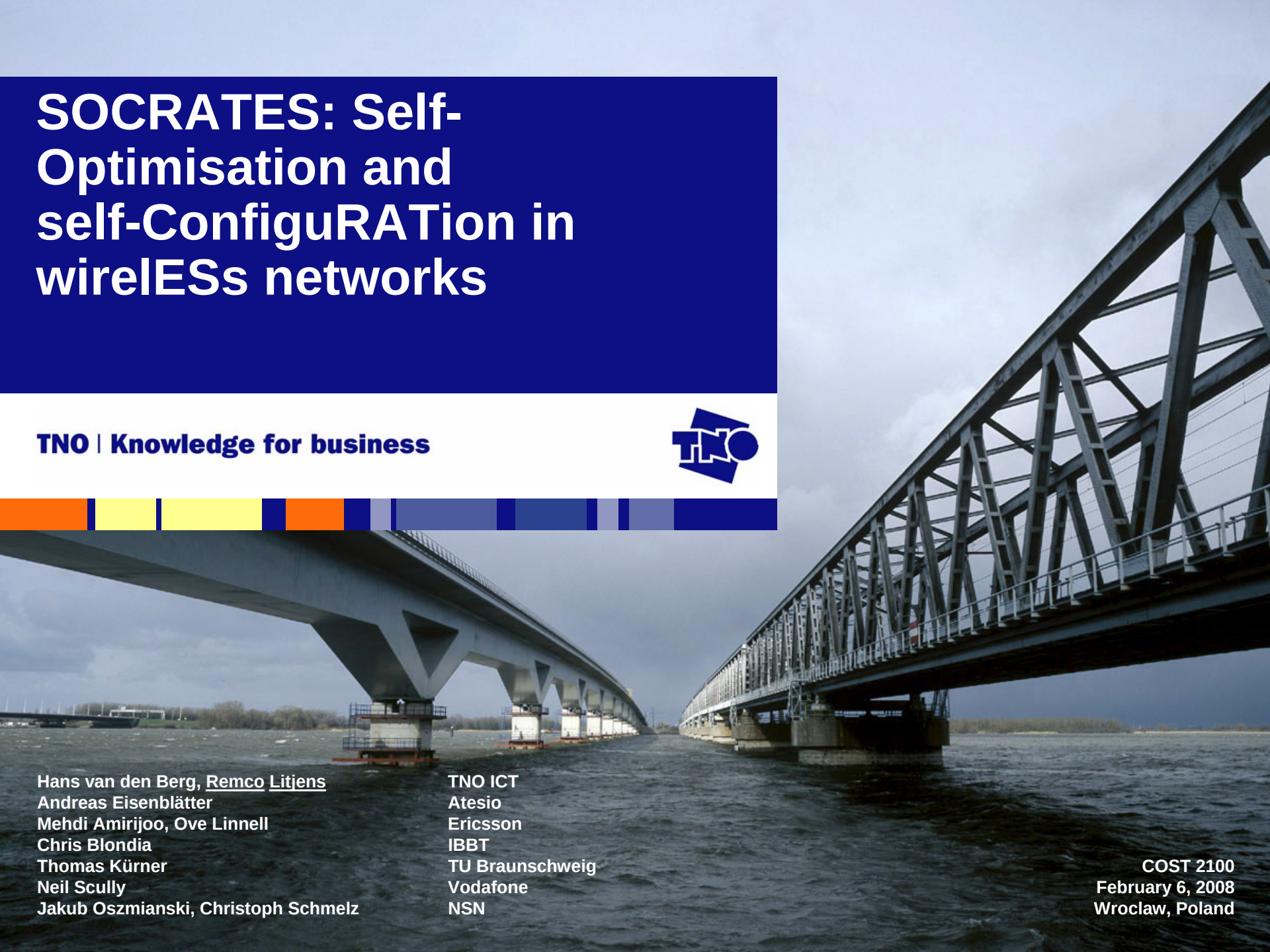
SOCRATES: Self-Optimisation and self-ConfiguRATion in wirelESs networks

