



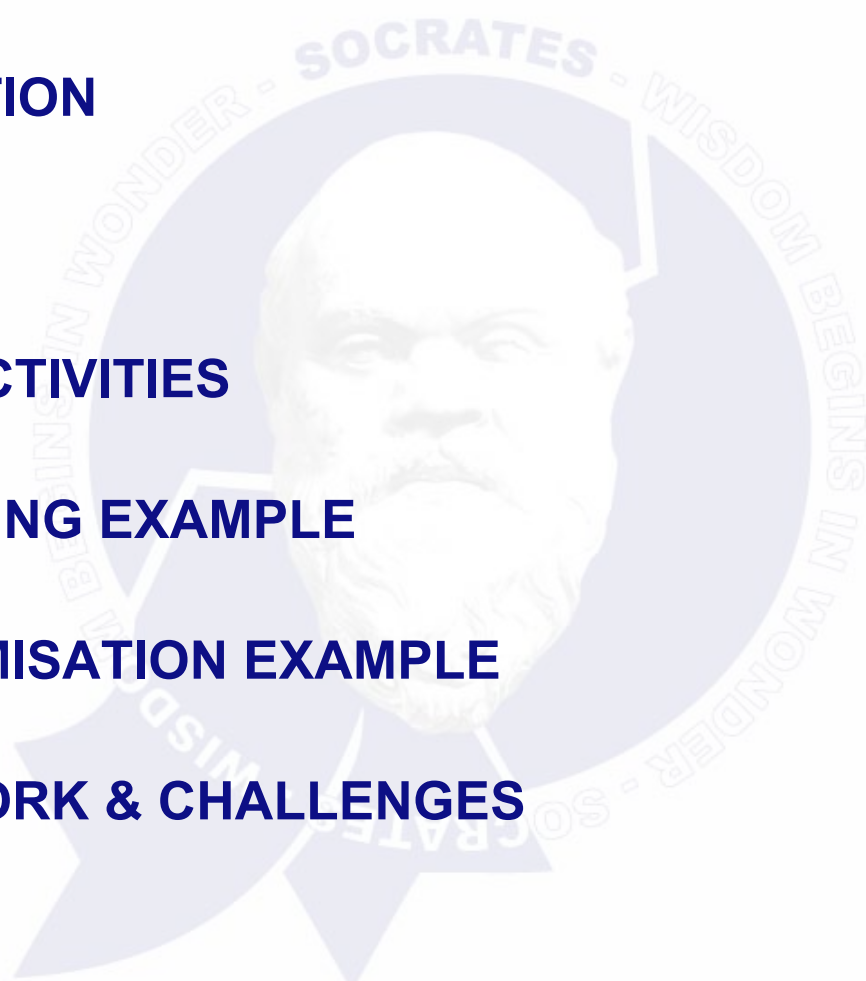
# Self-Optimising and Self-Healing Networks

Ljupco Jorguseski  
TNO Information and Communication Technology  
Delft, The Netherlands

3G Optimisation & UMTS 900  
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Movenpick Hotel, Prague, Czech Republic

# OUTLINE

- INTRODUCTION
- DRIVERS
- VISION & ACTIVITIES
- SELF-HEALING EXAMPLE
- SELF-OPTIMISATION EXAMPLE
- FUTURE WORK & CHALLENGES



# INTRODUCTION

- **Current networks are largely *manually* operated**
  - Separation of network planning and optimisation
  - ‘Optimised parameters’ after excessive off-line manual optimisations, trials, lab-experiments, etc.
  - Delayed, manual and poor handling of cell/site failures
- **Significant degree of self-organisation is expected**
  - Self-configuration, self-optimisation, self-healing
  - Broad attention → NGMN, 3GPP, FP7, ...
- **This presentation focuses on LTE (Release 8/9/10)**
  - Concepts applicable to 2G and 3G

