2012 16th International Conference on Intelligence in Next Generation Networks
Realising the Power of the Network
Enabling the Internet of Everything
8-11 October 2012, Berlin, Germany
icin 2012

Self-Organization in Heterogeneous Wireless Networks

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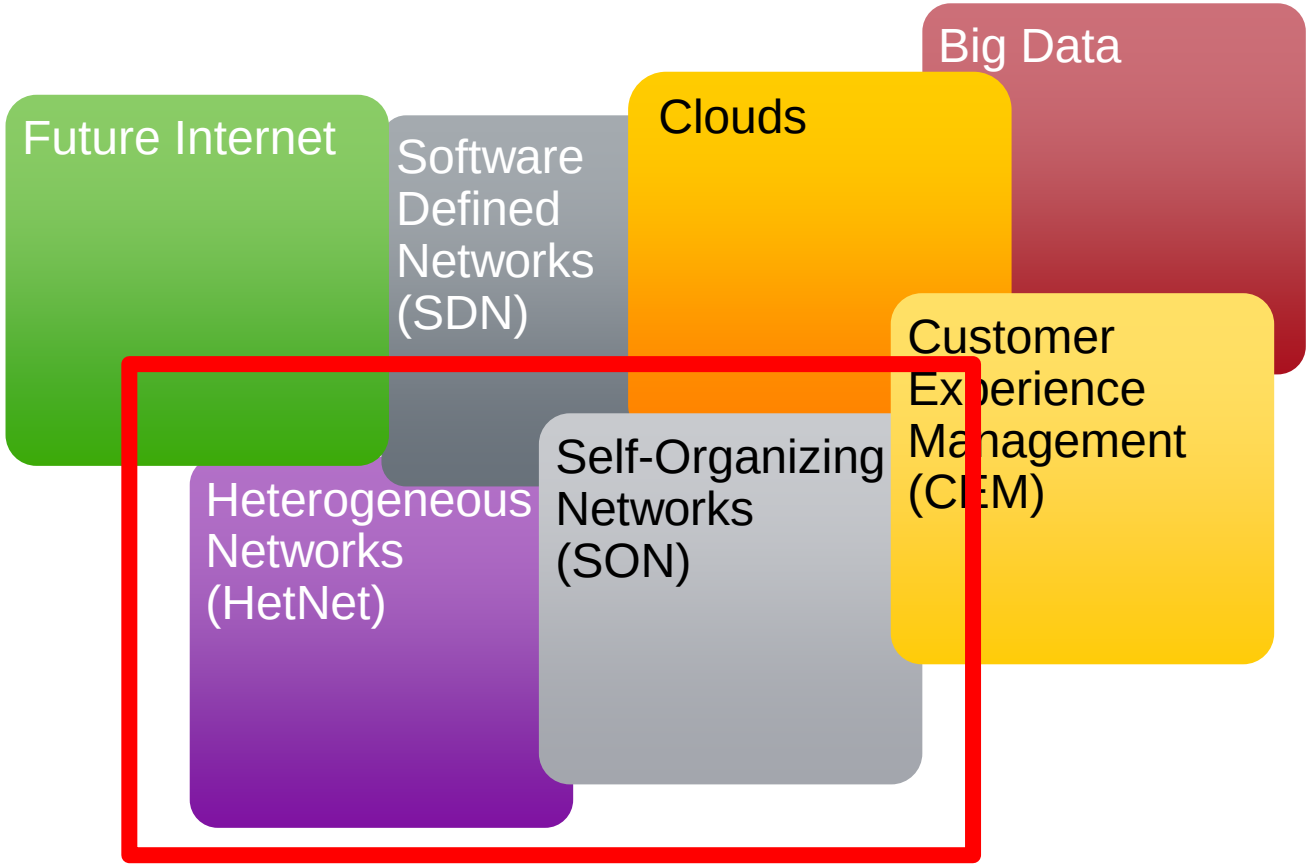
Some key topics in services / OSS / networking



“Nobody knows what SDN is, nor does anyone know what the Cloud really is, so those topics have a strong affinity to each other”: JS, September 2012.

