



Self Organizing Networks

A Manufacturers View

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SON – What it is about

- SON – Drivers
- LTE OAM Architecture
- SON Functional Domains
- Manual vs. SON-based Network Operation
- Implementation Approaches

Definition

“Self Organizing Networks” - SON

NSN's position

- Configure & optimize network automatically
- Allow operators to be final control instance
- SON goes beyond LTE
- SON starts a paradigm shift how to operate a network

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

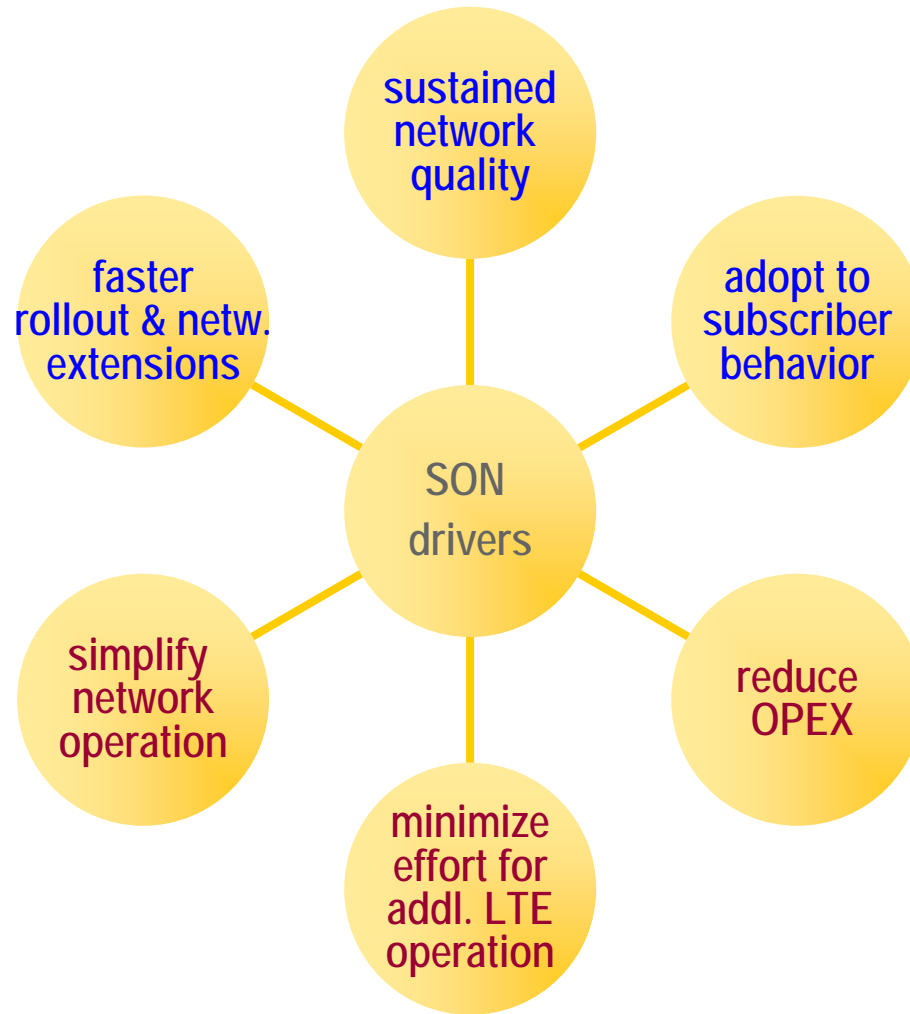


- OPEX reduction – reduce human interaction

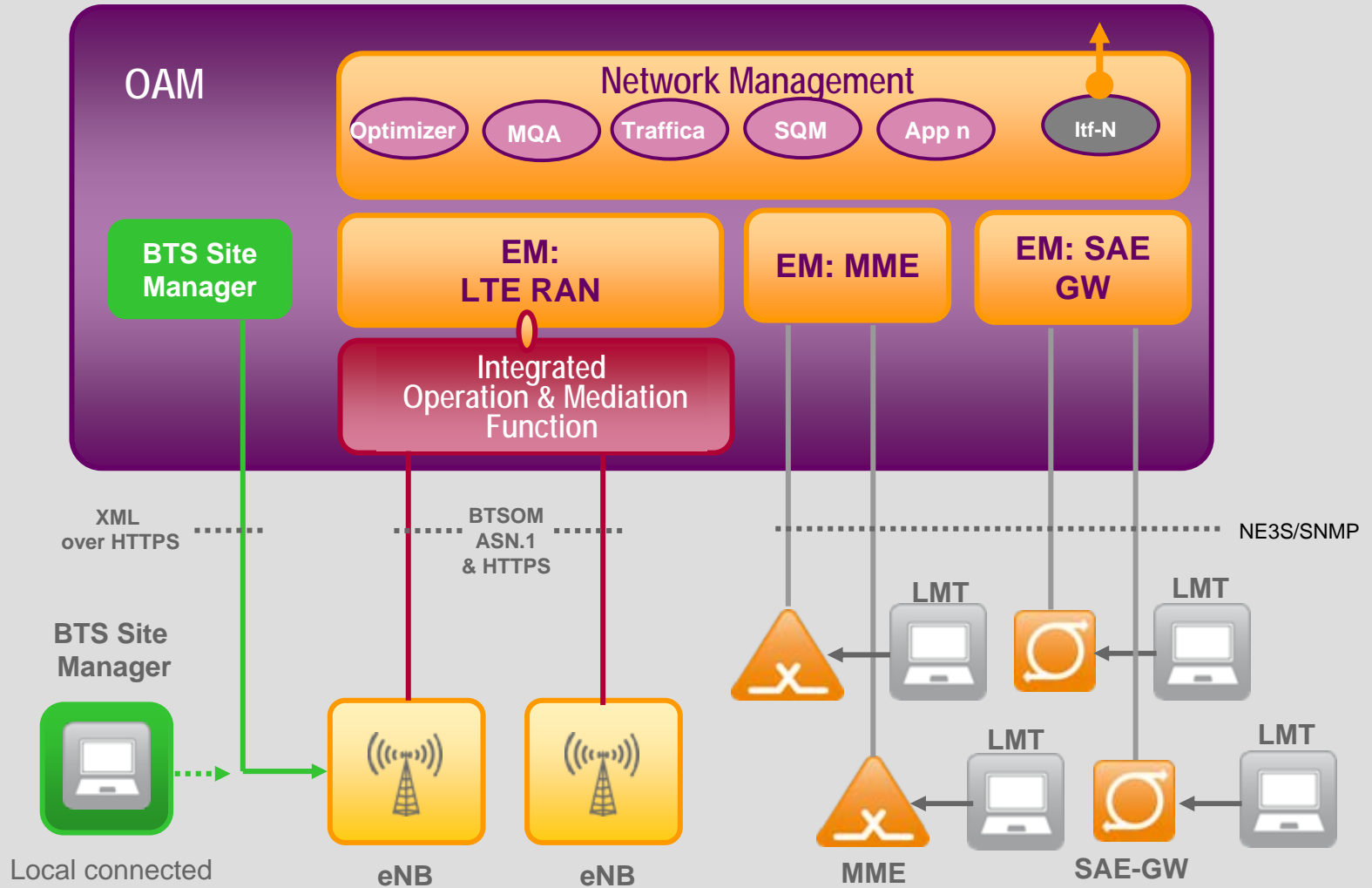


- Configure & optimize the network automatically
- But allow the operator to be the final control instance

Drivers for Self Organizing Networks



