WIRELESS WORLD
RESEARCH FORUM

Self-configuration, -optimisation and -healing in Wireless Networks

A Vision on the use of self-organisation methods

Dr. Werner Mohr
Nokia Siemens Networks
werner.mohr@nsn.com

April 23, 2008

WWRF 20th Meeting

Outline

- Drivers
- Vision
- Expected Gains
- State-of-the-Art
- Challenges
- The SOCRATES project
- Summary

Drivers

Technical:

- Increasing complexity and size of mobile networks
- Operation of several network generations in parallel
- Paradigm shift from telco specific towards IT networking technologies

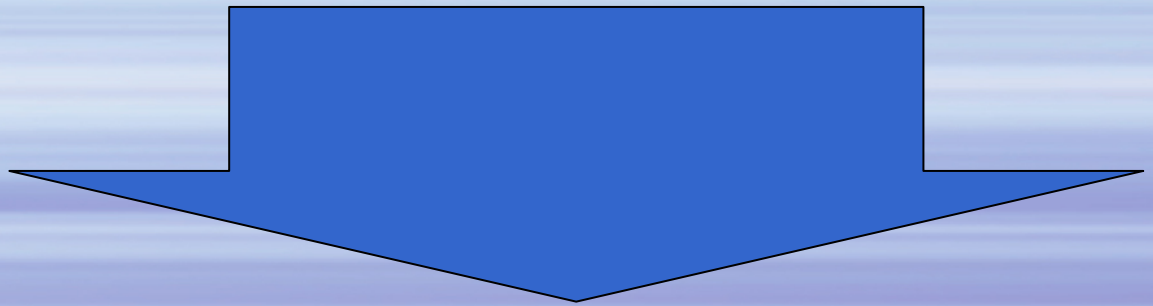
Market:

- Increasing diversity and complexity of offered services
- Reduced time-to-market and lifetime of services
- Enhanced requirements on service quality

High efforts for radio NW planning and optimisation

Vision

Minimise human interaction for planning, configuration and optimisation tasks



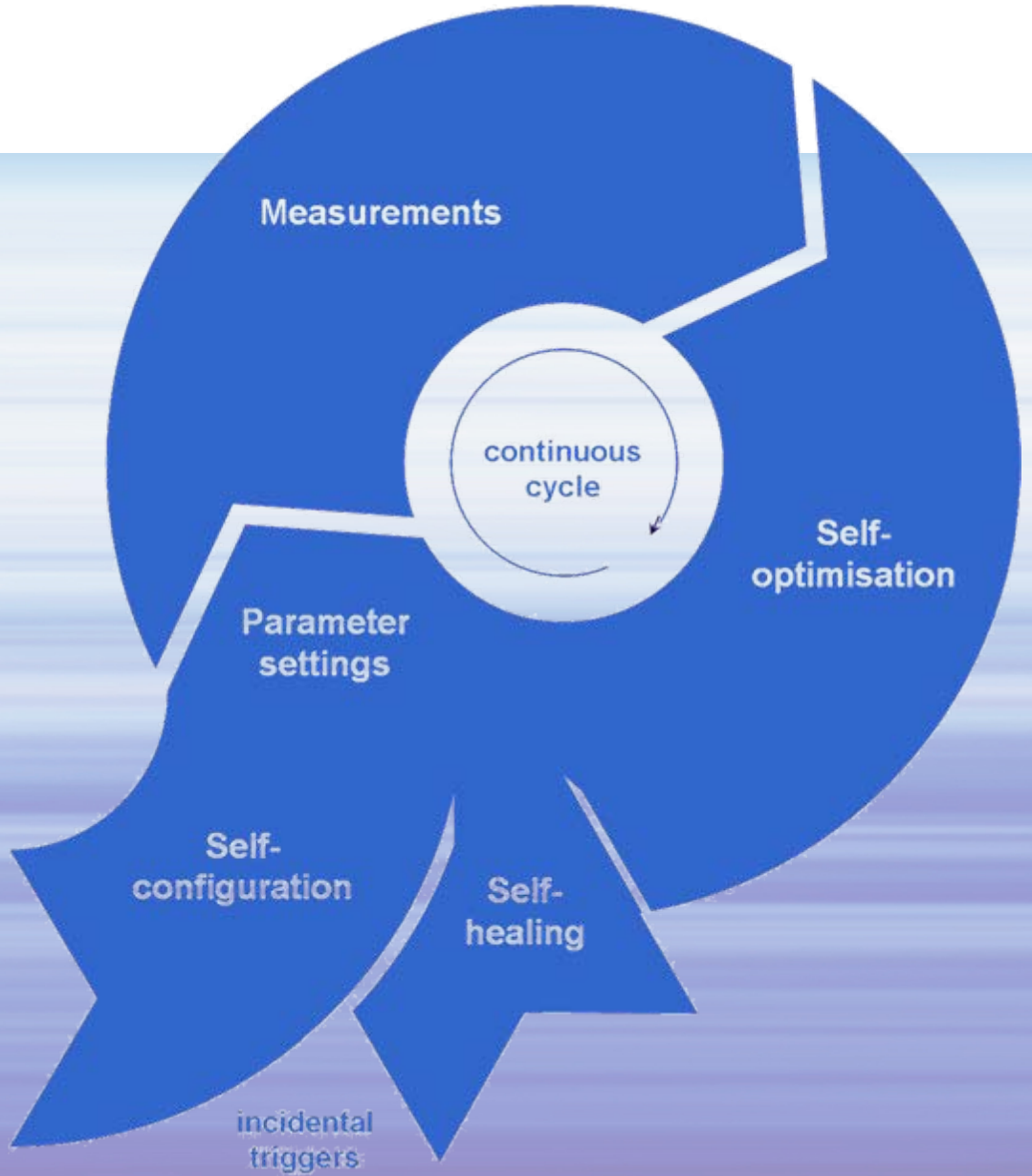
Introduction of Self-organisation methods for Wireless Mobile Networks

