

Reliable Operation of Heterogeneous Wireless Networks with SON (Self-Organizing Networks) - Integrated SON demo

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Tutorial DRCN 9th International Conference on
Design of Reliable Communication Networks



SON operation: SON management + SON coordination

- **SON management:**

- Enabling the control of the SON system by the human operator (governing the behaviour of the SON functions (target definition) based on business-level requirements) in a uniform way → „design-time“
- Configuration (target setting, on/off, time scheduling, stop points / approval of actions), Monitoring (results) of the individual SON functions → „run-time“

- **SON coordination (a.k.a. „conflict management“, „semantic coordination“):**

- Assuring the stable operation of the SON system as a whole by addressing the interactions between the use cases → „run-time“
- Key characteristic: relates to more than one single function instance
- SON coordination itself should be automated (e.g., by rule-based decision making), yet it may be run under close human supervision (manual approval of coordination actions) as well

→ both SON management and SON coordination need a proper interface (GUI, tool chain) to the human operator

Why SON coordination is required

- Intra-area (optimization):
 - SON functions realize only parts of the overall optimization and are embedded into the live network
 - SON functions monitor specific KPIs and react autonomously to detected conditions by changing CM parameters
 - Inter-area
 - healing – optimization: suspend optimization during recovery action execution
 - energy saving – healing: avoid false alarms
 - energy saving – optimization: adapt optimization execution
- Avoid *run-time* concurrency issues (effect cancellations, race conditions, deadlocks) and oscillations („feature interaction“ in a distributed system)
- Automatically suspend actions or trigger actions

SON coordination corresponds to human- and machine-level coordination activities in conventional management, e.g.,

- consistency checking at planning time for offline optimization
- suspending new CM plan download in case of a fault incident

Logical relationship of SON functions

Bell Labs Technical Journal 15(3), 5–18 (2010):

