Self-Organisation in Future Mobile Communication Networks

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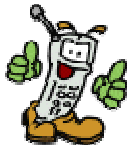
Problem area

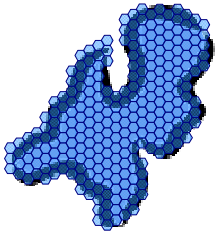
- Mobile access networks are largely *manually* operated
  - Separation of network planning and optimisation
  - (Non-)automated planning tools used to select sites, radio parameters
  - Manual configuration of sites
  - Radio (resource management) parameters updated weekly/monthly
  - Delayed, manual and poor handling of cell/site failures
- Future mobile access networks will exhibit a significant degree of *self-organisation*



  - Minimal human involvement in planning & optimisation
- Broad attention: 3GPP, NGMN, FP7

Motivation

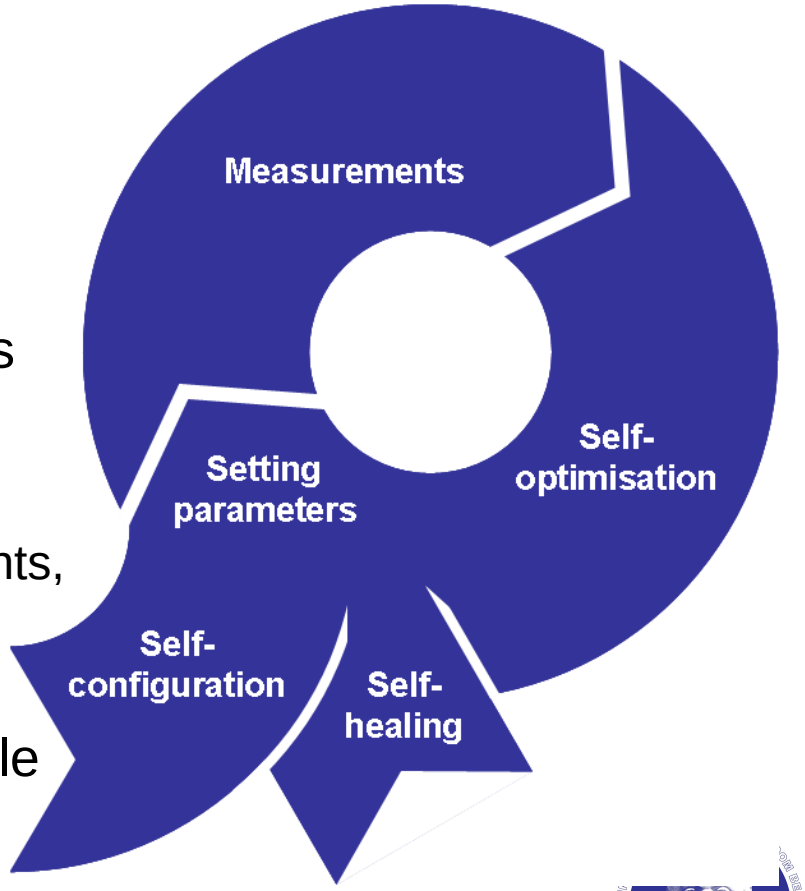
- Key drivers
  - Technogical perspective
    - Complexity of future/contemporary wireless access networks
      - Multitude of tuneable parameters with intricate dependencies
      - Multitude of RRM mechanisms on different time scales
      - Complexity is needed to maximise spectral potential



    - Higher operational frequencies → Increasing #cells
    - Growing suite of services with distinct char'tics, QoS req'ments
    - Heterogeneous access networks to be cooperatively managed
  - Market perspective
    - Increasing demand for / diversity of services
    - Need to reduce time-to-market of innovative services
    - Pressure to remain competitive