Vision (II)

Goal of self-organisation methods:

Involvement of the human operator only for

- feeding the system with policies for the desired system behaviour
- management of failures that cannot be solved automatically (e.g. in case a new site has to be installed, or in case of hardware failures)



Vision (III)

Measurement phase:

- Continuous activity, collection of information from various sources (incl. raw counters from network elements, active probes, mobile terminal measurements etc.) – examples are radio channel characteristics, network element load, user mobility aspects, etc.

Self-optimisation phase:

- From intelligent measurements processing (algorithms), radio and resource management parameters are continuously updated, e.g. antenna parameters, power settings, congestion control, handover control

Vision (IV)

Self-configuration phase:

- Triggered by “incidental events”, such as deployment of new network elements or new services; includes the initial configuration of a set of parameters, e.g. radio or site-specific parameters

Self-healing phase:

- “Automated fault-management”, for example to ensure coverage in case of dropping-out cells, by re-configuration of surrounding cells

Parameter settings phase:

- The newly calculated or updated parameters are updated at the network element – the self-optimisation cycle continues with the measurements phase

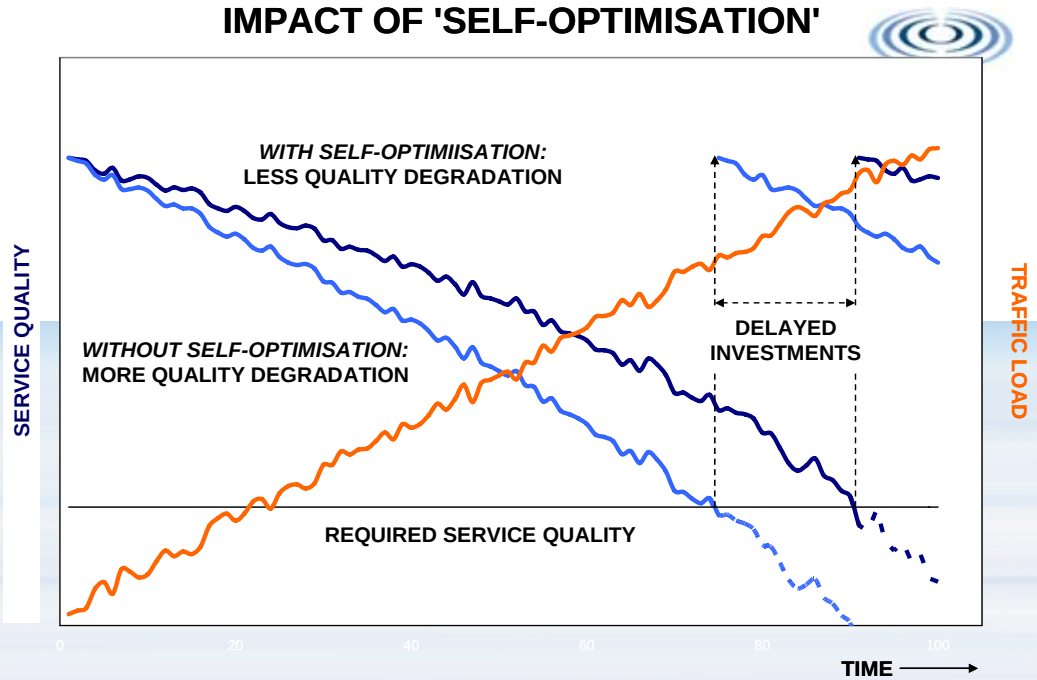
Expected Gains

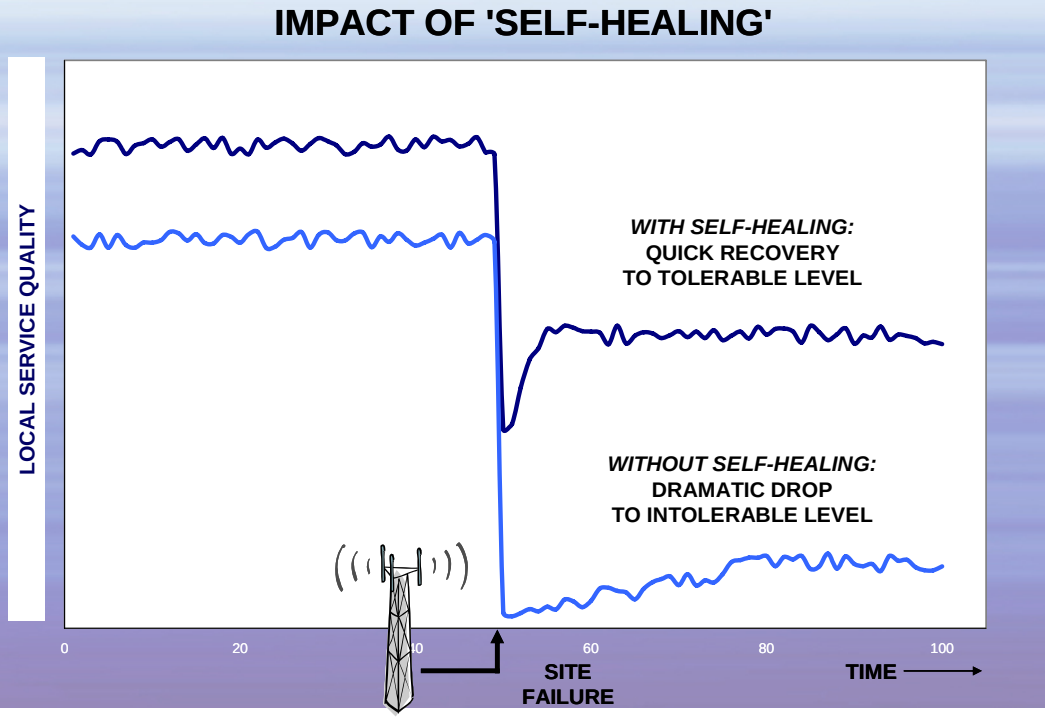
- OPEX reductions
  - Less drive testing necessary
  - Less efforts for network planning, monitoring, optimisation → manual efforts substituted by self-organisation methods
- Performance enhancements
  - Optimal and realtime tuning of radio parameters according to actual traffic and mobility requirements, and propagation conditions
  - Optimal number of sessions at desired service quality level
- CAPEX reductions
  - Due to optimal network utilisation delayed investment in additional capacity