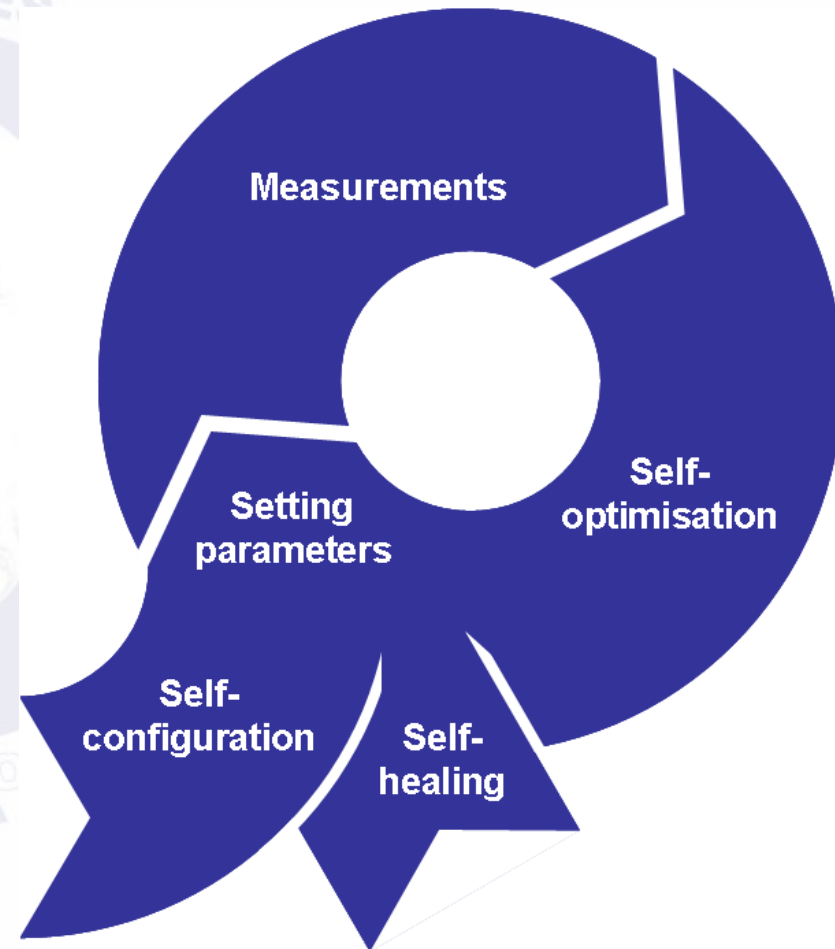


# DRIVERS

- **Technology drivers**
  - Increased optimisation complexity i.e. multitude of tuneable parameters/mechanisms with intricate dependencies
  - Heterogeneous (e.g. 2G, 3G, LTE) networks to be cooperatively managed
  - Base stations and terminals are getting smarter
- **Market drivers**
  - Increasing demand for wireless broadband and diversified services
  - Need to reduce time-to-market of innovative services
  - Pressure to remain competitive e.g. OPEX/CAPEX reduction, enhance resource efficiency, keep prices low, etc.

# VISION

- **Minimise human involvement**
- **Self-configuration**
  - **Plug and play' installation of network nodes, features**
- **Self-healing**
  - **Automatic outage detection and compensation**
- **Self-optimisation**
  - **Continuous self-optimisation of radio parameters**
  - **Triggers/suggestions in case capacity expansion is unavoidable**



## NGMN ACTIVITIES

- **Cooperation among world-leading mobile network operators**
- **Objectives**
  - **Operator requirements and recommendations for future mobile networks**
  - **Performance targets, fundamental recommendations and deployment scenarios**
- **SON Project 12 Output (available from [www.ngmn.org](http://www.ngmn.org))**
  - **NGMN Recommendation on SON and O&M Requirements**
  - **NGMN Use Cases related to Self Organising Network, Overall Description**
  - **NGMN Informative List of SON Use Cases**
- **Follow up SON Project**
  - **Operational Efficiency – Starts March 2009!**

