

Licensed Shared Access to spectrum

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Spectrum is the real estate for Mobile Broadband

A proper network deployment goes hand in hand with a sound spectrum strategy

800/850, 900, 700, UHF
FDD, ~10MHz BW
Macro

Coverage

1800/1900, 2100, 2600
FDD, ~20MHz BW
Macro + light HetNets

Capacity

2300: LSA
3500: Co-primary
ISM, 5000+: Unlicensed

Complementary

2600, 3500, 2300
TDD, ~20MHz BW
dense HetNets

Densification

We cannot
generate new
spectrum,
but we can
optimize its use!

Overall Efficiency

Complex processes towards new spectrum for exclusive Mobile Broadband

All attractive spectrum is assigned to some service today

“new” spectrum means re-purposing of bands by relocating existing services

Harmonization is key and spans countries and regions

Lengthy process in identifying potentially suited bands in national and regional World Radio communications Conference (WRC) preparatory work, currently under way for WRC-15 until November 2014

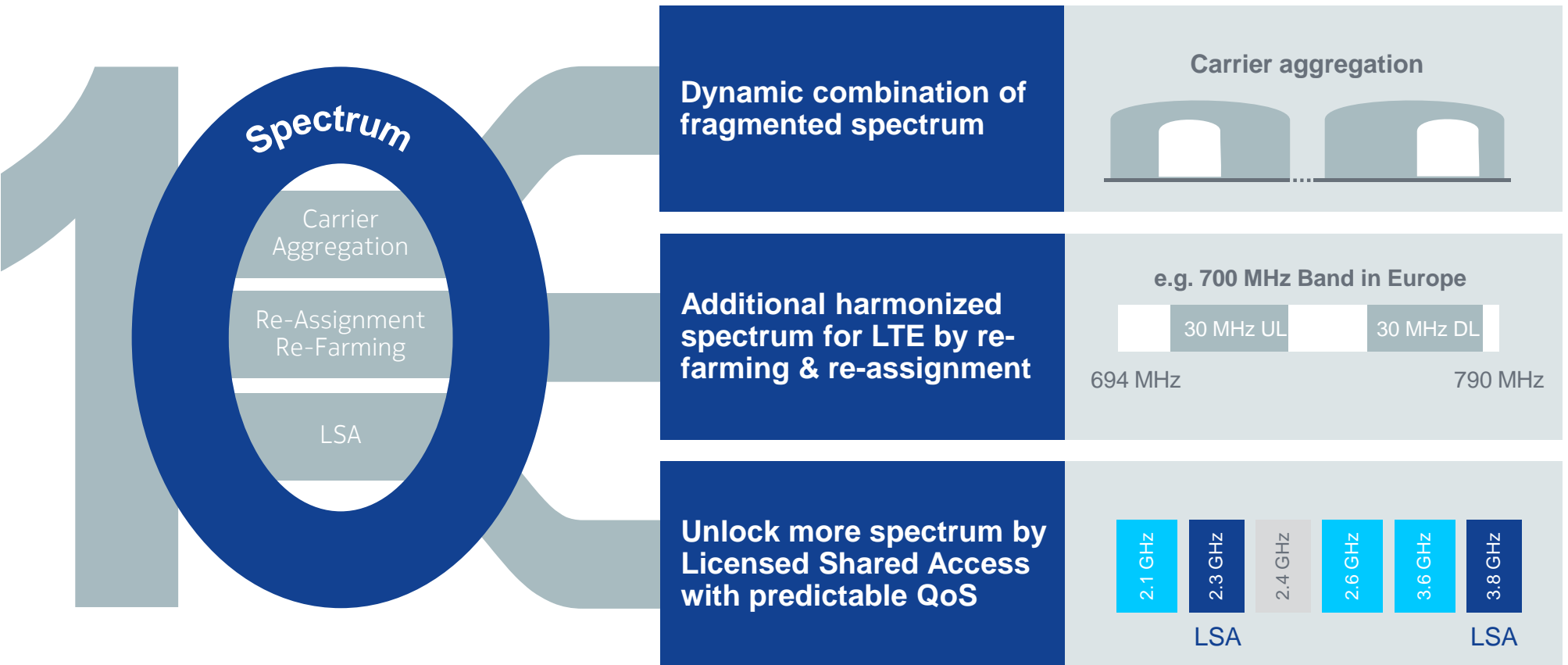
WRC agreements need to be mirrored on regional and national levels

e.g. 700 MHz band plan definition work in CEPT for 700 MHz

e.g. 700 MHz national spectrum assignments like Finland and Sweden announcements to re-purpose 700 MHz band from Broadcast to MBB in 2017

