LSA EVOLUTION ENABLES LOCAL HIGH-QUALITY WIRELESS NETWORKS

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Dr. Seppo Yrjola, Nokia Corporate Strategy & Development
Dr. Heikki Kokkinen, Fairspectrum

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Megatrends in wireless

Enables unbundling of investments in spectrum, infrastructure and services

Cloud, NFV and network slicing are transforming network infrastructure deployment

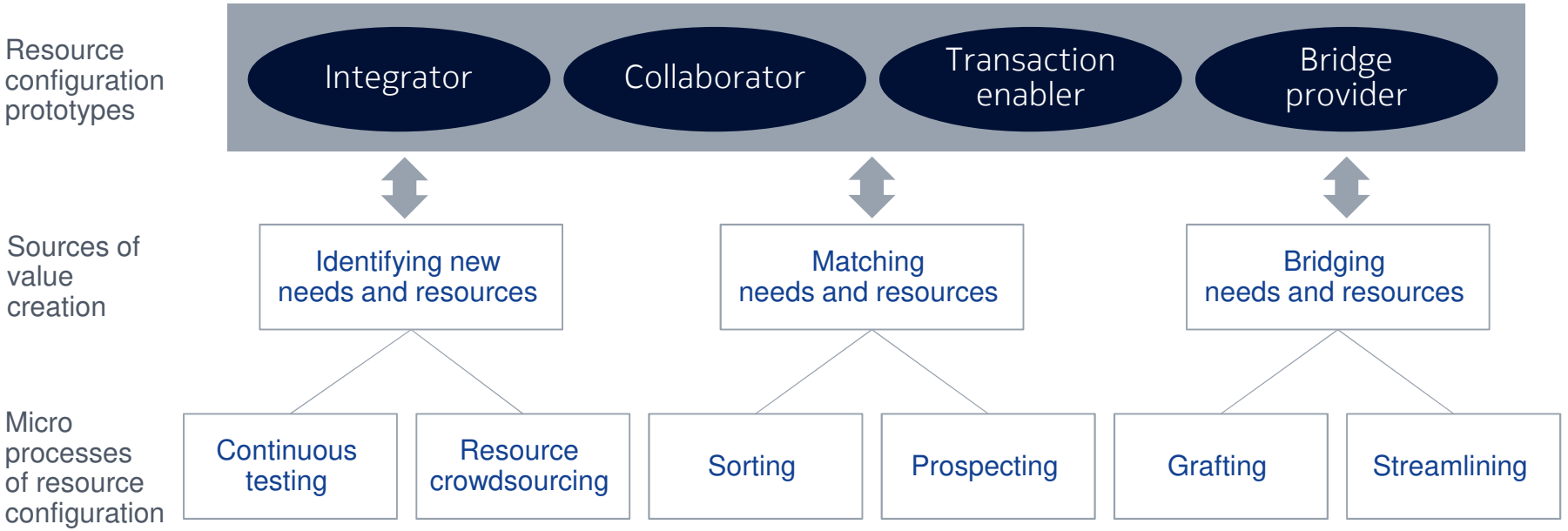
Shared spectrum is ‘virtualizing’ the spectrum asset ownership, altering valuation and utility

Localized edge services and ultra low latency, high reliability applications emerging with vertical needs

Business model innovation boosting as-a-Service models

Novel resource configurations and value creation

Enables new business models and ecosystem roles



Amit, R. and Han, X., "Value Creation through Novel Resource Configurations in a Digitally Enabled World," Strat.Entrepreneurship J., Aug 2017

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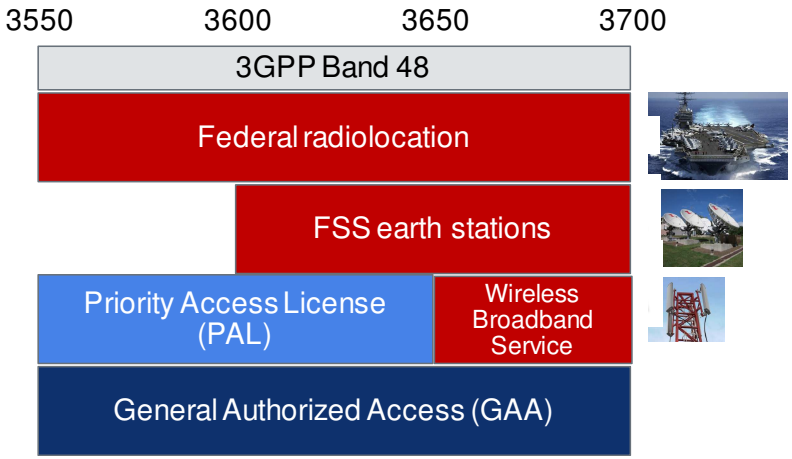
Research questions

