SON for LTE Networks

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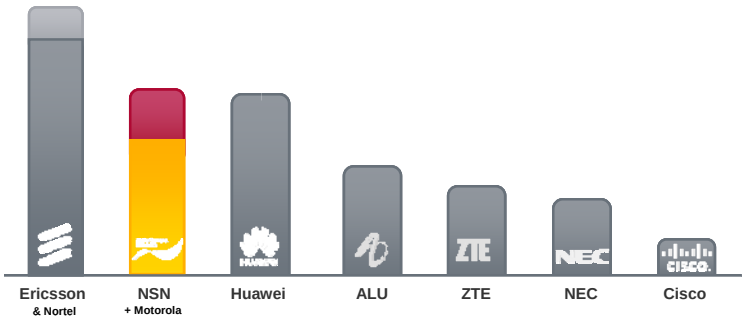
Nokia Siemens Networks:
A global company with a rich heritage

- Joint Venture of Nokia and Siemens,
  recently acquired Motorola's wireless networks infrastructure business
- Started operations on April 1, 2007
- €12.7 bn net sales in 2010
- 120+ years of telecom experience
- ~73,000 employees
- ~46,000 service professionals (including externals)
- > 80 out of the top 100 operators worldwide
- 150+ countries
- 3 billion mobile subscribers and ¼ of world's voice households served

2010 Wireless infrastructure revenues



Notes: Wireless networks revenues include Radio, Core and MWR
Source: NSN SBD IPS estimates; financial statements; Huawei revenue estimated based on its 2010 report

Load and Service Based HO within U900 & U2100

Example of manual parameter settings needed in establishing Base Station adjacencies.

U900

PrxTarget = 8dB
Prxoffset = 2dB
PrxTargetPSMax = 8dB
PrxLoadMarginDCH = 4dB
PrxLoadMarginEDCH = 0dB
PrxLoadMarginMaxDCH = 0dB
PrxMaxTargetBTS = 12dB
PtxTarget = 42dBm (20W LPA)
PtxOffset = 1dB
PtxTargetPSMax = 42dBm
LHOPwrOffsetUL = -1 dB
LHOPwrOffsetDL = -2 dB
LHOWinSizeONInterference = 15s
LHOWinSizeOFFInterference = 5s
LHOHystTimeInterference = 2s
LHODelayOFFInterference = 30s

LHOResRateSC = 90%
Reservation of SF128 codes in the cell (including only min HS-PDSCH codes (5)
LHOWinSizeONResRateSC = 15s
Averaging of code tree usage measurements to decide overload
LHOWinSizeOFFResRateSC = 5s
If averaged code tree usage measurements are above overload threshold fort his amount overload state is decided
LHOHystTimeResRateSC = 2s
If averaged code tree measurements are below the over load thresholds then system will wait this long until this cell status is changed back to "not over loaded"
LHODelayOFFResRateSC = 30s
LHONumbUEInterFreq = 2
How long time PS R99 NRT has to be active before it can be as a target for LB HO
LHOMinNrtDchAllocTime = 20s
NCH
NCH
NCH
SLH
supp
Ave
If av
abo
ove
If av
are
will
changed back to "not over loaded"

SLHOUseBackgroundPSNRTData = 1 (LB HO)
SLHOUseConvCSSpeech = 1 (LB HO)
SLHOUseConvPSRTData = 0 (none)
SLHOUseConvPSSpeech = 0 (none)
SLHOUseInteractivePSNRTData = 1 (LB HO)
SLHOUseStreamCSNTData = 0 (none)
SLHOUseStreamPSRTData = 0 (none)
SLHOprofileConvCSspeech = 4 (WCDMAmacro)
SLHOprofileConvCSTdata = 2 (WCDMA)
SLHOprofileConvPSspeech = 2 (WCDMA)
SLHOprofileConvPSRTdata = 2 (WCDMA)
SLHOprofileStreamCSNTdata = 2 (WCDMA)
SLHOprofileStreamPSRTdata = 2 (WCDMA)
SLHOprofileInteractivePSNRTdata = 4

groundPSNRTdata = 4
NRT = 1
OInterval =
plicable)
PS R99 NRT users are allowed to use Compressed Mode for LB HO measurements (if the terminal penetration for dual receiver terminals is high enough this could be set to 0)
Load measurements not available then the whole frequency is NOT blocked (not known if U2100 RNC as DRNC delivers the load information), if load info is delivered then the parameter value can be changed to 0

Have you ever tried to manage 30.000 elements with hundreds of parameters each by hand?

Lowest HSPA loaded U2100 layer based on U2100 HSPA load sharing

U2100 f1

AdjiPenaltyTimeNCHO = 10s
AdjiMinRscpNCHO = - 102dBm (macro), -92 (micro), -90dBm (indoor)
AdjiMinEcNoNCHO = -12dB (macro), -8 (micro), -8 (indoor)
AdjiTxPwrDPCH = 24dBm
AdjiEcNoOffsetNCHO = 3dB

Main HSPA layer and secondary R99 layer

U2100 f3

AdjiHCSpriority = 0 (highest priority WCDMA macro)
AdjiHandlingBlockedCellSLHO = 1
AdjiComLoadMeasDRNCCellNCHO = 0
AdjiPenaltyTimeNCHO = 10s
AdjiMinRscpNCHO = - 102dBm (macro), -92 (micro), -90dBm (indoor)
AdjiMinEcNoNCHO = -12dB (macro), -8 (micro), -8 (indoor)
AdjiTxPwrDPCH = 24dBm
AdjiEcNoOffsetNCHO = 3dB

U2100 f2

AdjiHCSpriority = 1 (2nd highest priority WCDMA macro)
AdjiHandlingBlockedCellSLHO = 1
AdjiComLoadMeasDRNCCellNCHO = 0
AdjiPenaltyTimeNCHO = 10s
AdjiMinRscpNCHO = - 102dBm (macro), -92 (micro), -90dBm (indoor)
AdjiMinEcNoNCHO = -12dB (macro), -8 (micro), -8 (indoor)
AdjiTxPwrDPCH = 24dBm
AdjiEcNoOffsetNCHO = 3dB

