Mobile Network Architecture: End-to-End Network Slicing for 5G and Beyond

The path from concepts to practice: The 5G PPP Phase 2 project 5G-MoNArch

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Background
5G mobile network architecture evolution

Requirements

- Support of large variety of vertical-driven use cases
- Diverse requirements on service availability, flexibility, reliability and security
- Diverse service characteristics: lifetime, location, number of users, traffic properties
- No one-fits-all approach for network architecture and capabilities

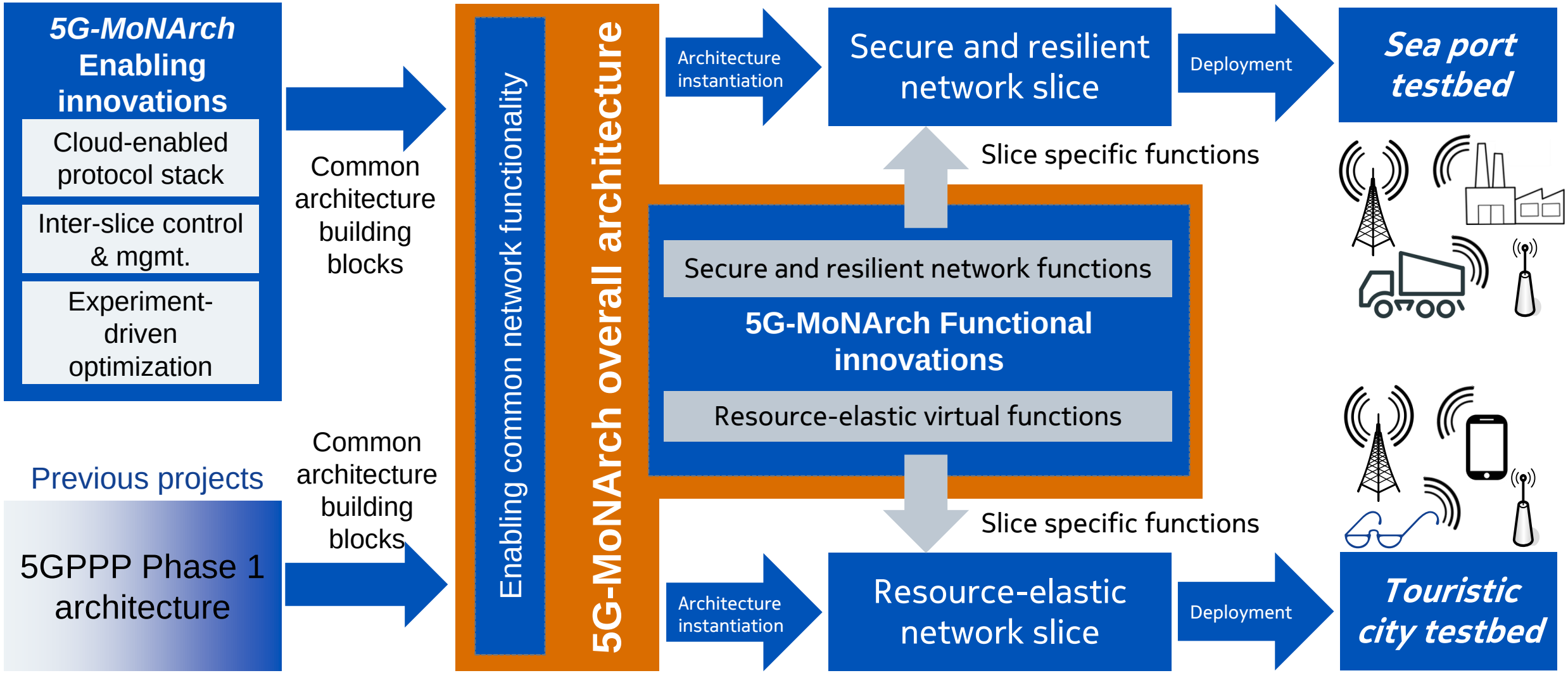
5G-PPP Phase I

- Baseline: SDN & NFV
- Network slicing: multiple logical networks on the same infrastructure
- **Flexible instantiation and location** of NFs
- **SW-defined control and orchestration** for NFs
- Joint optimization of access / core NFs through **intelligent interaction design and co-location**

