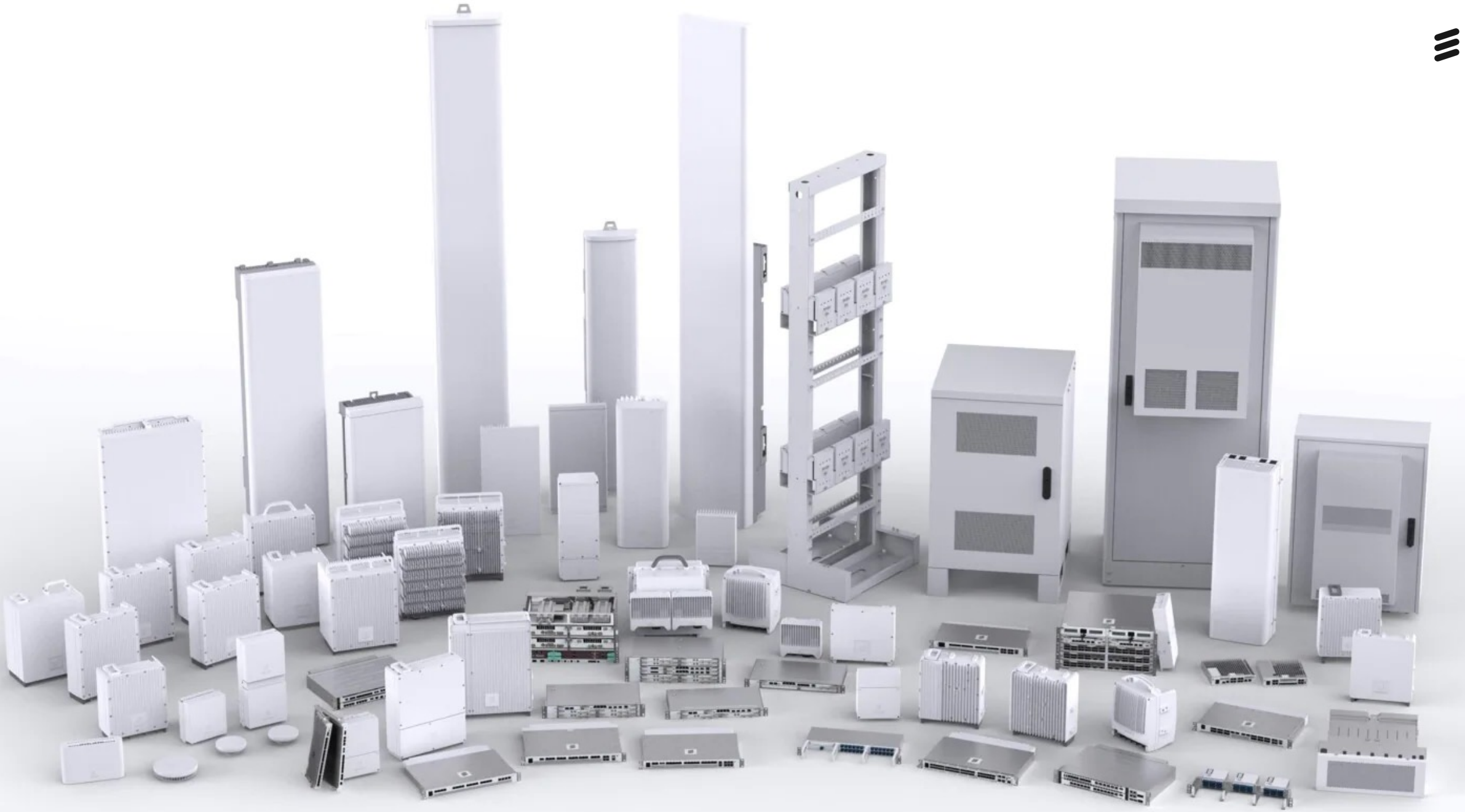
ULTRA RELIABLE
VERY LOW LATENCY
VERY HIGH AVAILABILITY