Drivers for Self Organizing Networks

- Saturated markets, revenue per bit is dropping
- Parallel operation of LTE with 2G and 3G networks
- Large and complex number and structure of network parameters
- Expanding number of Base Stations (HetNet)

- OPEX reduction – reduce human interaction

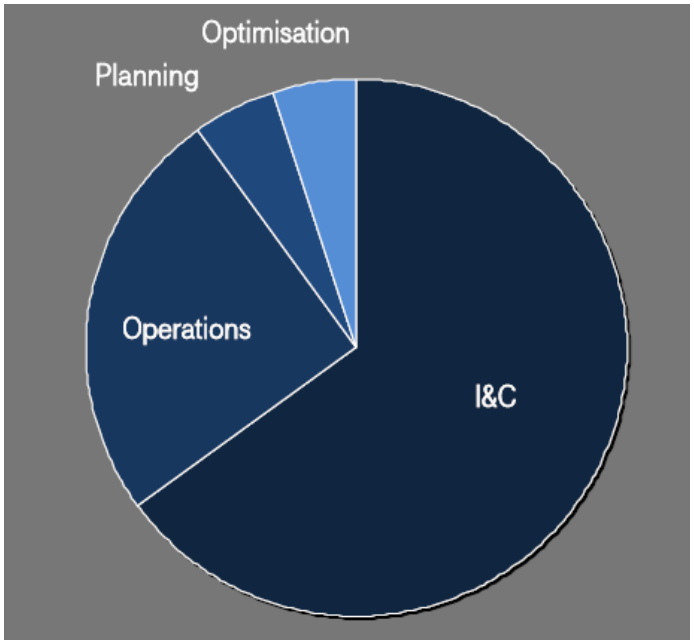
- Configure & optimize the network automatically
- But allow the operator to be the final control instance

Operator Motivation for Self Organizing Networks (Source: Deutsche Telekom)

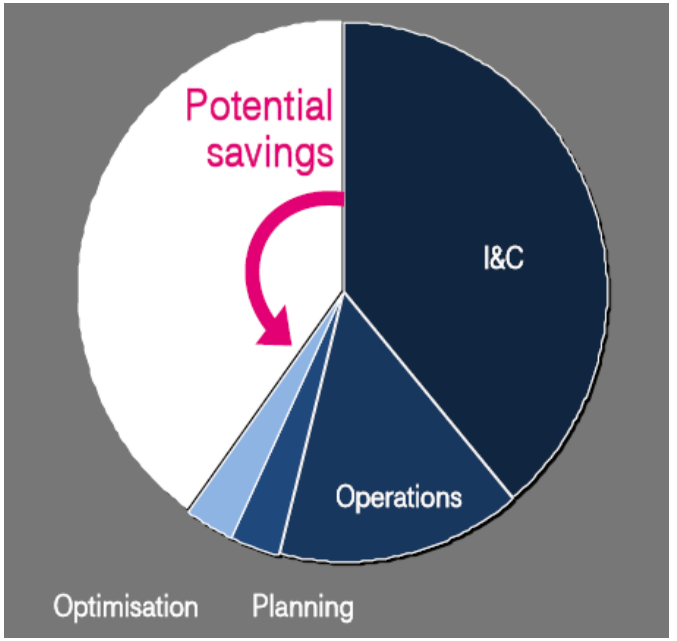
Question

Have you ever tried to manage 30.000 elements with hundreds of parameters each by hand?

Analysing cost drivers in site life cycle ...