TNO | Knowledge for business



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COST 2100
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OUTLINE

- INTRODUCTION
- DRIVERS
- VISION
- EXPECTED GAINS
- CHALLENGES
- SOCRATES
- CONCLUDING REMARKS

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INTRODUCTION

- **Current networks are largely *manually* operated**
  - **Separation of network planning and optimisation**
  - **(Non-)automated planning tools used to select sites, radio parameters**
    - ‘Over-abstraction’ of applied technology models
  - **Manual configuration of sites**
  - **Radio (resource management) parameters updated weekly/monthly**
    - Performance indicators with limited relevance
    - Time-intensive experiments with limited operational scope
  - **Delayed, manual and poor handling of cell/site failures**
- **Future wireless access networks will exhibit a significant degree of self-organisation**
  - **Self-configuration, self-optimisation, self-healing, …**
- **Broad attention**
  - **3GPP, NGMN, SOCRATES, …**

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DRIVERS

- **Technogical perspective**
  - **Complexity of future/contemporary wireless access networks**
    - Multitude of tuneable parameters with intricate dependencies
    - Multitude of radio resource management mechanisms on different time scales
    - Complexity is needed to maximise potential of wireless access networks
  - **Higher operational frequencies**
    - Multitude of cells to be managed
  - **Growing suite of services with distinct char'tics, QoS req'ments**
  - **Heterogeneous access networks to be cooperatively managed**
  - **Common practice in network planning and optimisation**
    → *labour-intensive operations delivering suboptimal solutions!*
- **Enabler**
  - **The multitude and technical capabilities of base stations and terminals to perform, store, process and act upon measurements increases sharply**

DRIVERS

- **Market perspective**
  - **Increasing demand for services**
  - **Increasing diversity of services**
    - Traffic characteristics, QoS requirements
  - **Need to reduce time-to-market of innovative services**
    - Reduce operational hurdles of service introduction
  - **Pressure to remain competitive**
    - Reduce costs (OPEX/CAPEX)
    - Enhance resource efficiency
    - Keep prices low