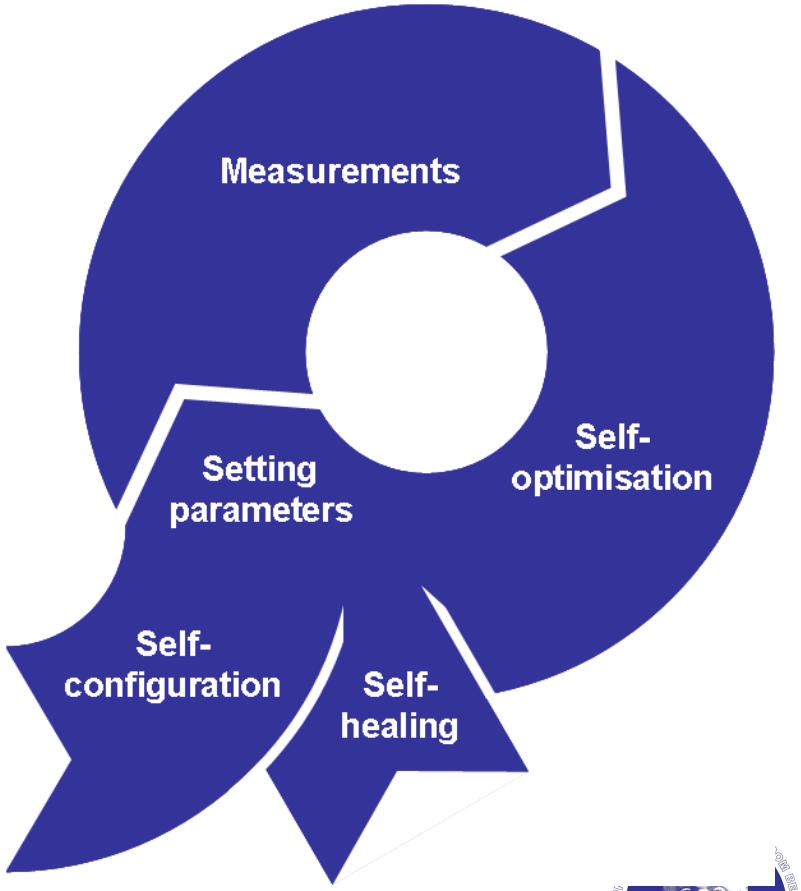
Vision of Self-Organisation

- Self-optimisation
  - Measurements
    - Performance indicators
    - Network, traffic, mobility, propagation conditions
  - Self-optimisation of radio parameters
    - Process measurements into parameter adjustments
      - E.g. tilt, power, scheduling weights, AC thresholds, neighbour lists
    - Triggers/suggestions in case capacity expansion is unavoidable



Vision of Self-Organisation

- Self-configuration
  - ‘Plug and play’ installation of new base stations and features
    - E.g. download of initial radio network parameters, NCL generation, transport network discovery/configuration, …
  - Incidental, intentional events
- Self-healing
  - Cell outage detection
  - Cell outage compensation
    - Automatic minimisation of coverage/capacity loss
  - Incidental, non-intentional



Challenges

- Measurements
  - What data? What frequency? Tuned to urgency?
  - Trade-off: signalling cost *vs* achieved performance
  - Appropriate processing to determine ‘network state’
  - Detection/handling of erroneous/ malicious reports
- Effectiveness of self-organisation
  - Multi-objective optimisation
  - Intricate parameter dependencies
  - Frequency of adjustments
  - Mutual timing $\rightarrow$ prevent oscillations
  - Centralised *vs* distributed control
  - Timely detection, swift response

Challenges

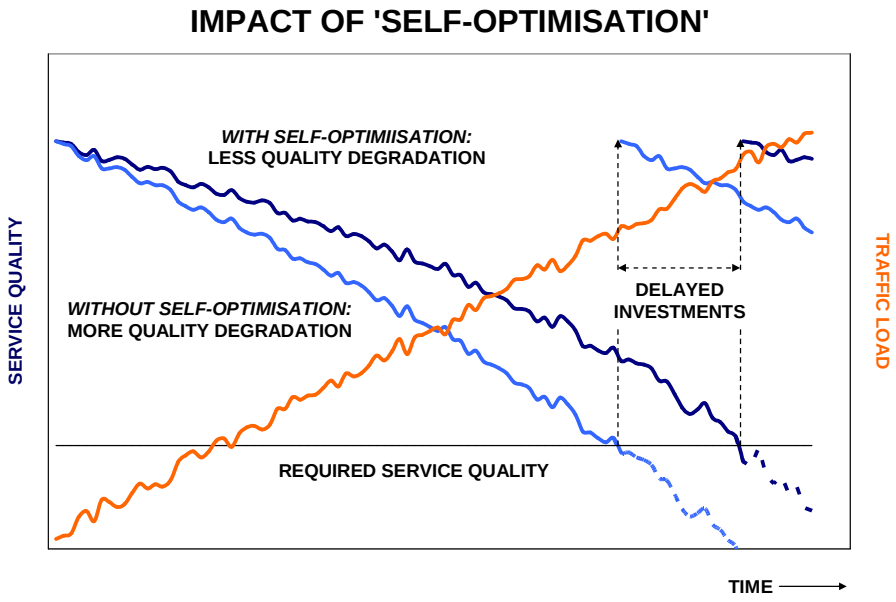
- Dealing with delayed feedback
  - Feedback upon control actions is not immediate
  - Effects of control decisions *or* due to natural variations
- Reliability
  - Actions must be reliable
  - No human sanity checks or revision of actions
  - Operator must trust the system before giving up direct control
    - Gradual introduction
- Shape the network architecture
  - Incorporation in actual systems
  - Protocols, interfaces, architecture