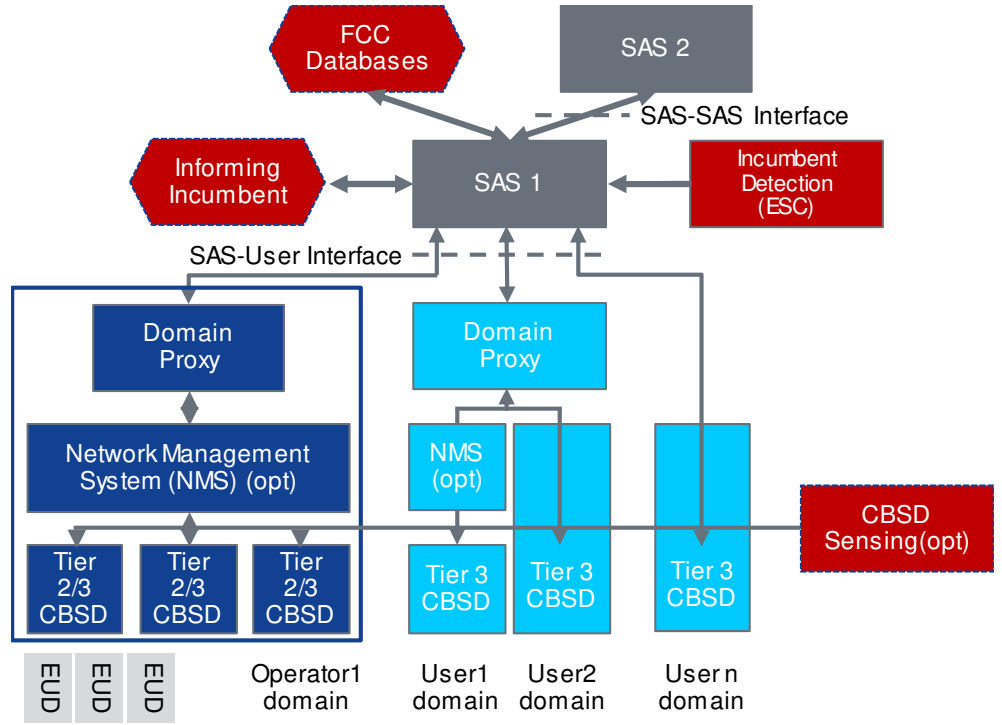
What are new requirements and amendments for the LSA spectrum sharing evolution to enable local high-quality wireless micro-operator networks?

What are the needed revisions in architecture and technology?

How could this be of help for key stakeholders and regulators in implementing LSA evolution?

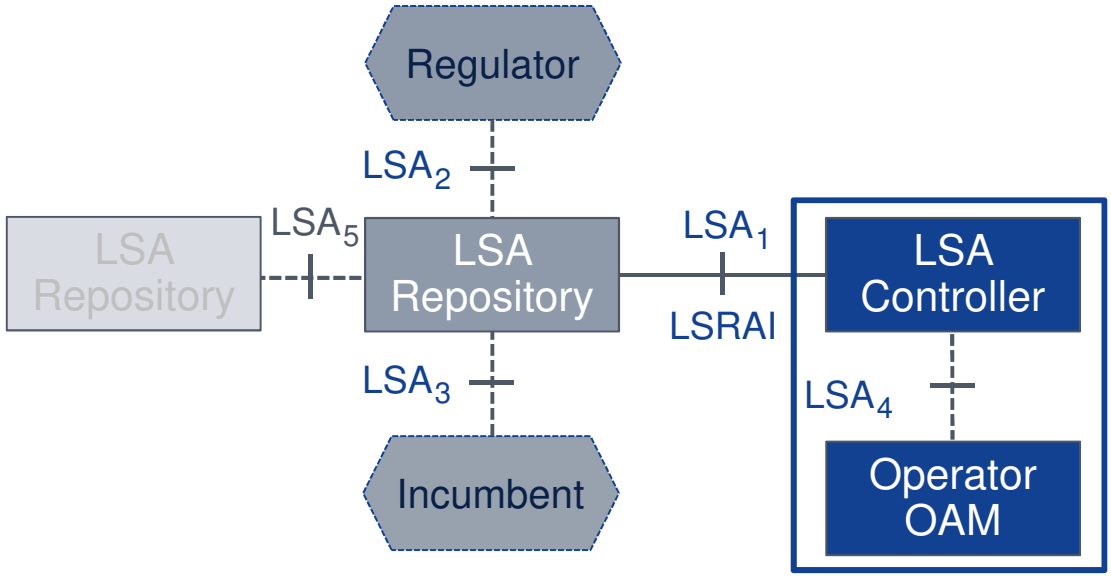
CBRS concept and functional architecture