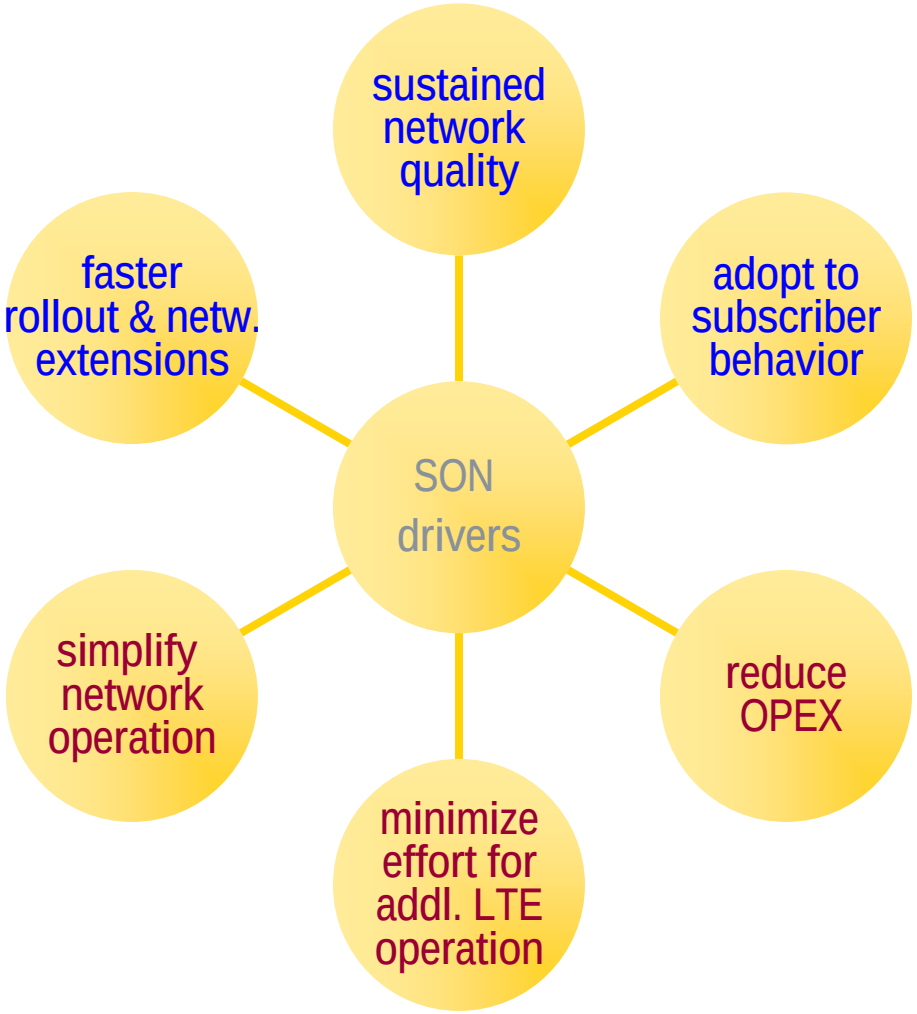


w/o SON



with SON

Drivers for SON are Quality and OPEX - decisive push through NGMN



ngmn
the engine of broadband wireless innovation

"it is of vital interest to operators to minimize operational effort by introducing self-organizing mechanisms "

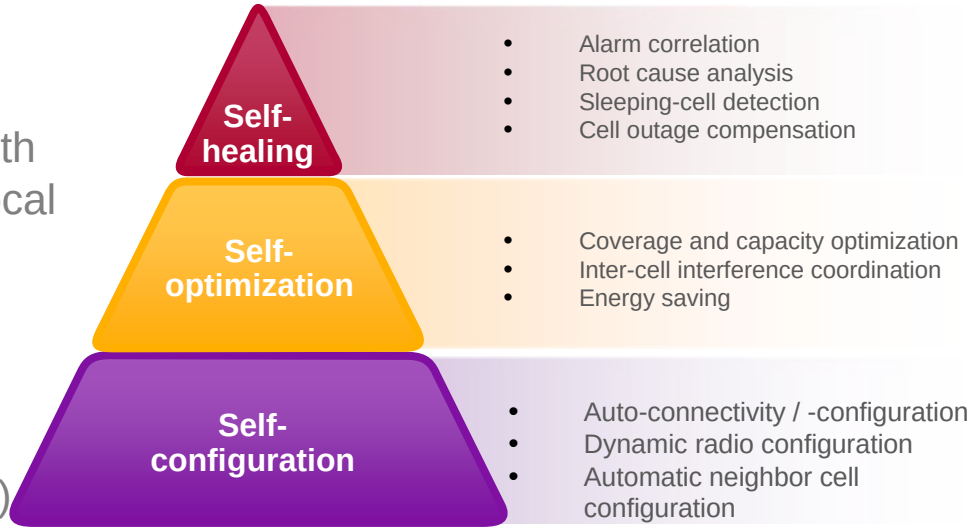
NGMN White Paper, Dec. 2006

Main Functionality of Self Organizing Networks

Self-healing: automatic detection, localization and removal of failures

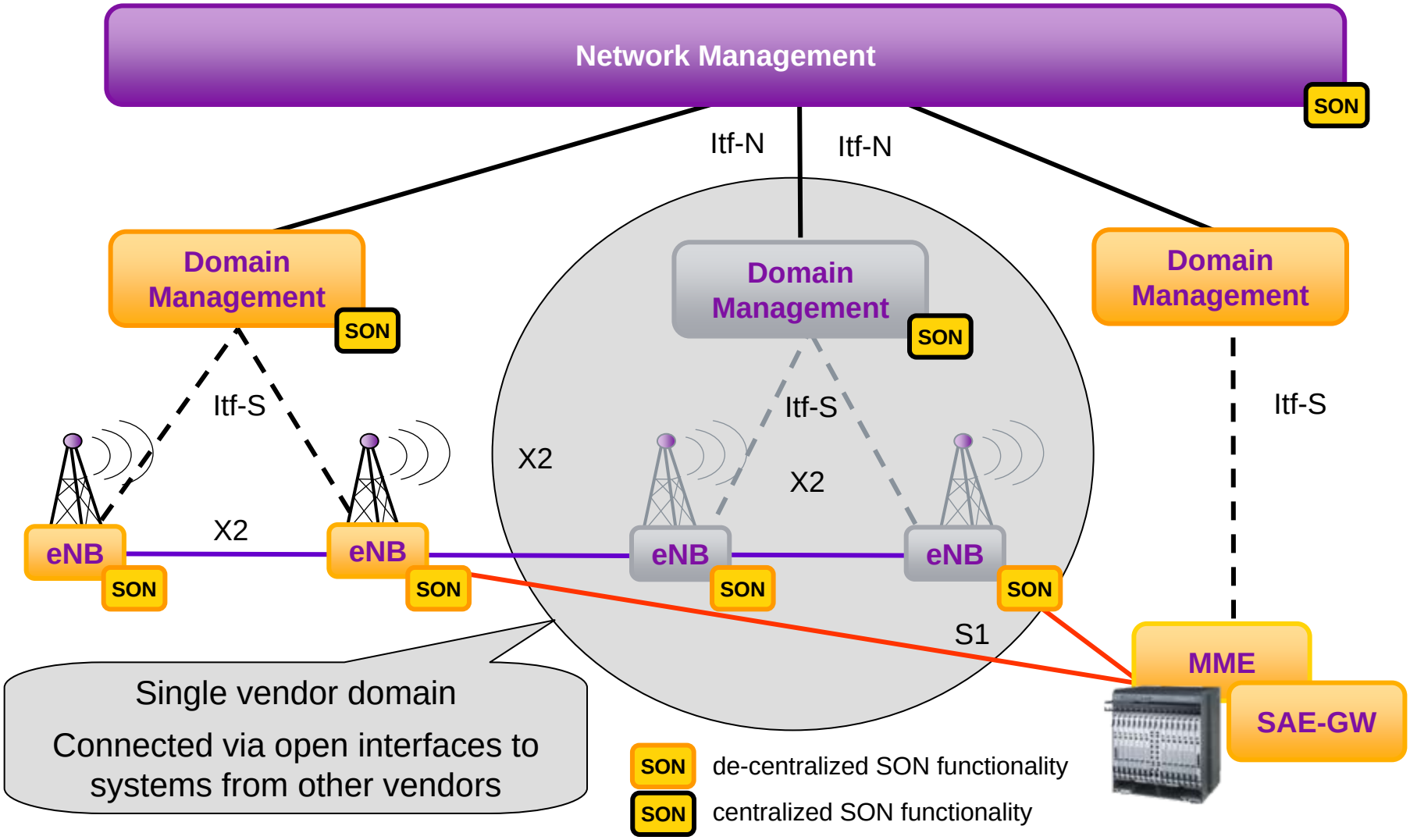
Self-optimisation: auto-tune the network with the help of UE and eNB measurements on local eNB level and/or network management level