LTE / SAE: Flat OAM Architecture



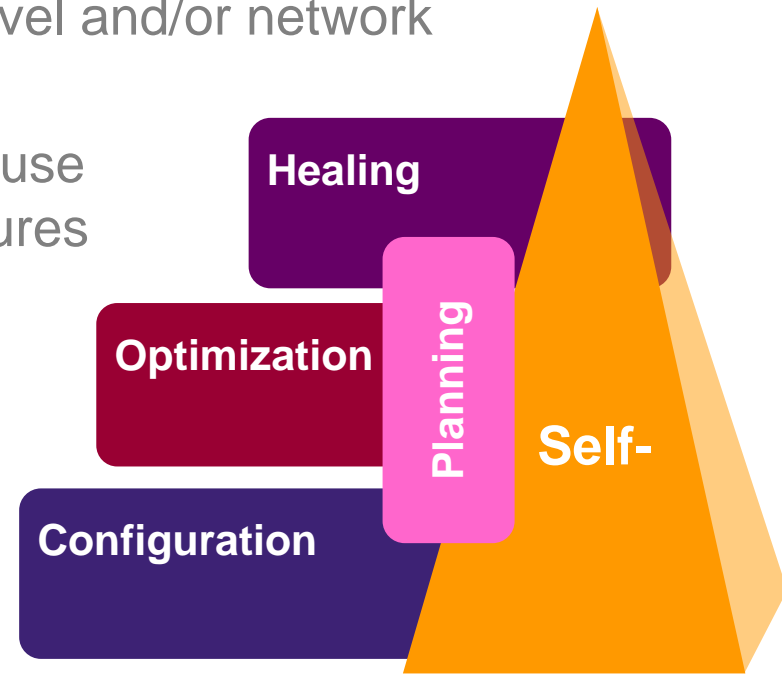
SON Functional Domains

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

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

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

Self-planning: dynamic re-computation of network plan, e.g. due to capacity extensions, traffic monitoring or optimization results



SON Functional Domains

Self-Configuration

Plug and Play

Auto Setup, -Config., Phy. Cell-ID
Auto Connectivity X2, S1
Auto Neighbor Relation, ANR

Self-Planning

“Dynamic re-computation”
due to capacity extensions, traffic monitoring or optimizations

Self-Optimization

Auto Tune

Coverage & Capacity, Energy savings, Mobility Robustness, Load Balancing, RACH, Inter-Cell Interference Coordination