Wireless Innovation Forum, "SAS Functional Architecture," WINNF-15-P-0047-V1.0.0, Sept 2015

LSA architecture reference model



ETSI, System Architecture and High-Level Procedures for operation of Licensed Shared Access (LSA) in the 2300 MHz-2400 MHz band. TS 103 235, 2015.

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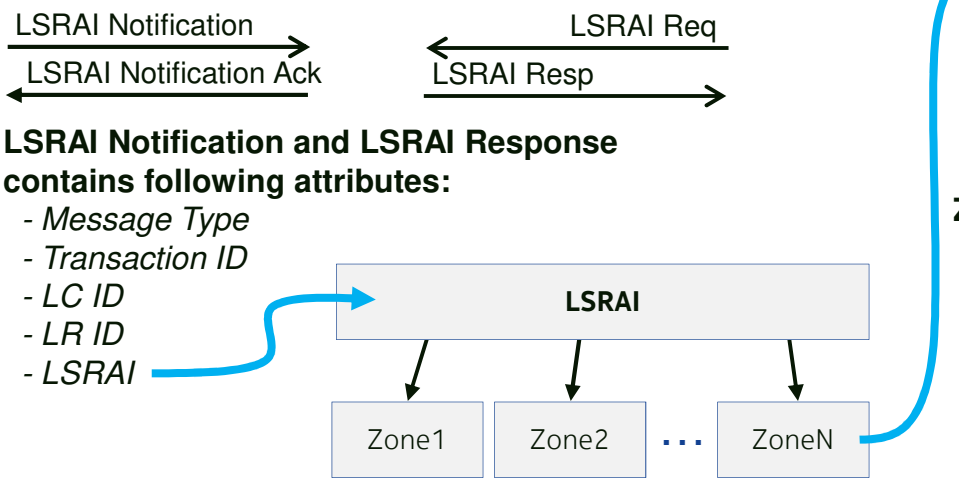
Scope of LSA in Europe

Final CEPT ECC Report 205

- *a complementary spectrum management tool under an "individual licensing regime".*
- *facilitates the introduction in a frequency band of new users while maintaining incumbent services in the band.*
- *aims to ensure a certain level of guarantee in terms of spectrum access and protection against harmful interference for both the incumbent(s) and LSA licensees, thus allowing them to provide a predictable quality of service.*
- *excludes concepts such as "opportunistic spectrum access", "secondary use" or "secondary service" where the applicant has no protection from primary user(s).*
- *licensees and incumbents operate different applications and are subject to different regulatory constraints. They would each have exclusive individual access to a portion of spectrum at a given location and time.*
- *first practical use case of LSA will be to provide access to additional spectrum for mobile broadband services (MFCN)*

LSA protocol elements and LSRAI

ETSI TS 103 379 - LSA Spectrum Resource Availability Information (LSRAI)

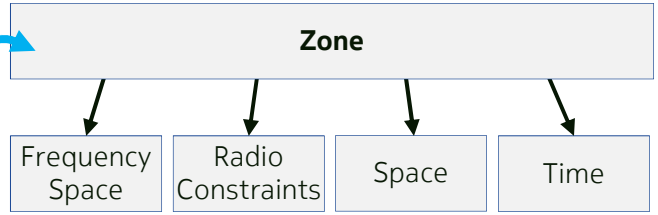


LSRAI Notification and LSRAI Response contains following attributes:

- *Message Type*
- *Transaction ID*
- *LC ID*
- *LR ID*
- *LSRAI*

The LSRAI IE contains one or several zone descriptions referring to zones and following additional attributes:

- *Number of zones*



Zone contains following attributes:

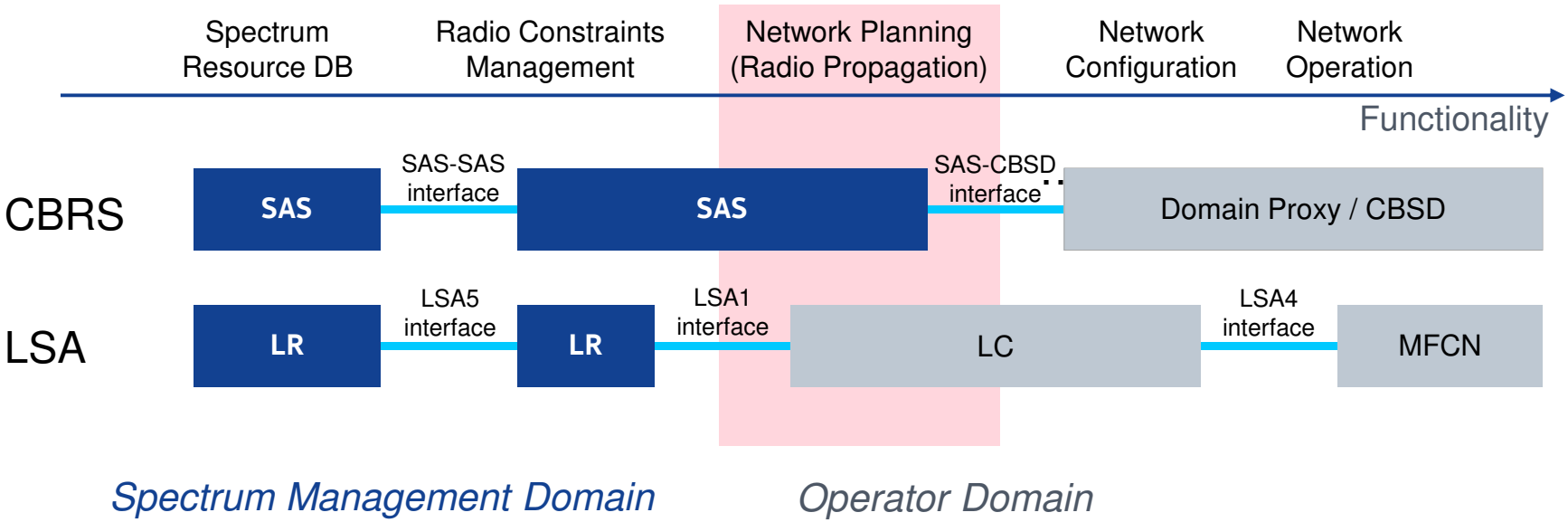
- *Zone-ID*
- *Zone-Type = EZ, PZ, RZ*
- *Action = Create, Modify, Delete*

exclusion zone: geographical area within which LSA Licensees are not allowed to have active radio transmitters