Self-configuration: automated network integration of new eNB by auto connection and auto configuration, core connectivity (S1) and automated neighbour site configuration (X2)



Configure & optimize the network automatically, but allow the operator to be the final control instance

LTE Network Management Architecture



The colour of a box denotes a vendor. Straight lines denote open interfaces.

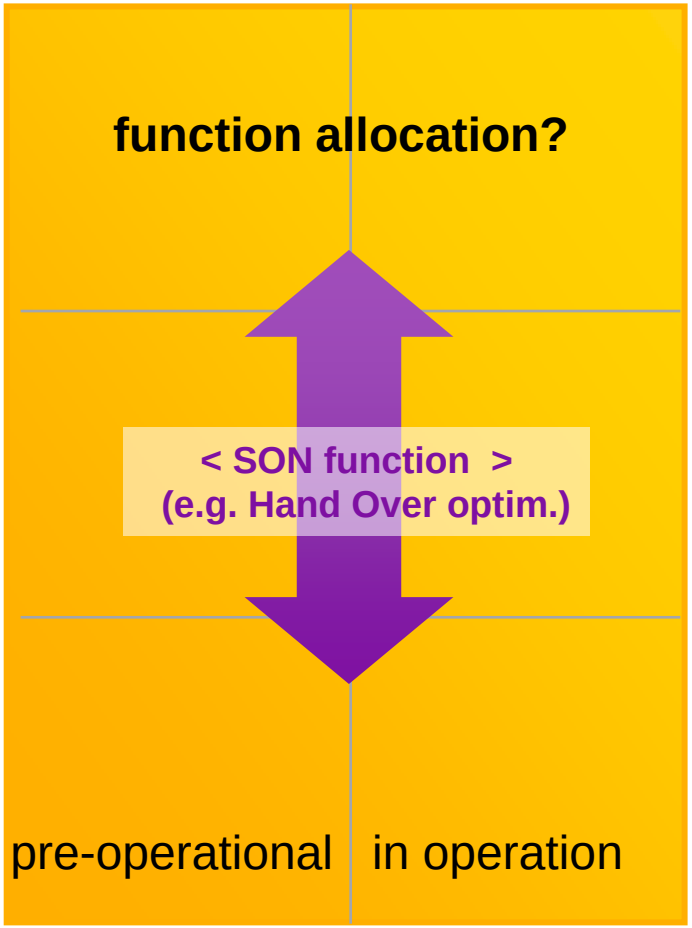
Implementation challenge: Where to allocate SON functions best ?

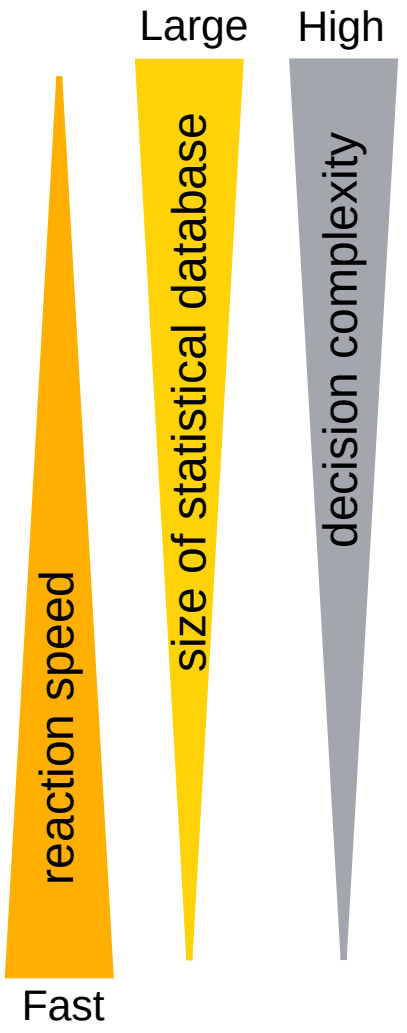
SON function execution:

Centralized
= large number of cells involved

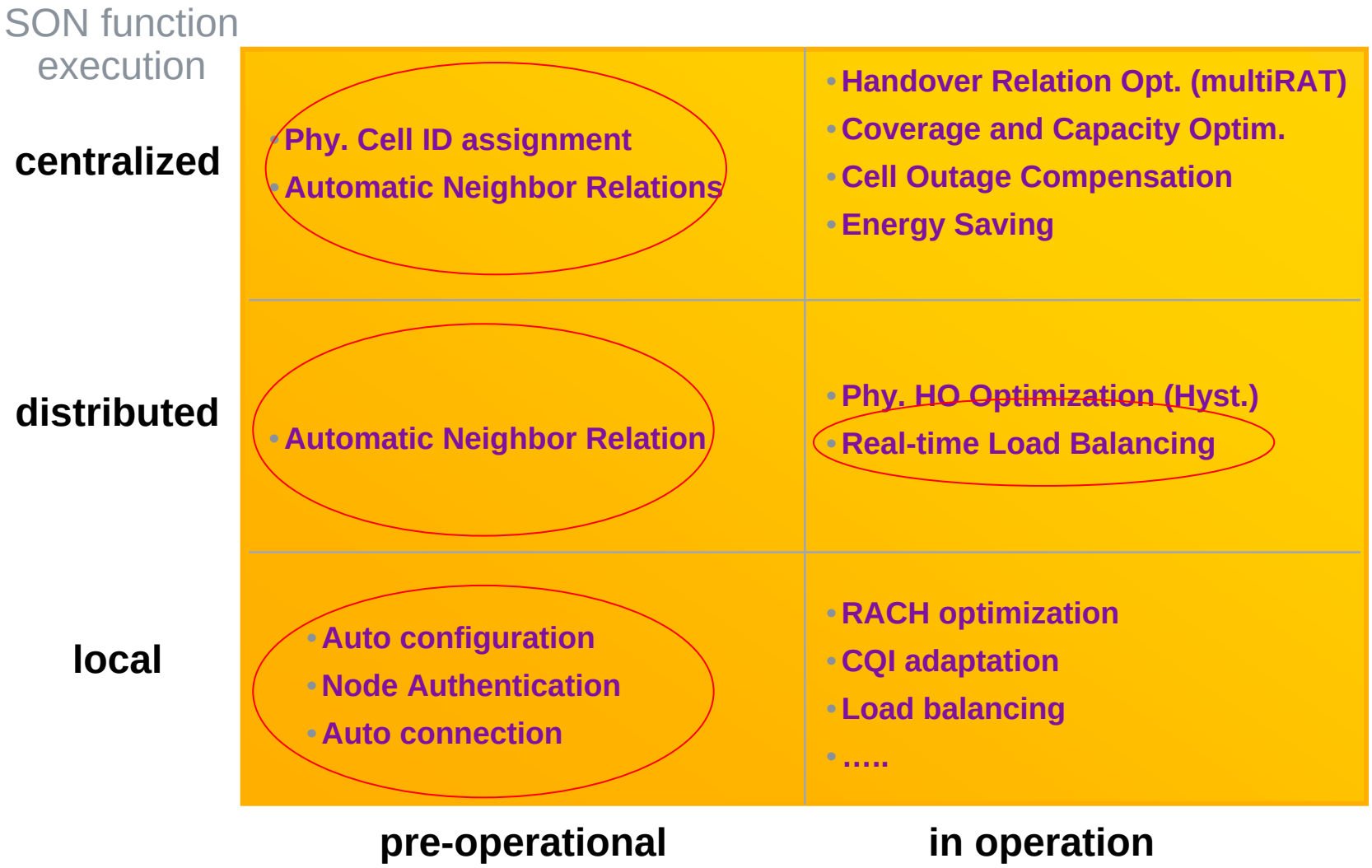
Distributed
~ 2 cells involved

Local
= single cell scope





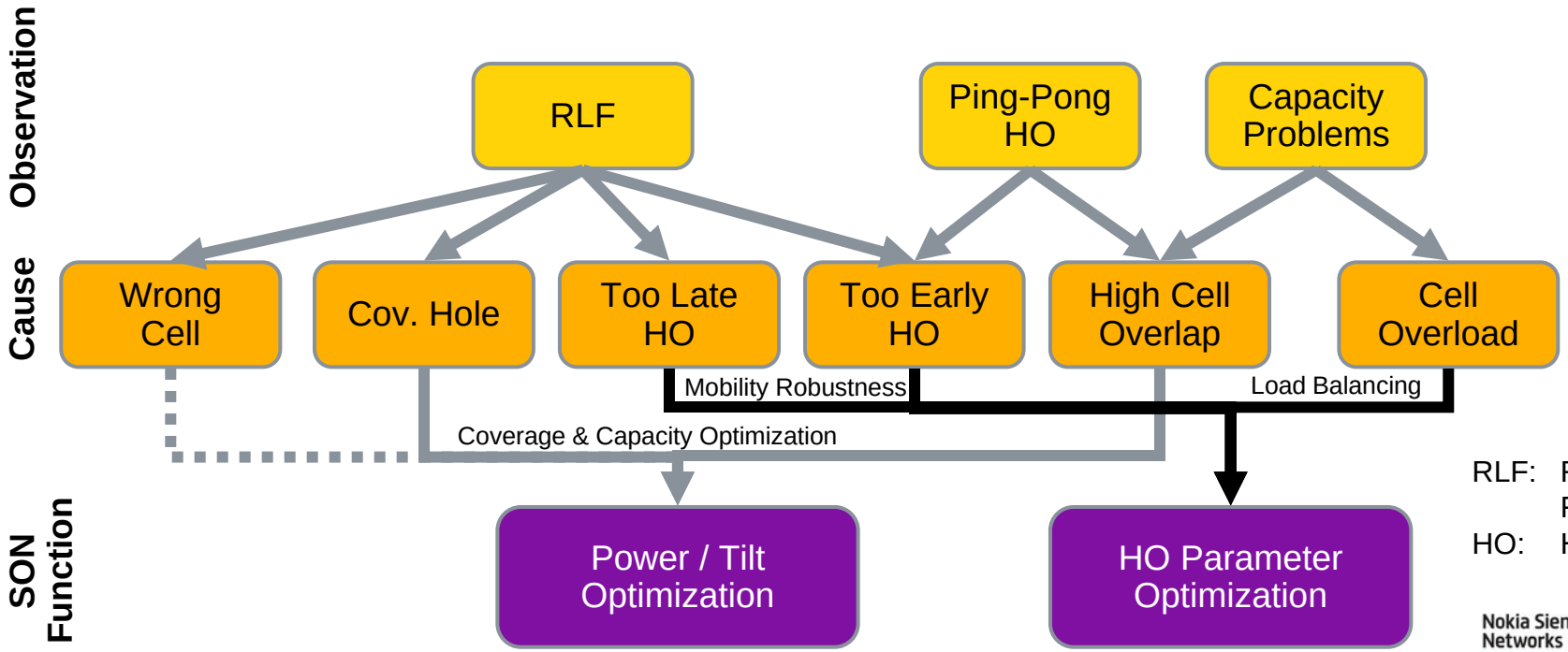
NSN's view on optimized function allocation