## 3GPP ACTIVITIES (snapshot March 2009)

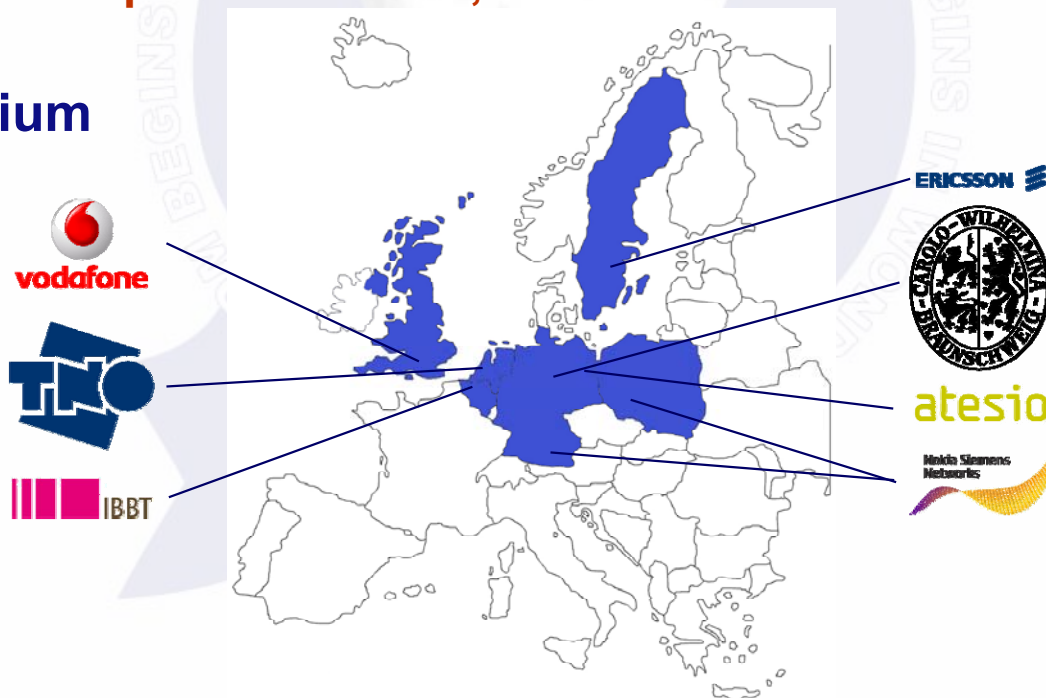
- **E-UTRAN (LTE) standardisation**
  - Radio Access Network (RAN 1, 2, 3, 4, 5)
  - Service and System Aspects (SA 1, 2, 3, 4, 5)
- **Release 8 (March 2009)**
  - Self-establishment of new eNode B, Automatic Neighbour Relations (ANR), Auto-configuration of PCI, interference and load info exchange between neighbour eNodeBs for ICIC and load balancing
  - Recommended reading: TS 32.501, TS 32.521, TR 36.902
- **Release 9 (December 2009)**
  - RAN3 Work Item (WI) on SON for Coverage & Capacity Optimisation, Mobility (Handover) Optimisation, Load Balancing, and RACH Optimisation
- **Release 10 (December 2010)**
  - Wrap-up of previous work
  - Open for new use cases



## FP7 ACTIVITIES (SOCRATES) 1/3

- Self-Optimisation and self-ConfiguRATIon in wirelEss networkS
  - Self-configuration, self-optimisation, self-healing
  - See [www.fp7-socrates.eu](http://www.fp7-socrates.eu)
- STREP with 3-year duration until 31/12/2010
  - Effort: 378 person months, € 4.980.433

- Consortium







## FP7 ACTIVITIES (SOCRATES) 2/3

- **Objectives**

- **Novel concepts, methods and algorithms for self-organisation in LTE.**
- **Assessment of gains in network performance from self-organising features and operational impact**
- **Influence on 3GPP standardisation and NGMN activities**