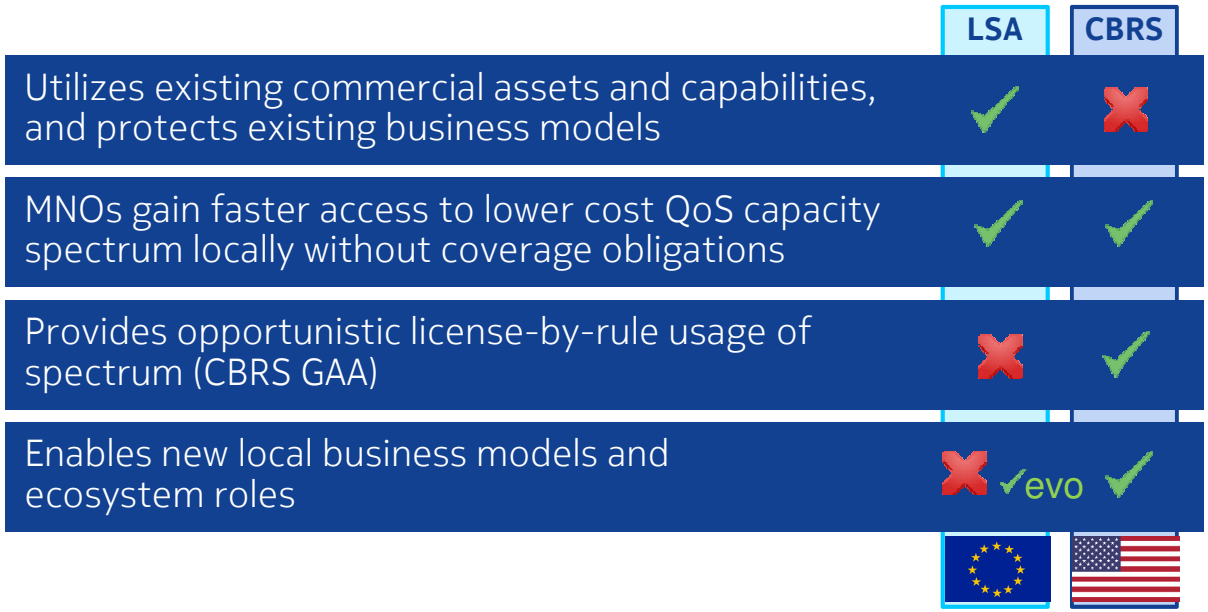
A **protection zone** is defined using specific measurement quantities and thresholds (e.g. a mean field strength that does not exceed a defined value in dBµV/m/MHz at a defined receiver antenna height above ground level)

restriction zone: geographical area within which LSA Licensees are allowed to operate radio transmitters, under certain restrictive conditions (e.g. maximum EIRP limits and/or constraints on antenna parameters)

LSA – CBRS comparison - Functional architecture



LSA – CBRS comparison - Business model enablers



LSAevo requirements – Regulation & System

ETSI RRS - LSA Architecture Instantiations for Local High-Quality Wireless Networks

LSA Regulation (CEPT/NRA)

- Opening and adaptation of the LSA method to vertical sectors players
- Opening of appropriate frequency bands, establishing a respective Sharing Framework for the vertical sector players
- Considering new sharing methods like mutual renting, spectrum pools, and/or local spectrum sub-licensing
- Allowing new Incumbents (e.g. MNOs, verticals)
- Simplification of the LSA License process to handle a high number of vertical sector players, e.g., LSA license for vertical sector players to access a LSA spectrum resource pool

LSA System

- Locally confined deployment areas, indoor and outdoor, for flexible radio deployments
- Deployment durations ranging from several hours to several years, i.e. support of flexible grant and relinquishment procedures for LSA spectrum resources
- Deterministic and predictable channel arrangements (fixed channel plans) to satisfy the stringent QoS requirements of local high-quality wireless networks
- Handling of multiple coexisting Sharing Frameworks and respective sharing methods

ETSI RRS, "DTR/RRS-0148: Feasibility study on temporary spectrum access for local high-quality wireless networks ," Early draft 0.0.6, June 2017