Enhanced mobile broadband



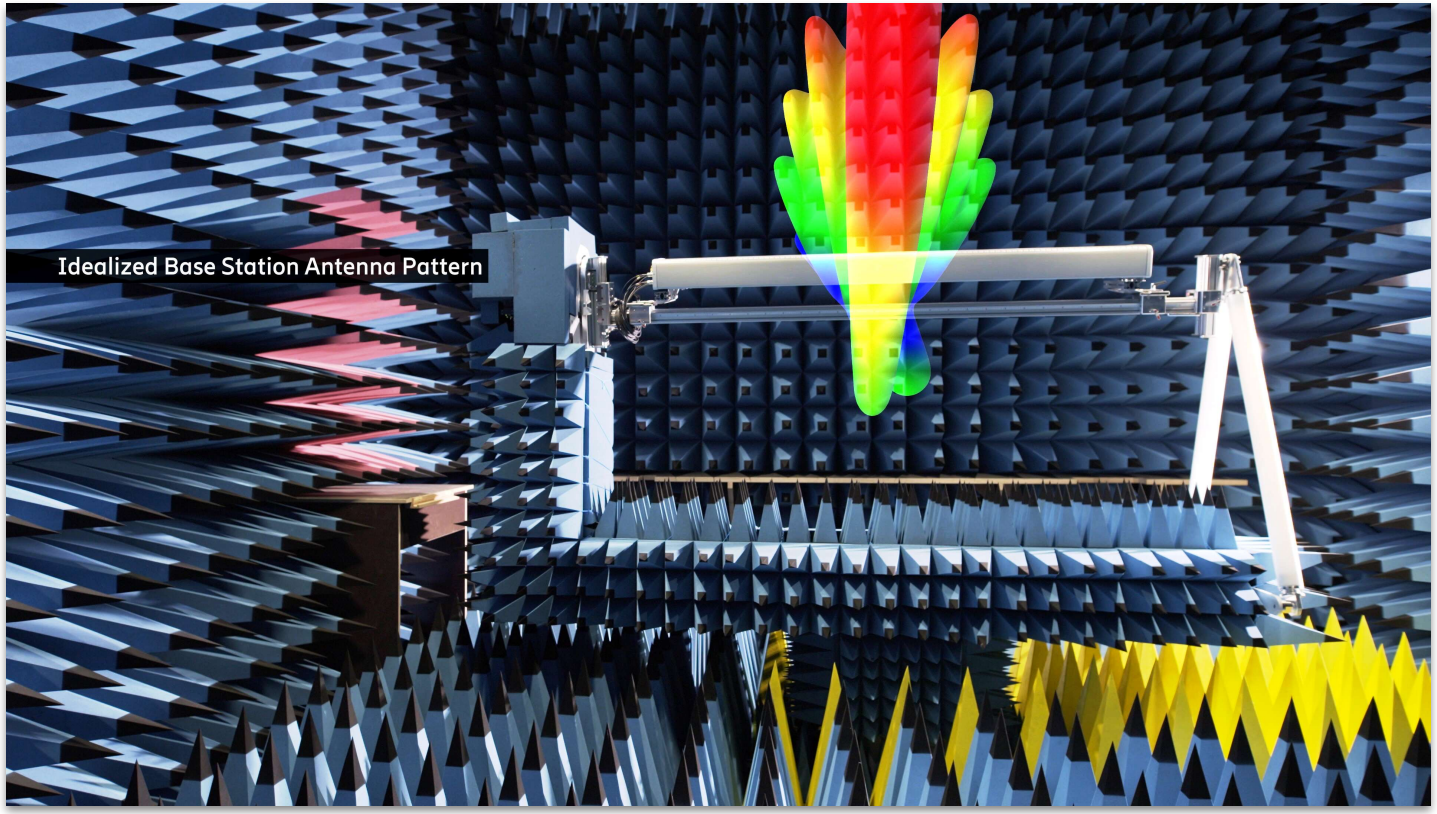
6G: Connecting a cyber-physical world





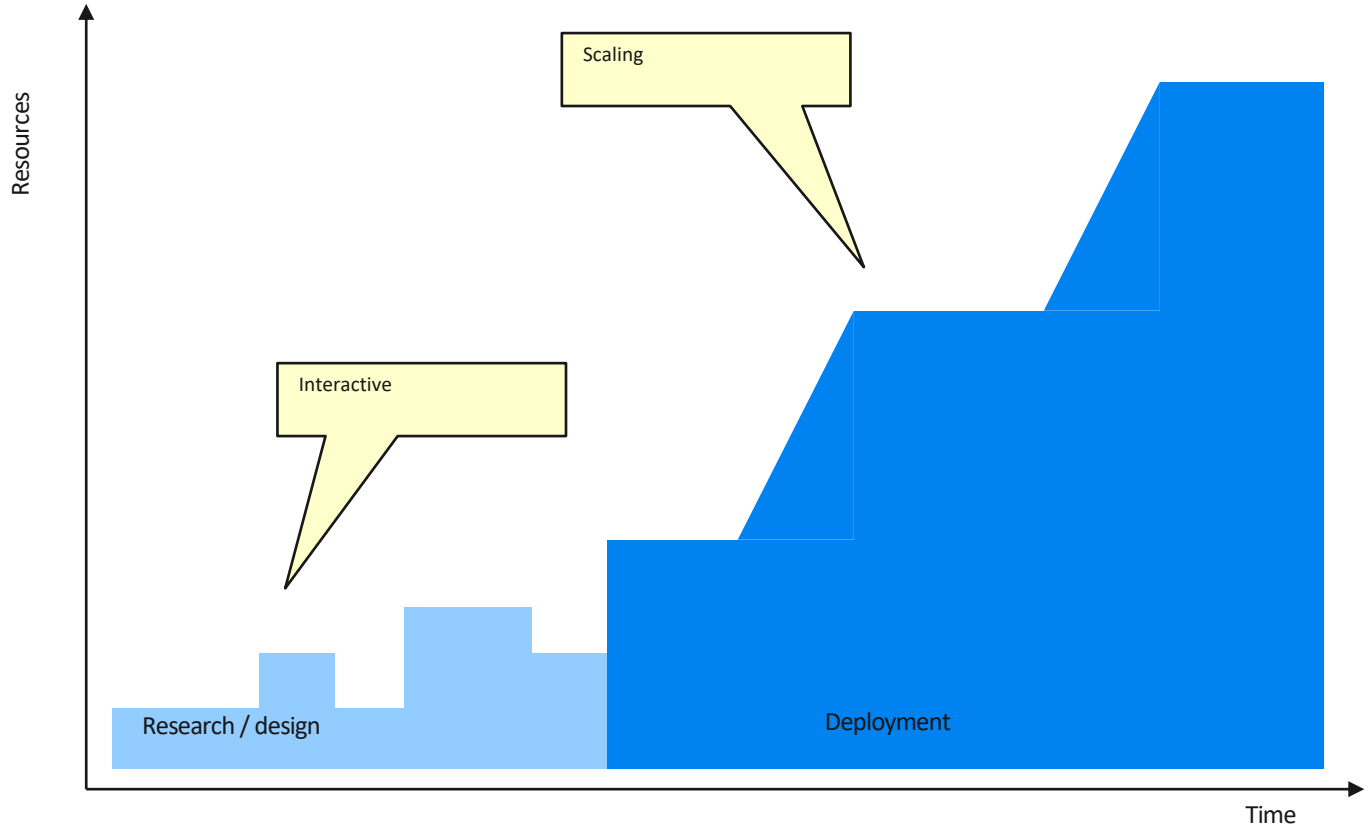
Application areas

- Not only traditional HPC
  - Large scale radio simulations
    - User behavior
    - Wave propagation
  - Chip design
  - Thermal design
  - Antenna design
- Machine learning
  - AI is everywhere
- Security
  - Often sensitive data
  - Algorithms, solutions & results are confidential
- Also interactive models, not just batch



