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Surface Radars at Thales

Life on the Far Edge

Lionel MATIAS – Radar Processing Architect
Forum TERATEC – 21st October 2026

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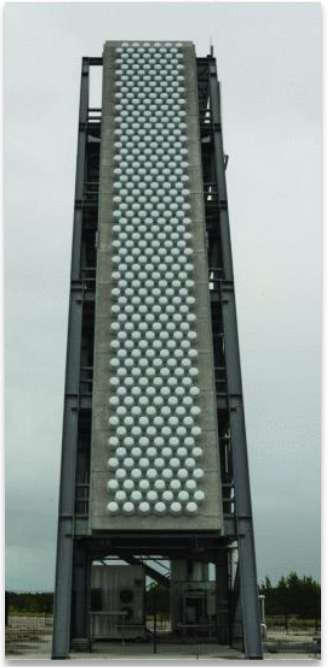
A Continuum on the Edge





Fixed Sensors

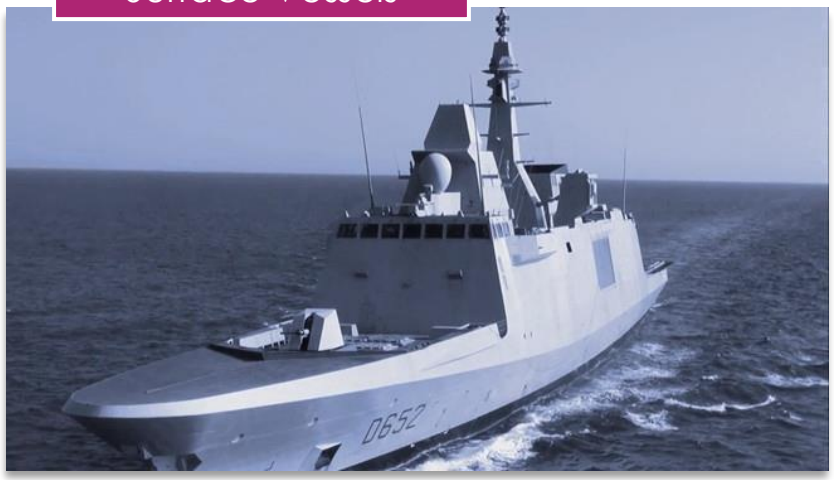




Tactical Systems



Surface Vessels



Radar As Infrastructure



« Embedded » is a spectrum

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Surface Radars

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> Highly autonomous systems in contested, bandwidth-limited environments

> Embedded systems (on a spectrum) – “Far” Edge with harsh environment constraints

> Mixed Processing Loads – High computing intensity / Low-latency

> High reliability expected in all conditions

> Very long life-cycles (up to 25-30 years)

> Safe and Secure systems



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Surface Radars are Software-Defined

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> Thales selects and masters best-of-breed commercial and open-source technologies

- Harnessing the state of the art of computing technologies (CPU, FPGA, DSP, GPU) …
- … and the best available software technologies (languages, runtimes, compilers, libraries)

> Thales concentrates its investment where it creates differentiation

- Radar design & development
- Radar control and detection software

> Portability is a deliberate design investment

- The ability to re-target is key

> IT/HPC tech rarely useable as-is in constrained systems



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The HPC / Datacenter / AI Trends seen from the Far Edge

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> HPC & Supercomputers

- Throughput is key, make the best possible use of the FLOPS in the life-time of the system - I/O optimized for batch traffic
- Standardized a number of components – BLAS/FFT libraries – that are now *expected* of new computing hardware

> Datacenters and hyper-scaling

- Huge, heterogeneous and multi-generational dense distributed systems, designed for query/answer but also stream processing, optimized for core count and cost of operation
- Standardized a number of key concepts: hardware abstraction, microservices/serverless, orchestration, high-availability

> AI datacenters

- Scale-in (dense GPU-full nodes, bespoke NVLink) and scale-out with Infiniband/Ethernet (rack-scale NVLink too)
- Standardized *programmable* heavily-optimized linear-algebra-capable hardware and its programming model, constantly pushing the envelope on memory bandwidth, compute intensity
- Changing the status-quo on floating point standards – optimizing for AI sometimes to the detriment to other workloads
- In high demand – Global memory supply shortage at least until 2030 ?

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The Challenge of Real-Time Latency-Sensitive Systems

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> Surface Radars are adaptive, dynamic systems

> Agility is key: Reaction time is a differentiator



> Latency, Latency, Latency

- Antenna Control: Real-Time, Deterministic
- Output: Processing Delay and the Data Deluge
- Looped: Reacting from sensor data (cognitive Radar)

> Adaptation to *changing* environment, *changing* operational needs, external systems, hardware failures, *changing* specific targets/clutter, specific missions

- In Ukraine, one new combat tactic emerges every 3 weeks, its counter-measure in 2 weeks

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Digital Twins for Surface Radars

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> Delivering them for more than 20 years – Trending increase in customer and internal needs

> A large number of use cases

- High-fidelity simulation, Performance evaluation, Training, System Integration
- Is Real-Time behaviour needed ? What hardware target platforms ? Latency-oriented vs. Throughput-oriented
- Parallelism/Monte-Carlo ?

> Digital Twins are a on spectrum too

- The most representative: the actual operational software on its actual operational hardware …
- … or "just" models (specific signal / radar simulators, simplified models)
- A whole gamut of combinations of simulated/virtual/actual data/software/hardware



> Virtualization/Orchestration as tools to build Digital Twins

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The Future of Surface Radars

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> More sensors, higher resolutions, smarter algorithms in smaller, denser packages

> Research & Exploration

- Preserving deterministic latency guarantees while benefitting from throughput-oriented technologies – a key design question
  - What would the underlying middleware look like ?
  - What would be the best way to re-target/deploy our software ?
- Architectures inspired by the HPC trends of "sensor data deluge ingestion"
  - Inspired by the most demanding data-ingestion systems: SKA, sonar/weather/geodesic instruments, CERN
  - Multi-tier approaches with large buffers/memories and intelligent (heavy-compute) refining/pre-detection filters at each step
- Leveraging Quantum advantage where applicable

> Digital Twins as accelerators

- Faster iteration, new designs, features, capabilities, products



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HPC Challenges on the Far Edge

> HPC hardware can't survive embedded conditions

- And it should probably no try to
- Not all Radar systems need to sustain the heaviest conditions
- We still can harness the software, architectures, new paradigms from the HPC community

> Resilience to vendor lock-in through portability

- Multi-architecture software stacks
- Diversified supply, with a preference for European and open technologies, where mature

> AI Factories are an interesting example of initiatives to reach critical mass in a European context

- Integrating with them requires dedicated confidentiality and isolation models
- We are open to working on it with the community



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Contact

Lionel MATIAS

Radar Processing Architect

lionel.matias@thalesgroup.com

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Thank you

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