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The 6G Computing Continuum:
Meeting the 6G computing challenges

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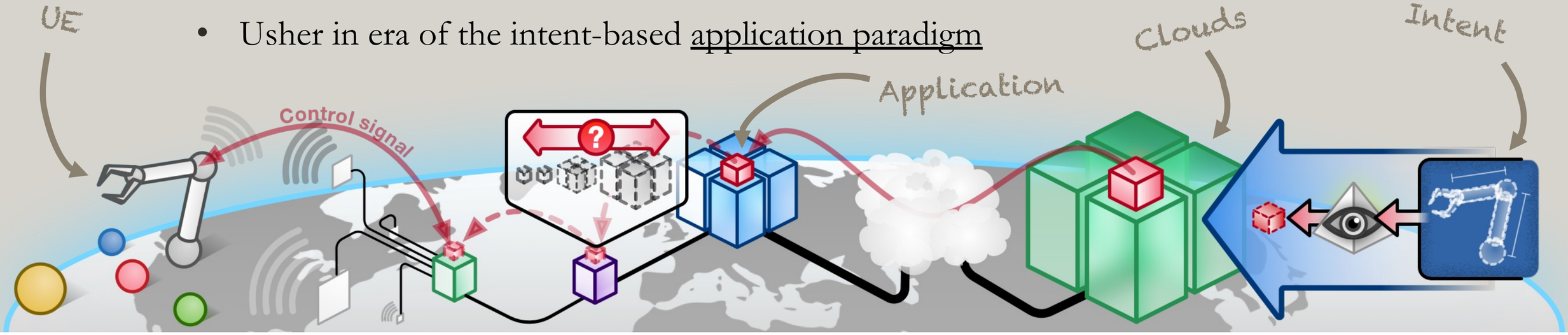
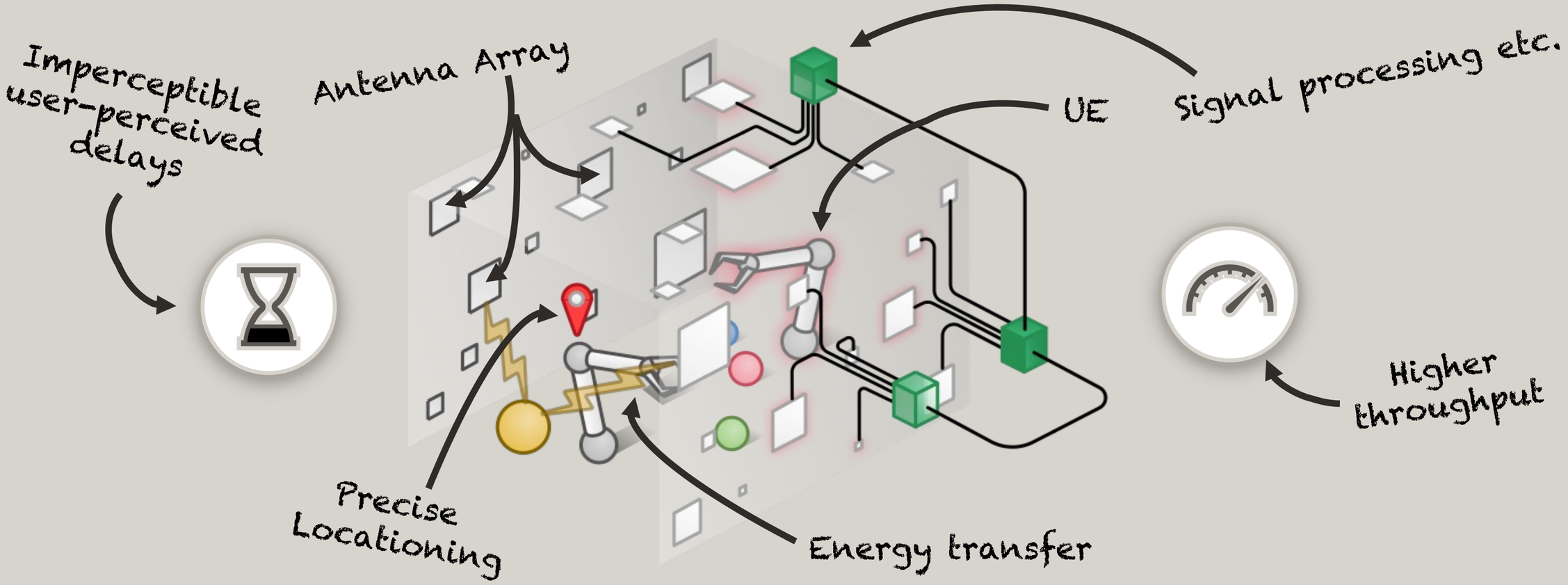
Expectations on computing in 6G

- Enable new RAN technologies for 6G: Large Intelligent Surfaces
- Enable cell-free RAN
- Enable 3rd party applications to co-exists with network services on a global scale
- Enable new cost models: Who will be paying and for what?
- Usher in era of the intent-based application paradigm