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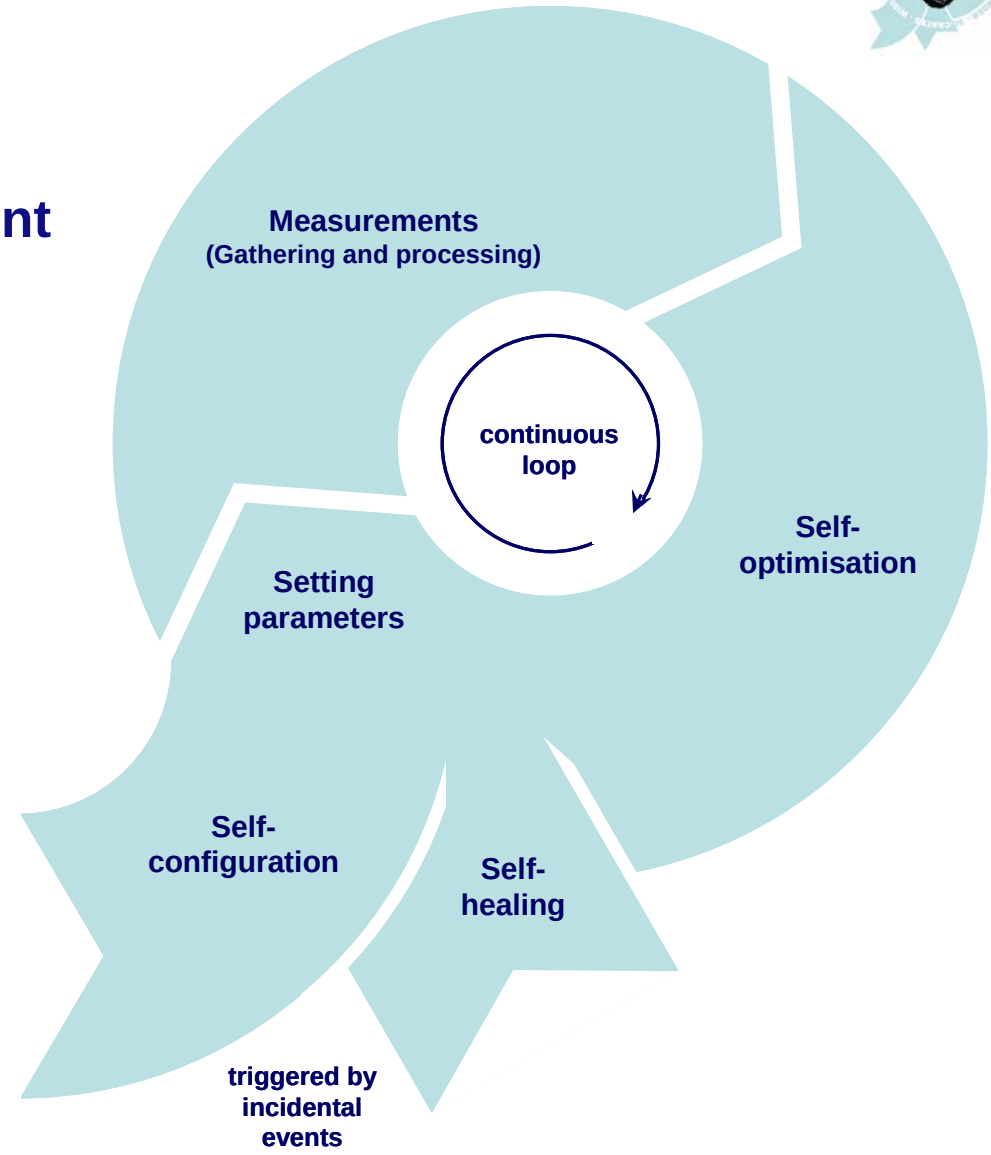
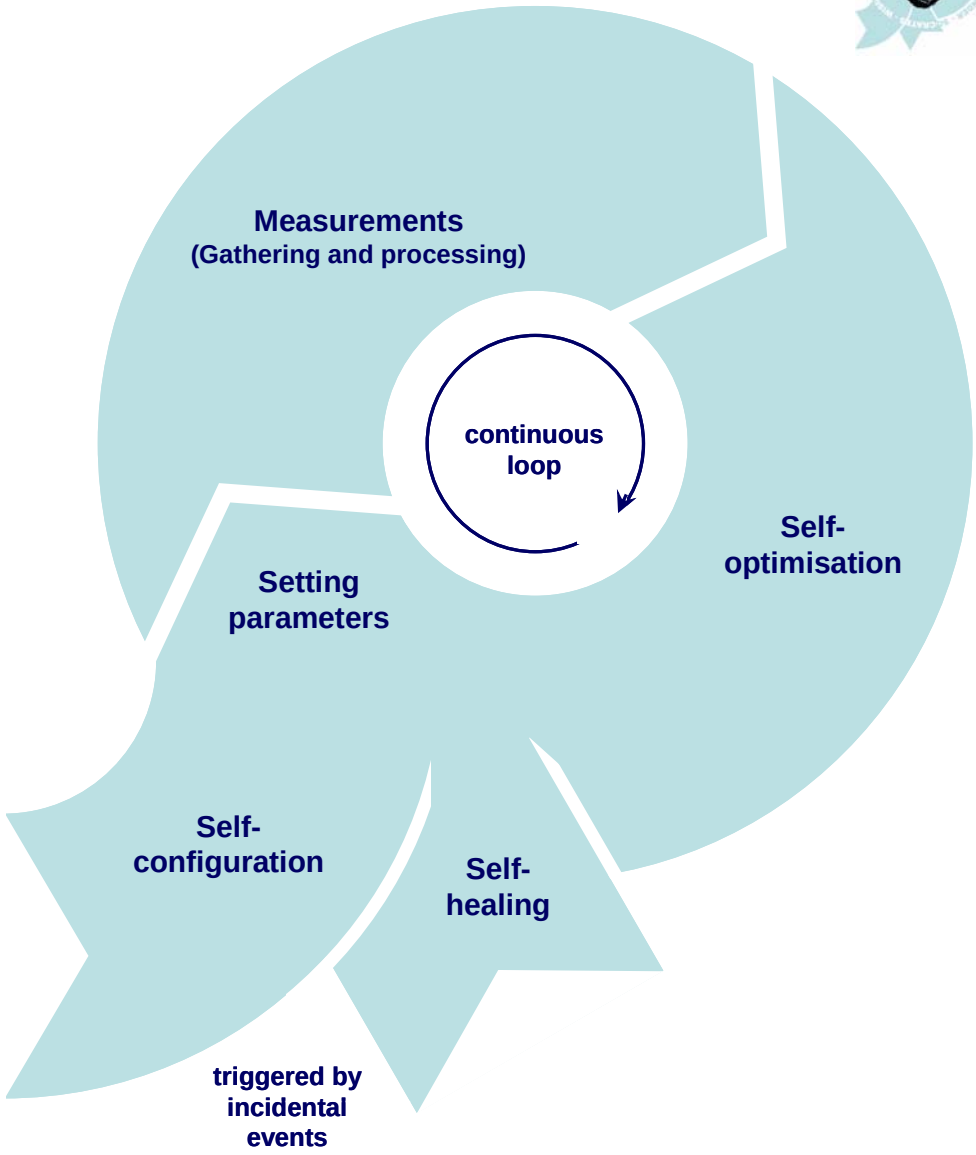
VISION