Main levers to optimize spectrum use for Mobile Broadband in bands below 6 GHz

10x spectrum for 1000x capacity



Harmonization and global standards drive economies of scale

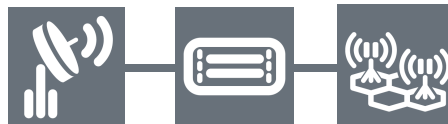
Spectrum usage models



**Mainstream Approach
Auctions
of Cleared Spectrum**

Exclusive Use

Ensures
Quality of Service



**Complementary
License Model**
Licensed Shared Access

Exclusive Shared Use

Exclusive use on a *shared* and *binary*
basis in Time, Location, and/or Frequency
with Incumbent (government, defense etc.)
Predictable Quality of Service



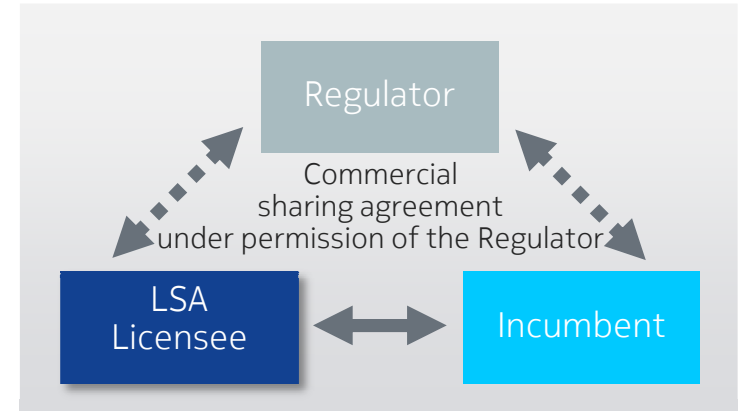
**Shared Approach
Unlicensed
(Wi-Fi, LTE-U, ...)**

Shared Use

Unpredictable
Quality of Service

A new way of licensing mobile broadband spectrum - Licensed Shared Access (LSA)

LSA is a simple concept which can be implemented today using available terminals and network



Regulatory framework

- LSA spectrum to be licensed is identified by the government
- Subject to a private commercial agreement between incumbent and LSA licensee

LSA unlock more spectrum with predictable QoS

Static LSA case with military incumbent in France

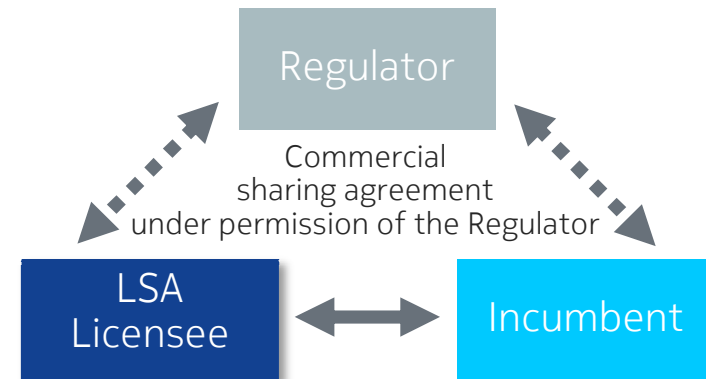
Approach

Enables timely availability and licensed use of harmonized spectrum with predictable QoS