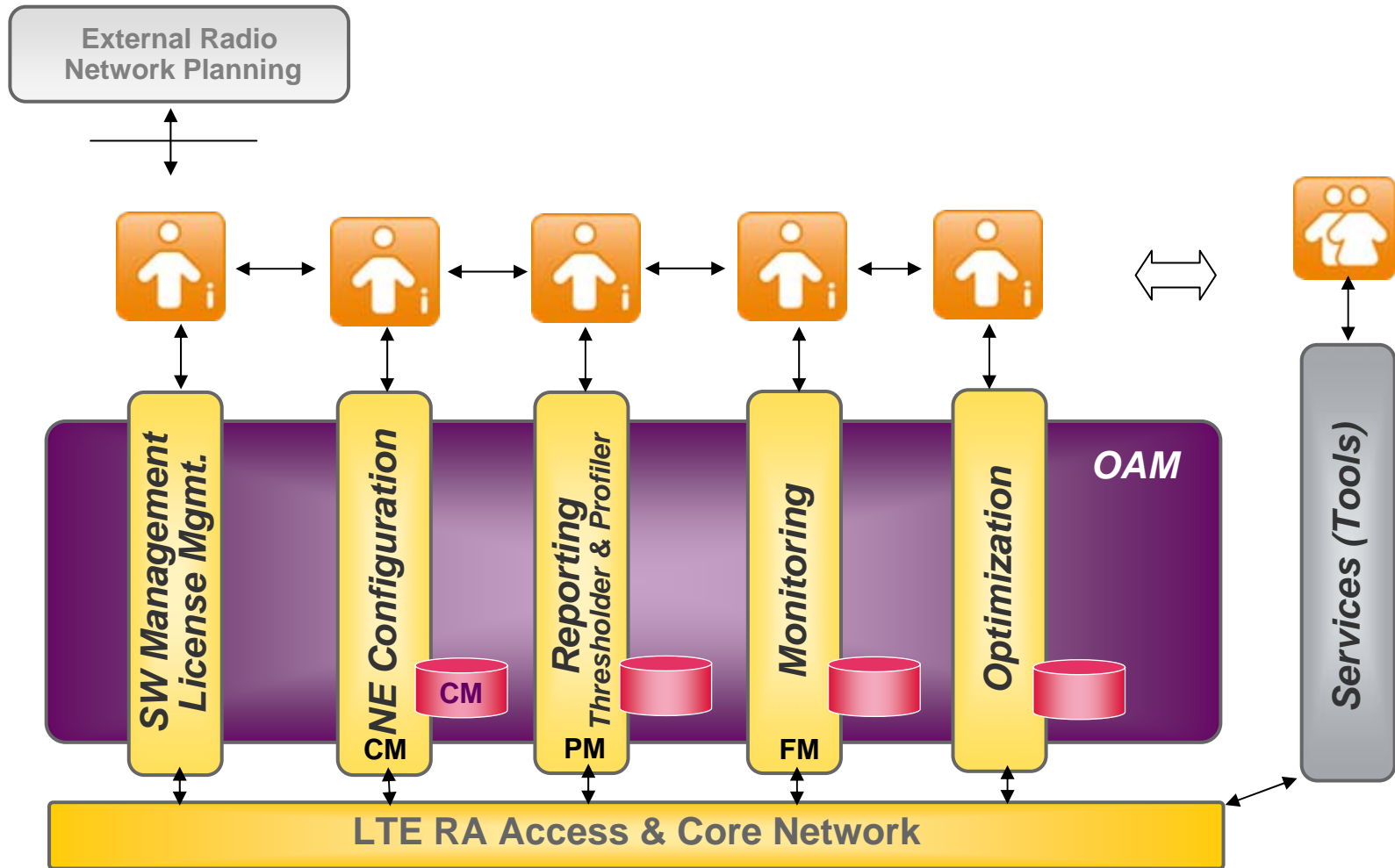
Self-Healing

Auto Repair

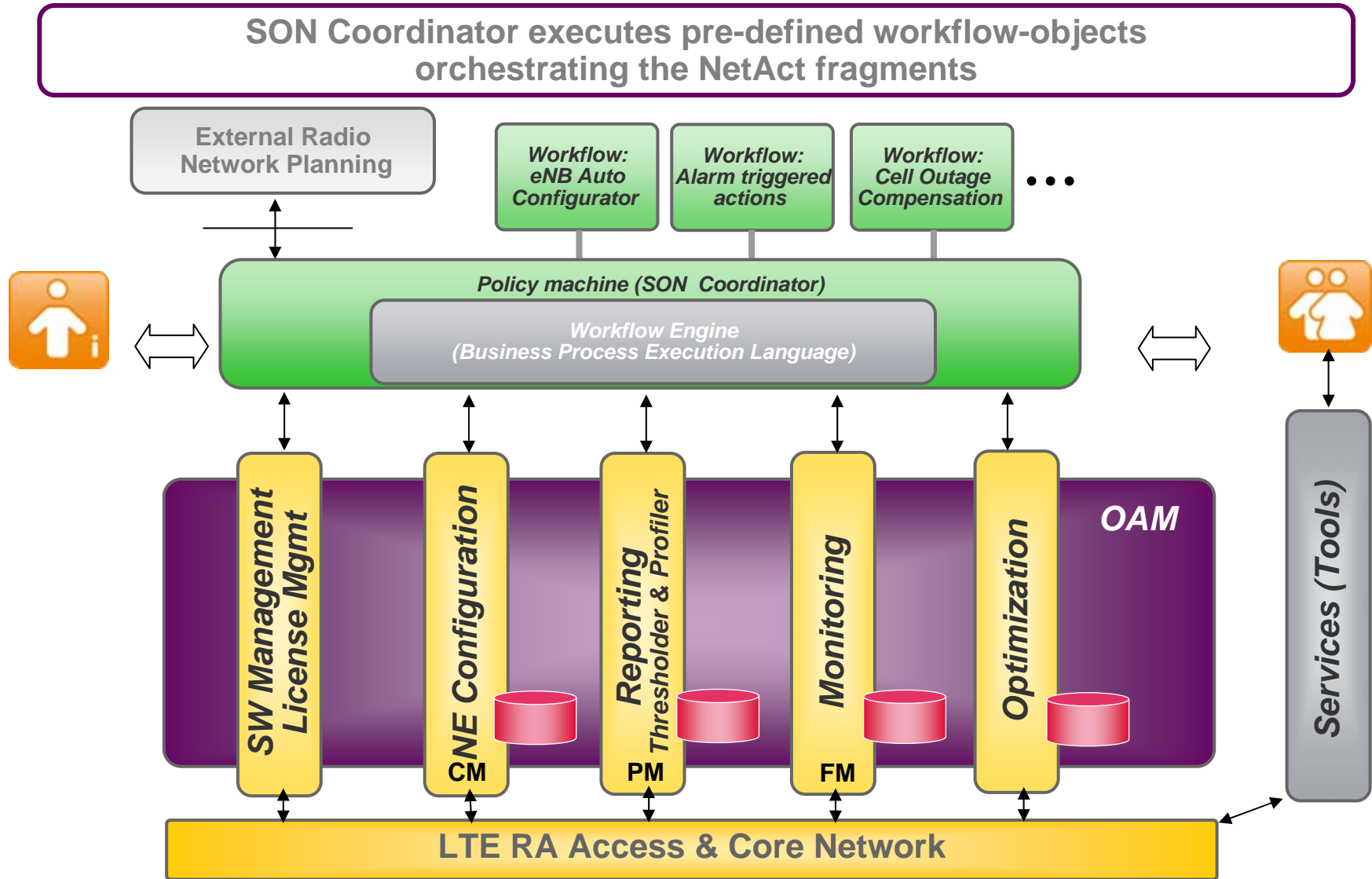
HW/SW-Failure Mitigation
Cell Outage Detection and Outage Mitigation
Automatic Alarm Reaction



Current Network Operation (simplified)



SON enhanced Network Operation



SON Implementation Approaches

faster timescale of operation

number of cells involved

Centralized

Distributed

Localized

Criteria

- > 2 cells involved
- Slower update rate
- Long term statistics

- ~ 2 cells involved