SON Principle: From Observations to Root Cause

Detecting the Root Cause of a Problem

- from a large vector of input data
- while multiple changes impact the network concurrently
- ambiguity of observations
- trial-and-error in a live NW is prohibitive due to the risk of negative performance impact, effort and required time



RLF: Radio Link Failure
HO: Handover

Nokia Siemens Networks enabled products ... its about orchestration

eNB

Flexi Multimode BTS

Certification Authority

Nokia Siemens Networks entity
Management System for
Public Key Infrastructure

EMS/NMS

NetAct OSS5.2 CD 2
NetAct Unify (E/2011)

Entry level configuration:
Rack mounted servers

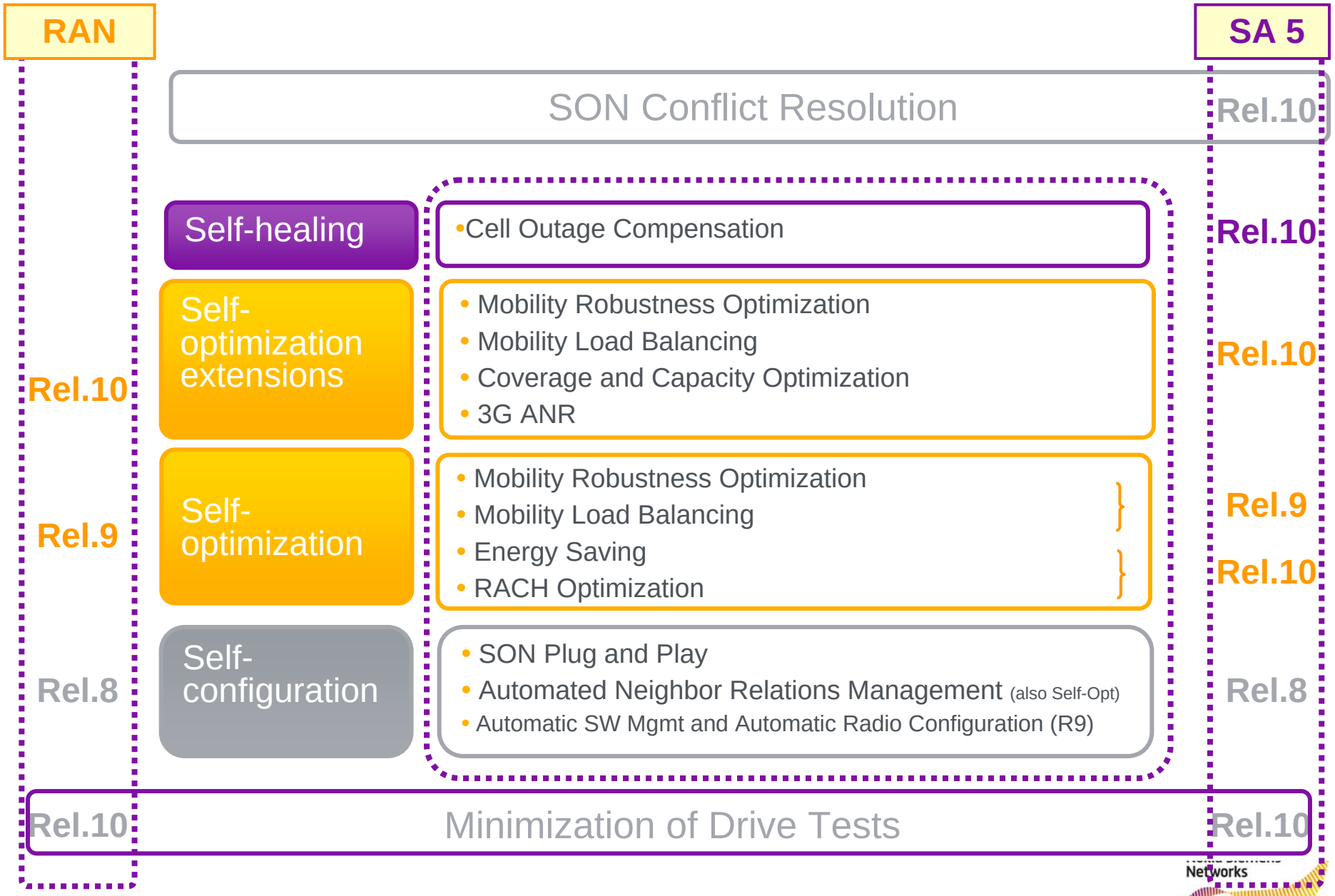
Medium &
large configuration:
Blade servers