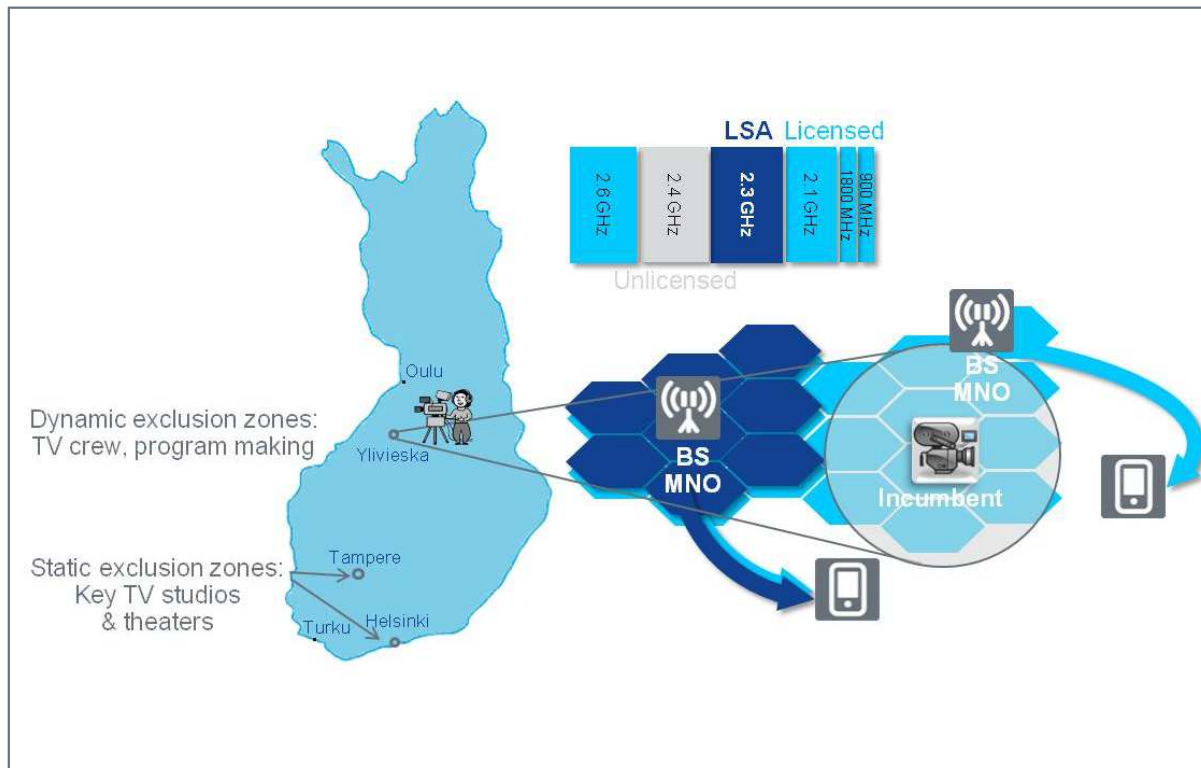
Operator benefits

- Accelerates spectrum harmonization
- Leverages available LTE technologies to ensure early use and Economy of Scale
- Opportunity for lower cost and high quality licensed spectrum