Key requirements for network infrastructure towards 2020

Support up to 1000 times more traffic

Manage up to 10 times more users

Enable Gbps peak speeds

Reduce latency to milliseconds

Improve energy efficiency

Make networks self-aware, self-adaptable, and intelligent

Deliver safe superior customer experience

We cannot predict all the use cases
so flexibility is a key requirement

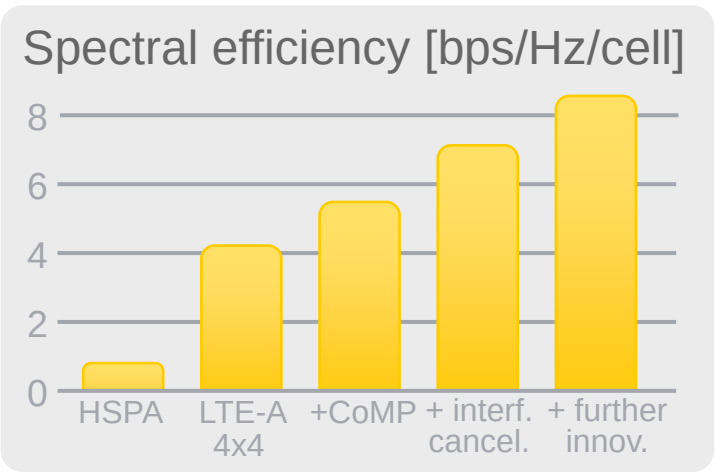
Support of up to 1000 times more capacity in wireless access