Expected Gains Examples

1. Network investments may be postponed due to optimised utilisation of network resources

2. Self-healing allows quick recovery to a tolerable service level in case of failures





State-of-the-Art

- Optimisation:
  - Tool-based planning, deployment and optimisation
  - High manual interaction, especially for measurements analysis and parameter generation
  - Long-time performance measurements used as input (weeks to months)
  - Only small number of radio parameters used
- Configuration:
  - Manual interaction with OAM system
  - No automated configuration solutions for initial network address, software and data provisioning

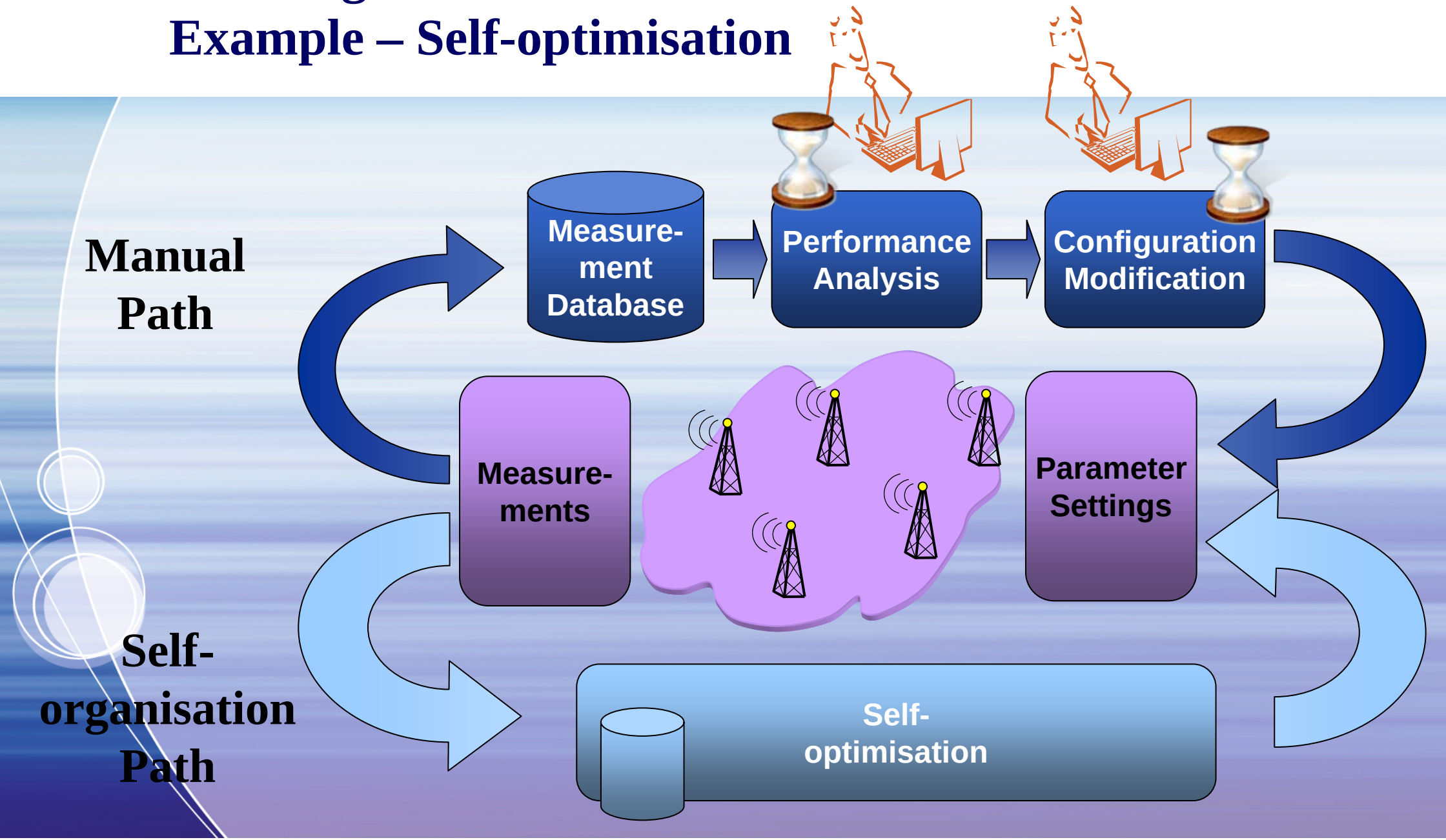
State-of-the-Art

- Healing:
  - High manual interaction required for the analysis and correlation of alarm messates, and the recovery of failures
  - Solutions for the network element internal recovery of failures are available
- Standardisation:
  - Self-configuration and self-optimisation are current topics in 3GPP 3G evolution standardisation
  - The operator-driven NGMN forum collects and promotes operator requirements and recommendations on self-organisation

Challenges

- Development of techniques for measuring and probing also in real time, and corresponding data management