- **Contacts and cooperation**

- **FP7 → E3, 4WARD, EFIPSANS, EURO-NF, ....**
- **COST 2100**
- **3GPP, NGMN, WWRF**





Come and see us at the joint   workshop\* on

# 'Self-organisation for beyond 3G wireless networks'

at ICT Mobile Summit '09 in Santander, Spain



ICT Mobile Summit 2009  
Call for Papers  
Santander - Spain  
10 - 12 June 2009

**Thematic Priorities**

- Next-Step: Content Convergence
- e-Health
- e-Learning
- e-Work
- e-Transport
- e-Health
- e-Work
- e-Transport

**Sponsorship Opportunities**

- Support Sponsor Identity & Build Relationships with Leading Industry and Research Organisations
- To Develop a Standalone or Customised Package, Contact [marketing@ict-mobilesummit.eu](mailto:marketing@ict-mobilesummit.eu)

**Exhibition**

- Call for Exhibitors will be published in January
- Innovative technology or Application Demonstrations are invited

**Submission of Papers**

- Paper Topics: Research, Technical, Visionary, or Techno-Economic Surveys
- Papers that highlight novel or innovative ideas will be given a special impact
- Project Description and Full Applications
- Project Full Research Analysis of Initial Critical Research Results, including where appropriate, Results of Commercialisation
- All Papers: 27-30 pages in length, Must Use the ICT Mobile Summit Paper Template

**Deadlines**

- Online Submission Deadline: 14 January 2009
- Provisional Acceptance: 27 February 2009
- Submission of Final Papers: 30 March 2009
- Presenter Registration: 6 April 2009

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## FP7 ACTIVITIES (SOCRATES) 3/3

- **Self-Optimisation Use Cases**

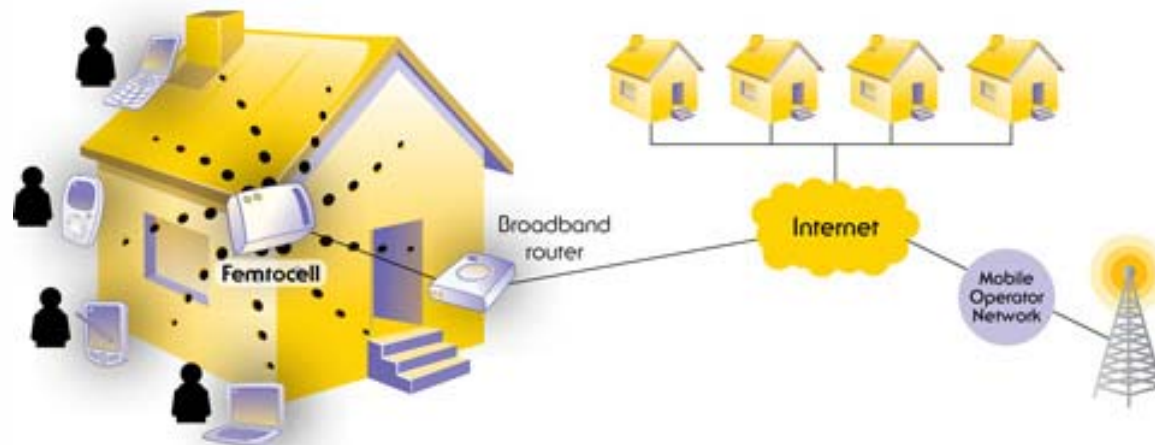
- Home eNodeB 
- Load Balancing
- Interference Coordination
- Packet Scheduling
- Handover
- Admission/Congestion Control

- **Self-Configuration & Healing Use Cases**

- Cell Outage Detection & Compensation 
- Coverage Hole Detection & Compensation
- Management of Relays & Repeaters
- Generation of default NE parameters