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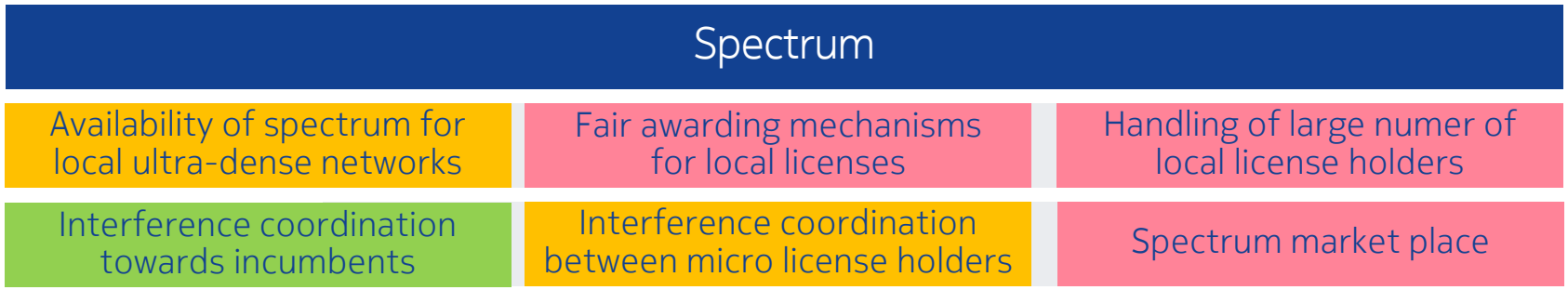
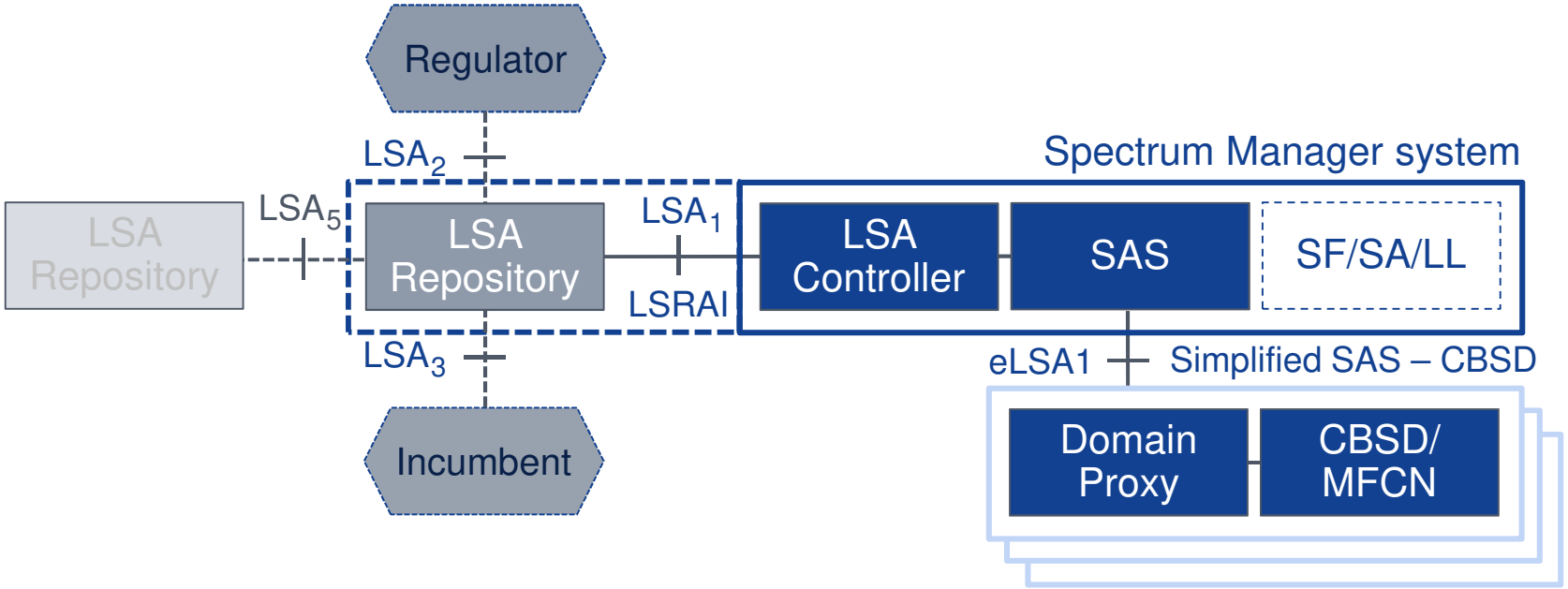
LSAevo requirements - Spectrum policy enablers