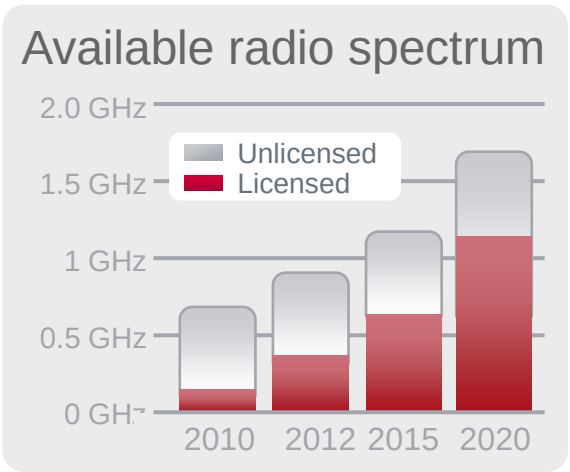
10x Performance

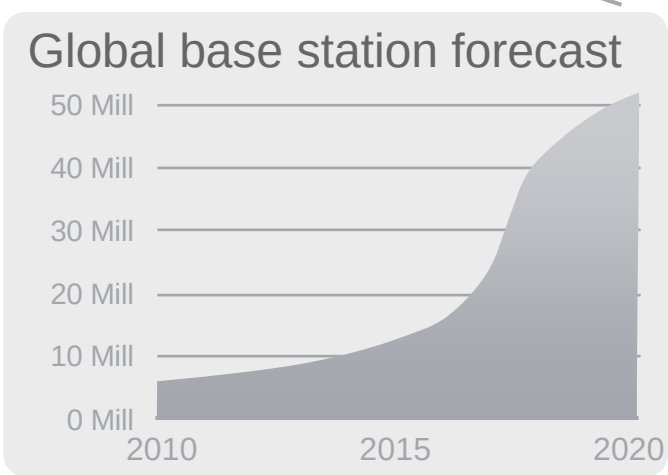
10x Spectrum

10x Base stations

= 1000x Capacity





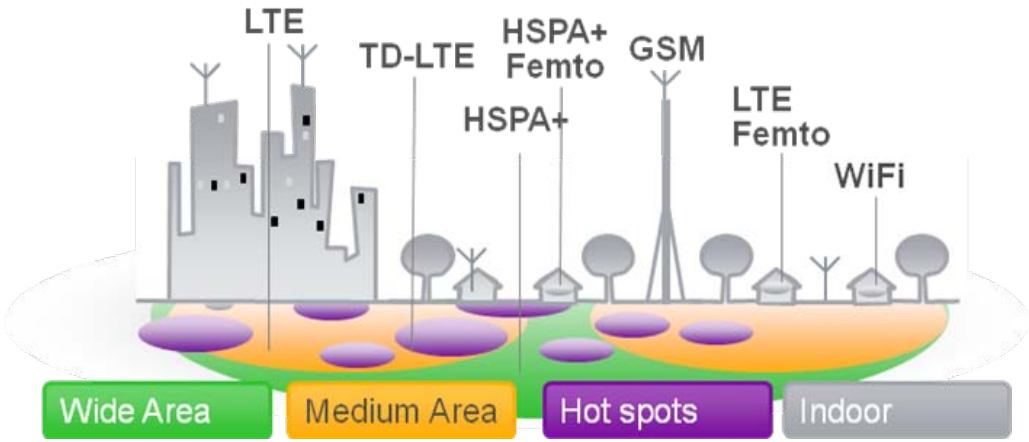


Most of these will be small cells

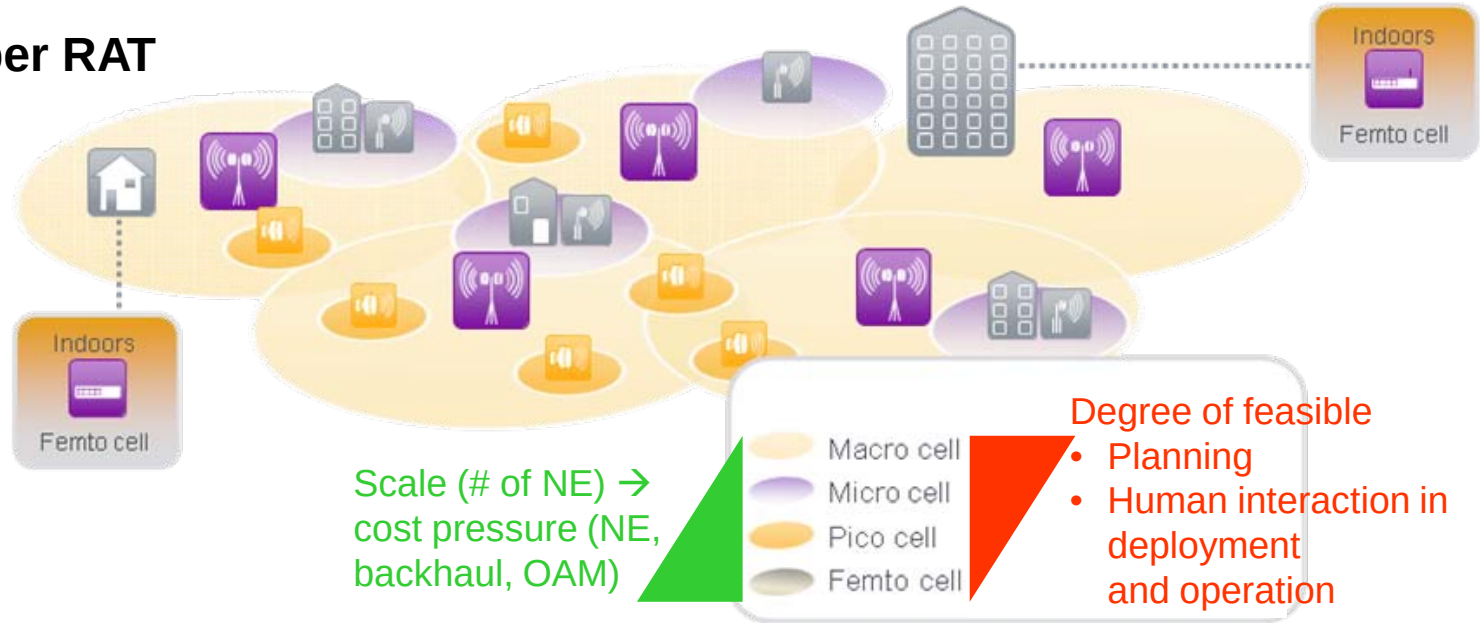
In addition over 500M WiFi APs

Heterogeneous Networks („HetNet“) providing “unlimited” capacity and “ubiquitous” coverage

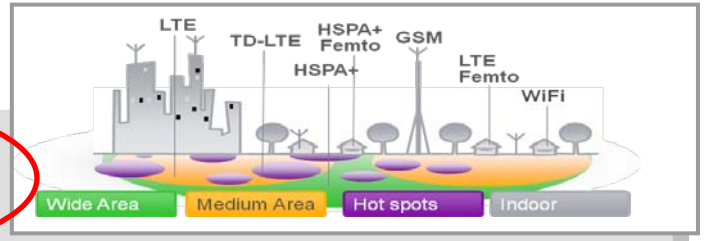
Multiple Radio Access Technologies („Multi-RAT“)



Multiple cell layers per RAT („Multi-layer“)