R&D processes and ways-of-working

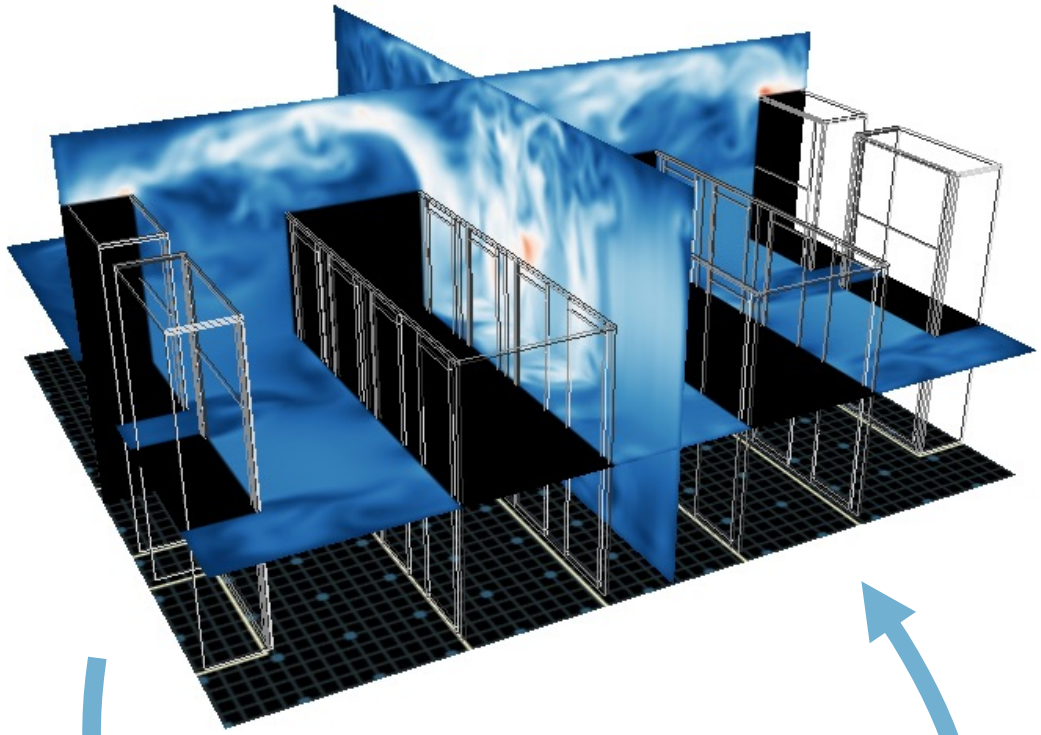
- Heterogeneous workloads
  - HPC vs cloud – educational resources
- Suitable for R&D processes and ways-of-working
  - Available when needing it – predictable access
  - Short lead-time to changes
  - Starting small: trials, knowledge-build-up
  - Scale up according to needs
- The company must be in control of the processes
- IT security compliance
  - Strict monitoring and audit trails
  - RBAC using company credenctials
  - Approved images & tools
  - etc..

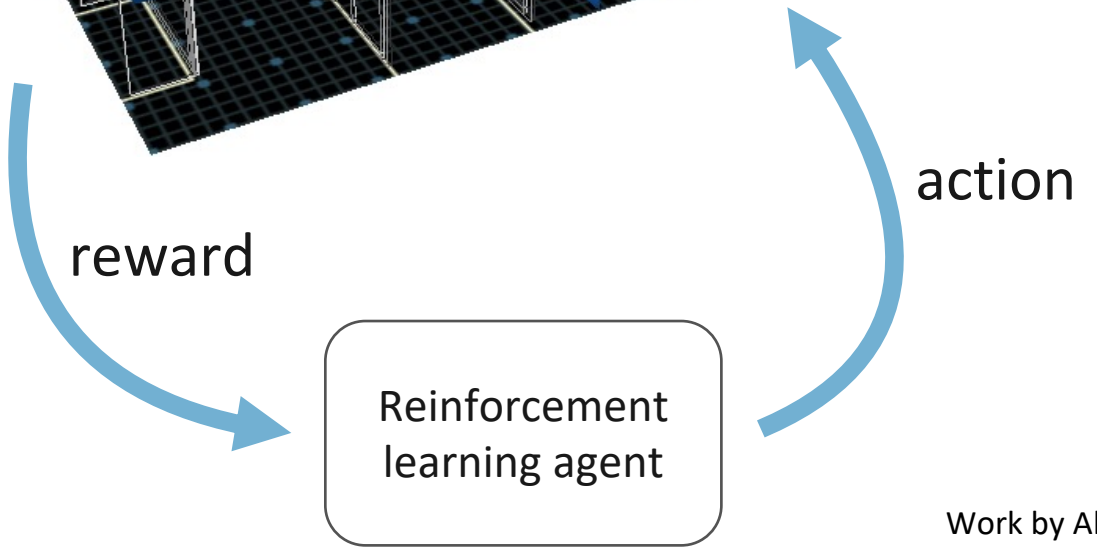


Development phases from research to deployment
(product or development tools)