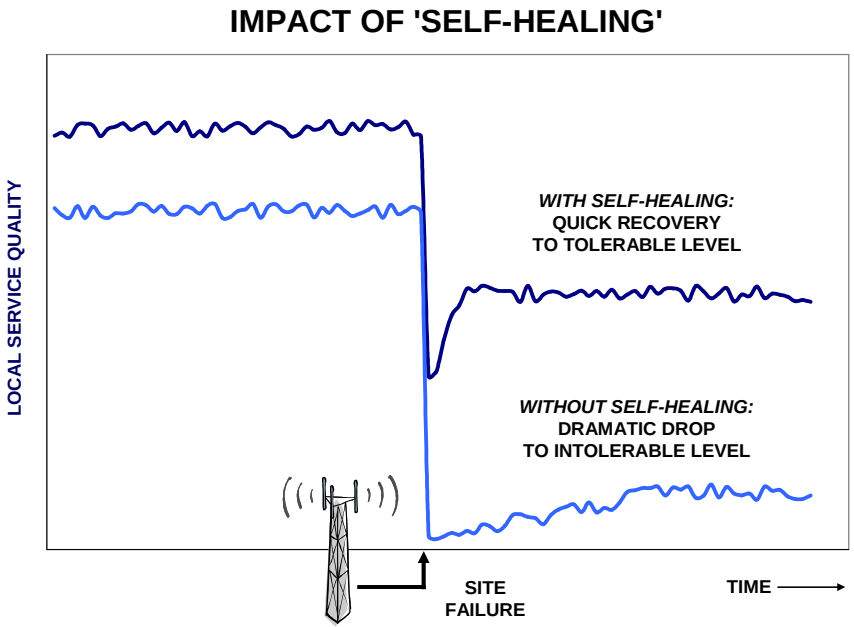
Expected gains

- OPEX reductions …
  - Primary objective!
  - Less human involvement in
    - Network planning/optimisation
    - Performance monitoring, drive testing
    - Troubleshooting
  - About 25% of OPEX is related to network operations
    - For e.g. Vodafone UK, this amounts to about € 1250.000.000

Expected gains

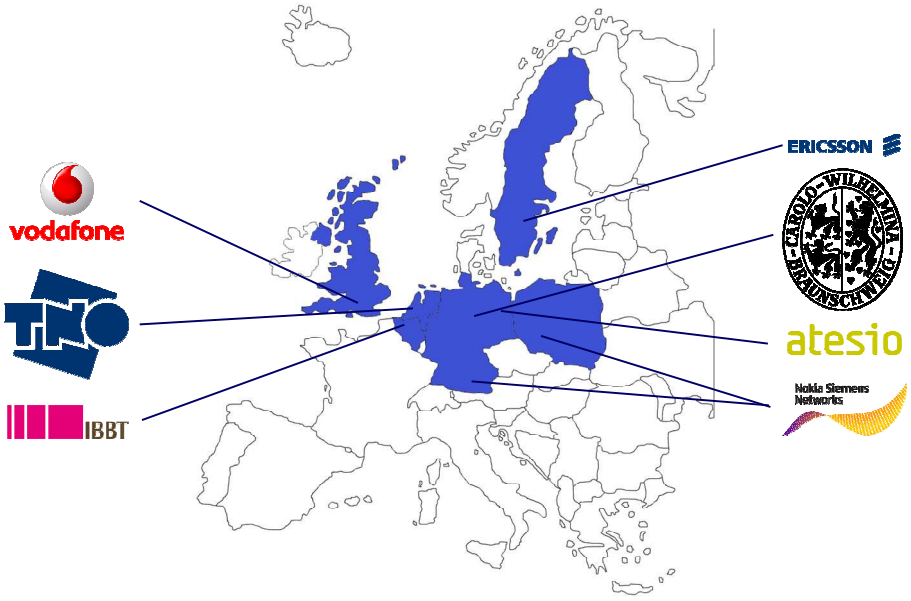
- … and/or CAPEX reductions …
  - Via delayed capacity expansions
  - Smart eNodeBs may however be more expensive
- … and/or performance enhancements
  - Enhanced service availability, service quality





FP7 SOCRATES

- Overview
  - Self-Optimisation and self-ConfiguRATion in wirelEss networkS
  - Technological focus: 3GPP E-UTRAN (LTE)
  - 3-year duration: from 01/01/2008 until 31/12/2010
  - Effort: 378 person months, € 4.980.433
- Consortium



FP7 SOCRATES

- Objectives
  - Development of **novel concepts, methods and algorithms** for the effective self-organisation of wireless access networks
  - **Specification of the required information**, its statistical accuracy and the methods of retrieval incl. the needed interfaces
  - **Validation and demonstration** of the developed concepts and methods for self-organisation through extensive simulation experiments, assessing the established capacity/coverage/quality enhancements, and the attainable O/CAPEX reductions
  - **Assessment of the operational impact** of the developed concepts and methods for self-organisation, w.r.t. the network operations, e.g. radio network planning and capacity management processes
  - **Influence 3GPP standardisation & NGMN activities**

Concluding remarks

- Self-organisation key approach to …
  - … reduce O/CAPEX
  - … cost-effective provisioning of high-quality services
  - … reduce time-to-market of new features, services
- Key components
  - Self-configuration, self-optimisation, self-healing
- Exciting challenges
  - Effectiveness, reliability, stability
  - Measurements, interfaces, protocols, architectures
- Involved parties/projects
  - NGMN, 3GPP, GANDALF, SOCRATES, …