# SELF-OPTIMIZATION: Home eNodeB 1/3

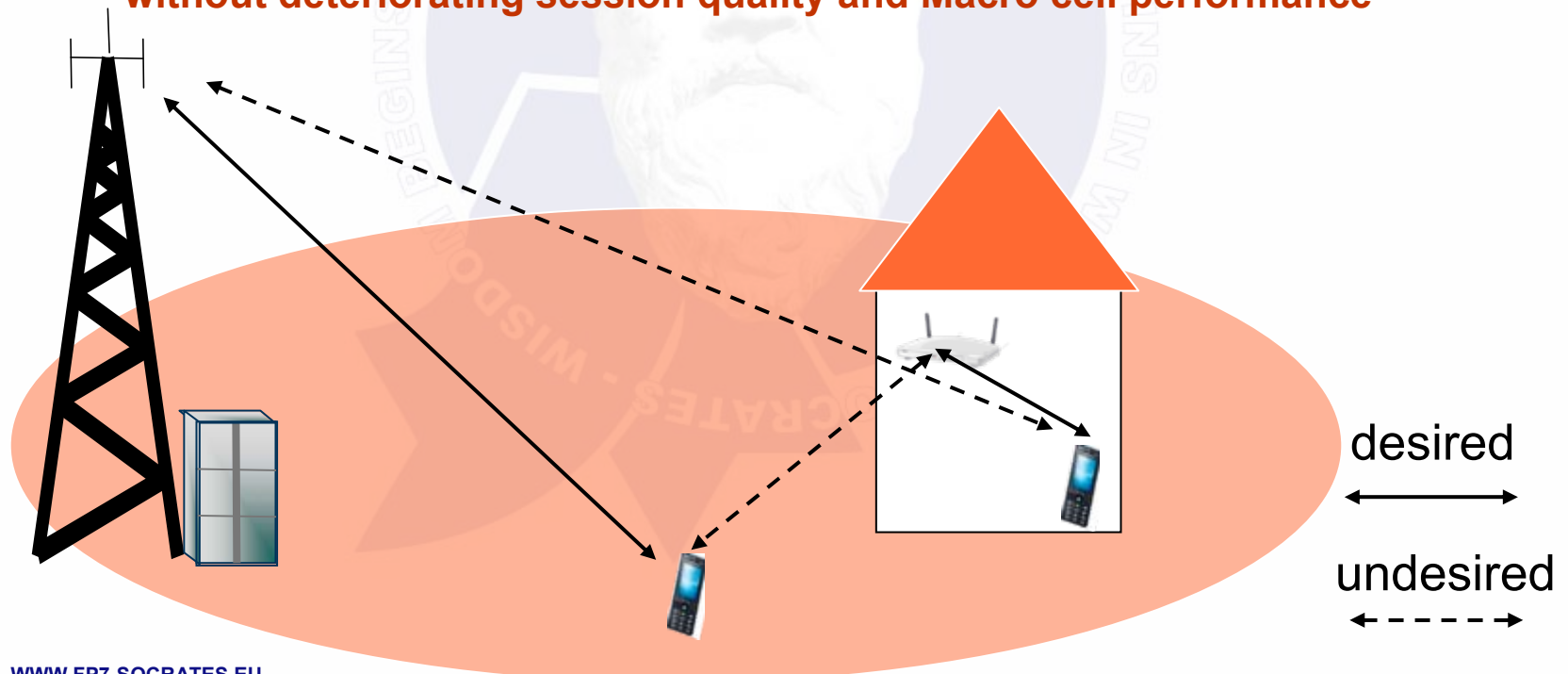
- **SELF-OPTIMIZATION** is a necessity as demanded by the deployment scenario:
  - **Ease of use**
  - **Unknown position indoor and with respect to Macro eNodeB**
  - **Open access versus closed access (CSG)**
  - **Arbitrarily switched ON/OFF**
  - **Etc.**



Source: [www.femtoforum.com](http://www.femtoforum.com)