- > 2 cells if changed parameters have only local impact (only neighbor info required)
for > 2 cells master/slave relations required to allow convergence
- utilize X2 signaling

- single cell scope
- fast update rate
- short term statistics

Examples

- Auto Configuration with dynamic self planning
- coverage and capacity optimization

- Automated Neighbor Relation ANR
- HO & Interference Optimization
- Cell outage compensation

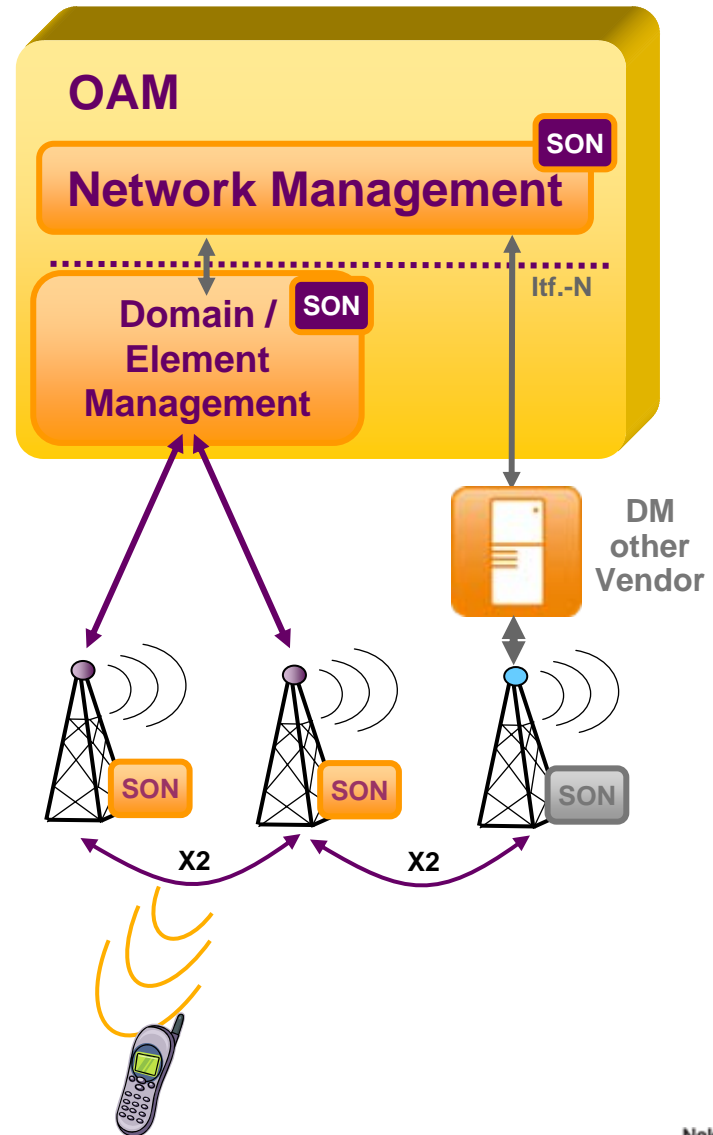
- adaptive MIMO
- Link adaptation
- RACH optimization

