

# LSA field trial using LTE network and SON LSA controller

WInnComm-Europe 2015, October 7, 2015

[Seppo Yrjola](#), Vesa Hartikainen, Lucia Tudose , Jaakko Ojaniemi, Arto Kivinen, Jarkko Paavola, Marko Palola and Tero Kippola

# Outline

Introduction

Research objectives

Overview of Licensed Shared Access (LSA) concept

LSA field trial environment

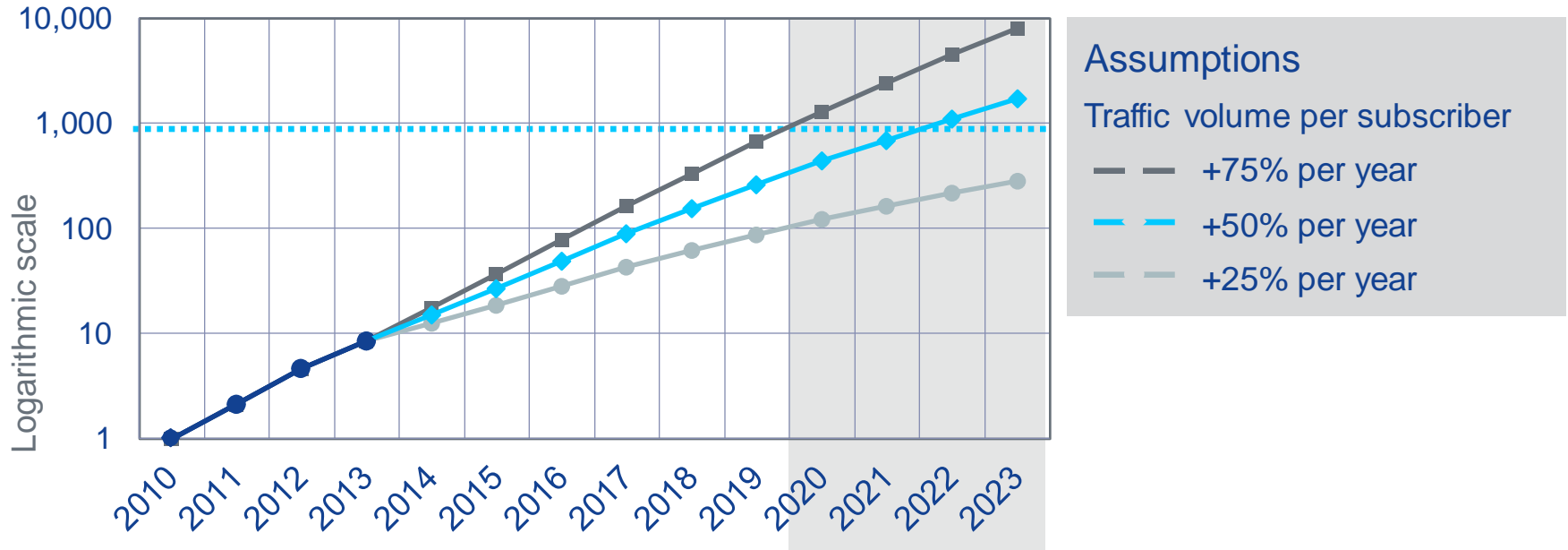
Trial set up and workflow

Performance validation

Conclusions

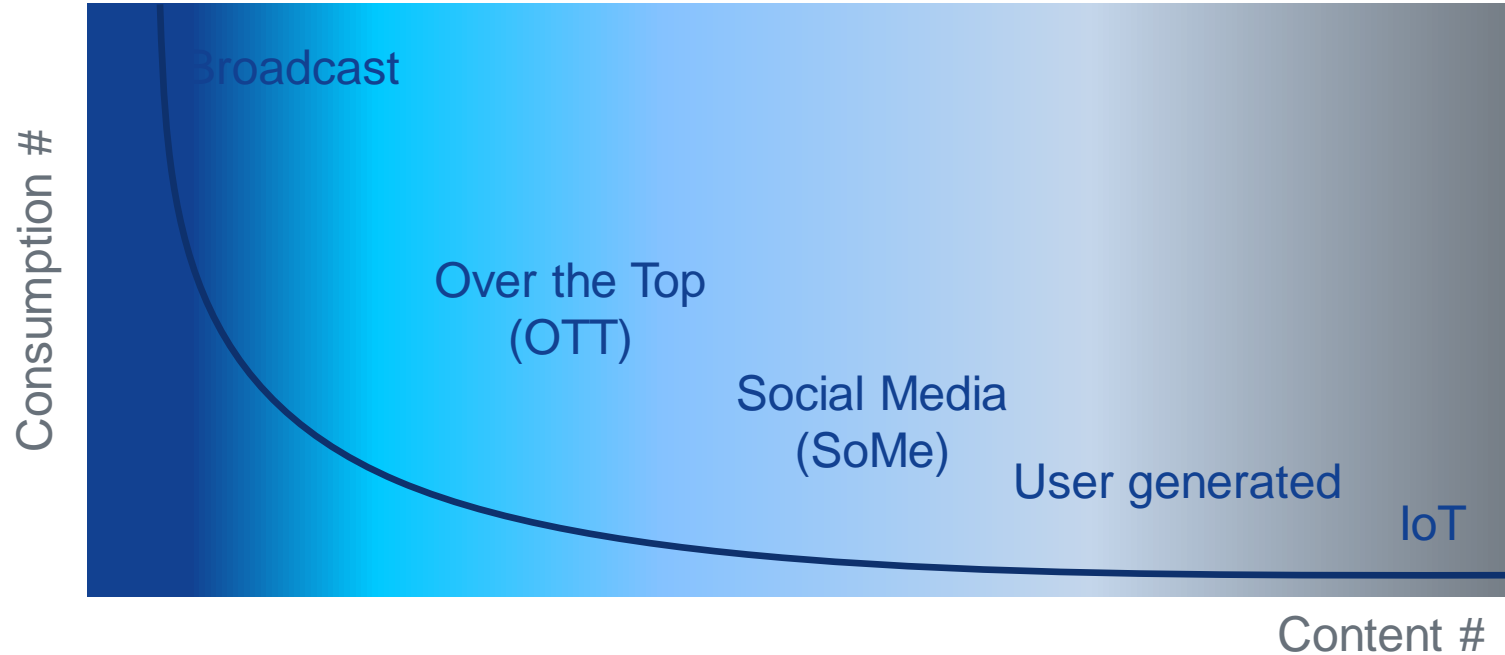
# Mobile traffic is expected to grow exponentially until 2020

Mobile data traffic increase scenarios



# Traffic pattern is changing

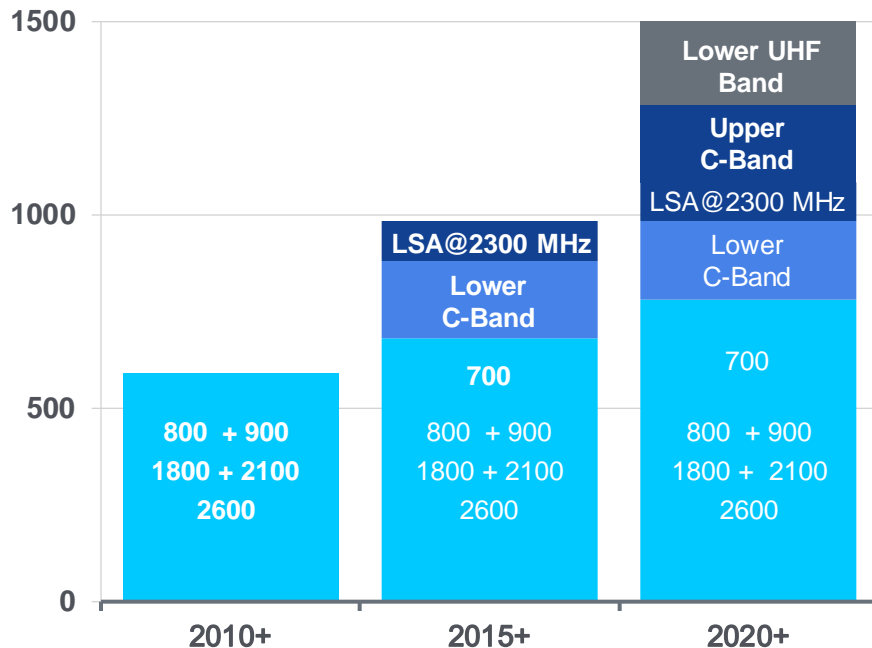
Long tail of media content, services and devices