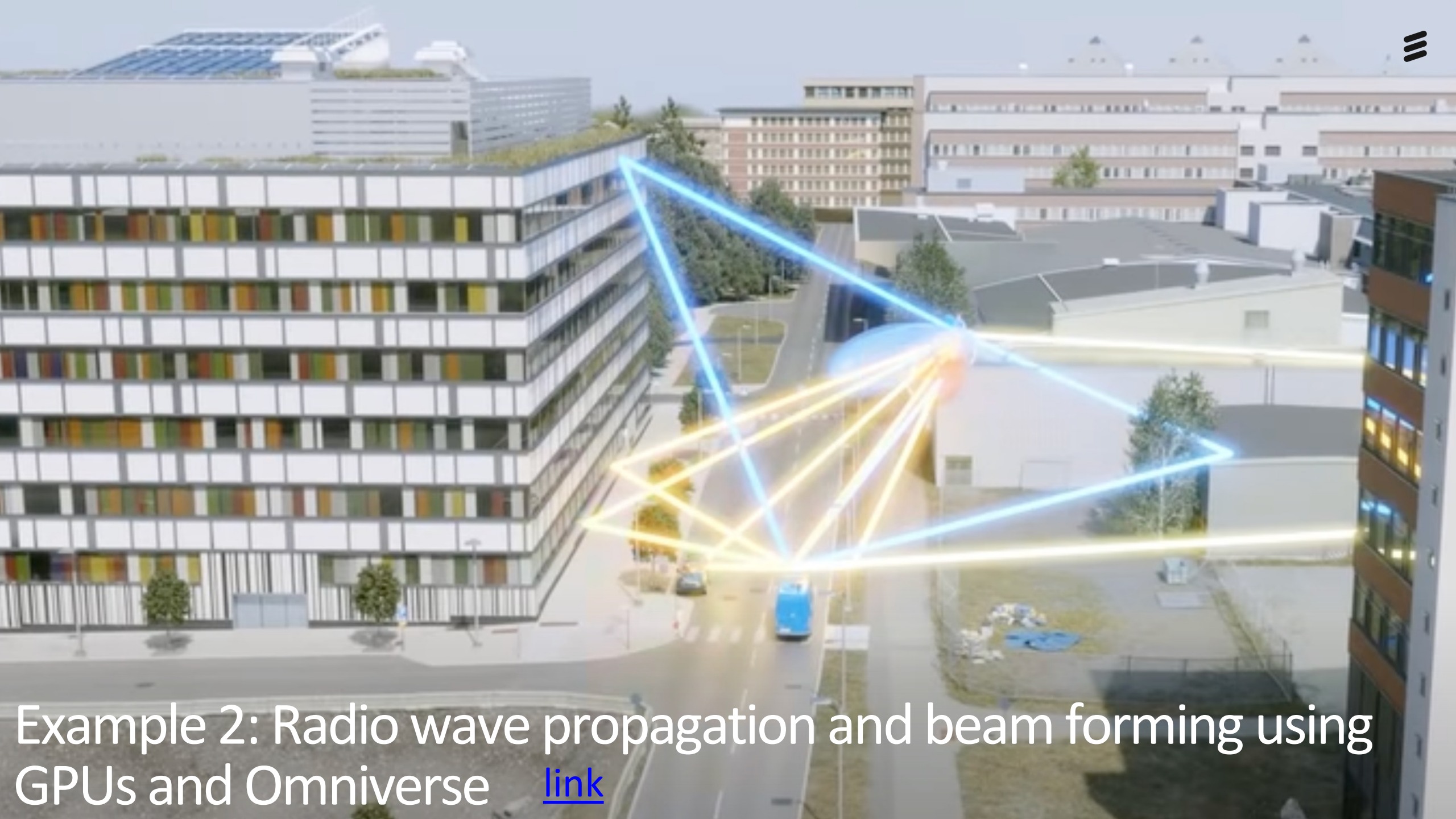
Example1: Real-time interactive CFD modelling

Closing the loop to save energy





Work by Albin Heimerson, Johannes Sjölund, et al.



