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Organic & Dynamic Infrastructure: Getting ready for 6G

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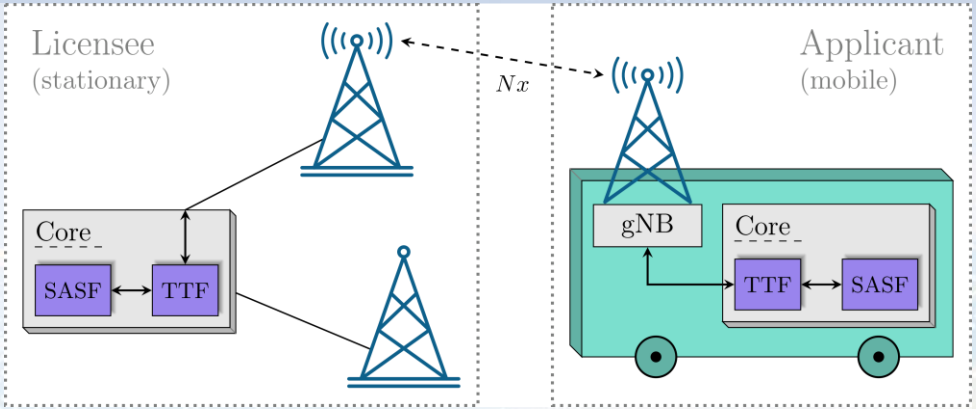
26. VDE/ITG Fachtagung Mobilkommunikation, Osnabrück

- Organic re-structuring of infrastructure
  - Joining separate networks
  - Splitting network
  - Temporary, partly extension of network
  - Spawning/Termination of additional NF instances
  - Merging/Division of runtime memories (UE sessions, trust relations, …)

- Example
  - Rural Farm
  - Stationary, permanent interconnection only tightly around building
  - On crop fields not required all the time
  - Temporary, moving infrastructure spawning on-demand

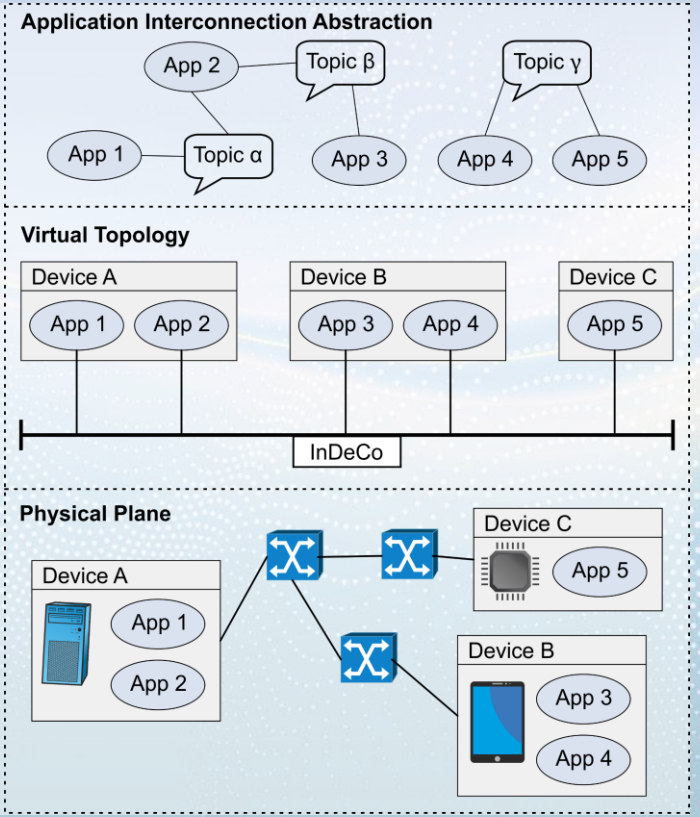
- Nomadic Networks
  - Mobile (transportable) or moving infrastructures
  - Moves into / is started inside coverage of stationary infrastructure
  - Co-existence, Interaction between full systems
- Core-to-Core (CtC)
  - Interaction between separate full infrastructures
  - Required for Nomadic Networks
  - E.g. dynamic and/or efficient Spectrum Allocation