# Spectrum roadmap for mobile broadband

## European example

Total Amount of Spectrum / MHz



- 470-698 MHz convergence and shared use between Broadcast and Broadband
- Shared use in C-band will enable wider bandwidths for dedicated small cell layers
- Licensed Shared Access (LSA) will unlock additional spectrum for LTE
- Additional Spectrum shall be allocated and put into use quickly
- Exclusive Spectrum Access has top priority
- Dynamic combination of fragmented spectrum through Carrier Aggregation

**Licensed +  
Licensed *Shared* Access**

# Key trends shaping mobile broadband industry



## Research objectives

Demonstrate the LSA concept and validate key performance parameters for sharing between MNO and Program Making and Special Events incumbent.

Introduce LSA controller implemented as a part of Self Organizing Network solution fully integrated into commercial Operational Support System.

Validate advanced incumbent protection algorithms to maximize LSA spectrum resource availability while ensuring incumbent protection.

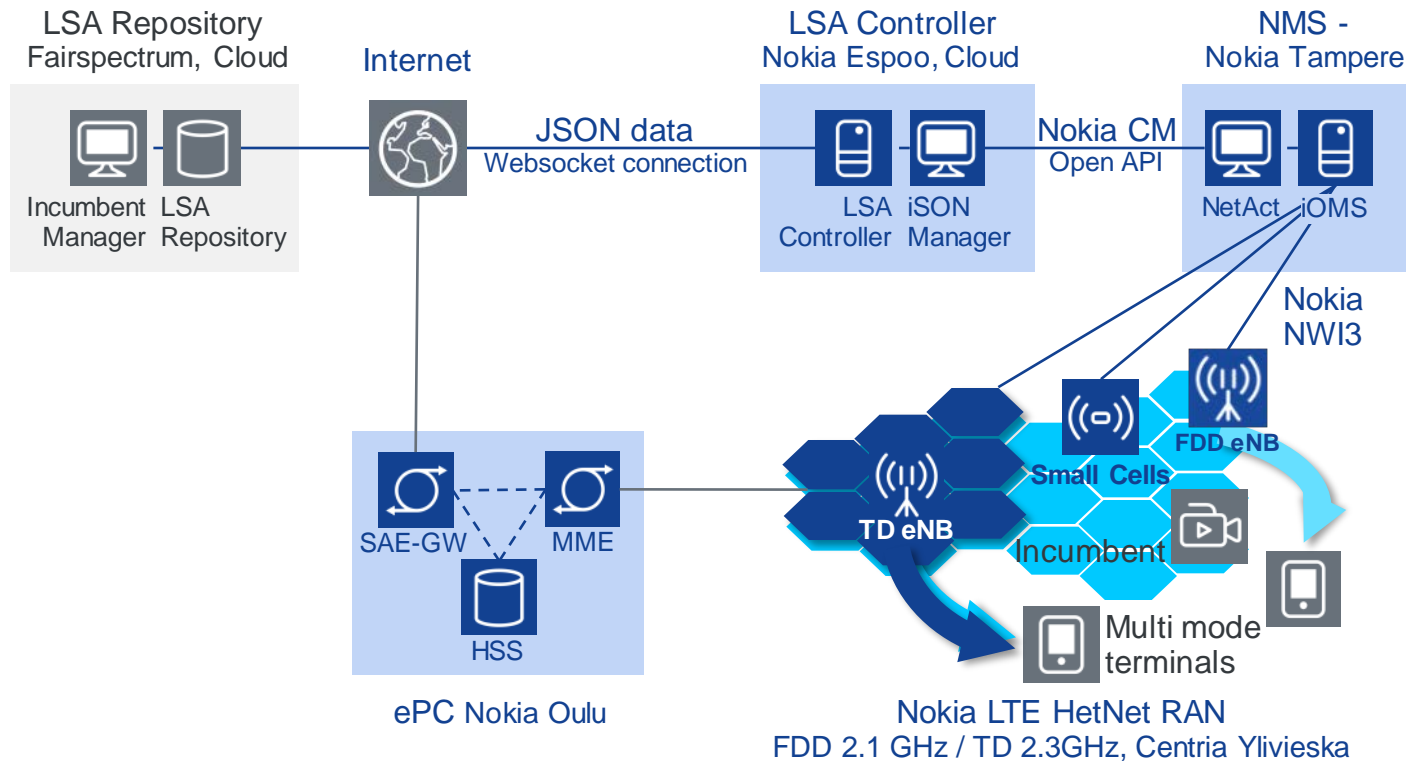
## Technical and administrative functions