MME & SAE-GW

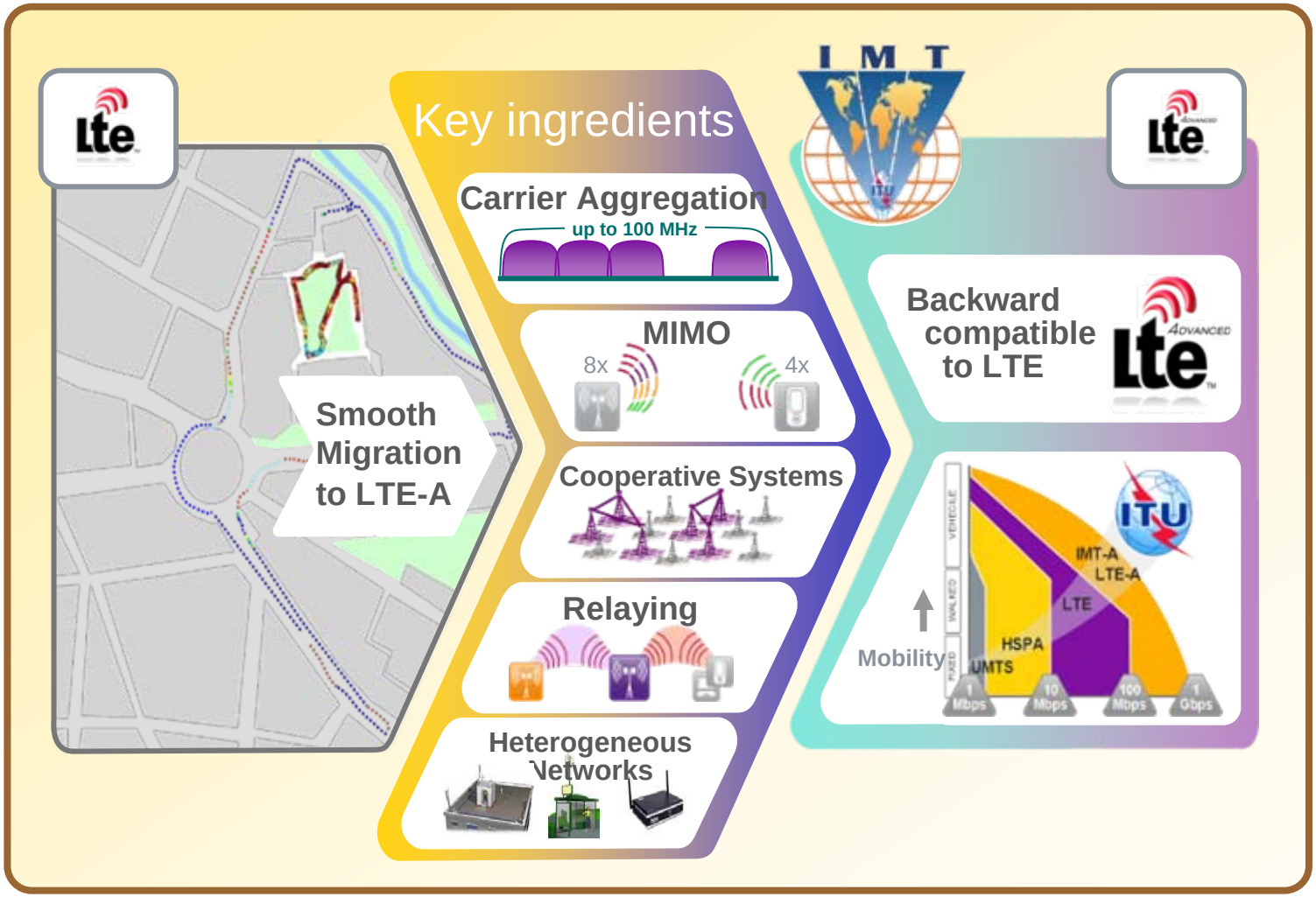
Flexi Network Server
Flexi NS

Flexi Network
Gateway
Flexi-NG

SON Use cases in 3GPP



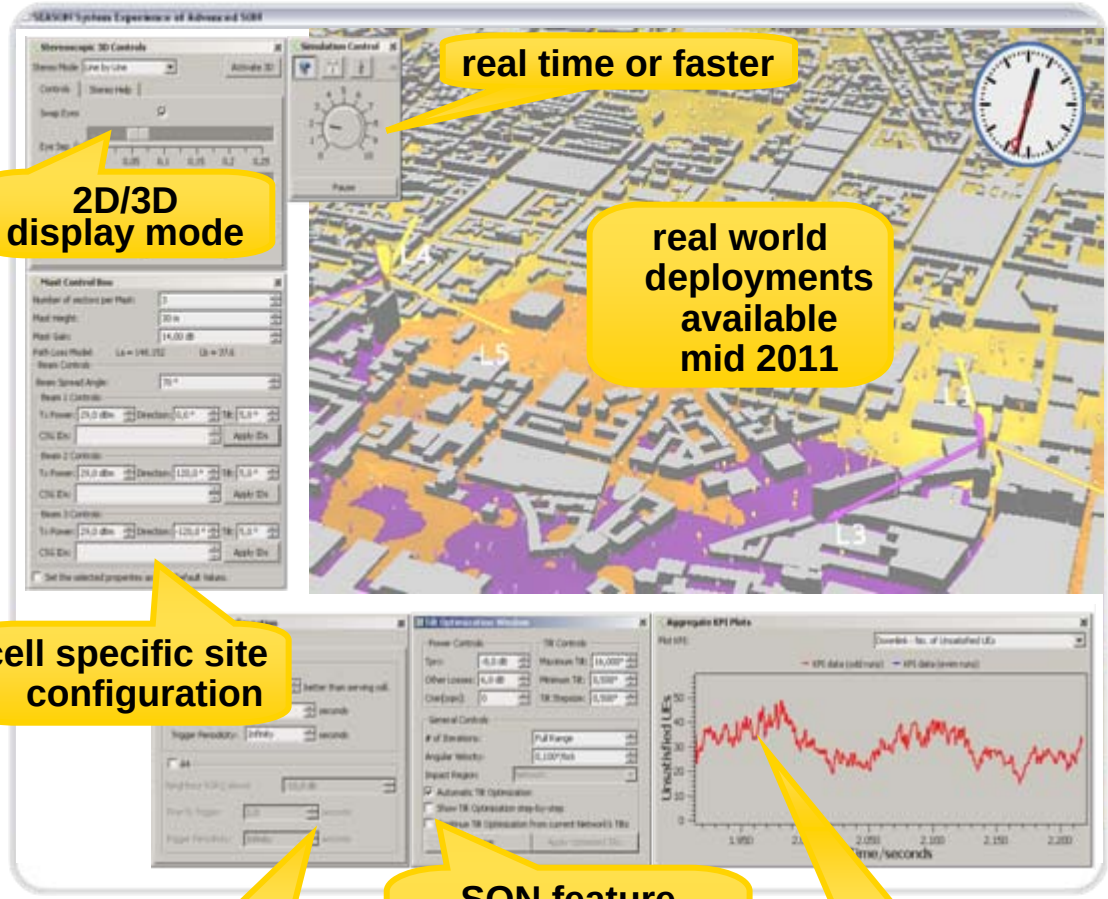
What's next: … SON for LTE-A / Beyond 4G