# SELF-OPTIMIZATION: Home eNodeB 2/3

- **Coverage & Interference optimisation**
  - Superior indoor coverage/quality vs. low negative impact on Macro cell layer performance
- **Handover optimisation**
  - Connect to and remain in HeNB as soon and as long as possible without deteriorating session quality and Macro cell performance



# SELF-OPTIMIZATION: Home eNodeB 3/3

- **Control Parameters**
  - **Interference & Coverage: DL/UL power, Scheduling Parameters, antenna parameters**
  - **Handover: RSRP/RSRQ thresholds, offsets and hysteresis**
- **Assessment Criteria**
  - **Macro layer: blocking, dropping, throughput, coverage, etc.**
  - **Home eNodeB: coverage, throughput, handover success rate towards/from macro, handover ping-pong ratio, etc.**

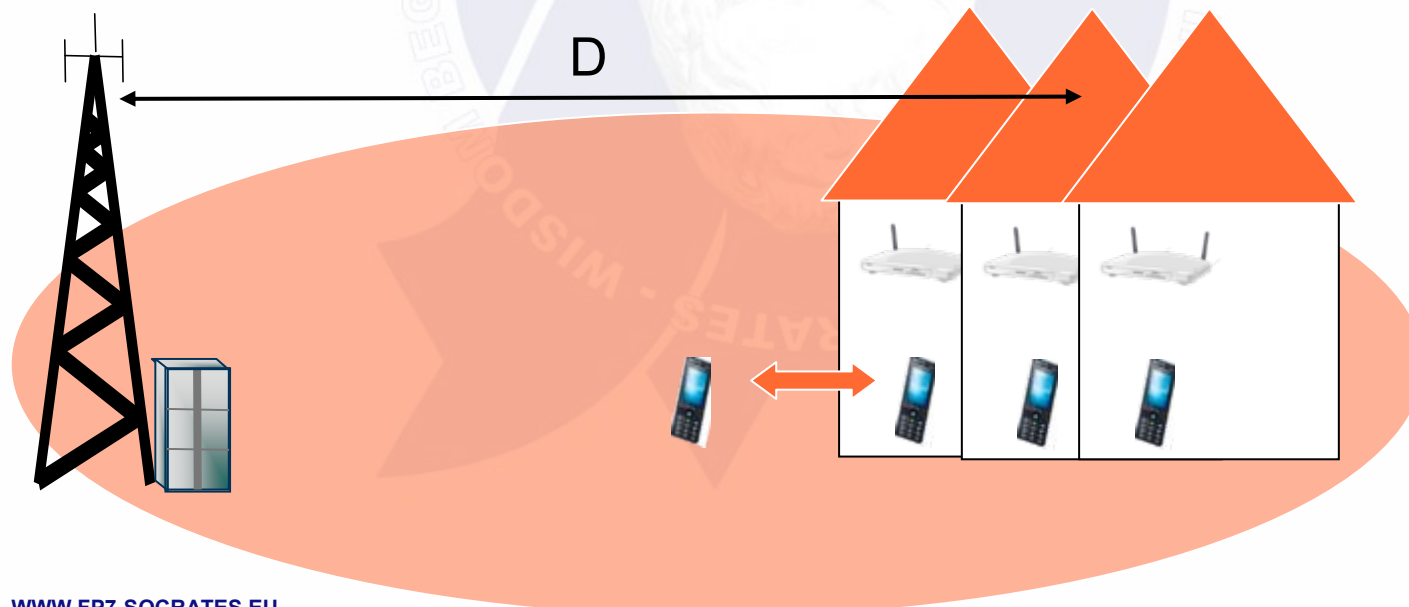


# SELF-OPTIMIZATION: Home eNodeB scenarios

- Different deployment options
  - Distance  $D$ , Home eNodeB density, residential area, office building, etc
- Different spectrum allocation options