- Design of methods to infer the actual network status from measurements
- Consideration of possible delays before the results of optimisation actions become observable, taking also into account natural variations of the environment
- Optimisation of frequency and size of control steps to gain maximum effectiveness, avoid oscillations in system behaviour and service quality
- Reliability of self-organisation methods, algorithms and quality of models

Challenges
Example – Self-optimisation



The SOCRATES Project

Self-Optimisation and self-ConfiguRATion in wirelESs networks

- STREP project within the EU Framework Programme #7
- Duration Jan. 2008 – Dec. 2010

Goals:

- Development, Evaluation and Demonstration of methods and algorithms for self-configuration, self-optimisation and self-healing
- Improve network coverage, resource utilisation and service quality
- With a focus on 3GPP E-UTRAN, investigation of impact on standardisation, network operations and service provisioning

SOCRATES Phases

Requirements phase:

- Identification of use cases and requirements for self-organisation
- Definition of a self-organisation framework

Development phase:

- Detailed solutions (methods and algorithms) for self-organisation
- Validation of solutions

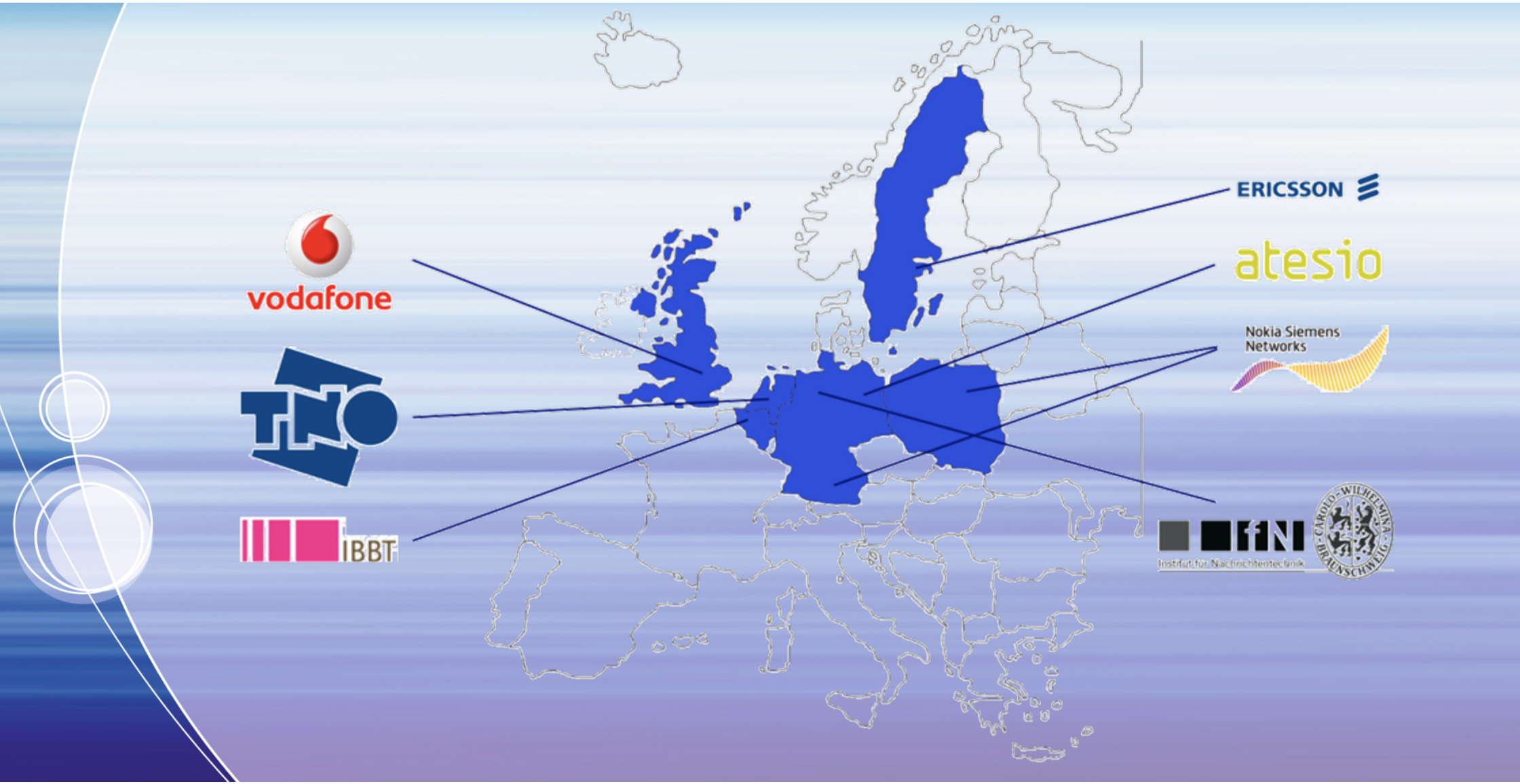
Integration phase:

- Integration of solutions with framework
- Demonstration of benefits and implications of solutions
- Dissemination of solutions (standard contrib., workshops)

SOCRATES – Use Case Examples

- Interference coordination: Minimise the impact of inter-cell interference by managing the resources used in neighbouring cells, to ensure good cell edge performance including QoS requirements of users
- Automatic generation of default parameters: Provide newly installed NEs with a default set of radio network related parameters as basis for site specific configuration / optimisation
- Load balancing: detect cells with load imbalance (cell with high load, but neighbours with low load) and automatically shift traffic between them; to raise network accessibility and retainability
- Cell outage prediction: estimate potential of cell outage through continuous analysis of measurements and automatically initiate compensation actions, and inform operator

SOCRATES Partners



Conclusion

- Self-organisation is a key approach in reducing OPEX and CAPEX of mobile radio networks, and to enable cost-effective support of mobile communication services and applications
- The introduction of self-organisation requires the challenging integration of network planning, performance and configuration management, and fault management methods towards an automated and autonomous system, to enable the reduction of neccessary human interaction in network deployment and operation
- A step-wise approach for the introduction of self-organisation is foreseen, with a detailed study of the impact on network behaviour and service quality before taking the next step

Contact

SOCRATES Project Website: www.fp7-socrates.org

Authors of WWRF contribution:

L.C. SCHMELZ (Nokia Siemens Networks, Munich, Germany)
J.L. VAN DEN BERG, R. LITJENS (TNO ICT, Delft, The Netherlands)
A. EISENBLÄTTER (Atesio, Berlin, Germany)
M. AMIRIJOO, O. LINNELL (Ericsson, Linköping, Sweden)
C. BLONDIA (IBBT, Gent-Ledeberg, Belgium)
T. KÜRNER (TU Braunschweig, Braunschweig, Germany)
N. SCULLY (Vodafone, Newbury, United Kingdom)
J. OSZMIANSKI (Nokia Siemens Networks, Wroclaw, Poland)

Contact:

Dr. Werner Mohr
Nokia Siemens Networks GmbH & Co. KG
80240 München Germany
werner.mohr@nsn.com

Lars Christoph Schmelz
Nokia Siemens Networks GmbH & Co. KG
80240 München Germany
lars.schmelz@nsn.com