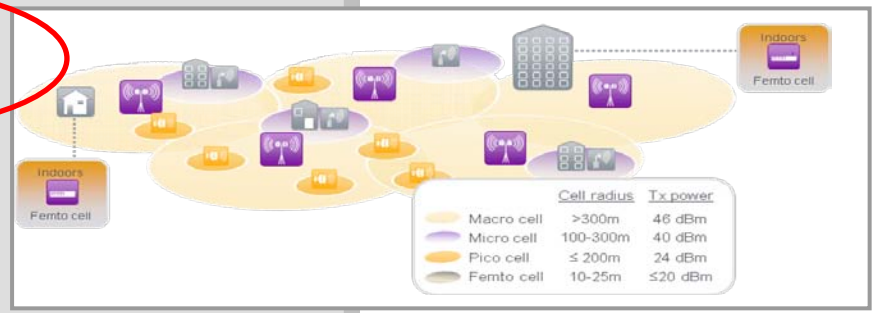


Multi-RAT, Multi-Layer, Multi-vendor HetNets



Multi-RAT

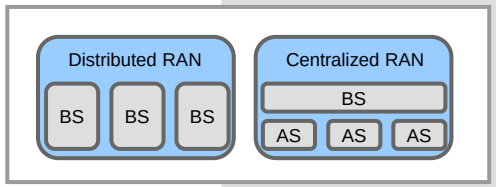
Multi-Layer



time

Multi-Architecture

Distributed & Centralized ("CloudRAN")