LSA opens TD LTE 2300 band for operators in Europe

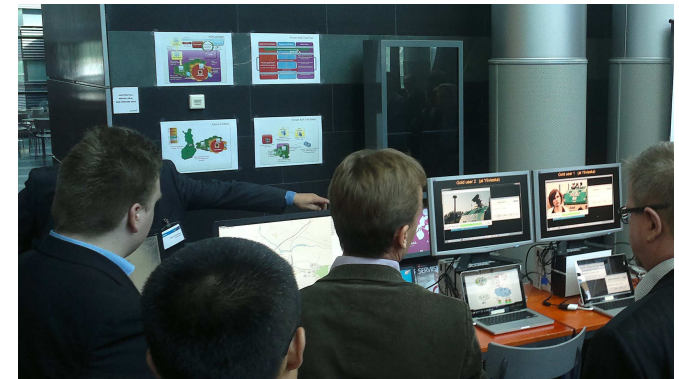
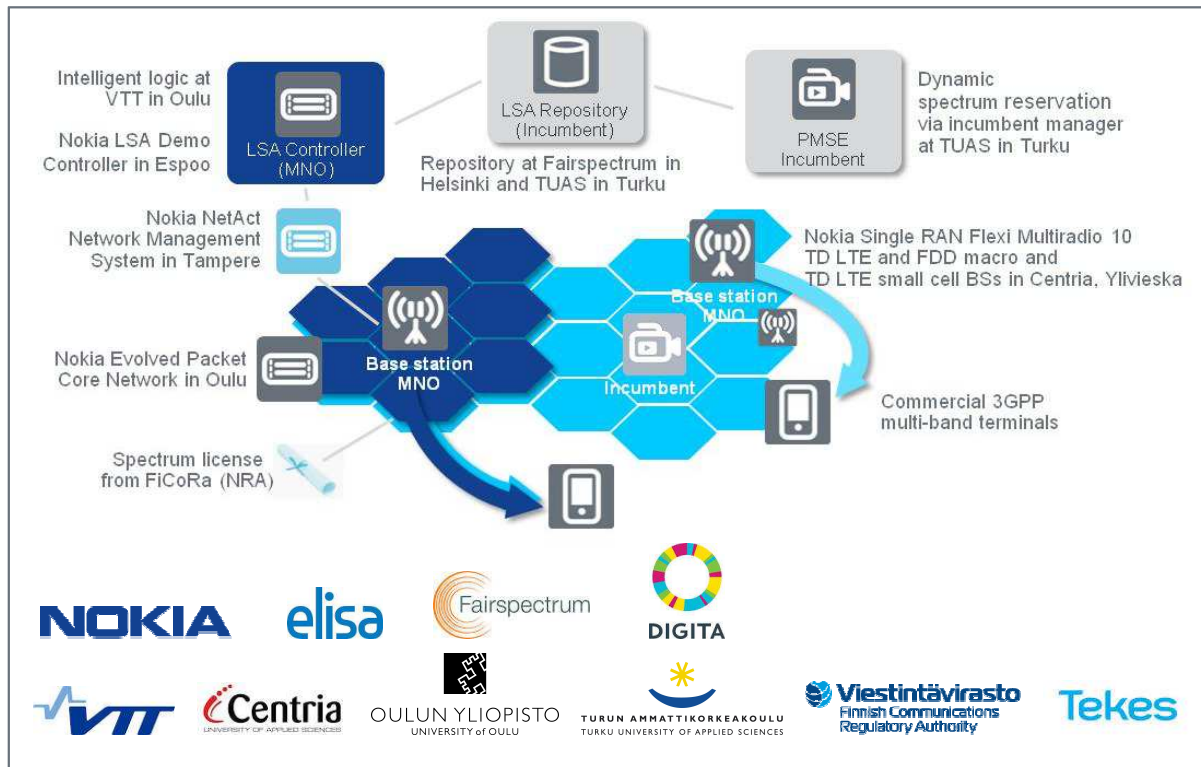
Semi static LSA case with PMSE incumbent in Finland



LSA opens bands otherwise locked for long time for harmonized MBB use like the 2.3 GHz / 3GPP band 40 in Europe supported in many commercial devices today

LSA
QoS spectrum

World 1st LSA over the air field trials with e2e ecosystem proved the concept LSA TD LTE 2300 with PMSE cordless cameras



Trial included full e2e LSA ecosystem in Finland: regulator, incumbents, MNO and supplying industry in CORE+ project

LSA Ecosystem

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



LSA Trial system end-to-end performance evaluation

CORE+ LSA Trial demonstrated in IEEE DySpan April 2014

TABLE I. LSA/ASA BAND EVACUATION RESULTS

Location	LSA/ASA Evacuation	Delay [s]	St. Dev. [s]
LSA/ASA Controller	Evacuation decision	0.624	0.190
LTE OAM	BS switch off begin	2.999	1.568
User terminal	End-user handover begin	7.144	1.118
LTE channel	End-user handover complete	16.700	2.668
LTE channel	LSA/ASA band evacuated	25.856	1.803
LTE OAM	BS switch off execution time	28.973	2.168
LTE OAM	BS status query execution time	30.333	11.443
LSA/ASA Controller	Evacuation state complete	65.825	14.744