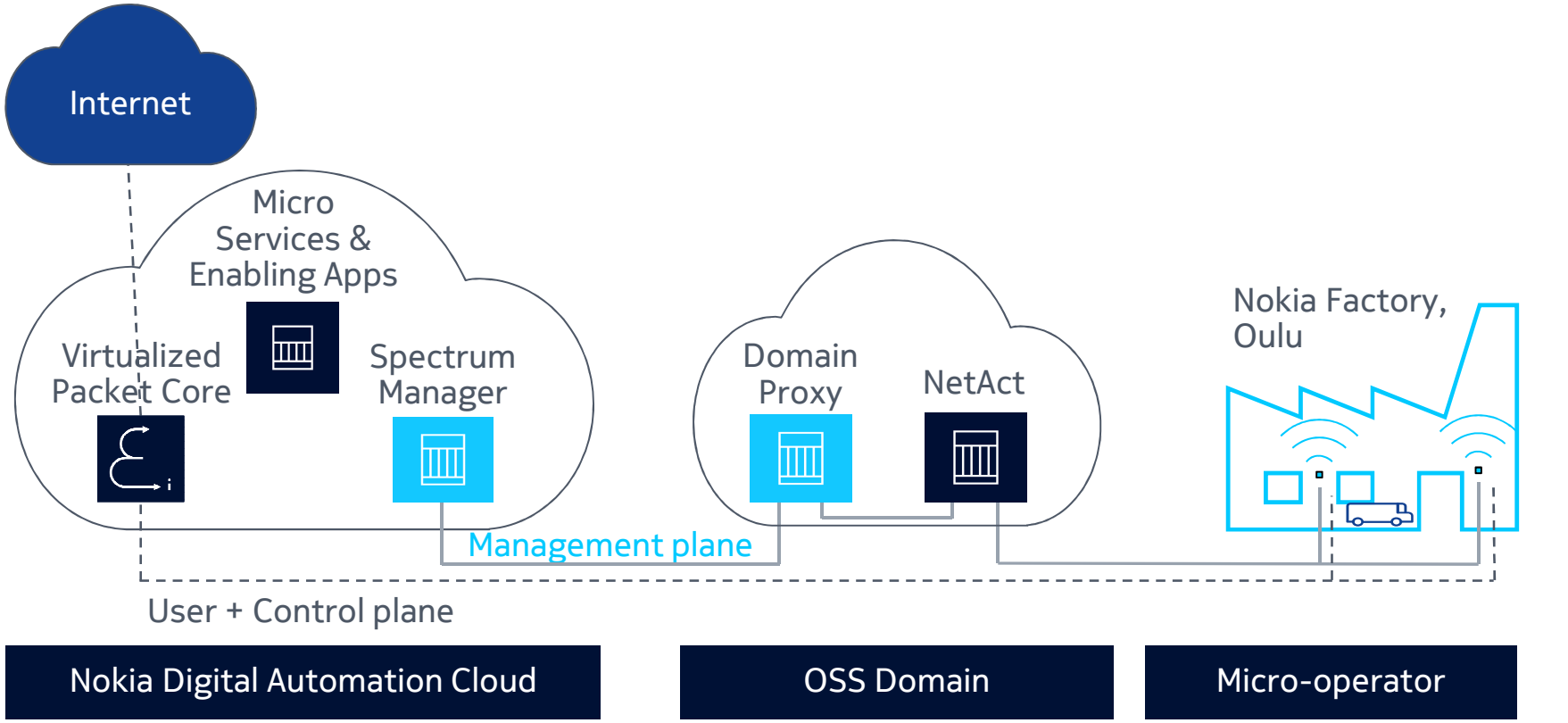
M. Matinmikko, M. Latva-aho, P. Ahokangas, S. Yrjölä & T. Koivumäki, "Micro-operators to boost local service delivery in 5G," Wireless Personal Communications, May 2017.