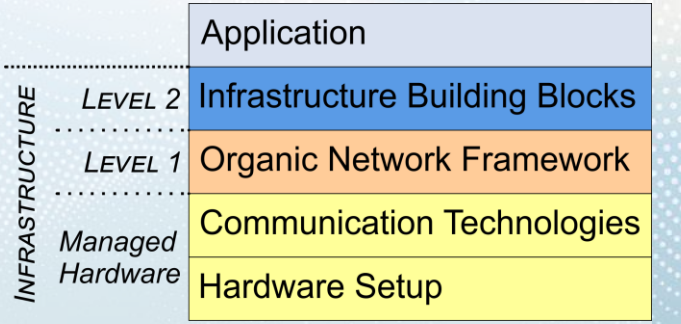
SASF: Spectrum Allocation & Sharing Function
TTF: Trust & Traceability Function
[1] „Radio Resource Sharing in 6G Private Networks: Trustworthy Spectrum Allocation for Coexistence through DLT as Core Function" (Krummacker, Veith, Lindenschmitt)
(A manuscript that introduces a DLT-based Core function for trustworthy interaction between separate infrastructures, specifically to negotiate dynamic spectrum allocation and sharing)

Architecture Design

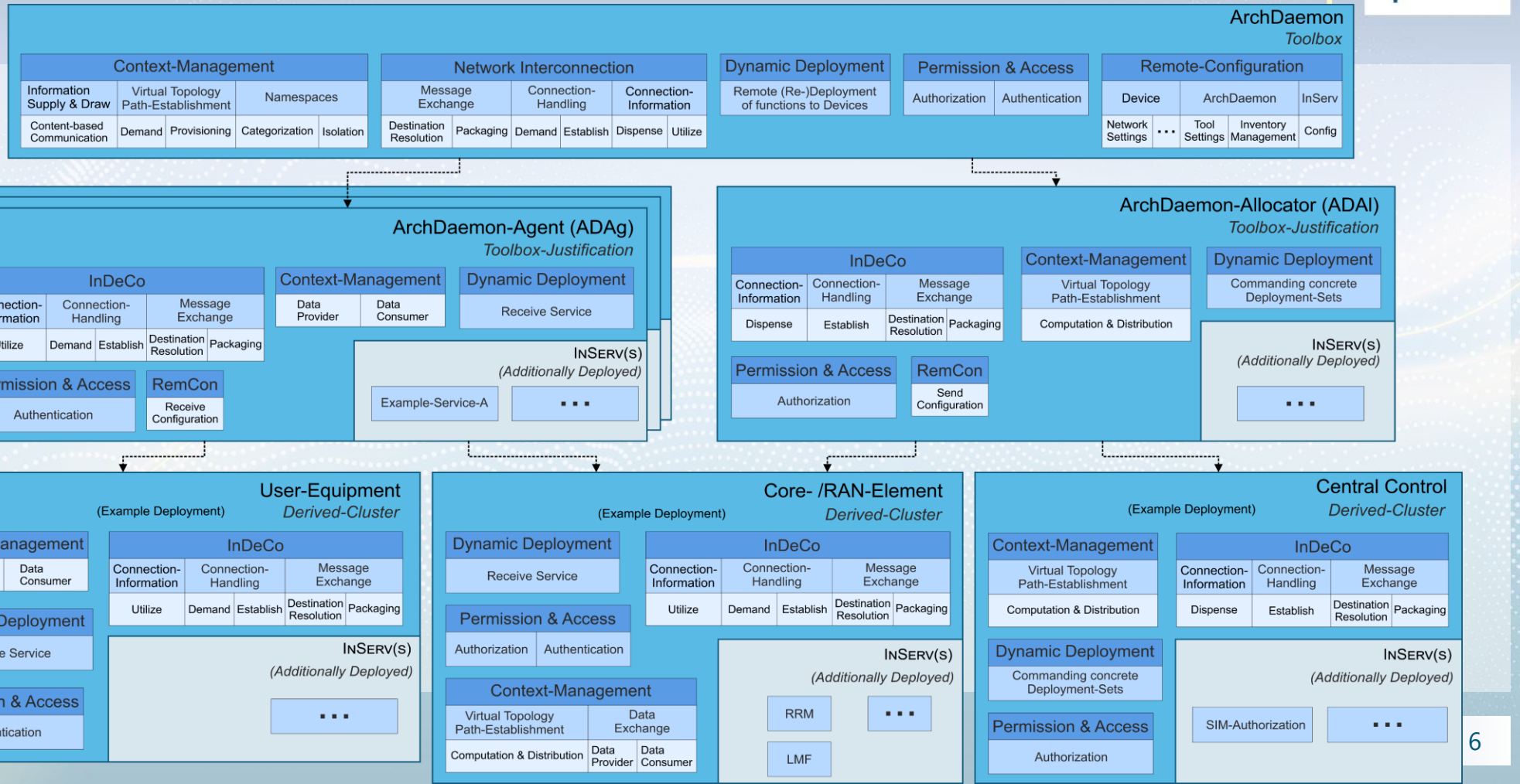
- System design paradigm and Software Suite
  - Logical Interconnection of services
  - Grants comfortable tools for data exchange
  - Flexibility and Dynamicity for Infrastructure during operation