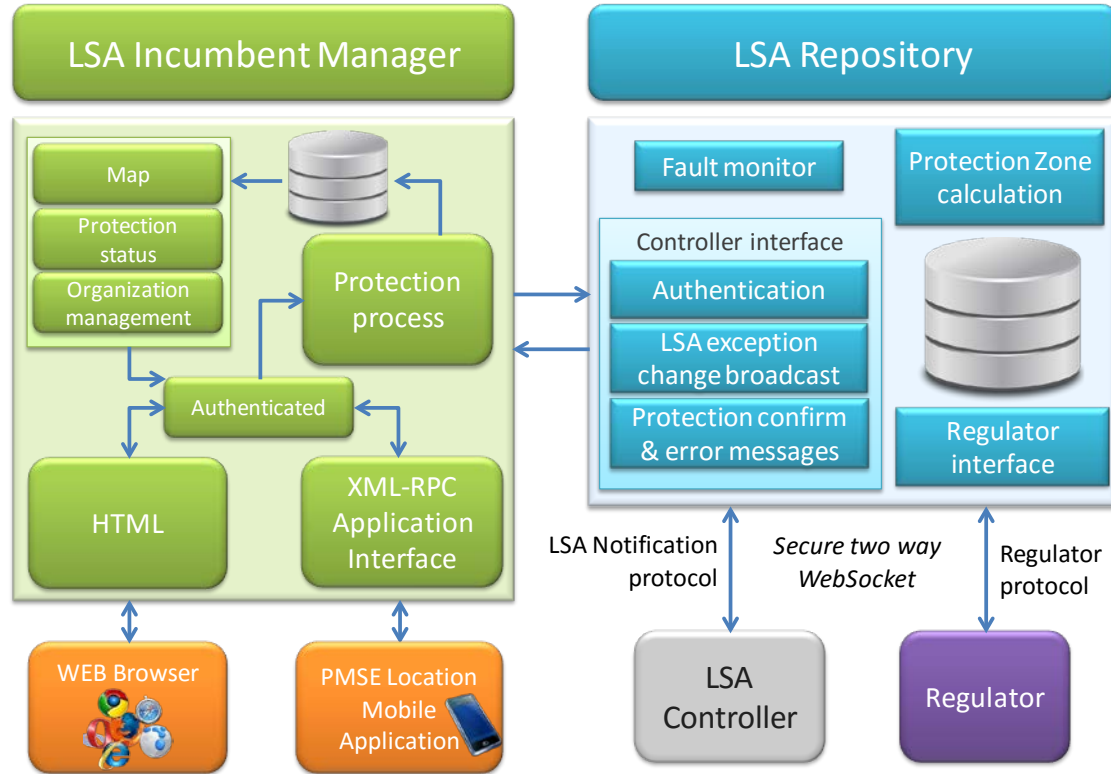


# Finnish CORE++ LSA trial environment

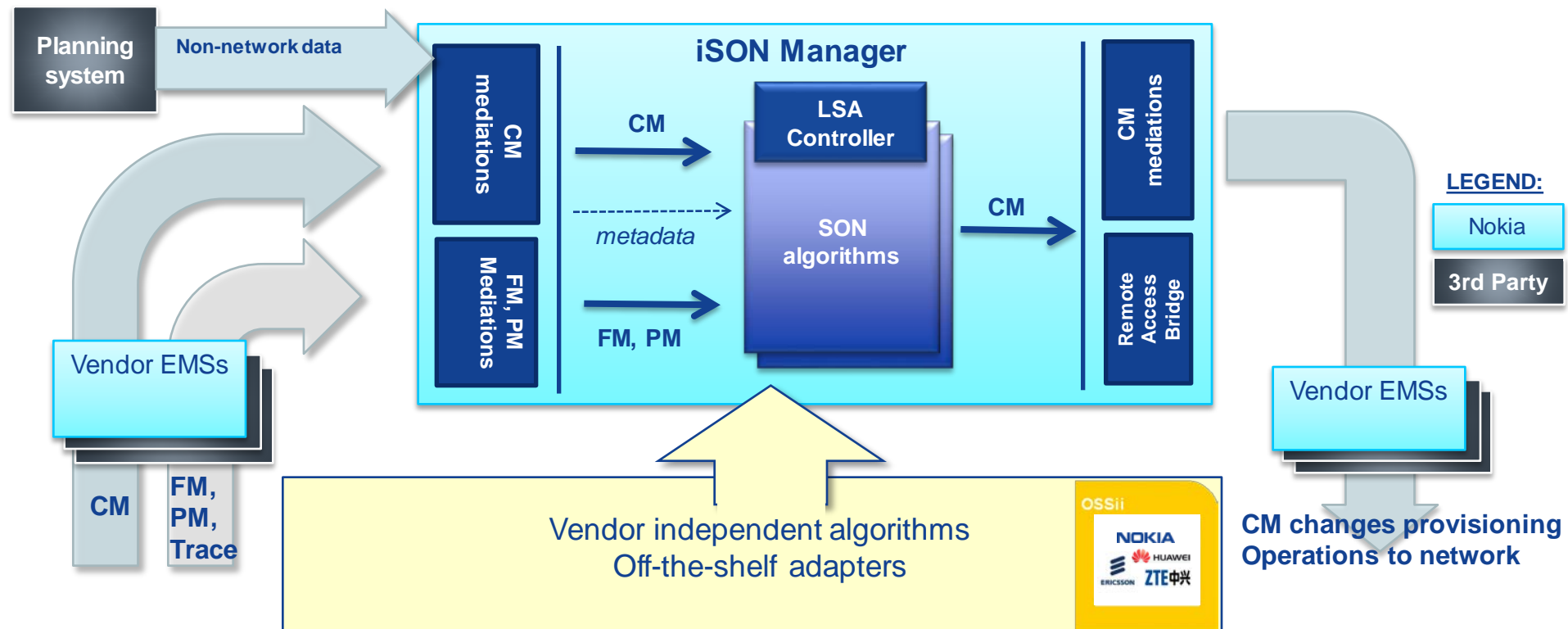
Trial uses global and available