Example 2: Radio wave propagation and beam forming using GPUs and Omniverse link

Example 3:
HPC for cryptography

- Searching for optimal Boolean circuit implementation of AES S-Box
  - Gate-sharing in 18x8 linear transformations
  - Search tree with backtracking
- 5G encryption – SNOW-V
  - Searching for linear feedback polynomials with low weight
  - Primitive polynomial of degree 127 and weight 3 or 4
  - Used in construction of new air encryption algorithm in 5G.
- Using 1500-3000 coredays each
  - Highly parallel, loosely coupled

Maximov, A., & Ekdahl, P. (2019). New Circuit Minimization Techniques for Smaller and Faster AES SBoxes.

Ekdah,l P., Johansson T., Maximov, A and Yang, J (2018). A new SNOW stream cipher called SNOW-V

Example 4: Thermal design simulation

Ericsson Remote Radio systems

- Radio system family:
  - Macro, Massive MIMO, mmWave, Micro, Indoor remote radio and antenna-integrated
  - Operate in GSM, WCDMA, LTE & 5G
  - Can be installed in cabinets, close to antennas, or fully integrated in antennas

AIR 6428

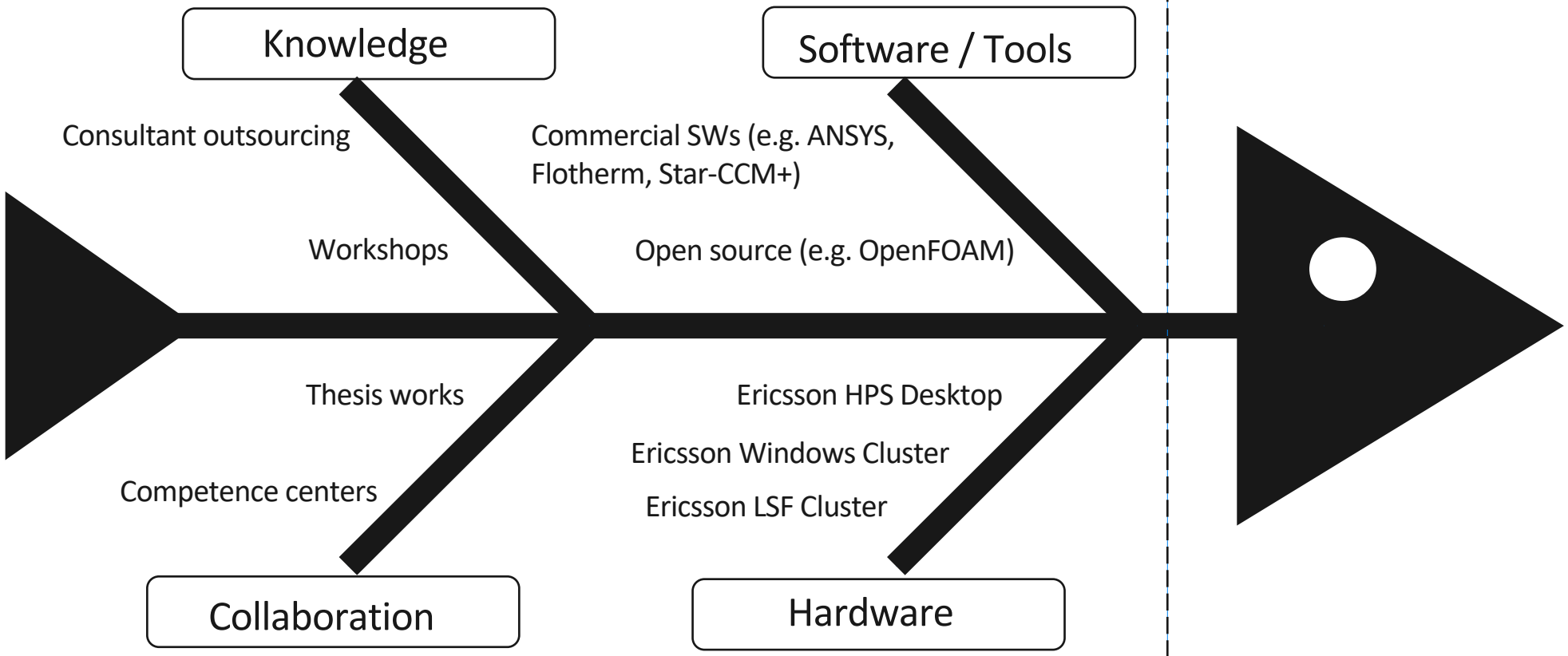
- Capacity

64 T/R branches
25 kg
400 MHz instantaneous BW
340 W output power
192 antenna elements
Passive cooling

Thermal Design Strategy

Advanced simulation

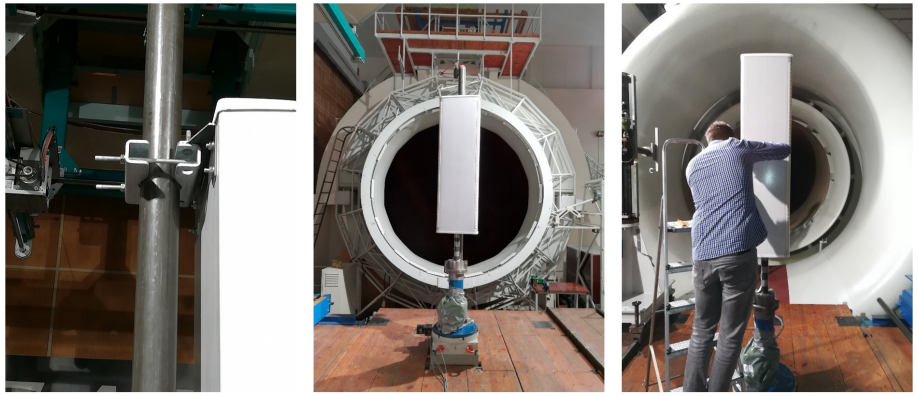
Business requirement



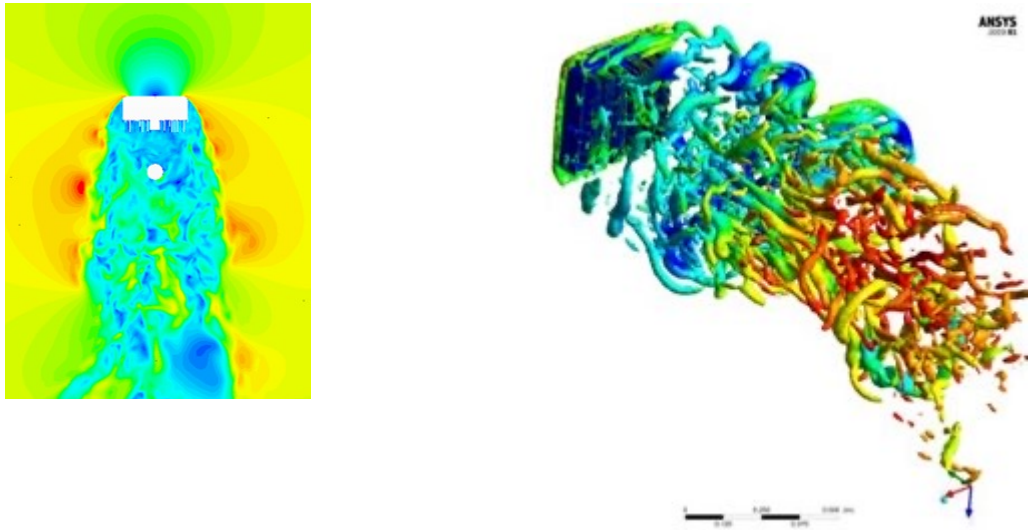
- Better products
- Lower cost

Wind Load

Physical testing (Wind tunnel)



Virtual testing (Advanced simulation)



- Benchmark test case: DES (Detached Eddy Simulation) with ANSYS Fluent

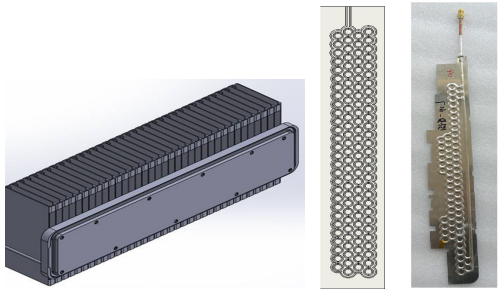
	Ericsson HPS Desktop	Ericsson Windows/HPS Cluster	Note
No. of CPUs	8 (max. allowable usage)	30 (1 node)	Computing performance deteriorates if >30 CPUs are used; might be due to poor scaling on Windows cluster
Time (hours/case)	60	15	Assume linear scaling.