5G-PPP Phase II

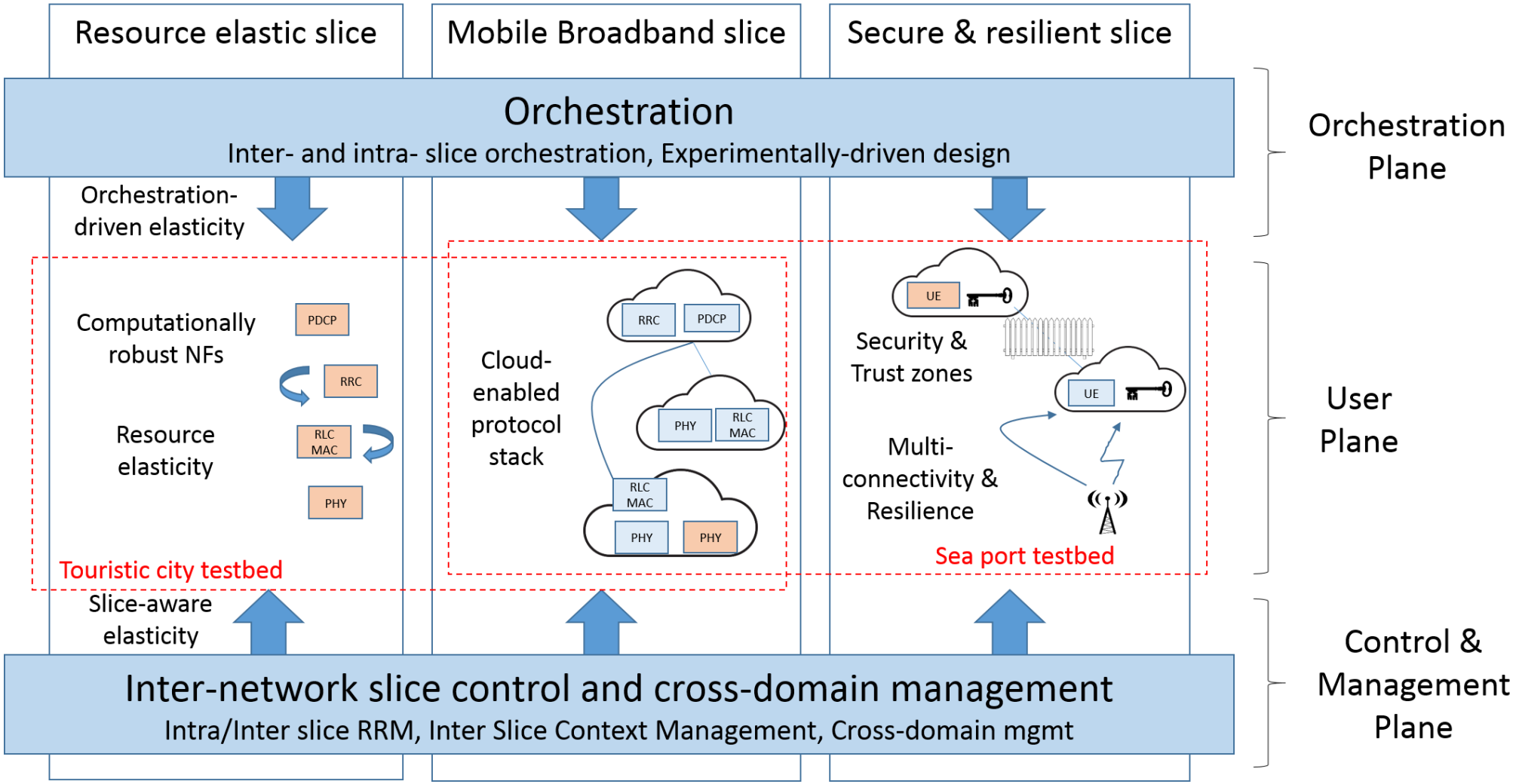
- Enhance and complete Phase I and 3GPP network architecture concepts with **enabling innovations**, filling gaps
- Develop and implement dedicated **vertical use cases** with specific functionality requirements
- Proof-of-concept and validation through **simulation and real-world testbeds**