SEASON

System Experience of Advanced SON

- **Realtime** multi user, multi-cell radio network emulator supporting **dozens of sites** and **more than 1000 terminals**
- System requirements: **Windows @ standard laptop**
- **Interactive control** via graphical I/F
- Timescale: **100 ms**
- Designed for evaluation and visualization of **SON** features: (Multi-RAT) ANR, LB, CoC, Tilt Opt., MRO, MDT, Energy Saving
- Traffic Steering: **Multi-RAT** and **Multi-Layer** scenarios
- **LTHE:** Multi-Flow Operation
- **Cognitive Radio**: Multi operator frequency sharing ('licensing light')
- Version 2: Support of **Real World deployments** (Munich City Center)

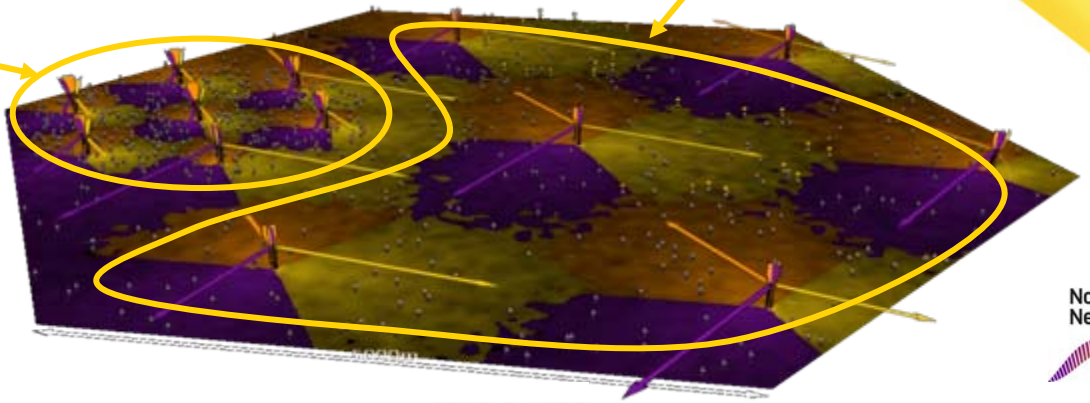


SEASON Demos

1. **Tilt Optimization**
2. **Cell Outage Compensation (COC)**
3. **Load Balancing (LB)**
4. **Automatic Neighbor Relations (ANR)**

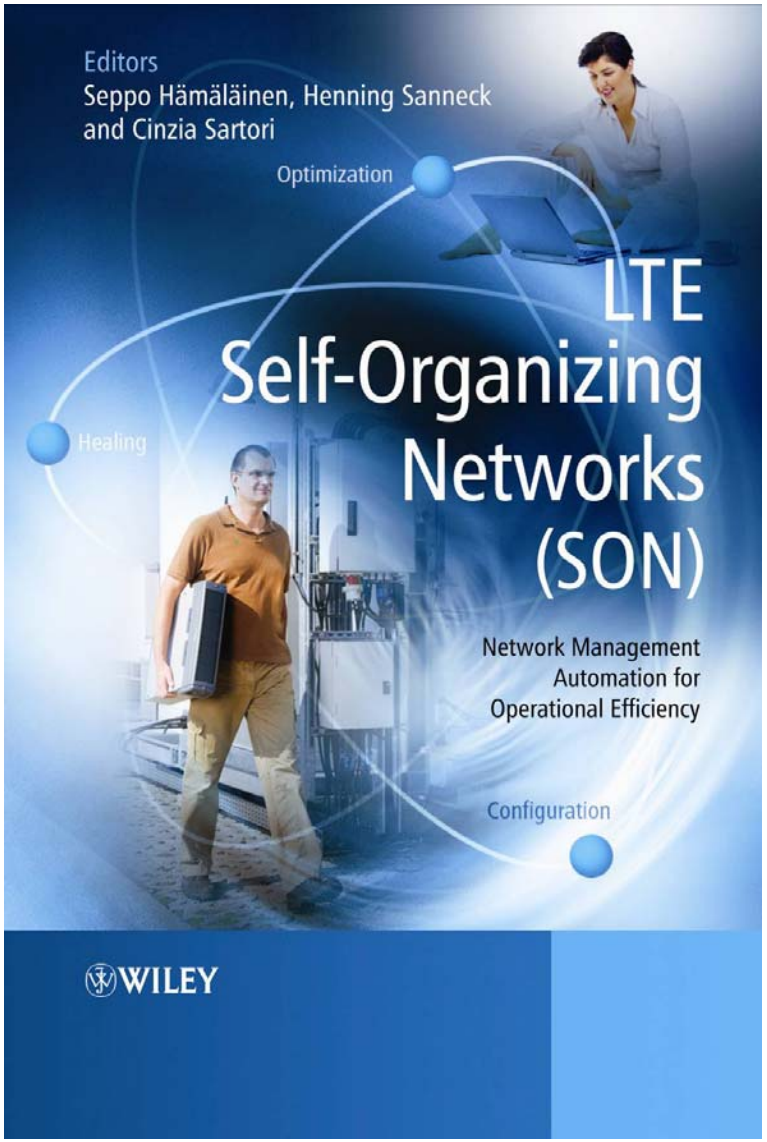
rural area
inter site distance: 3.5 km

urban area
inter site distance: 1.2 km



Commercial Break

- NSN Editors & Authors
- Publication: 01/2012
- Hardback, ~448 pages
- ISBN 978-1-119-97067-5
- Table of Contents:
  1. Introduction
  2. LTE Overview
  3. Self-Organizing Networks (SON)
  4. Self-Configuration (“Plug-and-Play”)
  5. Self-Optimization
  6. Self-Healing
  7. Supporting function: Minimization of Drive Tests
  8. SON for Core Networks
  9. SON operation
  10. SON for Heterogeneous Networks (HetNet)
  11. Future Research Topics



Thank you

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