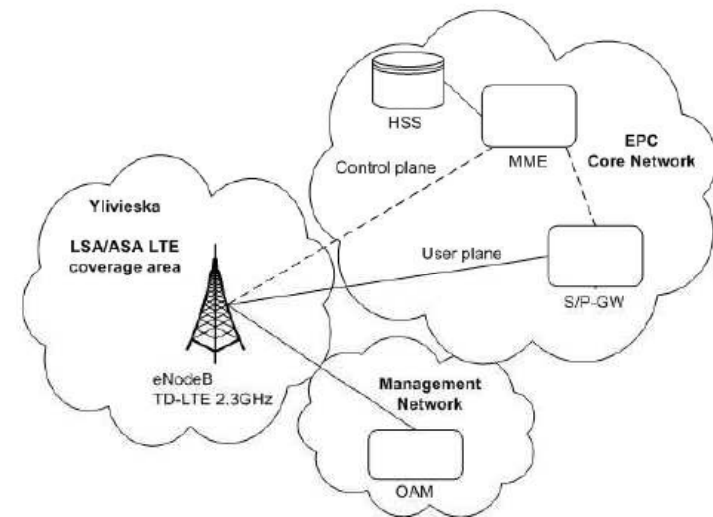


Fig. 4. NSN LTE Core network is located in NSN site in Oulu and the Management Network in NSN site in Tampere.

On average LSA band was cleared in 26 seconds

Source: Live field trial of Licensed Shared Access concept using LTE network in 2.3 GHz band; Palola, Matinmikko, Prokkola, Mustonen, Heikkilä, Kippola, Yrjölä,... ;IEEE DySpan'14

Scaled up real OSS system end-to-end performance for LSA case

NetAct 8 LTE radio configurator performance test results for typical network wide configuration