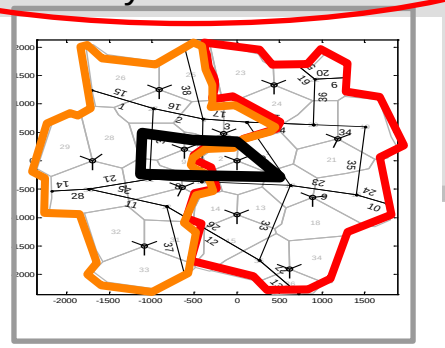


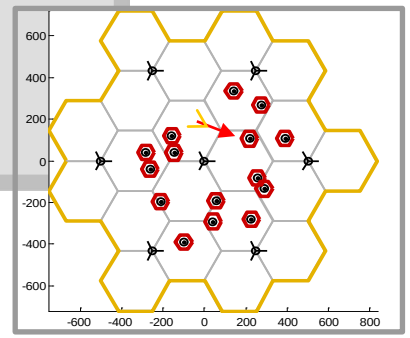
Multi-vendor

Different vendors providing different RATs / cell layers

Multi-operator

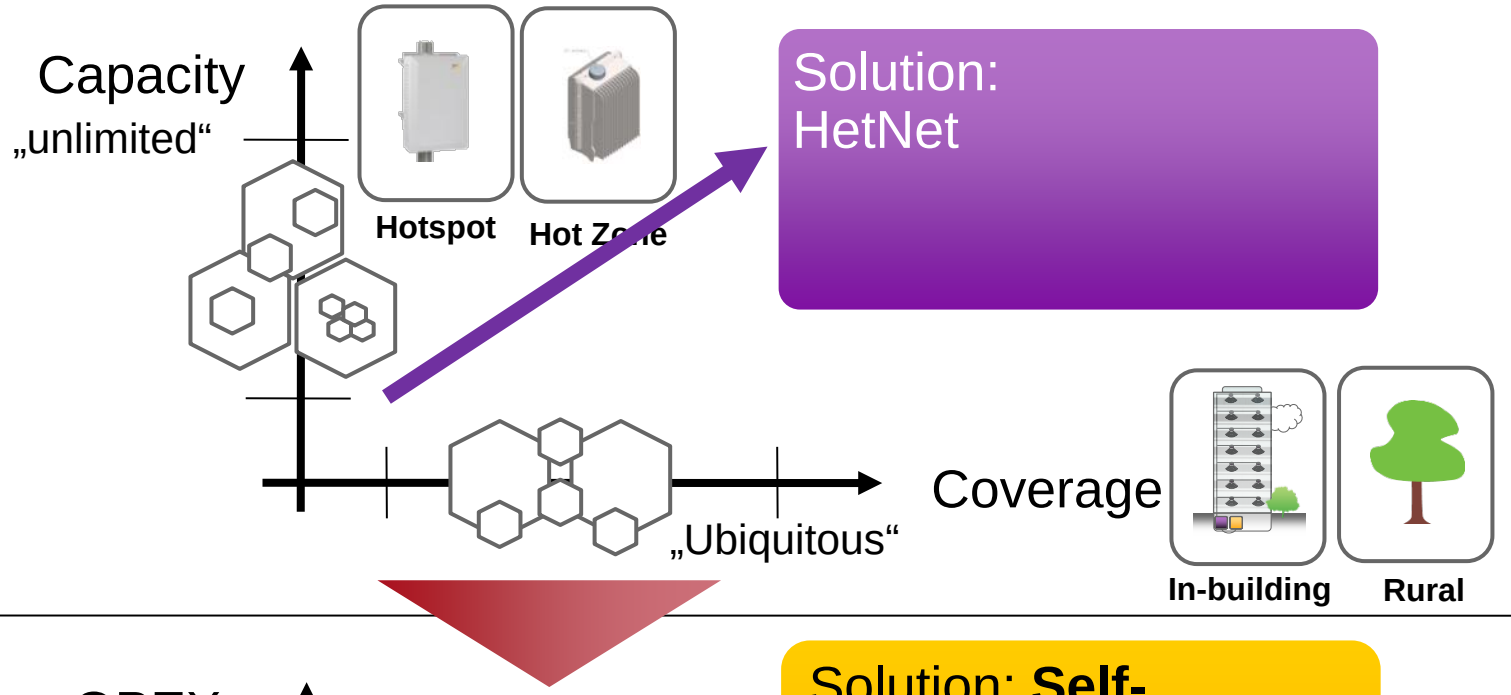
Network sharing / virtualization



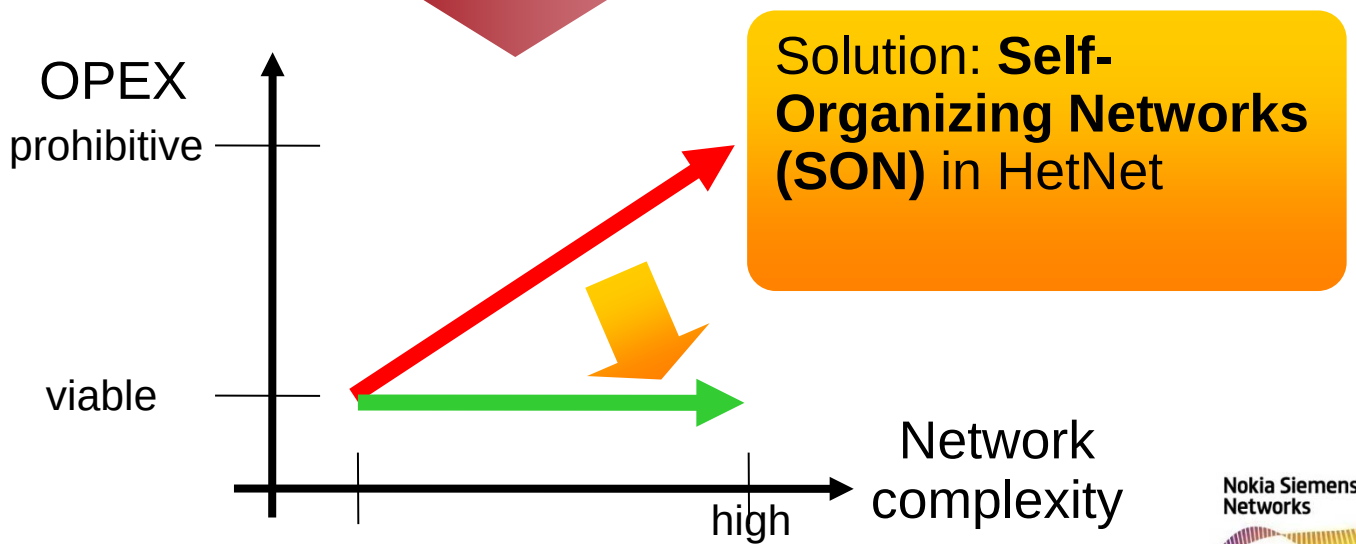


Densification and higher distribution brings complexity

Trend: exploding demand for ubiquitous mobile broadband



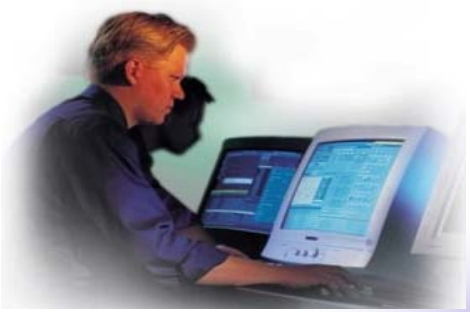
Problem: exploding OPEX to operate a complex (fragmented) network infrastructure



Self-Organization

applied to infrastructure networks ?