LTE technologies to ensure economies of scale and early use



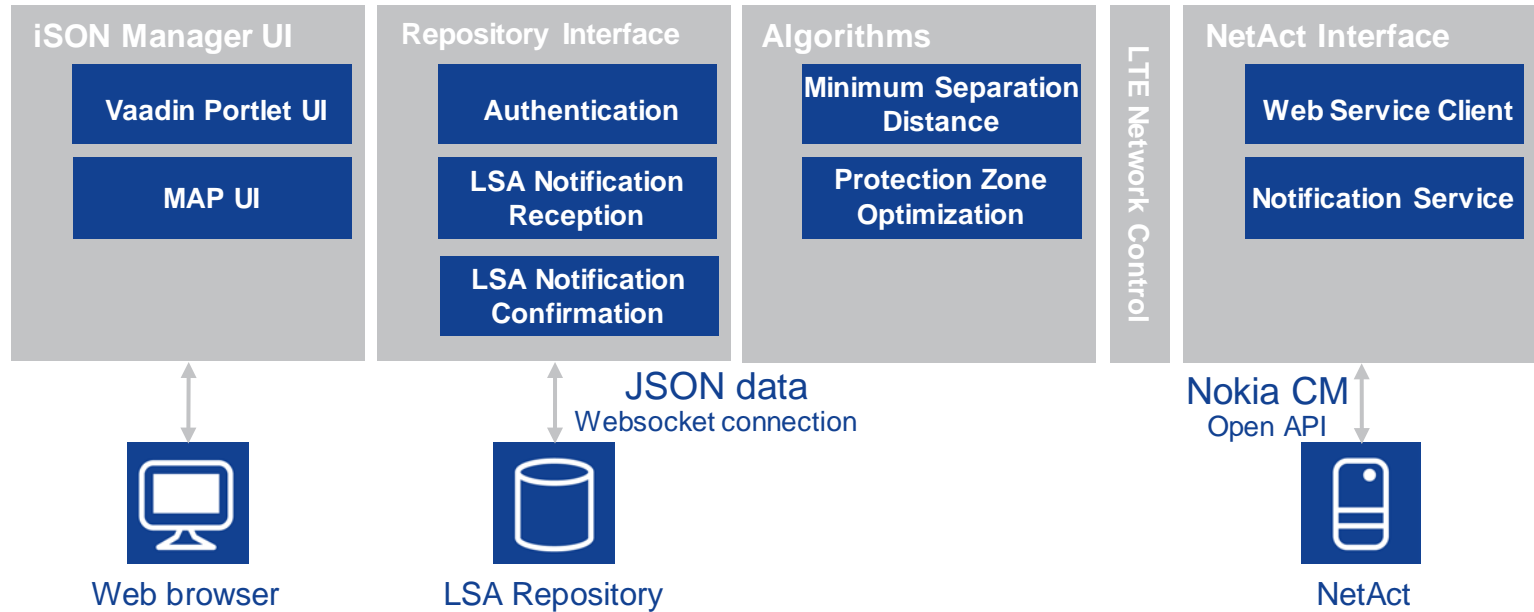
# CORE++ Incumbent manager and repository