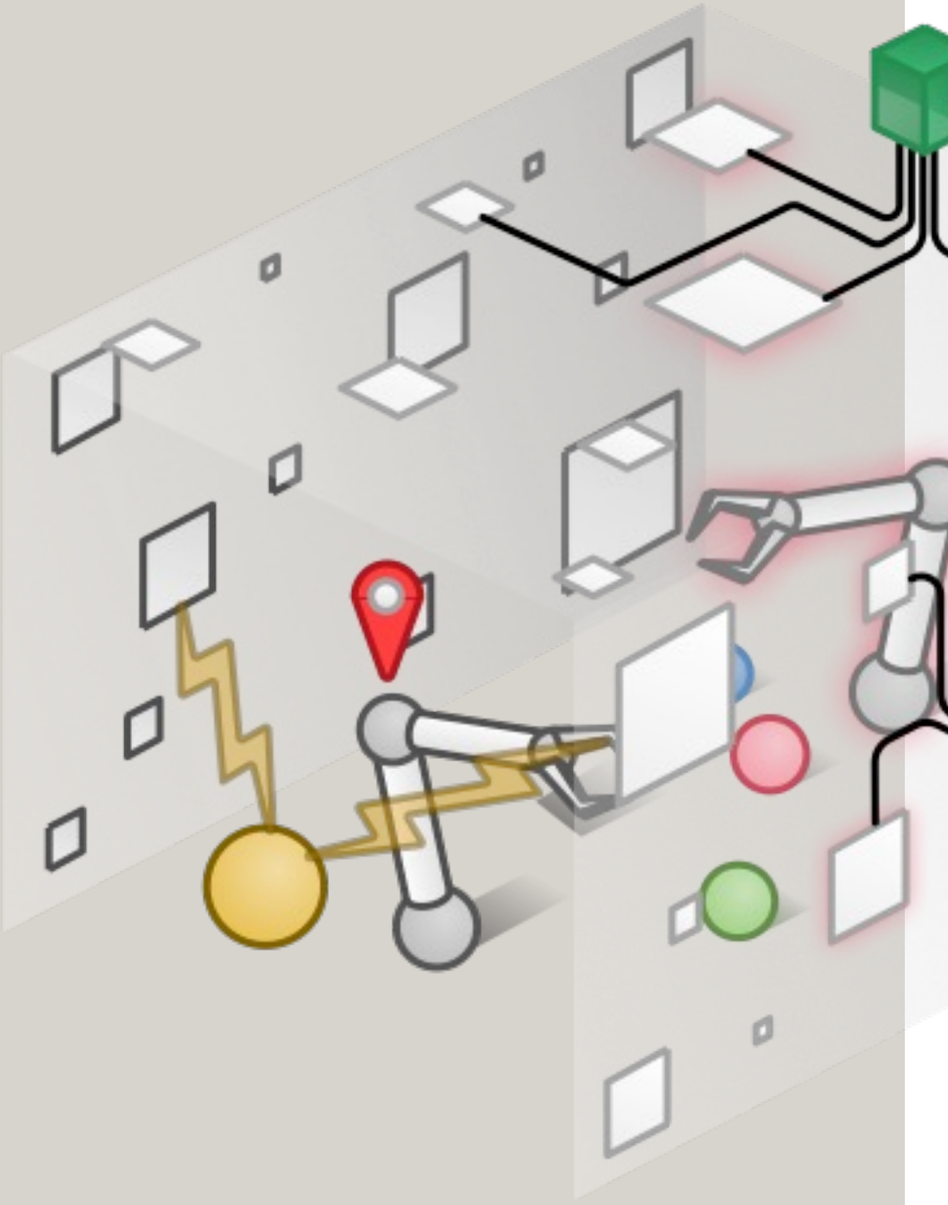
Large Intelligent Surfaces (LIS)