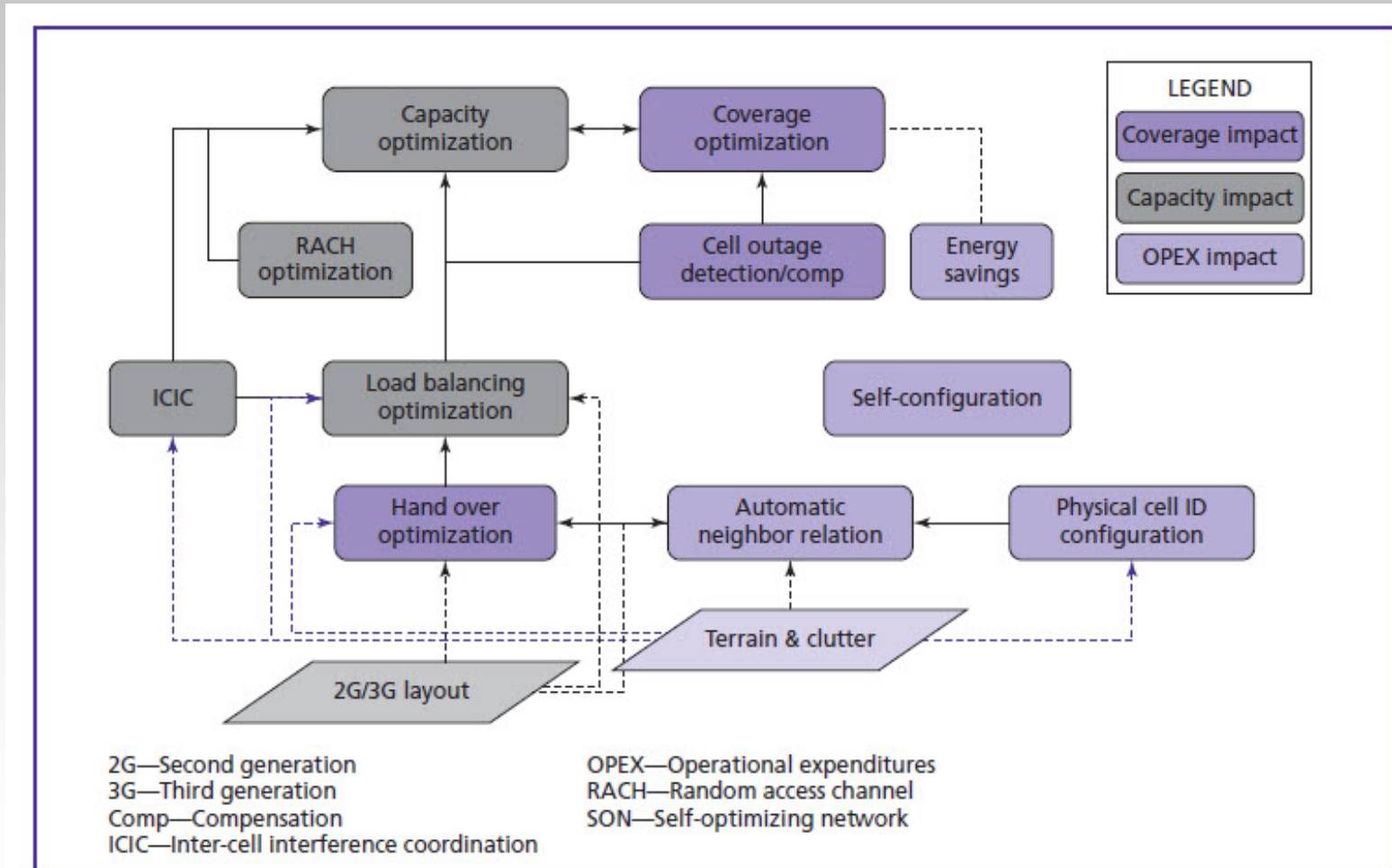
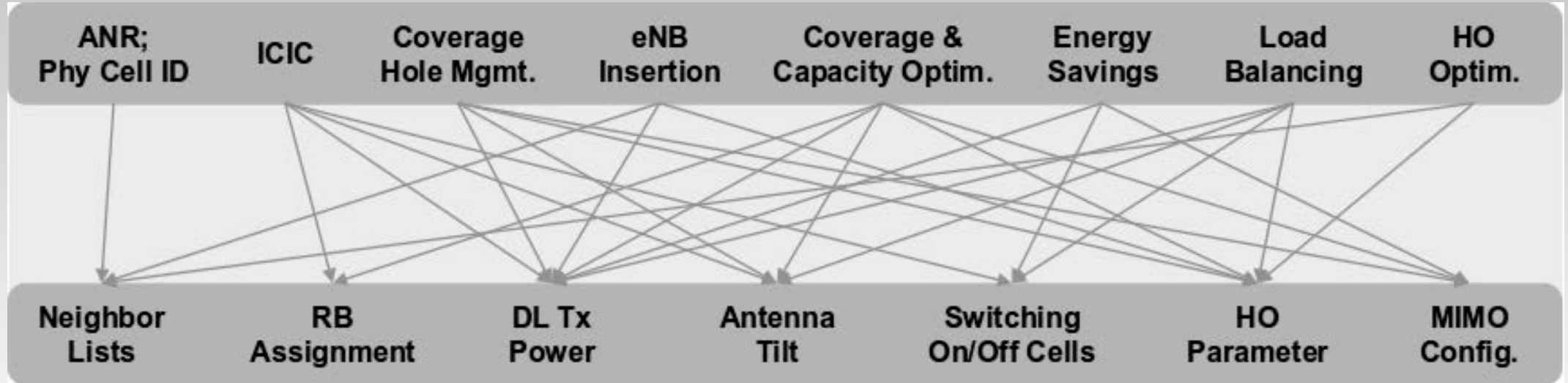


Figure 1.
Various SON use cases shown with their dominant optimization purpose (coverage, capacity, or OPEX reduction).