## LSA demo controller build on multivendor capable iSON manager platform

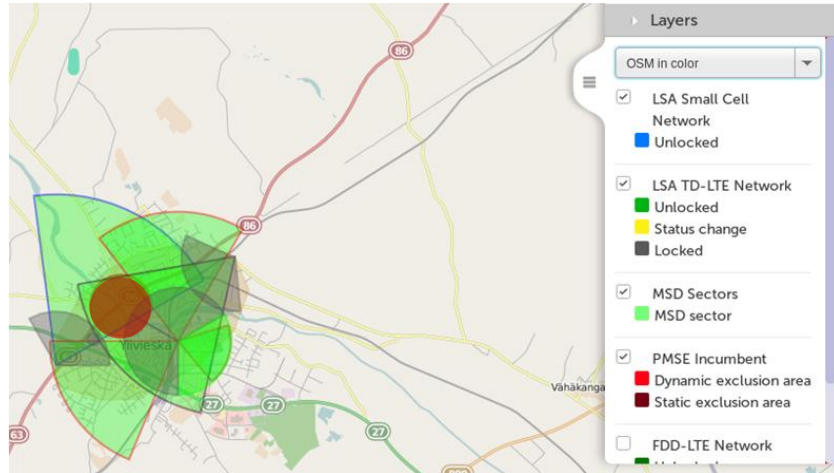


# LSA demo controller building blocks



# LSA demo controller UI

Example of the calculated Minimum Separate Distance (MSD) protection areas



## LSA Demo Controller

### LSA network operations

- ☐ Enable LSA network
- ☐ Emergency evacuation

### ☒ Minimum separation distance protection

- ☐ Dynamic protection zone optimization

Optional

### ☐ Graceful shutdown

- ☐ Power control

Provision LSA Network

Incumbent Protection

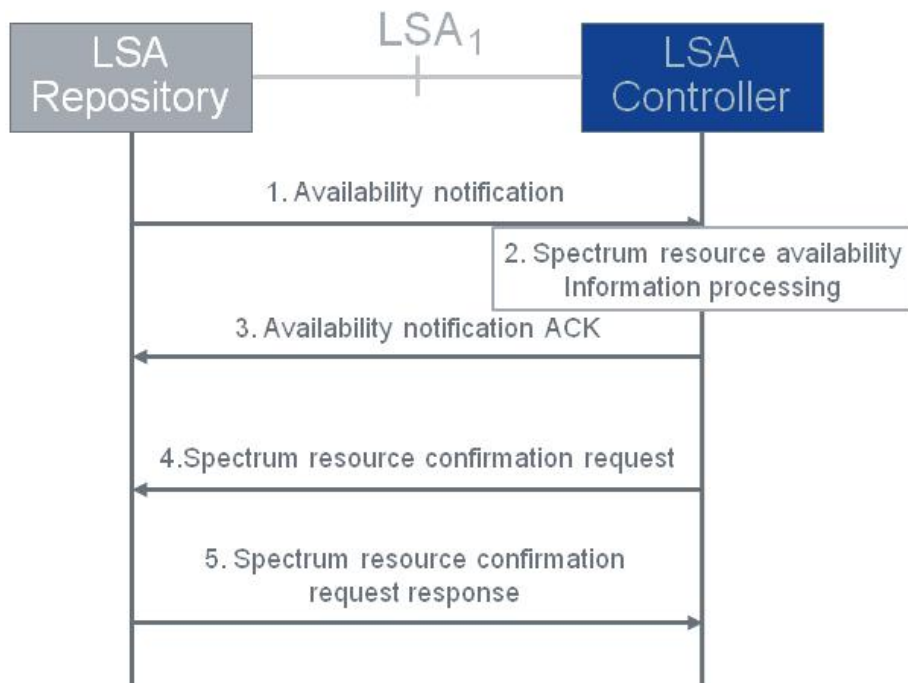
### TD LTE 2300 LSA network status in Ylivieska License Area