- 2-Level Abstraction
  - Level-1: Basic Toolbox to establish managing hardware and handling logic
  - Level-2: Special purpose-oriented building blocks that in collaboration form the actual infrastructure behavior
- Level-2 is what actually operates “organically”
  - Is a set of uniform software pieces
  - Called Inserted-Services (InServ)
- Level-1 provides unifying tools
  - Manages InServs
- Architecture-Daemon (ArchDaemon)



Architecture-Daemon (ArchDaemon)
Software Toolbox



Proof-of-Concept
Showcase of Implementation

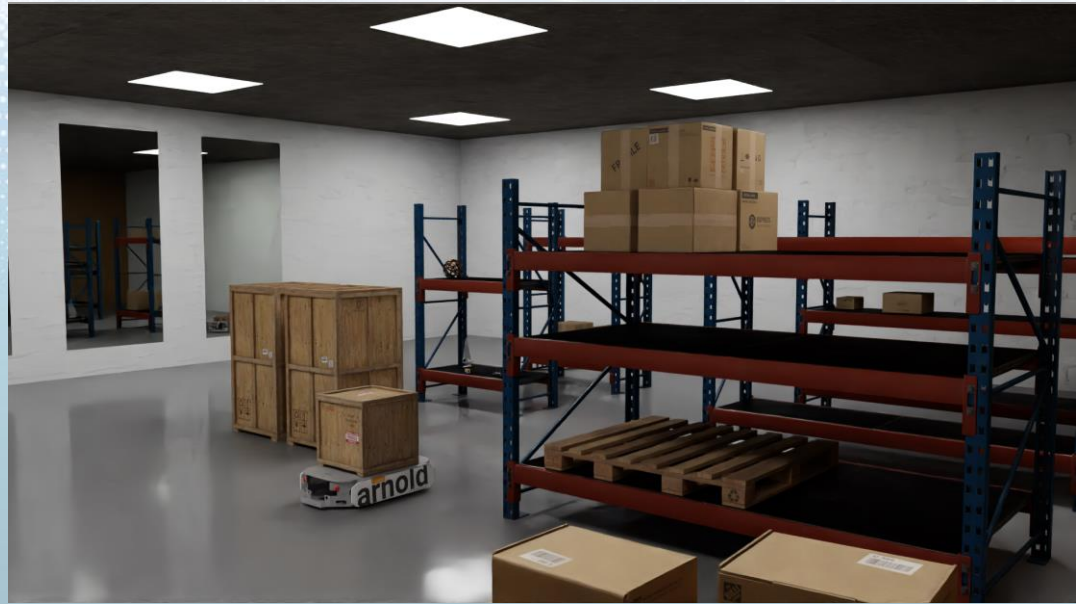
Physical Demonstrator

- 5G Radio, AGVs, Edge & Cloud Servers, Sensors
- Complex Interconnection
- Controlled via Software
- Side-by-side Operation of multiple use-cases
- Evolving System

- Everything managed, connected and orchestrated by ArchDaemon

Virtual Environment; Digital-Twin

- Image of real world
- Prediction, Monitoring, Optimization, AI
- Emergent-Intelligence



Future Work

- More features to implement to serve the use-cases
  - Network Functions for inside the Core domain
    - CtC
    - Dynamic Spectrum Allocation
    - Distributed Ledger Technology for Trust
      - E.g. immutable logging of utilized radio ressources or negotiated operation under shared spectrum
  - „Service Memory Handling“
    - A framework for:
      - Splitting/Merging runtime status of processes
      - Checkpoint/Restore → Combine with live-Migration
- 6G Architecture
  - Core-less Architecture
  - Logical interconnection between services
  - Additional „service serving services“.
    - Context-Management, Data-Analytics, Reasoning, AI

Thank you for your Attention

For Questions, please contact

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