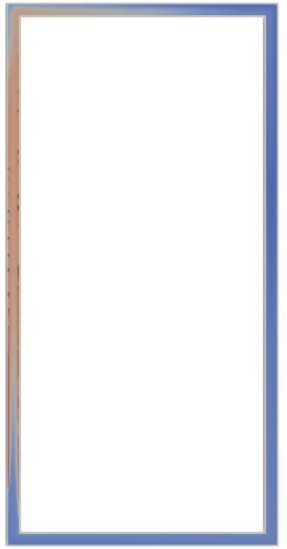
Multi-Phase Cooling

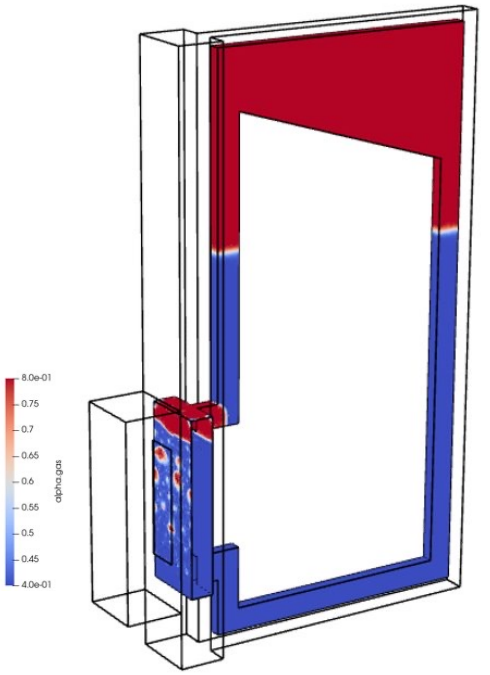
➢Understanding of the dynamical processes of 2-phase system for design purposes so that our innovation capabilities are not limited

➢Own predictive tools to dimension or to qualify the 2-phase components

	Ericsson LSF cluster
No. of CPUs	252 (7 nodes)
Time (hours/case)	168



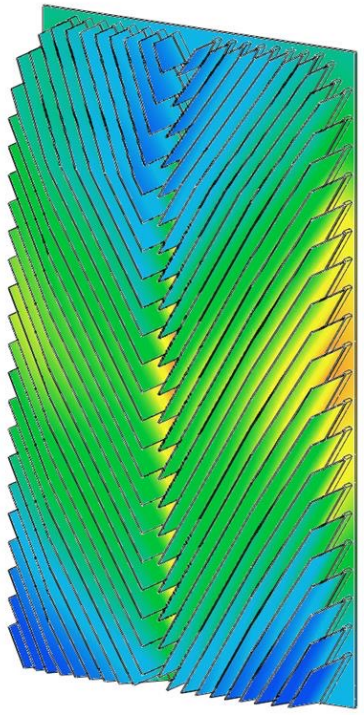


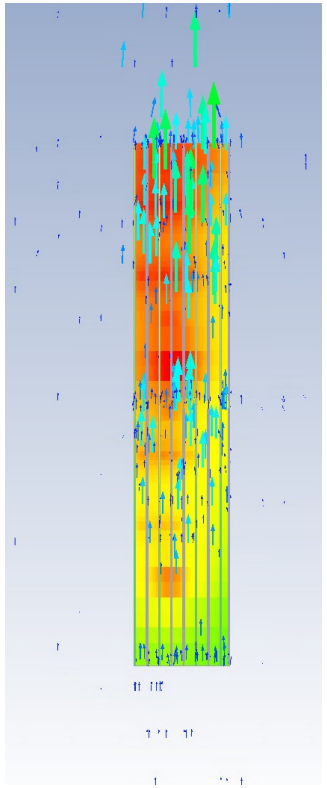


➢ For real geometries, computational time is expected to be much more higher

Air Cooling

- Conjugate heat transfer simulations (acc. for condition, free convection and radiation)
- Different power budget scenarios to run per product for each heat sink configuration
- Applicable for: Remote Radios, Base Bands, Antennas…





	Ericsson HPS Desktop	No. of power budgets
No. of CPUs	8	20
Time (hours/case)	2-3	40-60

Summary

- A wide range of workloads
- AI focus is rapidly increasing
- Cloud style access to resources
- Security is a main concern

ericsson.com/future-technologies