- Minimise human involvement in planning/optimisation
- Self-configuration
  - ‘Plug and play’
- Cells continuously self-optimise radio parameters
  - In response to changes in network, traffic and environmental conditions
  - Objective is to provide the targeted service levels most efficiently
    - Service availability
    - Service quality
- Self-healing of failures



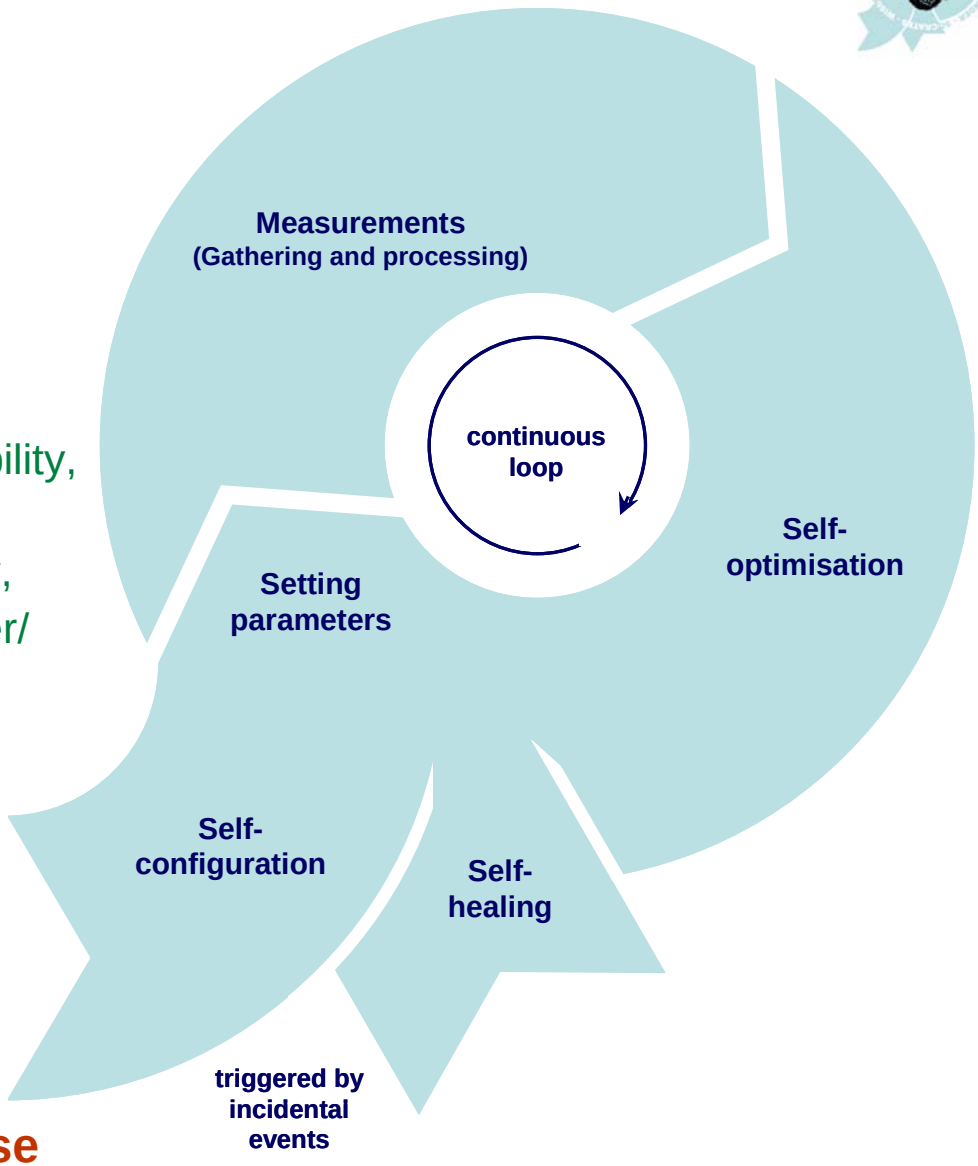
VISION

- **Self-configuration**
  - **Incidental, intentional**
  - **New base stations**
  - **New features**
    - E.g. download of initial radio network parameters, neighbour list generation, transport network discovery and configuration, …
- **Self-healing**
  - **Incidental, non-intentional**
    - Automatic fault detection
    - Automatic minimisation of coverage/capacity loss in case of cell/site failures
    - Alarm bells



VISION

- **Self-optimisation**
  - **Measurements**
    - Gathering via terminals, base stations, probes
    - E.g. propagation, traffic, mobility, performance aspects
    - Optimal periodicity, accuracy, format depends on parameter/ mechanism that is optimised
  - **Self-optimisation**
    - Smart algorithms process measurements into para-meter adjustments
    - E.g. tilt, azimuth, power, RRM thresholds, scheduling weights, neighbour cell lists
  - **Triggers/suggestions in case capacity expansion is unavoidable**



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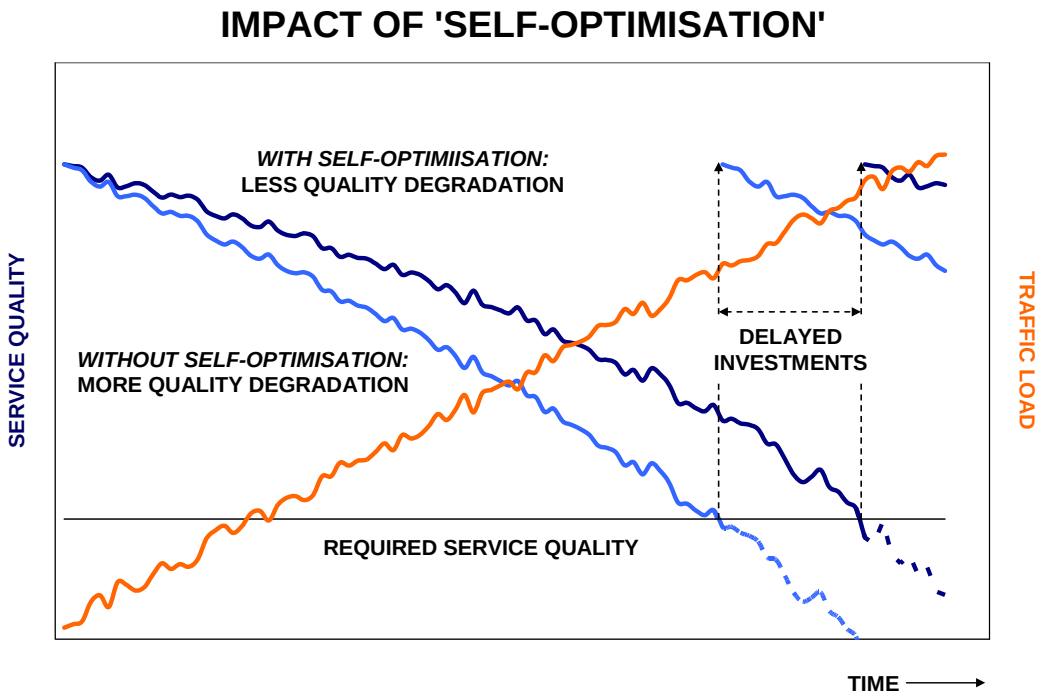
EXPECTED GAINS