Nokia Siemens Networks SON Architecture

Nokia Siemens Networks goes for **Hybrid SON**, parts of the self-organizing functions and algorithms are executed on OAM level while others are done in eNB:

- Quick short term and simple optimization schemes in eNB
- Complex, mid & long term optimization schemes in OAM (e.g. Optimization tools)
- Flexible to support different optimization cases
- Multivendor support via X2 Irf.*) and Domain Manager northbound Interface*)

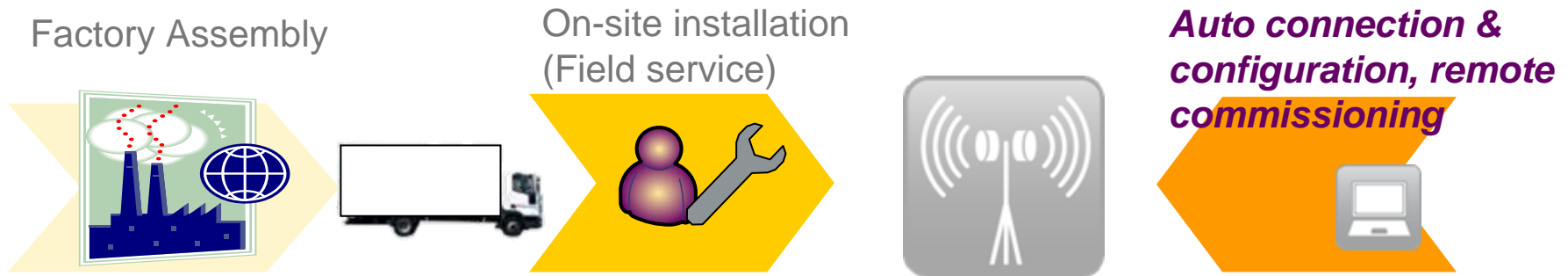
*) for standardized SON functions/Interfaces



SON - Examples

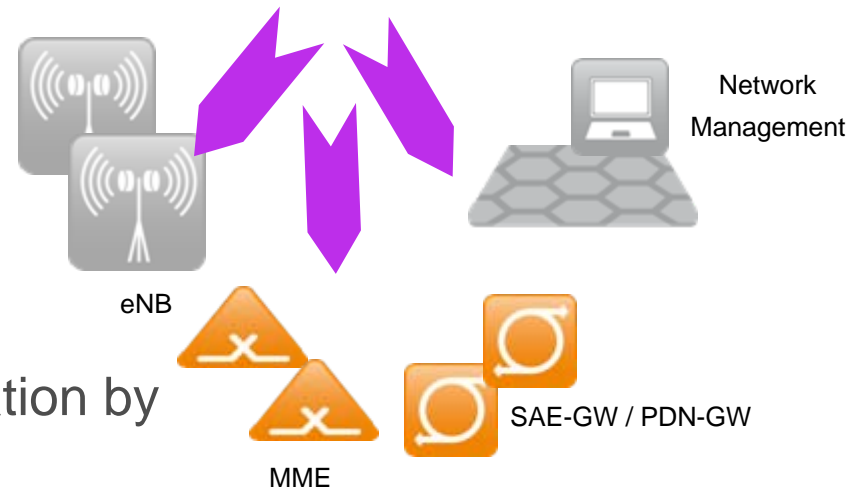
- Initial eNB Configuration
- Automated NW Planning
- ANR Configuration
- Self-healing