5G-MoNArch concept



5G-MoNArch concept

Innovations



5G-MoNArch concept
Innovations

Cloud-enabled protocol stack

- Supports decoupling of virtualized NFs from physical infrastructure
- Reduces dependencies between NFs to support flexible placement

Resilience & security

- RAN reliability: multi-connectivity & network coding
- Resilience in telco clouds: fault isolation & prioritization and scaling of NFs & semi-autonomous 5G islands
- Security: security trust zones and security fault isolation

Inter-slice control and cross-domain management

- Slice lifecycle management support
- Multi-slice (infra) resource management
- Slice prioritization & context sharing
- Slice control across infrastructure domains

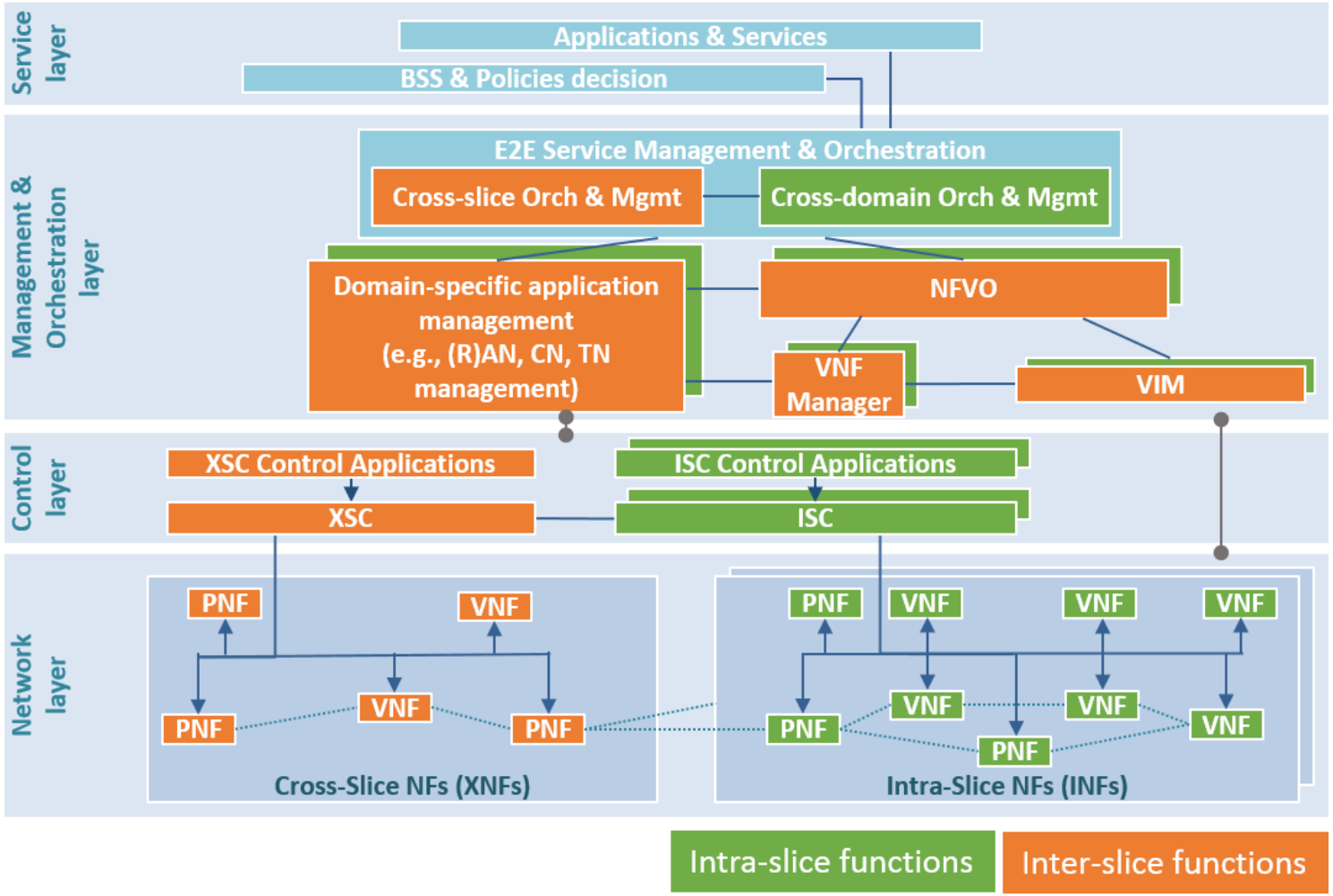
Experimentally-driven modelling and optimization