a little more

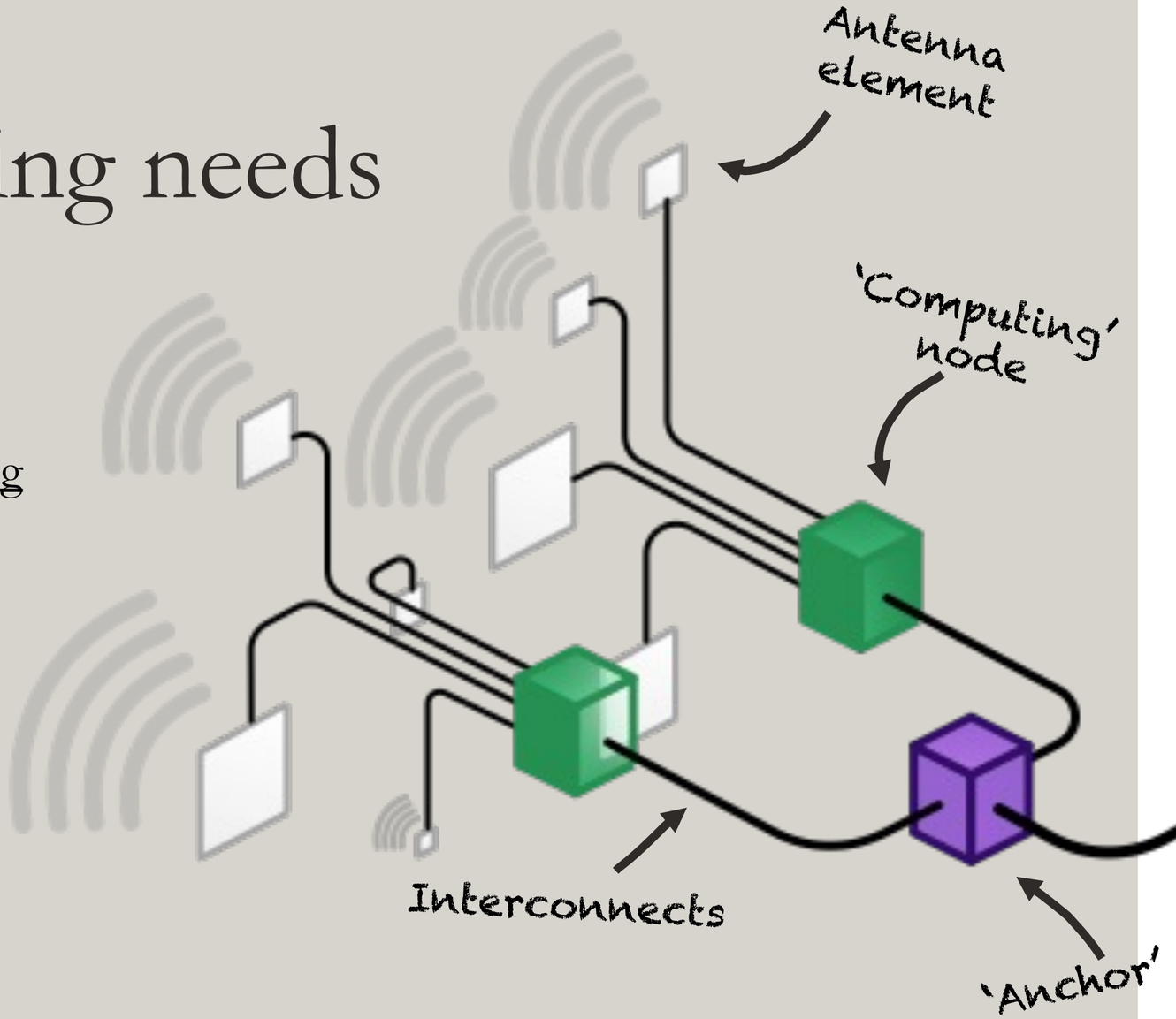
LIS in detail

- Orders of magnitude more antennas than current massive MIMO deployments
- Very high degree of spatial diversity yields a consistently favourable channel quality and low bit error rates
- Improved conditions for accurate positioning
- Efficient power transfer to energy neutral devices
- A LIS system: RadioWeaves