Example: Initial eNB Configuration

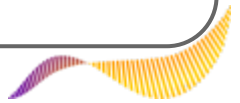
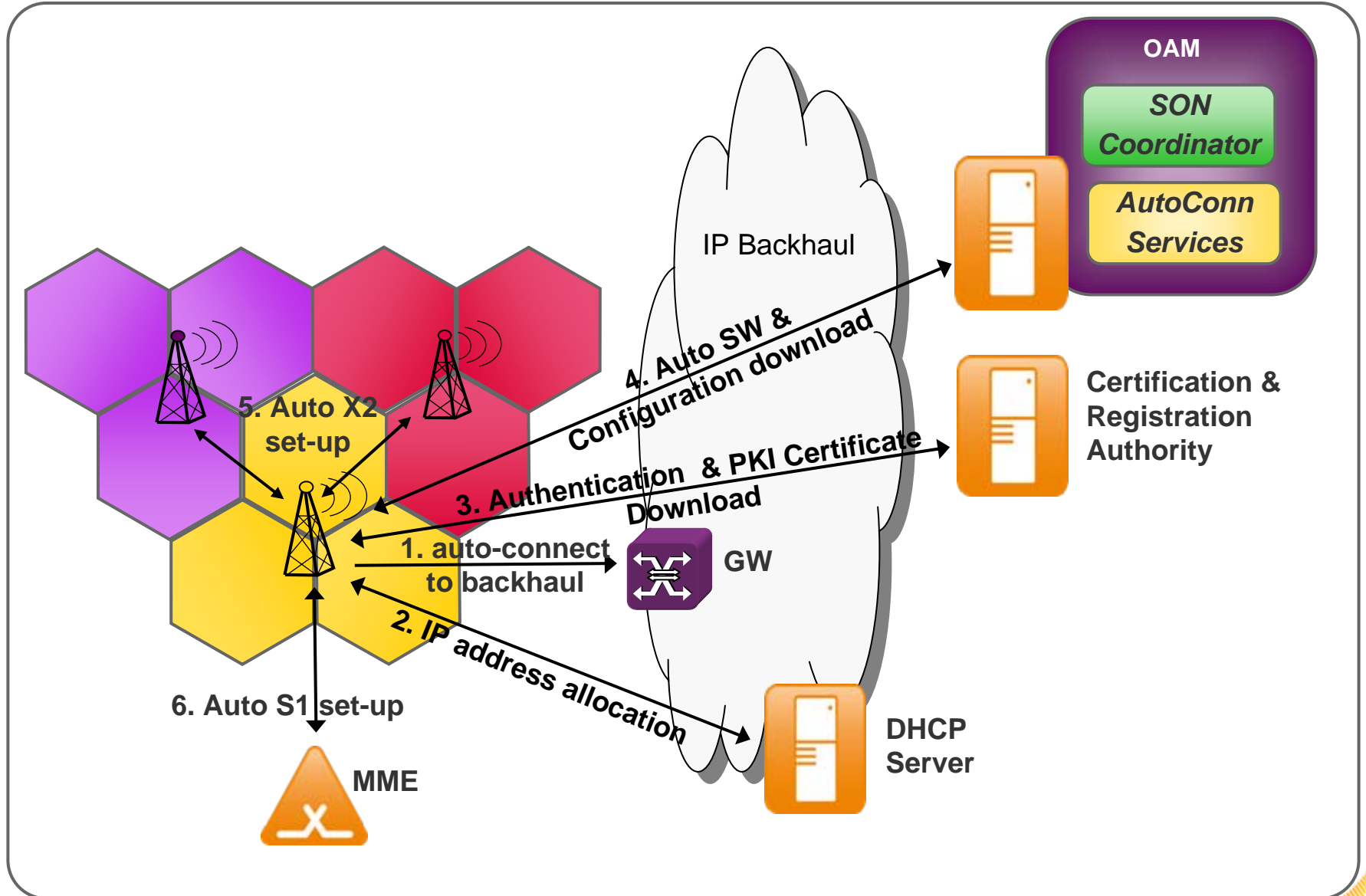


1-Touch-Deployment:

- eNB default pre-config. in factory
- Shipping to site
- Site preparation and eNB installation by field service – **plug & play**:
 - eNB gets automatically connected and configured from OAM System
 - eNB gets automatically integrated into the access-, core- and network-management networks



Example: Initial eNB Configuration Steps

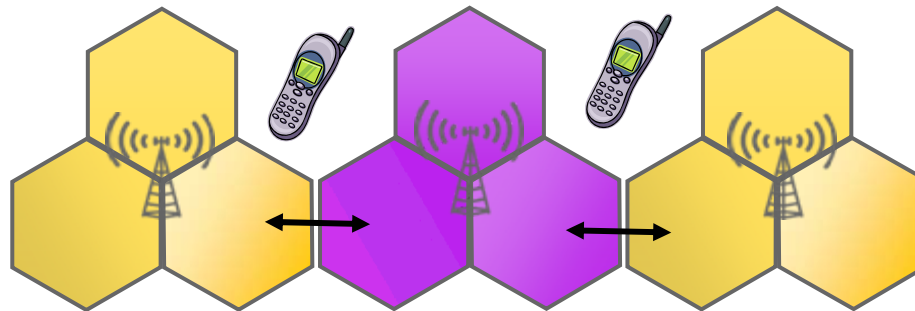


Example: Automated Neighbor Relation (ANR) configuration

- Relations between neighbor cell need to be carefully known respectively planned
- Wrong configurations cause HO failures / dropped calls
- Self configuration of relations avoids manual planning & maintenance

