

COHERENT

Towards a control framework for 5G mobile networks

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Motivation

- 5G mobile networks research and standardization picks up steam
- 5G systems aim to provide for
 - 1000-fold capacity increase, 10-100 more connected devices and higher user data rates
 - Heterogeneity and densification of the radio access network
 - Efficient spectrum management
 - Flexible and efficient control, coordination and configuration for 5G mobile networks
 - Sustainable energy efficiency and OPEX
 - Rapid service launch
- In order to deliver on this vision, we need
 - Better abstraction and control approaches in 5G radio access
 - Orchestration that enables a ubiquitous and unified service platform
- This presentation aims to serve as a
 - discussion opener in SDNRG for 5G topics
 - seed for a draft under the "multi-layer programmability and feedback control system" area of interest of the RG

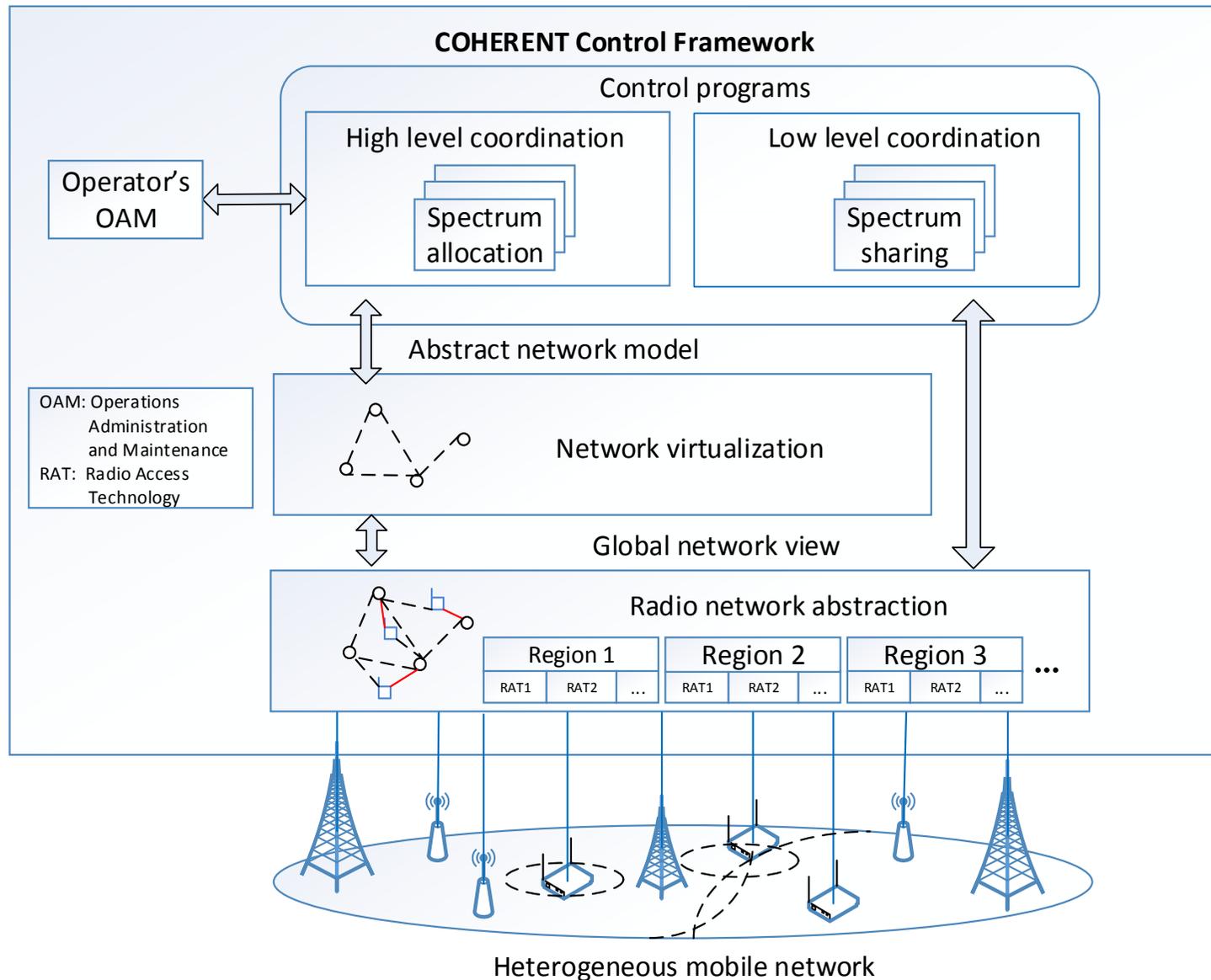
Discussion Opener

- In COHERENT (www.ict-coherent.eu), we started looking into a number of interesting topics:
 - interference management, mobility management, multi-point connectivity
 - programming abstractions for software-defined mobile networks
 - spectrum management and RAN sharing.
- Some of these topics are not the domain of IETF, clearly.
- But, SDN abstractions for mobile networks can be discussed and researched in the context of IRTF, as 5G systems will have a profound effect on how the Internet will look like in 10 years
 - How would we design IETF protocols if access was only wireless?
 - How do we apply SDN principles in systems that today reap tremendous benefits from tight integration of control and data planes (we've been there before)
 - How do we manage complexity as the network grows 10-100-1000-fold?