Ylivieska LSA Network	Administrative Status	LSA Operation Started	LSA Operation Ended
▼ LSA BTS			
▼ Puuhkala LSA 70			
▶ Sector 29201	unlocked	2015-05-15 12:03:36	2015-05-15 12:04:17
▼ Ratakatu LSA 71			
▶ Sector 29457	unlocked	2015-05-15 12:03:36	2015-05-15 12:04:17
▶ Sector 29458	unlocked	2015-05-15 12:03:36	2015-05-15 12:04:17
▶ Sector 29459	unlocked	2015-05-15 12:03:36	2015-05-15 12:04:17
▼ Alpmi LSA 72			
▶ Sector 29713	unlocked	2015-05-15 12:03:36	2015-05-15 12:04:17
▶ Small cell LSA 75			

Update LSA network status

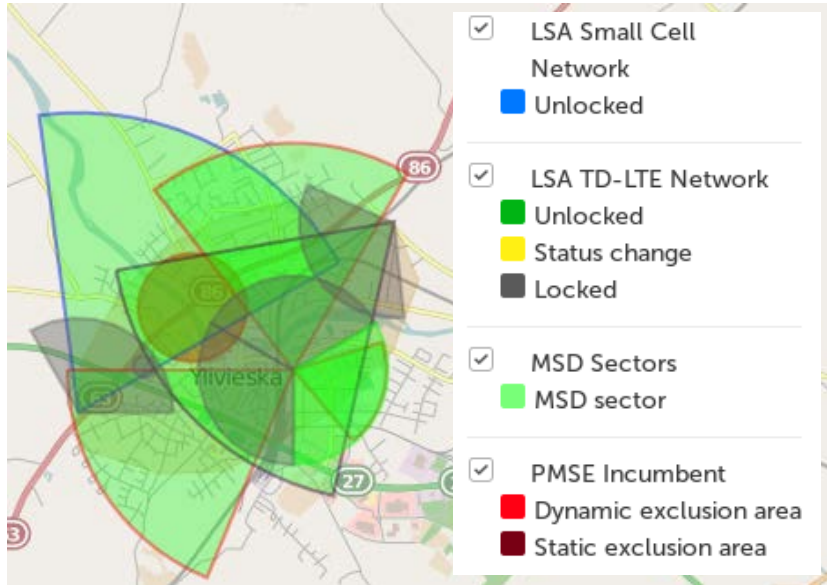
NOKIA

## LSA field trial set up and workflow

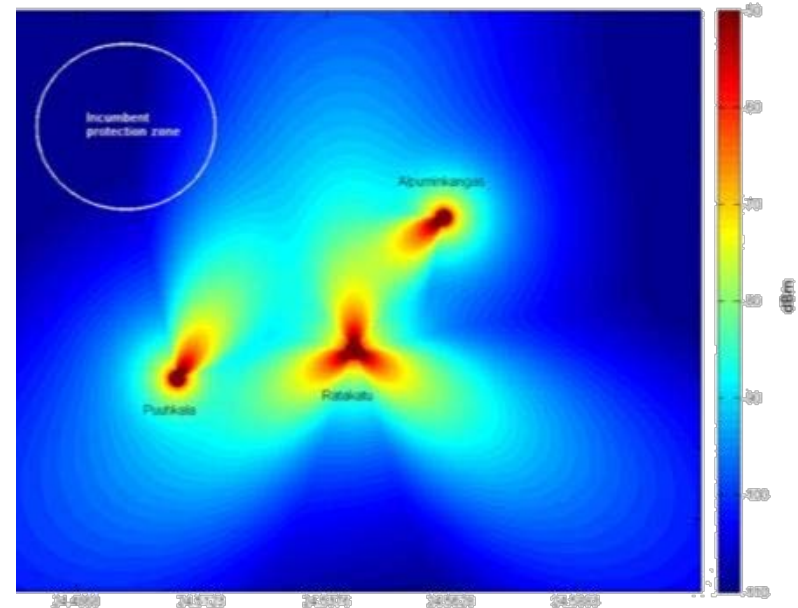


1. The LR sends a LSA Spectrum Resource Availability Notification message to the LC, containing new or updated LSA Spectrum Resource Availability information.
2. The LC will upon reception of the LSA Spectrum Resource Availability Notification message check the consistency of the information provided.
3. If consistency check is successful, the LC will respond with a LSA Spectrum Resource Availability Notification ACK message to confirm the reception of new spectrum resource availability information.
4. Upon successful configuration of the LSA spectrum resources, the LC sends a LSA Spectrum Resource Confirmation message to the LR to confirm execution of changes in the mobile network.
5. Upon reception of the LSA Spectrum Resource Confirmation Request message, LR acknowledges the reception of the confirmation by sending a LSA Spectrum Resource Confirmation Request Response message to the LC.

# LSA field trial with novel protection algorithms



Minimum Separation distance  
(MSD)



Protection Zone Optimization  
(PZO)

# LSA field trial performance measurement results

Table 1. LSA band evacuation measurement results

	Meas point	Evacuation MSD		Evacuation PZO	
		Time[s]	SD[s]	Time[s]	SD[s]
1. Incumbent makes evacuation request via LSA Incumbent Manager (IM)	LSA IM	0		0	
2. LC receives incumbent information from LR	LC	0,27		0,27	
3. OAM starts de-activation command	OAM	2,35	1,74	1,17	0,75
4.eNB/cell on LSA band is deactivated	LSA band	24,40	1,53	24,19	2,13