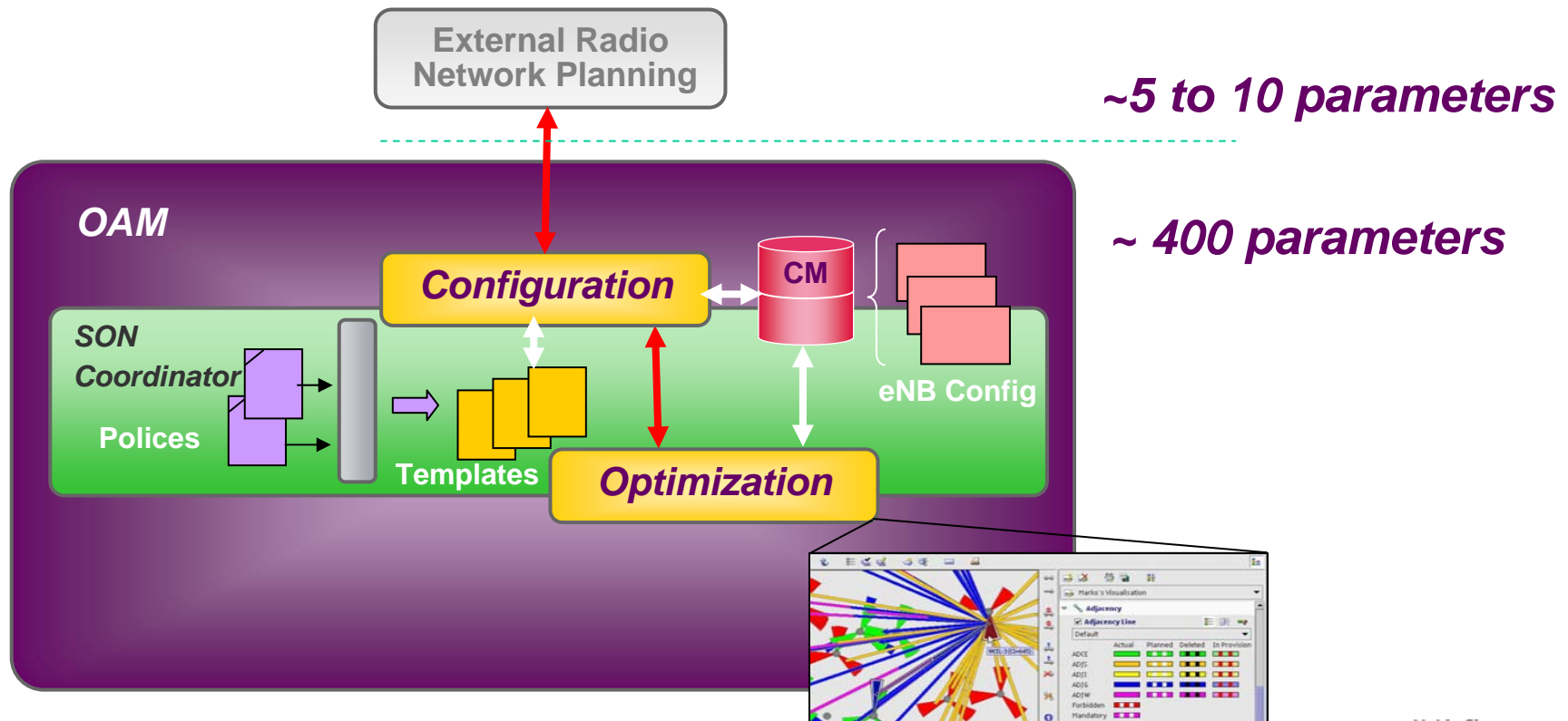
ANR covers 4 steps:

- Neighbor cell discovery
- Neighbor Site's X2 transport configuration discovery
- X2 Connection Set-up with neighbor cell configuration update
- ANR Optimization



Example: Automated Network planning

Planning tool delivers very few parameters, all other parameters are autonomously derived by the system, such as physical cell identifier, pilot specific settings, neighbors and other cell specific parameters by tight interworking of **Configuration Management** & **Network Optimization**



Example: Self Healing topics

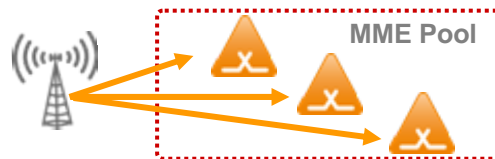
- Self Healing is closely related to fault management, performance management, redundancy & resilience concepts
- Nokia Siemens Networks applies self healing capabilities on LTE eNodeBs, higher level network elements and as part of NMS applications respectively on service level

LTE Base Stations:

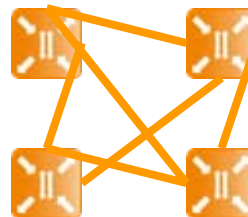
- Redundant Architecture for
 - System Modules
 - RF Modules and RF Heads
 - Power supply Module
 - Temperature control (fans)
- Integrated System Maintenance for permanent supervision and diagnostic
- Responsible for alarming and proper recovery measures like SW fall back



- Evolved Packet Core pooling concept for Mobility Management Entities and Gateways

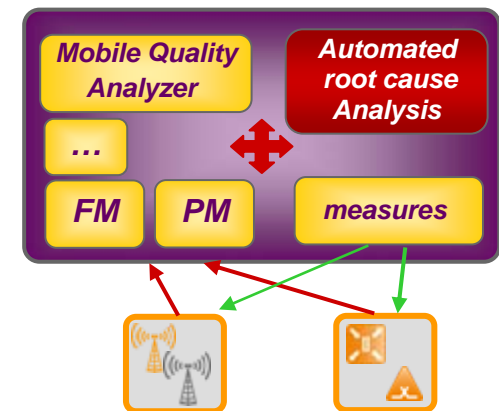


- Redundant and self routing Carrier Ethernet Transport and IP aggregation network



Network Management:

- Root Cause Analysis Automation
- Sleeping Cell detection
- Cell Outage compensation (e.g. by Remote Antenna Tilt adjustments of neighbors)



Example: Cell Outage Detection / Compensation

Detection algorithm will use thresholds for raising alarms which indicate a possible cell problem

- Thresholds based on typical network traffic of a cell
- Used tooling: Performance Management

Compensation by re-configurations of neighbor relations, changing interference related parameters, transmission power settings, antenna tilt setting, ...

