Automatic Pre- & Post-Deployment Optimisation of eNodeB Parameters

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Self-Configuration is one component of self-organisation

Automatic Generation of initial eNodeB Parameters (AGP)
  – Generating pre-optimized parameters for eNodeB deployment
  – Soft-integration concept
  – Design decisions
  – Inclusion of measurement data (X-map)
  – What’s in the demo

For more material on AGP see Final Report D5.9 Sections 3.2.9 & 8.8
Objectives

Improving network quality

- Use optimised cell-specific parameter settings instead of default setting
  → standardised process instead of standardised parameter sets
- Seamlessly integrated eNodeB
- Configuration compliant with operator policies
- Reduced risk of misconfiguration

Reducing operational effort

- Automating processes
- Cluster optimisation less important
Pre-deployment optimization using a centralized regime

- Off-line global view on network configuration
- Short- & medium-term traffic expectation
- Design rules & preferences (operator policies)
- Fancy performance models
- Input data contains errors, inaccuracies, etc.

Post-deployment optimisation using a centralised regime

- Measurements are use to augment/update input data from pre-deployment planning
Scenario
- 306 LTE cells @ 2.6 GHz modeled after 3.5G network
- Traffic map from 3.5G network
- 30 km x 50 km area containing several cities
- Traffic intensity varying over time

Performance Analysis
- Path-loss predictions with 10/100m resolution
- RxLev $\geq$ -95 dBm for coverage
- C/I $\geq$ -6.5 dB for coverage
- Truncated Shannon for capacity
- Cell capacity includes inter-cell interference and basic scheduling
- Quality measure: missed traffic (for lack of coverage or capacity)
The four phases of soft-integration

1. Initialization: *Observation Phase*
   - Determine network configuration, up-to-date coverage, interference, and traffic information
   - Compute target configuration based on available information
2. Activation: *Integration Phase*
   - Activated new site at low power and with high tilt settings
   - Gradually increase transmit power
   - Optimize antenna tilt’s at new site based on network feedback
3. Arranging With Neighbours: *First Tuning Phase*
   - Locally optimize new eNodeB and its immediate surrounding w.r.t. neighbour relations and tilts
   - Perform optimisation based on high traffic making interference effects visible
4. Optimizing Larger Surroundings: *Second Tuning Phase*
   - Locally optimise new eNodeB and its larger surrounding, again based on high traffic

Depends on the ability to perform coordinated changes across several eNodeBs.
Optimisation w.r.t. averaged traffic

- Network configuration optimised for one particular snapshot often has poor performance for other snapshots from the same distribution
- Configurations optimised for different snapshots differ largely (here 35-60 out of 90 sectors)
- Optimisation based on multiple snapshots or on the average traffic intensity leads to more robust results (significantly better average performance)
Fix transmission power a priori

- optimising power for instantaneous traffic does not produce a stable results
- hard to minimise transmission power without the assertion that all requirements are reflected in current measurements

Optimise antenna tilt

- tilt is generally observed to have a strong impact on coverage as well as capacity
- limit step size of tilt changes, thus avoid abrupt (and possibly oscillating) changes

Transmit powers of sectors vary over time

Optimised antenna tilt vary with transmit power
Optimise using high traffic

- adverse effects of interference hardly show at low traffic levels (low signal levels)
- interference must be “visible” in order to be handled by means of minimizing inter-cell coupling

The higher the traffic demand is scaled, the smaller becomes the fraction of traffic to be serviced. The configurations optimised on the basis of higher traffic volumes (factor 1.5 and up in this example) tend to perform better.
Optimise with increasing scope

- most of the quality improvement realised by new site (largely independent of the configuration details), here about 93% of the achievable effect
- further big improvement by seamlessly integrating the new site with its immediate vicinity, here beyond 99% of the achievable effect
- remaining improvements from optimising new site together with growing environment, relative effects tail off quickly
- increasing the scope in rounds reduces number of changes (applying some hysteresis)
1st Optimization

Network Quality Rating (solid)
Area of Interest

Total Network
Cell Efficiency

Relative Traffic Amount

Day 1
Day 2
Day 3

0:00
0:00
0:00

0
3
6
9
12

0
1
2
3

0
0.2
0.4
0.6
0.8
1

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Soft-integration successfully addresses
  – the lack of up-to-date (and accurate) data on network environment
  – seamless hand-off to regular self-optimisation functions → c.f. SON coordination

Three distinct stages address the challenges of soft-integration
  – pre-deployment optimisation of initial configuration to integrate with environment
  – “ramping up” site power with repeated fitting to environment, combining a pre-computed trajectory and live measurement feedback
  – post-deployment optimisation of site and its surrounding as to optimise performance

Gradual changes allow self-organisation functions at surrounding sites to adapt
  – drastic local changes may otherwise trigger strong reactions from self-healing as well as self-optimisation functions which would need to be controlled through SON coordination

The demonstrator as well as supporting simulations have helped to make choices in the AGP design
  – transmission power as the integration driver
  – integration followed by two optimisation rounds with increasing scope limits changes
  – optimisation is conducted around peak traffic

Seamless and optimised integration from the start improves network quality

High degree of automation in configuration process is achieved
Thank you very much for your attention