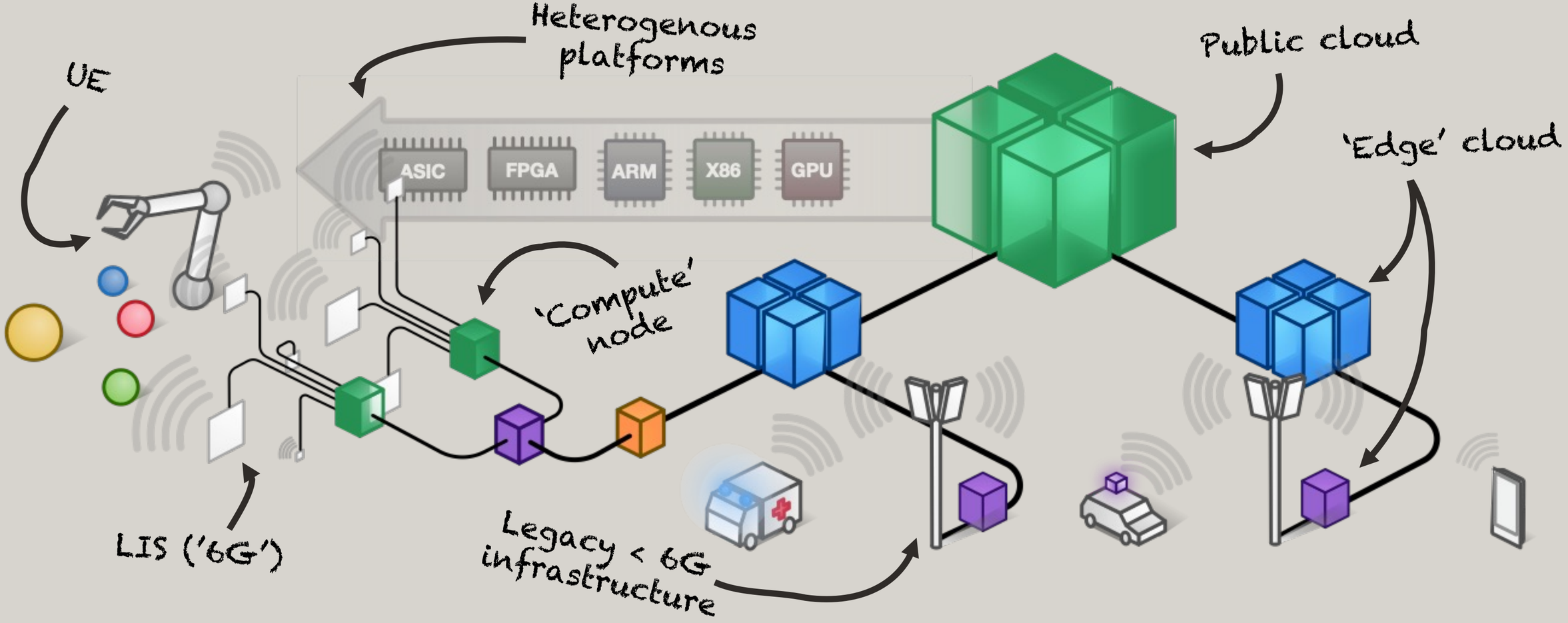


Basic LIS computing needs

- Distributed baseband processing between groups of antennas
- Distributed IP routing and forwarding
- Tight synchronization
- High throughput interconnects
- Full stack coordination between groups of antennas
- Service coordination and federation