- Used tooling: Network Optimization

Study topics:

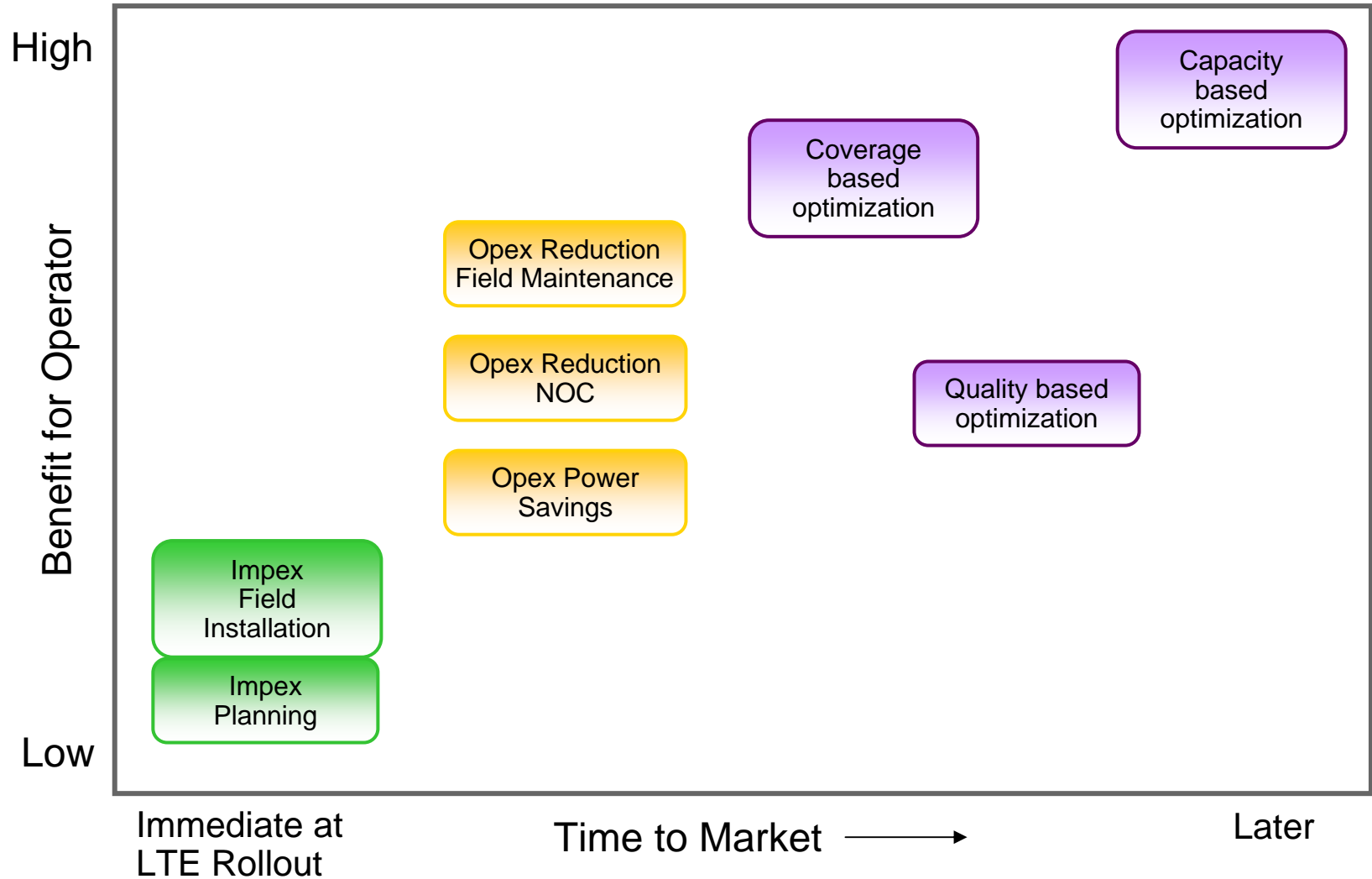
- Trigger points: when the procedure shall start
- Algorithm for automatic compensation: which perspective is the most important and which restrictions may be accepted for limited time



Wrap-up

- Time-to-market
- Summary

SON Operator Benefit and Time to Market



Summary

- Major drivers for SON are
 - Increased number of Base Stations in different layers (macro, micro, pico, femto cells)
 - Increased number of network parameters to be taken into account
 - Increased network planning and management effort needed
 - Strong requirements on OPEX reduction
- Quality of Service and user experience will only be maintained in such complex environment by means of
 - self-optimized and
 - self-managed networks
- SON concepts help to enable plug & play network extension and configuration