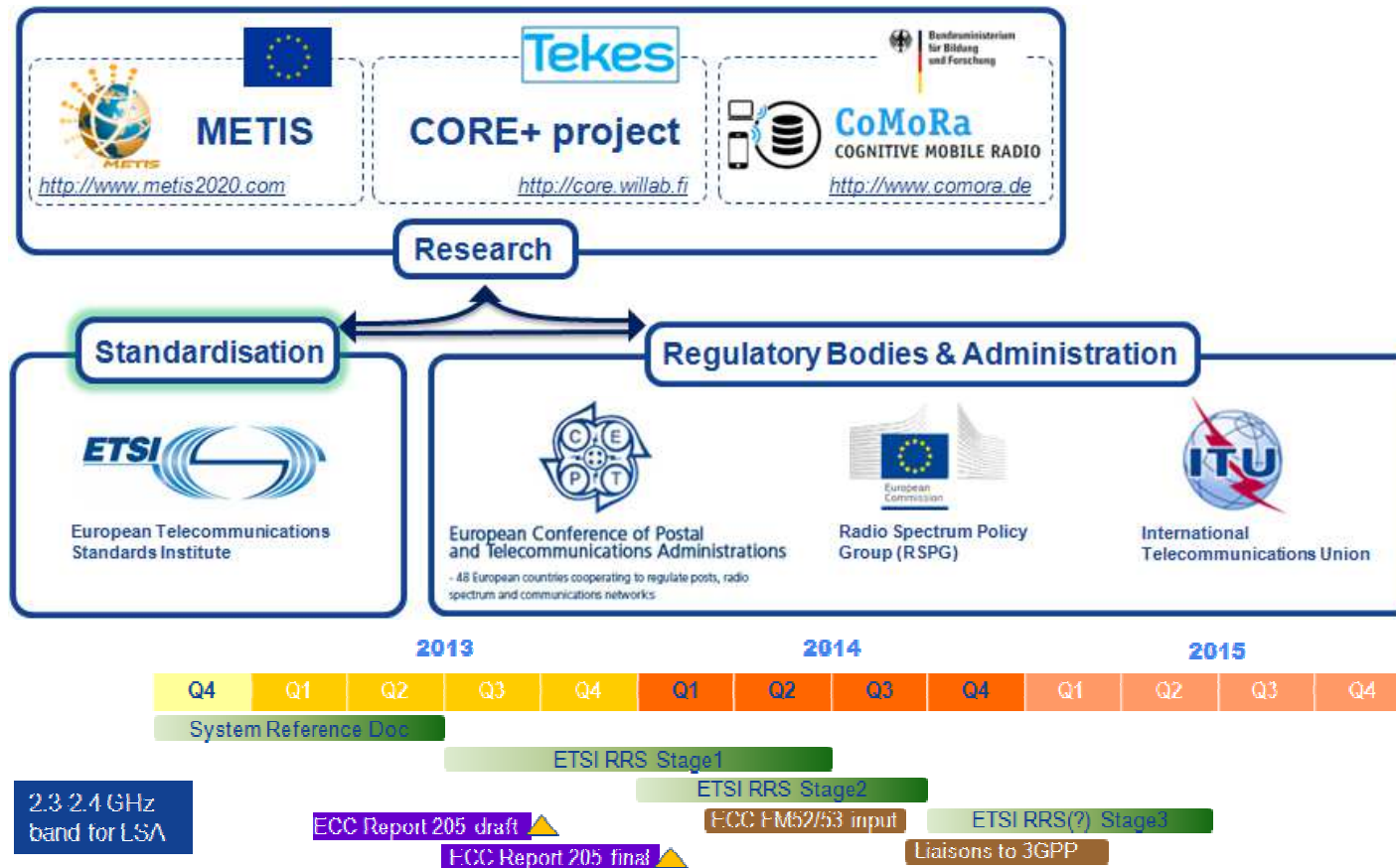
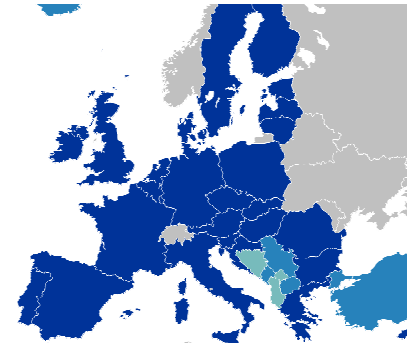
1 eNB HD		Configuration used in testing CM only and System Level PET	
<i>MRBTS</i>	1	<i>Objects in one eNB</i>	5432
<i>LNBTs</i>	1	<i>Cells in one eNB</i>	12
<i>LNCEL</i>	12	<i>OMSeS</i>	4
<i>LNADJ</i>	128	<i>eNBs below one OMS</i>	1 000
<i>LNADJL</i>	1536	<i>Total eNBs</i>	4 000
<i>LNREL</i>	1440	<i>Total cells</i>	48 000
<i>LNADJW</i>	256	<i>Total objects</i>	21.7 million
<i>LNADJG</i>	256		
<i>LNRELW</i>	960		
<i>LNRELG</i>	480		

Adjacency objects per eNB and data amounts in typical configuration

Test case	
Configuration plan file download for a single eNB	< 1 min
Emergency plan download with automatic activation operation for the whole network with small amount of online modifiable parameters (e.g. access class barring case, LSA).	< 3 min

LSA is progressing in all fronts in Europe

Nokia in Research – Standardization – Regulatory Bodies and Administration



Licensed Shared Access to Spectrum

- LSA allows for sharing while meeting the requirements of mobile operators and incumbents for predictable conditions of spectrum use and hence predictable QoS
- LSA opens bands otherwise locked for long time for harmonized MBB use like the 2.3 GHz / 3GPP band 40 in Europe supported in many commercial devices today
- LSA is a simple concept which can be implemented today
- The Finland trial has proven above aspects testified by all stakeholders including regulator, incumbent, mobile operator and supplying industry.
Visit <http://core.willab.fi/> for more information

LSA spectrum for LTE

NOKIA