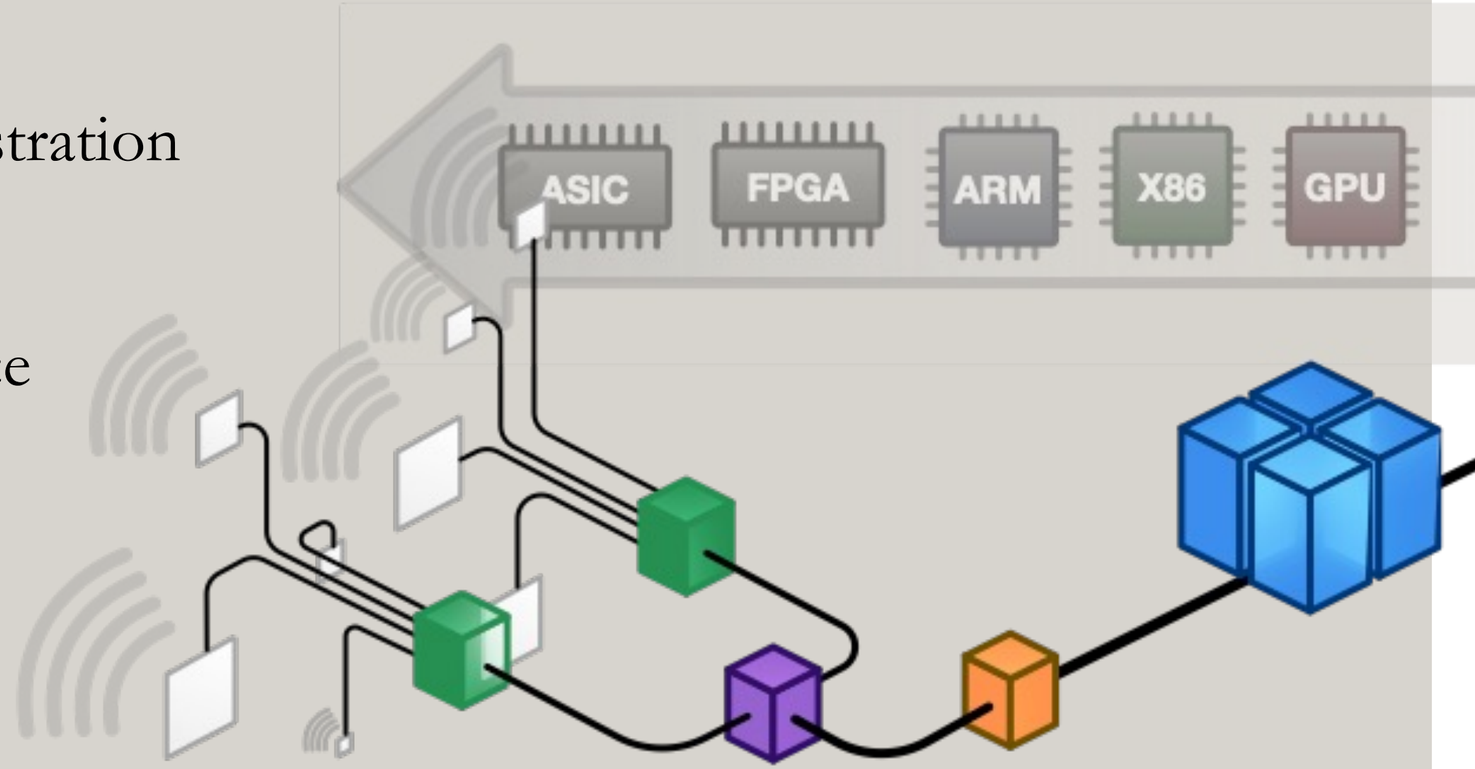


Resulting computing infrastructure

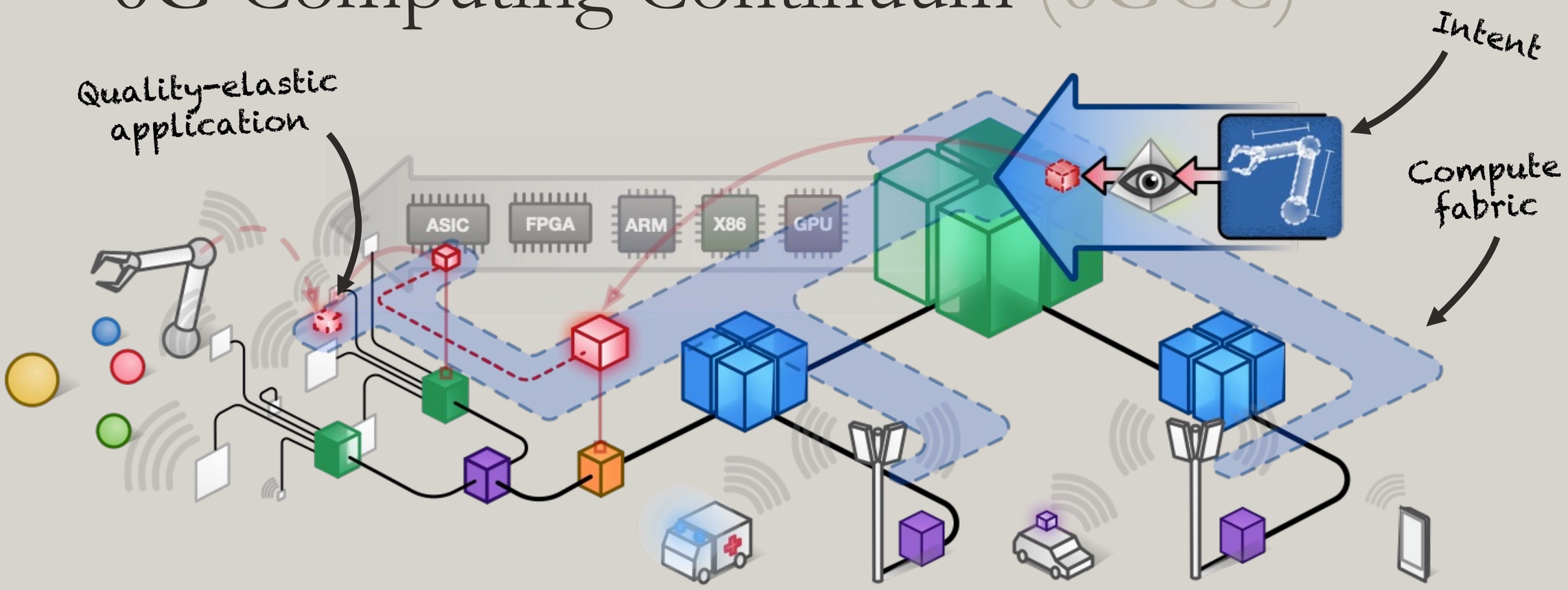


Computing challenges

- Scale
- Heterogeneity and orchestration
- Availability and reliability
- Applications' performance



6G Computing Continuum (6GCC)



Scaling to billions

Monitoring and managing a dynamic and complex global-scale infrastructure will incur enormous energy usage and performance overhead. Therefore, scaling and targeted monitoring and management is required. Anomaly detection and self diagnosis can play a key role in adapting to trade-offs between probing quality and incurred resource usage.

Heterogeneity and orchestration

LIS and its applications require a highly distributed compute infrastructure spanning all resources, for all compute needs, from radio-side processing, to resource orchestration, to user-facing applications. The dynamic nature of LIS requires that the system practices dynamic, efficient, and autonomous resource orchestration