5. OAM notify LC that plan commission is completed	LC	51,30	1,54	50,88	0,75
6. Incumbent user receives confirmation on evacuation to LSA IM	LSA IM	51,57	1,73	51,14	0,68

Table 2. Total measured execution times of each trial system element

Total execution time [s]	e2e		component	
	MSD	PZO	MSD	PZO
NMS	48,49	48,78	48,49	48,78
LC	51,03	50,61	2,55	1,83
LR	51,57	51,14	0,54	0,54
Algorithm calculation	0,30	0,09	0,30	0,09

On average LSA band was cleared in 24 seconds



## Conclusions

### LSA field trial using LTE network and SON LSA controller

- Trial successfully demonstrated that TD-LTE network licensee can take 3GPP band 40 (2.3-2.4 GHz) into LSA use and vacate it when requested by the incumbent.
- Dynamic availability of the LSA spectrum resource can be managed with commercially available radio network complemented by integrated LSA controller and LSA repository.
- First time the LSA Controller was developed as a SON feature within commercial OSS system.
- Protection zone optimization algorithms were tested to maximize LSA spectrum resource availability for the licensee while ensuring incumbent protection.
- Measurement results revealed that the evacuation operation can be done in a way that fulfills typical PMSE service incumbent's requirements.
- Validated OSS integrated SON LSA demo controller reduced overall LC operations delay approximately 90% compared to previous research platform based controller.

## Acknowledgment

This work has been done in the LASS, CORE++ and WISE2 research projects within the 5<sup>th</sup> Gear program of Tekes - the Finnish Funding Agency for Technology and Innovation.

The authors would like to acknowledge the project consortium members: VTT Technical Research Centre of Finland, University of Oulu, Centria University of Applied Sciences, Turku University of Applied Sciences, University of Turku, Aalto University, Fairspectrum, Anite and Finnish Communications Regulatory Authority.



Thank you  
Questions/discussion?

[seppo.yrjola@nokia.com](mailto:seppo.yrjola@nokia.com)

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