- Create and verify models for resource utilization
- Enable design of resource optimization algorithms

Resource elasticity

- Efficient scaling of resources through NFs
- Computational resources – graceful downscaling
- Orchestrate: re-allocate NFs within and across the edge cloud
- Slice-aware network size and resource optimization

5G-MoNArch concept
Architecture

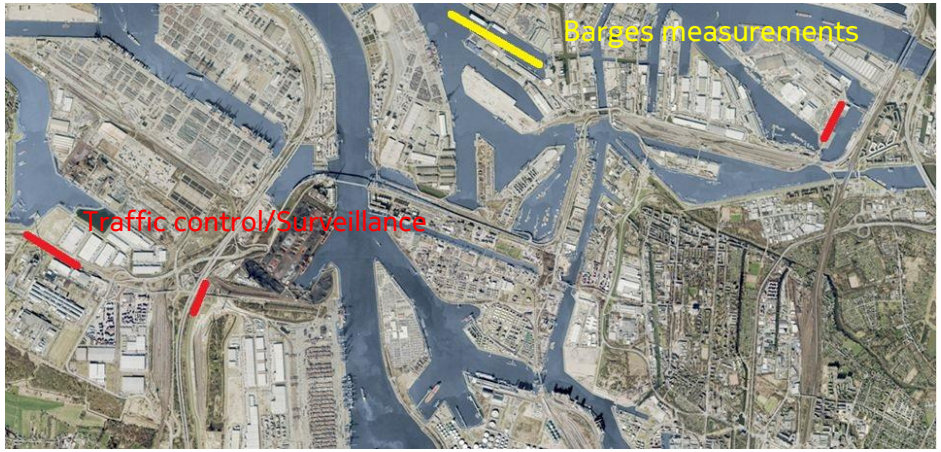


Key features

- Multi-tenancy capable network management and orchestration
- Dynamic resource sharing between slices
- Separation between common and dedicated network functions
- PNFs and VNFs integrated in common framework
- Separation between data layer, control layer, management layer

5G-MoNArch concept

Testbeds



Smart Sea Port (Hamburg)

Touristic City (Torino, Italy)

- Applications
  - Traffic light control (cMTC): Traffic lights which are connected through wireless connection; reliable and resilient; data integrity
  - Video surveillance (MBB): Video surveillance required to control entrance to areas, current status of areas, etc
  - Sensor measurements (mMTC); Sensor measurements on barges which must be connected through wireless terminals
- Application areas:
  - On-site live event experience (eMBB) by means of augmented / virtual reality – city view full of real and imaginary people
  - Cooperative media production (cMTC): interaction and cooperation with imaginary and real people having the same AR / VR experience
  - Extreme network elasticity (network slicing) to handle temporary mass events with high load / throughput per user

5G-MoNArch
Key Facts

- Project Details
  - Project runtime: July 2017 to June 2019 (24 Months)
  - Leadership team:
    - Coordinator: Nokia Munich (Germany)
    - Technical Management: Universidad Cárlos III de Madrid UC3M (Spain)
    - Innovation Management: Deutsche Telekom, Berlin (Germany)
  - Further information:
    - https://www.5g-monarch.eu

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