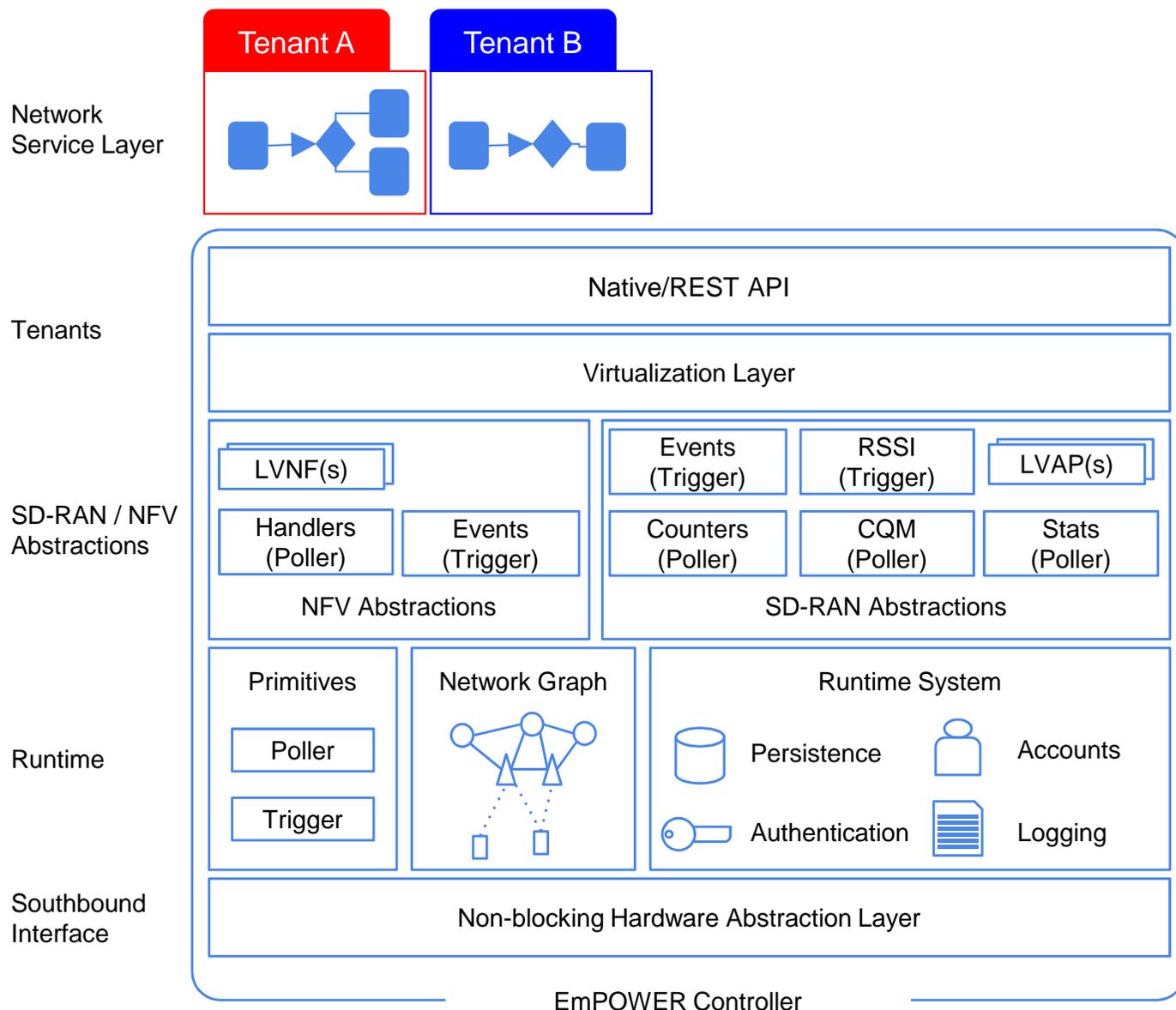
Radio Control/Data Planes

- RFC 7426: “SDN emphasizes the role of software in running networks through the introduction of an abstraction for the data forwarding plane and, by doing so, separates it from the control plane”
- In existing LTE and Wi-Fi Radio Access:
 - Network equipment (eNB, AP) include functionality of both user data processing and control of Layer 1 (PHY), Layer 2 (sub-layers are technology-specific) and Layer 3 (Radio Resource Control).
 - RRC in LTE is by far more demanding in terms of latency, given its synchronous operation resulting from high mobility requirements
- What kind of abstractions do we need to virtualize a given sub-layer?
- How do we deal with
 - interference management
 - mobility management
 - multi-point connectivity