Cellular macro network
- Tightly planned, automated operation
- Single operator
- Single vendor equipment per OAM domain



Cellular Heterogeneous Network
- Some parts only coarsely planned, highly automated operation
- Multi-operator (shared infra)
- Multi-vendor per domain

Ad-hoc / mesh network
- Uncoordinated deployment, autonomous operation
- Only node operator
- Open environment, standardized protocols between nodes

"Self-organization is a process where the organization (constraint, redundancy) of a system spontaneously increases, i.e., without this increase being controlled by the environment or an encompassing or otherwise external system." (F. Heylighen, Principia Cybernetica Web, 1997)

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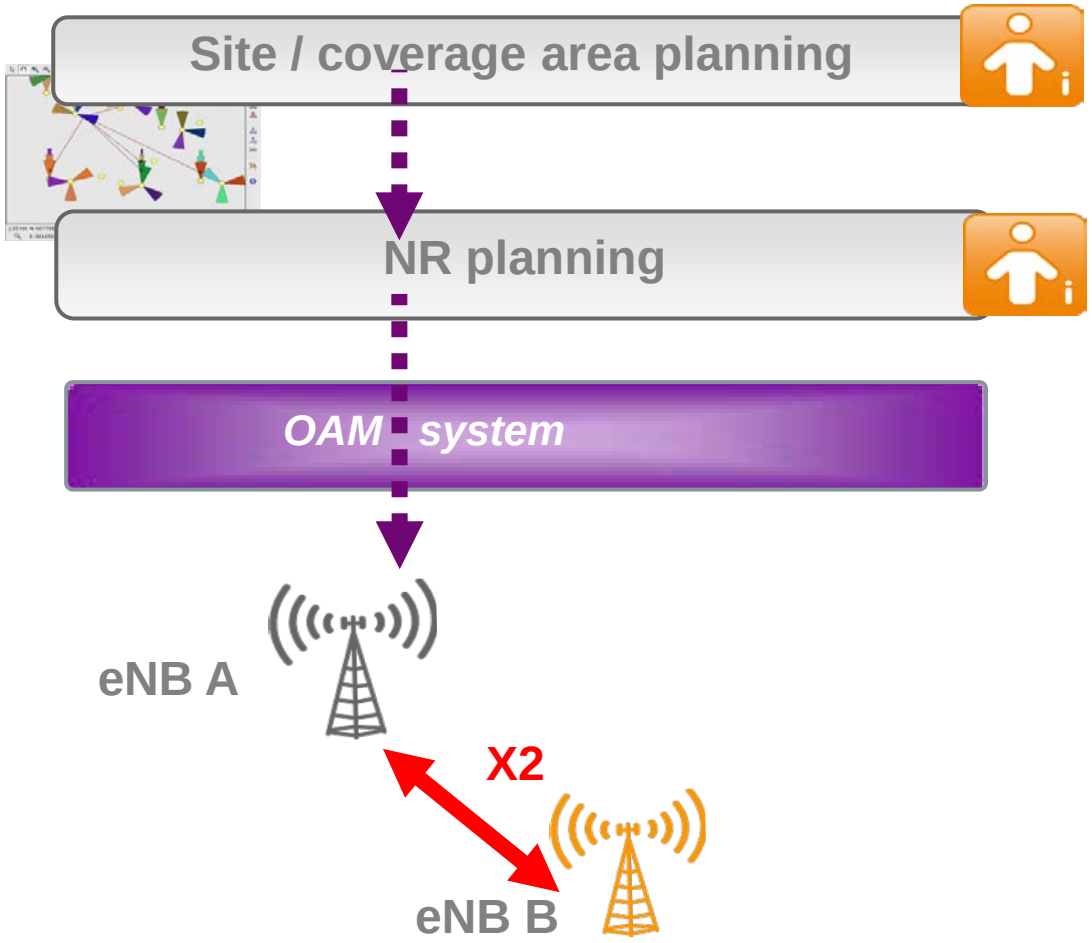
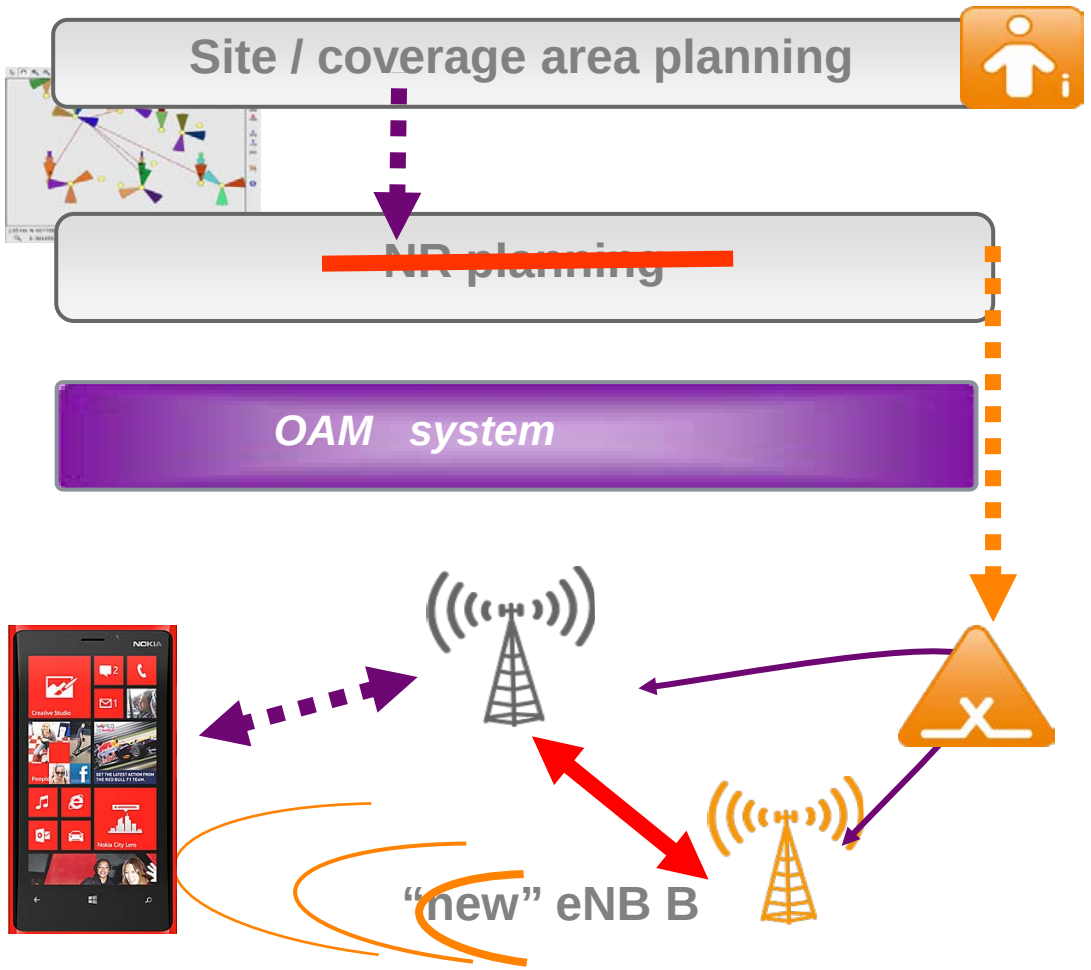
Example: Automatic Neighbour Relations (ANR)