- **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



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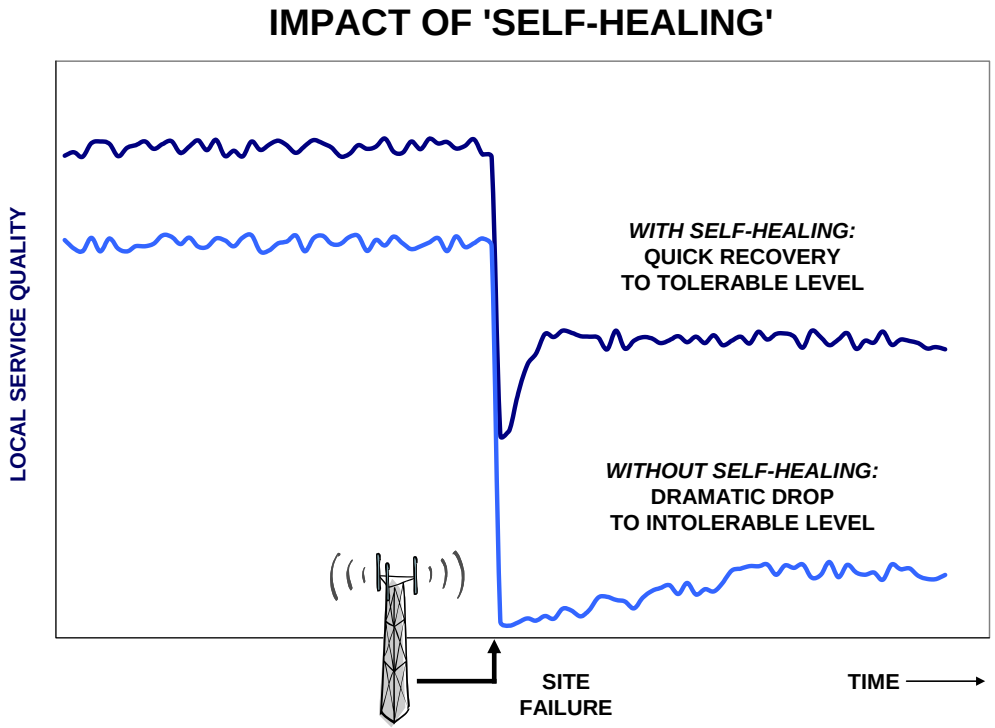

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CHALLENGES

- **Development of effective self-organisation methods imposes quite a few 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 → prevent oscillations
    - Centralised *vs* distributed control
    - Timely detection, swift response

CHALLENGES

- **Development of effective self-organisation methods imposes quite a few 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 when giving up direct control
      - Gradual introduction
  - **Shape the network architecture**
    - Incorporation in actual systems
    - Protocols, interfaces, architecture