Availability and reliability

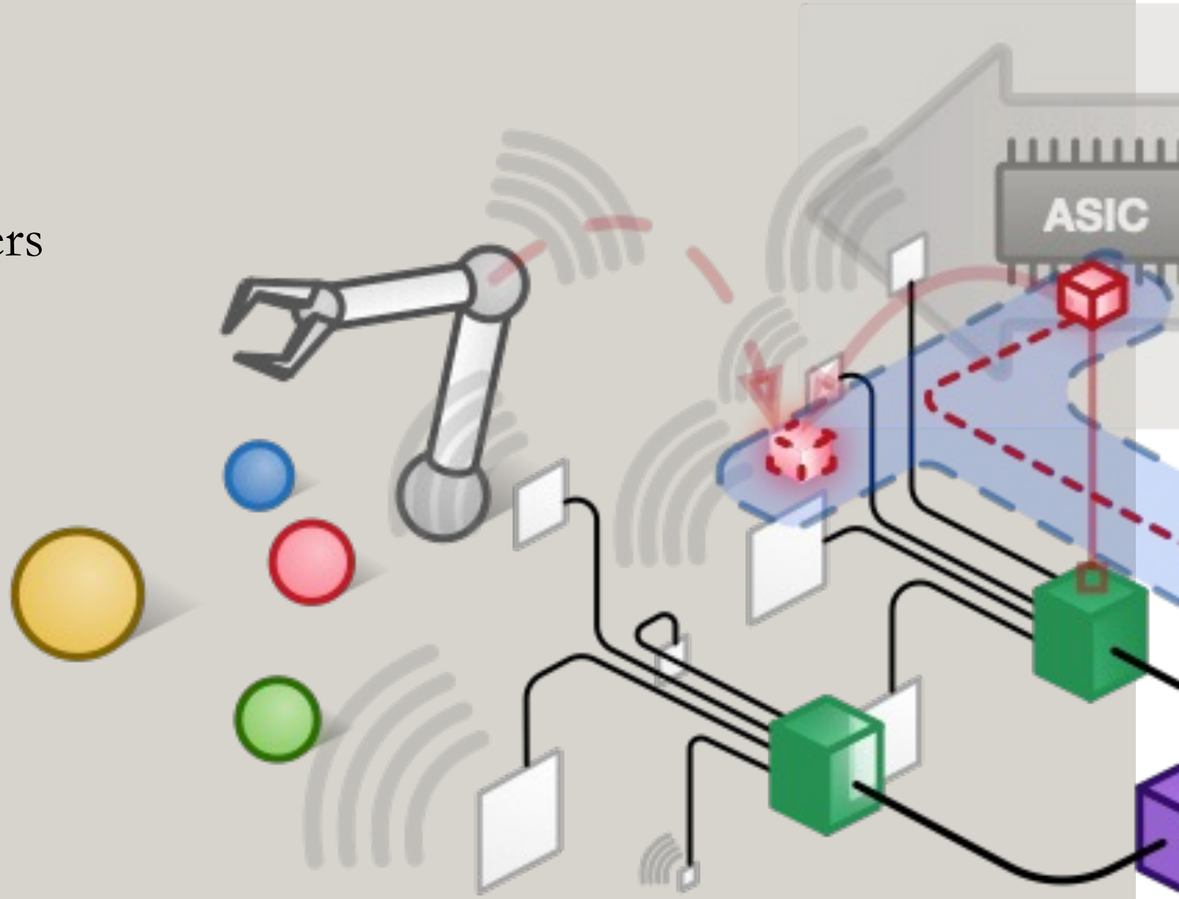
Although LIS will be based on nodes that are potentially unprotected from external impact, 6G applications require extreme availability and reliability. Consequently, such a system will require real-time continuous backups within nodes, real-time process and data replication to neighbouring nodes.

Applications’ performance

To be able to operate deep in a heterogenous and highly dynamic infrastructure, applications will have to be reimagined. Resources for applications and performance outcomes cannot be guaranteed and can change rapidly. Therefore, applications will have to practice quality elasticity and be synthesized, from an intent for the network.