LSAevo architecture

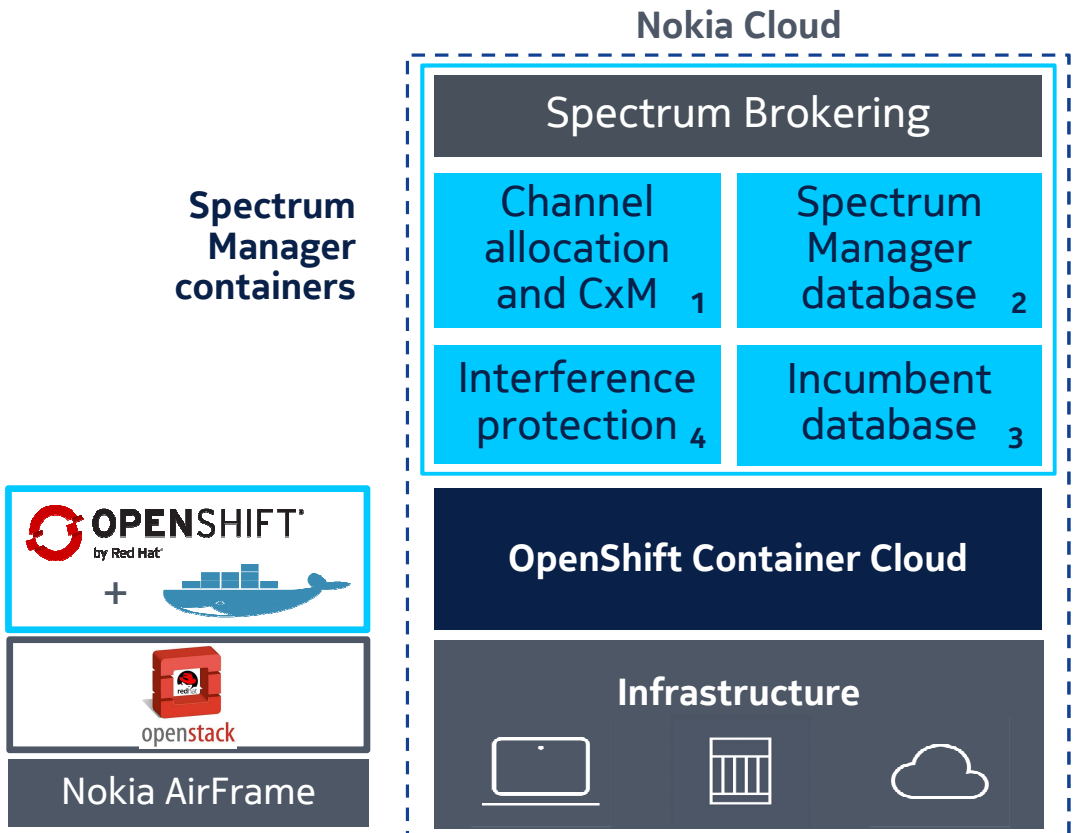
Reference model with the CBRS extension



LSAevo trial set-up



LSAevo Spectrum Manager Proof-of-Concept architecture



1. Channel allocation and co-existence management for shared spectrum users.

2. Storage for internal data, e.g., topographical data, protection zones and secondary user cell data.

3. Information of existing incumbent users.

4. Incumbents and other licensees protection from harmful interference.

Shared and sub-leased spectrum brokerage

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LSAevo validation – Spectrum reconfiguration measurement results

T1 Click on SM Map, SM algorithm begin

T2 SM algorithm ready, Terminate message is sent to DP

T3 DP starts eNB frequency configuration

T4 eNB locked due to new configuration applied

T5 eNB is online on new frequency

T6 NA configuration ready confirmation to DP

T7 Heart Beat is received at SM

Additionaly, the OAM execution time can be derived from NA CM log.

T	Cumulative time for workflow step T1-T8 in seconds	e2e
T1	Incumbent notification arrives at SM	0
T2	SM informs DP to vacate the spectrum	8
T3	DP sends relinquishment message for frequency in use. DP EMS configuration for freq. vacation starts	9
T4	UE LTE cell service dropped (Nemo Outdoor)	69
T5	EMS ends, DP asks new frequency grant from SM	81
T6	After HB, EMS configuration of new granted freq. begin	91
T7	UE LTE cell service received	154
T8	SM is informed EMS config. ready by DP via HB that	163

LSA spectrum cleared in 69 seconds after incumbent notification

LSA evolution enables local high-quality wireless networks

LSA

- Leverages scale and harmonization in regulation & standardization
- Utilizes existing commercial assets and capabilities
- Unlocks more QoS spectrum for 4G and enables early access to 5G bands

LSA evolution

- New frequency bands towards 5G (e.g., UHF, 3.5 GHz, 26 GHz)
- Localization of QoS spectrum triggers novel use cases, e.g., for verticals
- Horizontal sharing & sub-licensing for efficient use of the spectrum assets
- Lowers entry barrier for new service providers
- Meets typical static & semi-static incumbent requirements in Europe

Thank you
Questions/discussion?

seppo.yrjola@nokia.com