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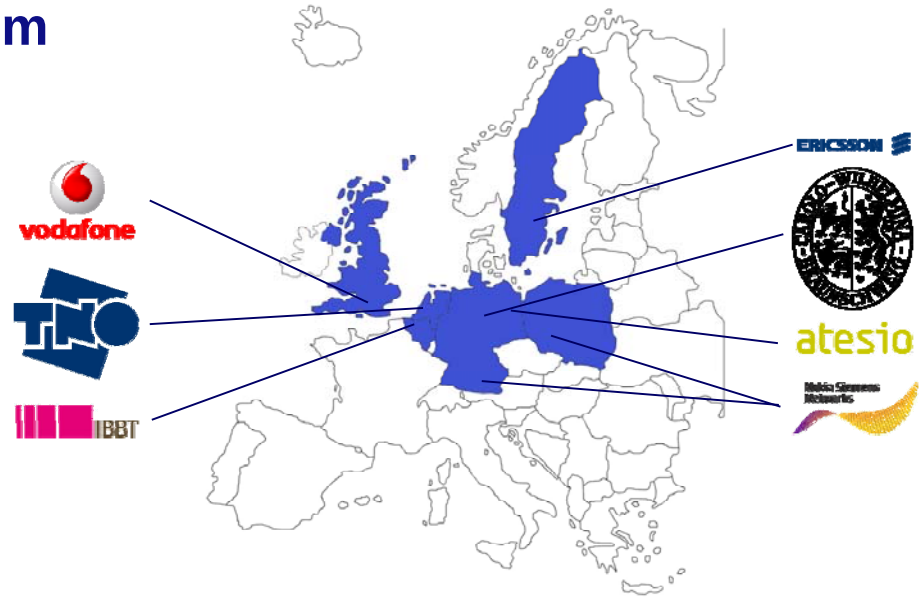
TNO ERICSSON IBBT vodafone Nokia Siemens Networks

SOCRATES

- **Overview**
  - **Self-Optimisation and self-ConfiguRATion in wirelEss networkS**
    - Self-configuration, self-optimisation, self-healing
  - **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**

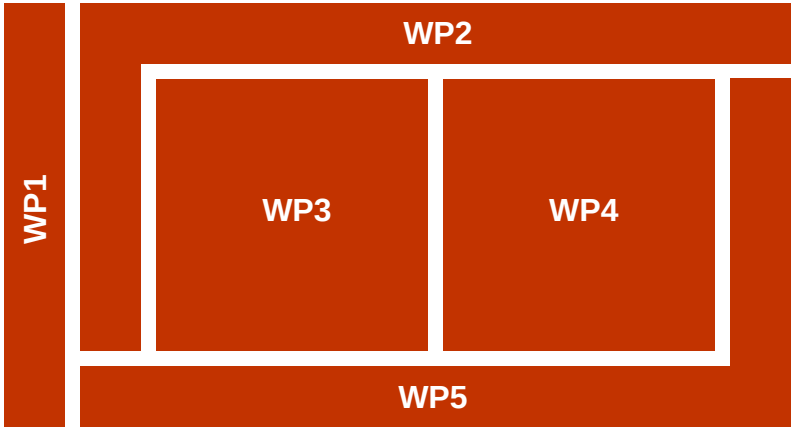


SOCRATES

- **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 protocol 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, with respect to the network operations, e.g. radio network planning and capacity management processes
  - **Influence on 3GPP standardisation and NGMN activities**

SOCRATES

- **Structure**
  - **WP1**
    - Project management
  - **WP2**
    - Use cases
    - Requirements
    - Assessment criteria
  - **WP3**
    - Self-optimisation of stand-alone functionalities
    - Self-optimisation of multiple integrated functionalities
  - **WP4**
    - Self-configuration
    - Self-healing
  - **WP5**
    - Unified framework
    - Dissemination, incl. 3GPP, NGMN, COST 2100, …
    - Impact on network operations, architecture, measurements, interfaces, …



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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, …