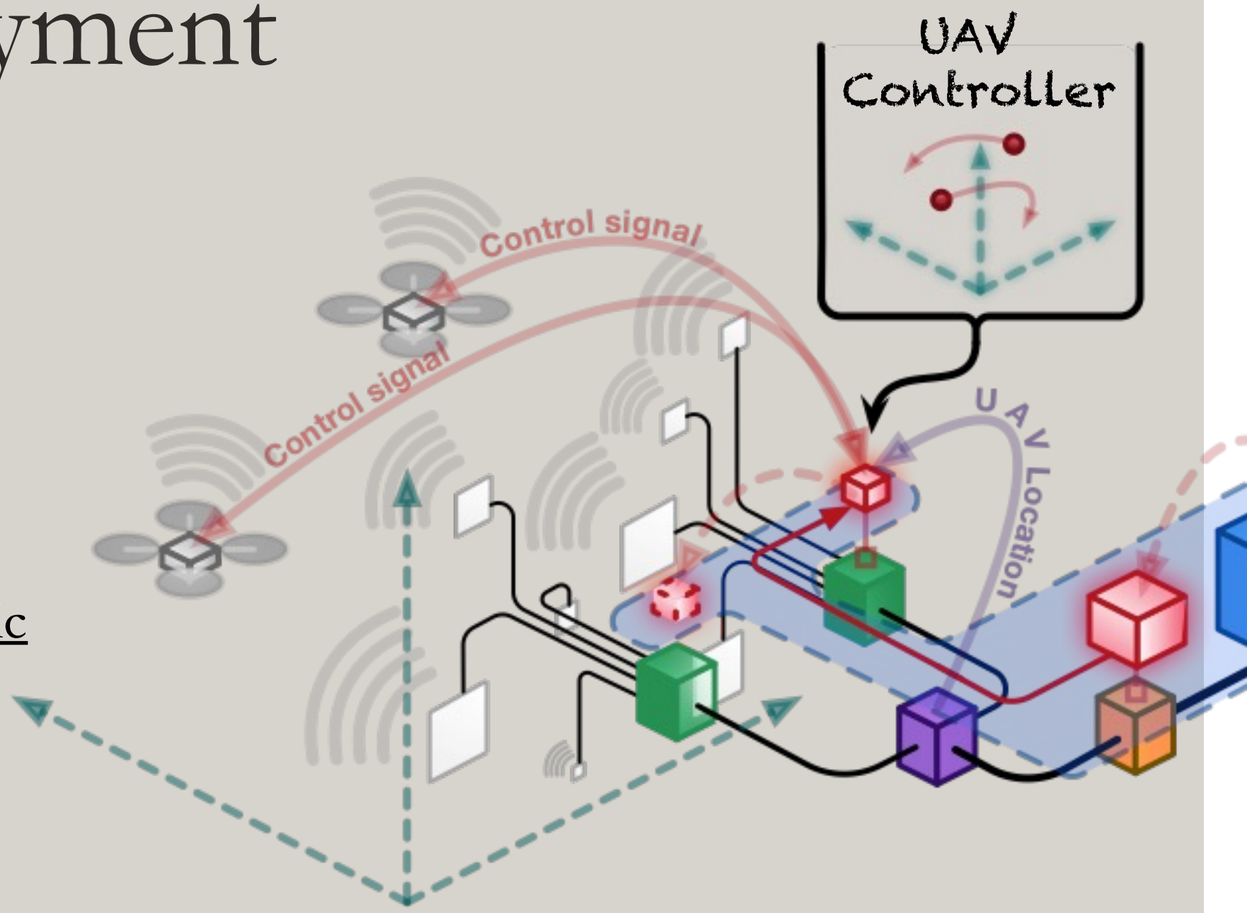
6GCC research

- Tight collaboration with LIS radio researchers at Lund University and KU Leuven
- Active in higher layer LIS research
- Multiple testbeds
  - End-to-end LIS
  - Simulator
  - TechTiles