COHERENT Control Framework

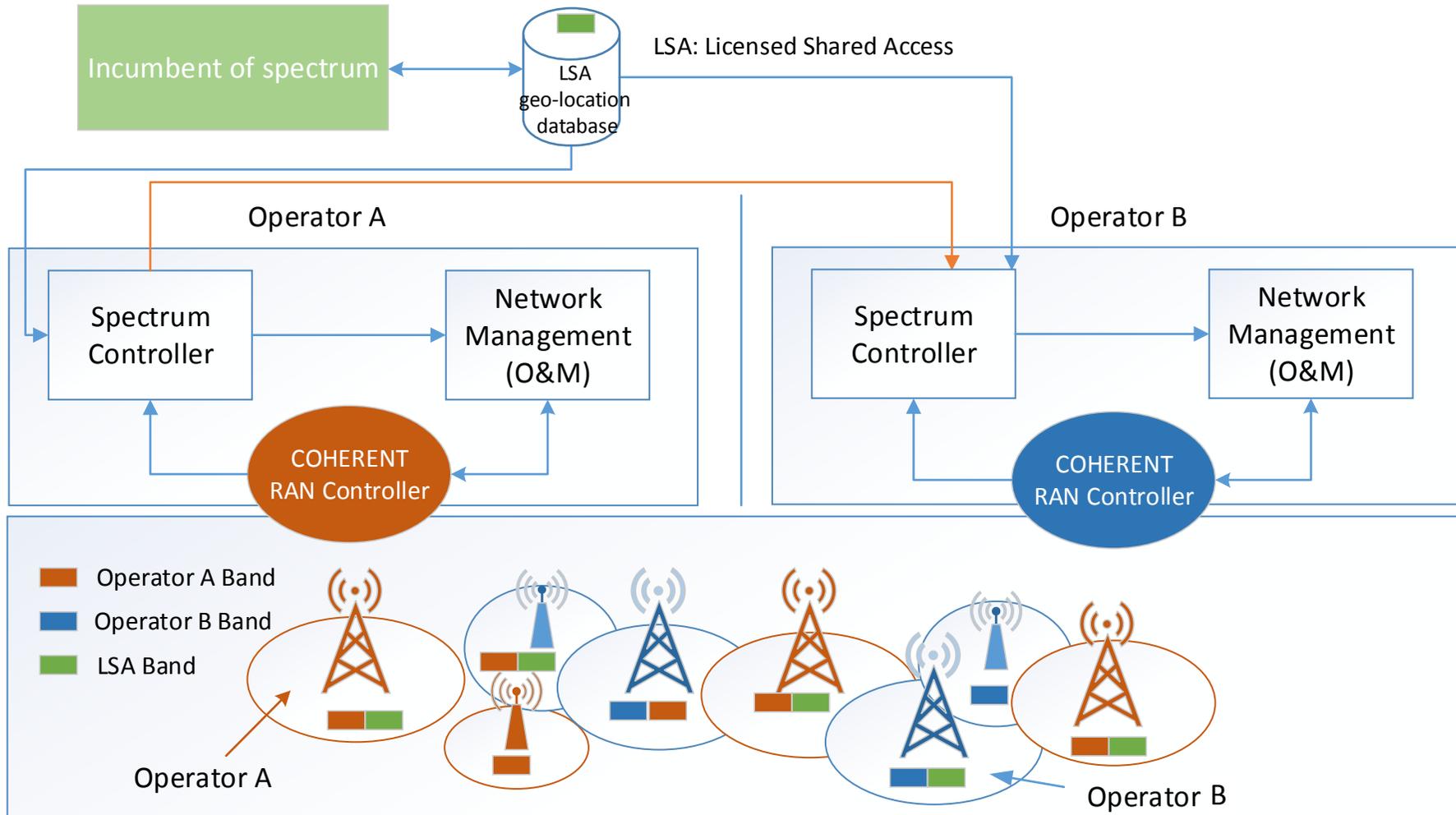


Example of a SD-RAN Controller



- ❑ Everything is a VNF (including radio access)
- ❑ Light Virtual Access Point (LVAP), abstracts the radio access: state management, per-tenant radio resource management
- ❑ Light Virtual Network Function (LVNF), perform arbitrary packet processing: MAC offloading, content caching, etc.
- ❑ Soft-state, hot-swappable: network runs in last known state if connection to controller is lost
- ❑ Supports both binary and text-based southbound protocols
- ❑ Tenants can use both the native Python DSL (Domain Specific Language) or the REST API
- ❑ Multi-platform (Windows, Linux, OSX)
- ❑ Prototype available at <http://empower.create-net.org/>

Spectrum Allocation and Sharing



Outlook

- Interesting challenges ahead:
 - Support for multi-connectivity and different CoMP implementations
 - Network Graphs (interference graph, channel quality map, backhaul)
- Standardization
 - There's ongoing work in 3GPP SA1 (SMARTER) and SA2
 - COHERENT is contributing to these efforts
- Towards an SDNRG draft
 - Why? This is where the world's SDN community congregates, for free
 - Establish a common understanding about SDN research for 5G mobile networks
 - Terminology, background, challenges for non-wireless experts
 - Example scenarios
 - Aiming for community input: (co)authors, contributors, and reviewers wanted