Parameter relationships of SON functions



Experimental system setup

KPI Viewer

Experimental coordinator GUI

Season

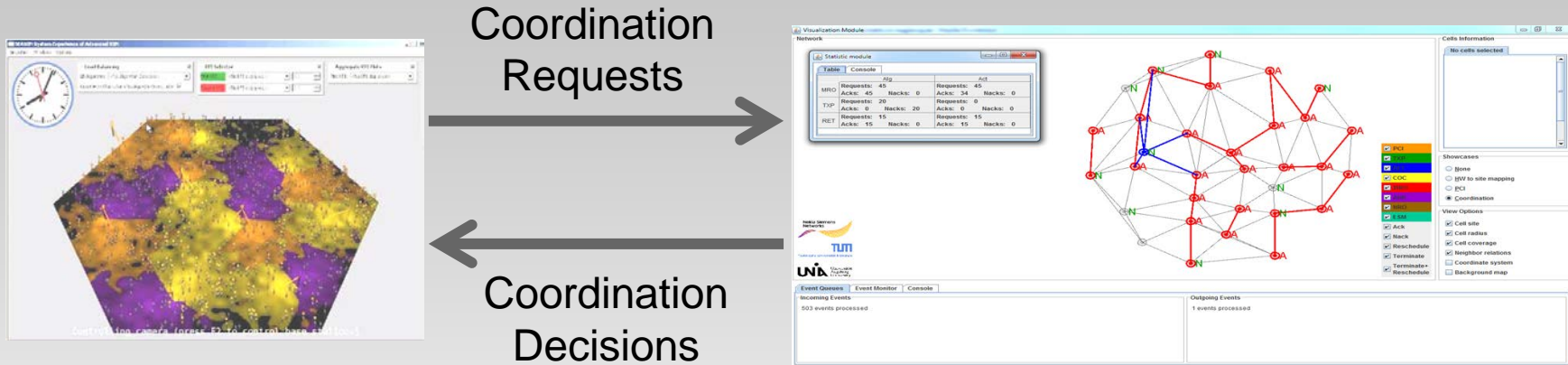
- ✓ LTE radio network simulation
- ✓ Continuous calculation of radio network performance
- ✓ Generation of KPIs for the C-SON functions
- ✓ Stand-alone D-SON function demos

Optimizer Experimental

- ✓ Simulation of centralized LTE SON capabilities: Analyses the received KPIs and provides new network configuration parameters
- ✓ KPIs and network performance improvement with distinctive GUI
- ✓ **SON coordination** and management

→ Radio network simulation, centralized SON optimization functions, SON coordination brought together in one experimental system

Experimental system setup



LTE Network Simulator

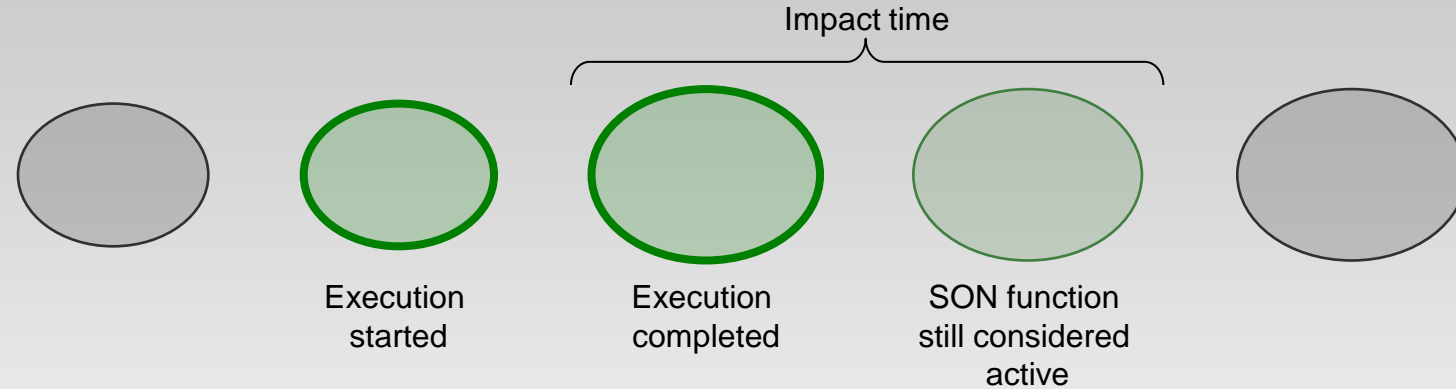
- 32 Cells
- Coverage Hole
- (D-SON functions: MLB, ANR)
- C-SON-functions
 - CCO(RET)
 - CCO(TXP)
 - MRO
- KPIs

SON Coordinator

- Coordination Logic (enforcement of Impact area and Impact time)

Visualization: Experimental coordinator GUI

- “Visualization” module: cell center, neighbourhoods events, human operator interaction
 - Cell coloring shows SON function activity (basic impact time)



- Popups for coordination actions (ack, reject, rollback)
- Workflow monitor: shows ongoing workflow (SON function) executions and their dependencies