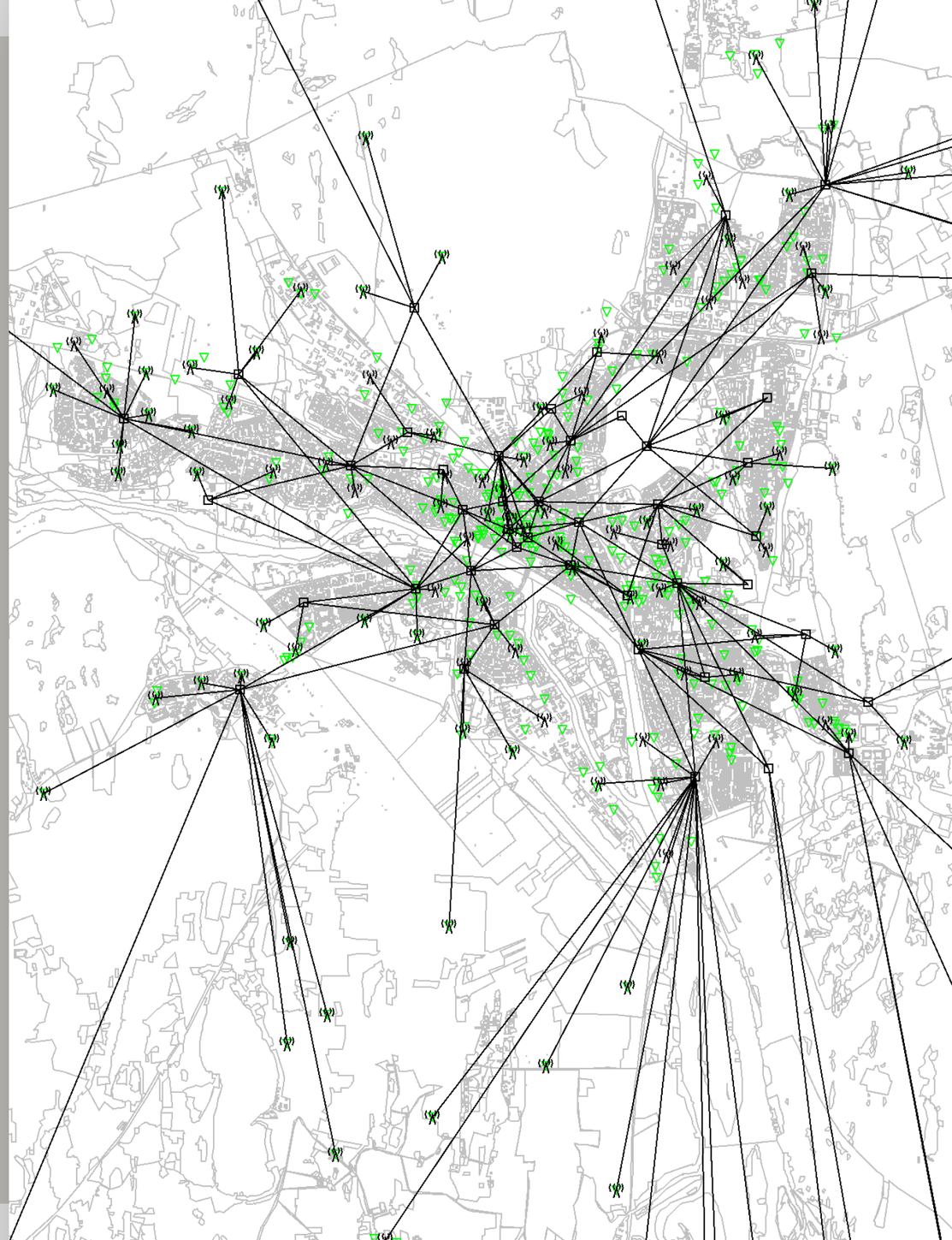
LIS & 6GCC deployment

- Focus: End-to-end full-stack LIS deployment
- Tight cross-layer coupling between the Physical, MAC, and Networking layers
- All computing infrastructure will be exposed and managed in a compute fabric
- Dynamic resource allocation
- UAV application with quality elastic controller hosted in the compute fabric



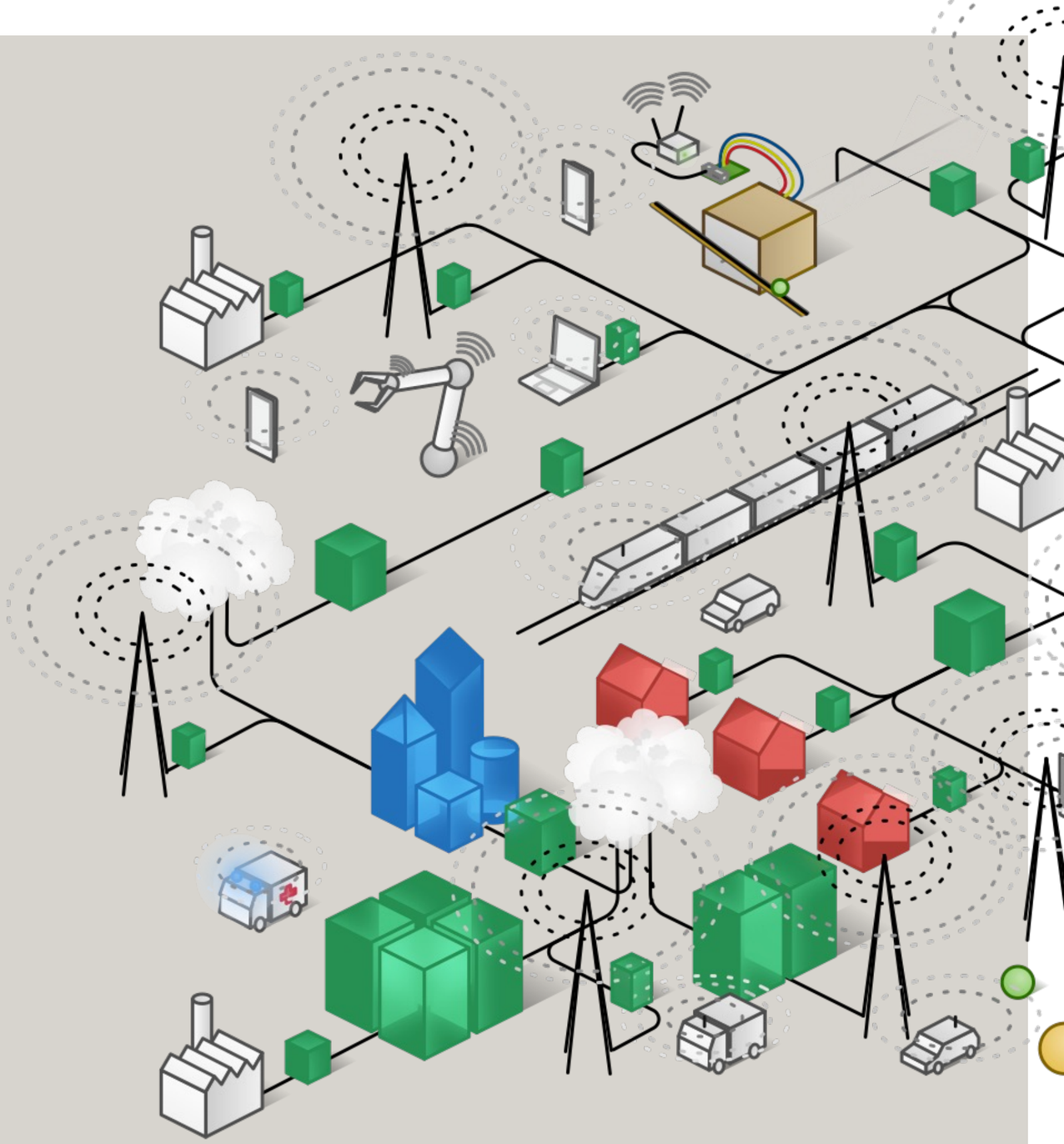
6GCC Simulator

- Focus: Exploring large scale orchestration strategies
- Build on in-house LIS simulator
- Resilient SDNs at Massive Scale
- Energy Efficiency at Scale



Conclusions

- 6G Computing Continuum addressed scale, heterogeneity, availability, and reliability with elasticity
- Research is being conducted around end-to-end an 6GCC implementation and through simulation at a global scale.



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