Conventional



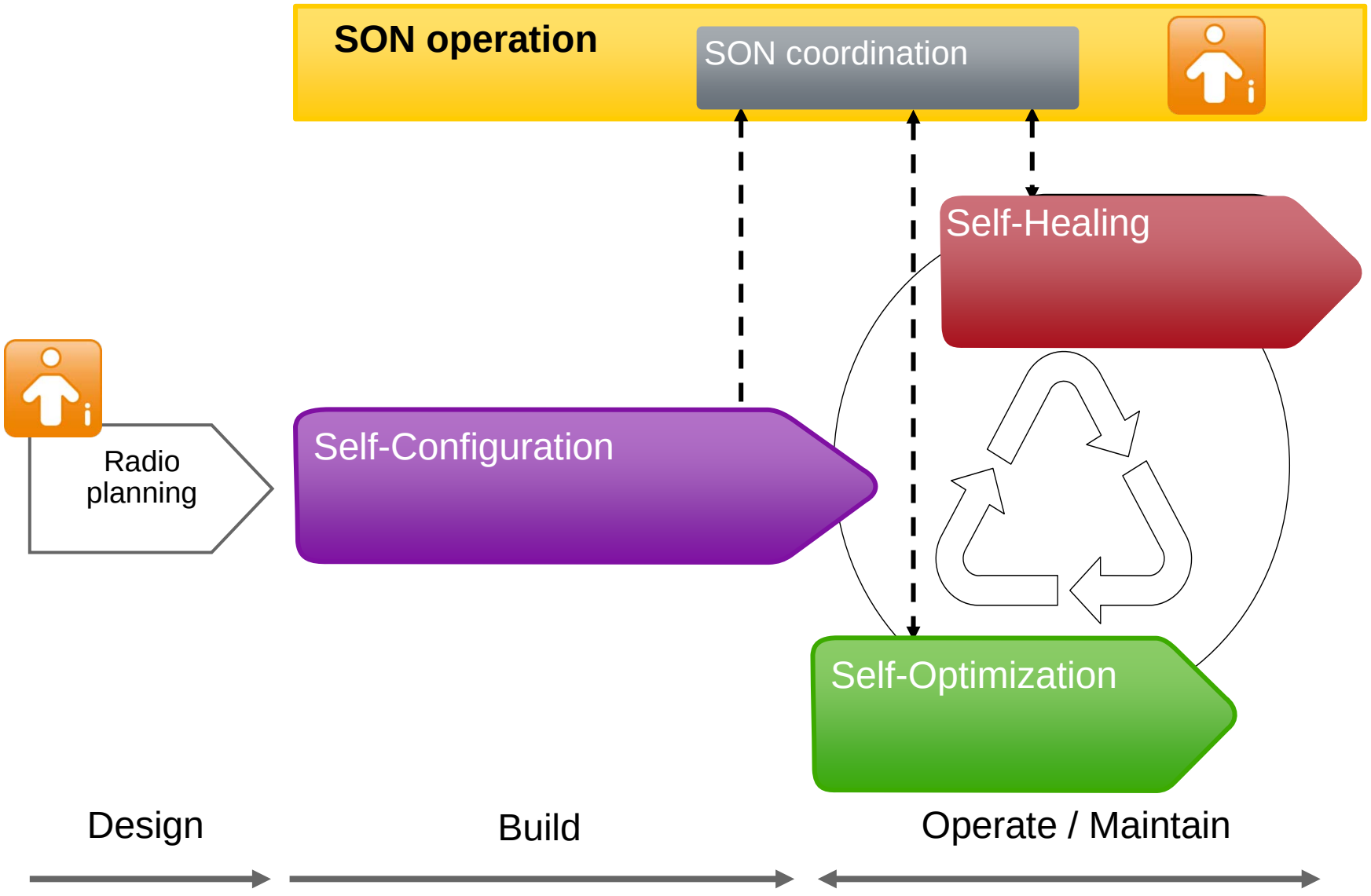
eNB A is pre-configured to know eNB B

ANR



UE relays info on eNB B to eNB A

Self-Organizing Networks (SON)



Self-Organizing Networks (SON)

SON operation

SON coordination

Additional requirements to SON functions wrt. HetNet:

- Functional: increased level of autonomy / knowledge on HetNet structure
- Non-functional: increased level of scalability, reliability and multi-vendor capability

Radio planning

Auto-connectivity & -commissioning

ANR

Self-Healing

Cell Degradation Detection, Diagnosis and Recovery

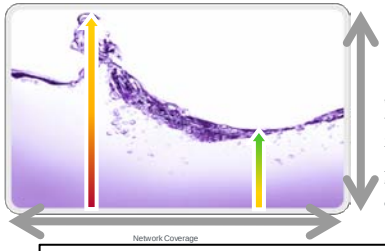
Energy Saving

MRO*

Self-Optimization

Interference Management

Traffic Steering incl. WiFi offload



Customer

Experience

Design → Build → Operate / Maintain

*MRO: Mobility Robustness Optimization

Conclusions

Mobile data traffic explosion → operators must „densify“ their network, increasing capacity and assuring coverage → **Heterogeneous Networks (HetNets)**

Decreasing revenue per user → operators must reduce costs to remain profitable; HetNets increase complexity and thus Operational Expenses (OPEX), however → **dilemma**

Self Organizing Networks (SON): manage complexity → drive down costs for **infrastructure** networks

- SON concepts for infra networks: careful evaluation (business value, legacy / standardization requirements, complexity)
- Combination of distributed (network element) and centralized (OAM system) features (both proprietary and standardized)

For HetNets, SON becomes imperative:

- Extension of existing concepts & new concepts → Multi-layer, Multi-RAT (→ Traffic Steering: making the resources appear as “one network”)
- Time horizon: combination of available features into a solution (cf. WiFi offload) → long-term research agenda (Cognitive Networks)

Innovation at the heart of our business

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Thank you

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