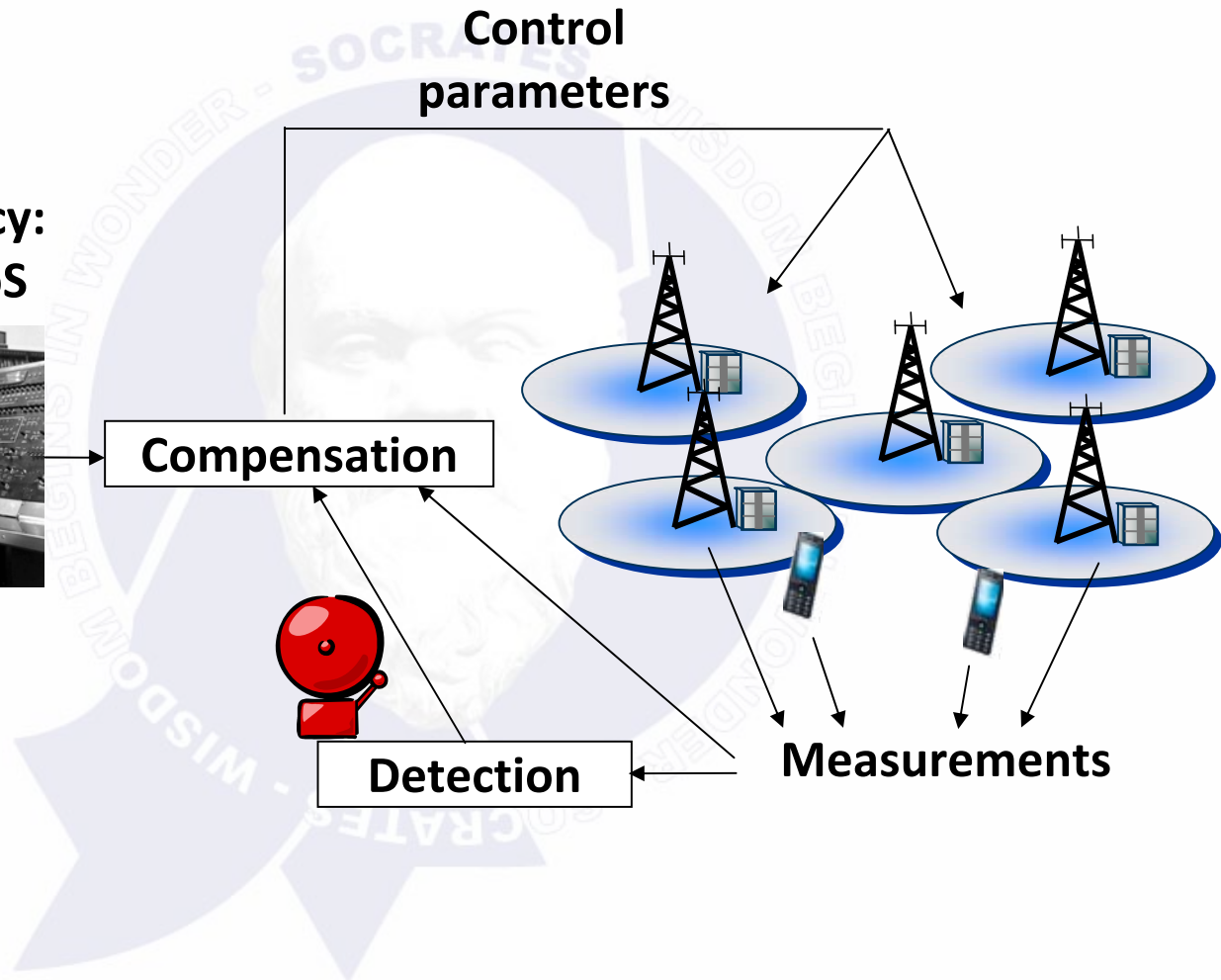


- Different mobility scenarios
  - Indoor to outdoor, outdoor to indoor, open access users passing by, etc.



# SELF-HEALING: Cell Outage Management 1/2

Operator policy:  
Coverage, QoS





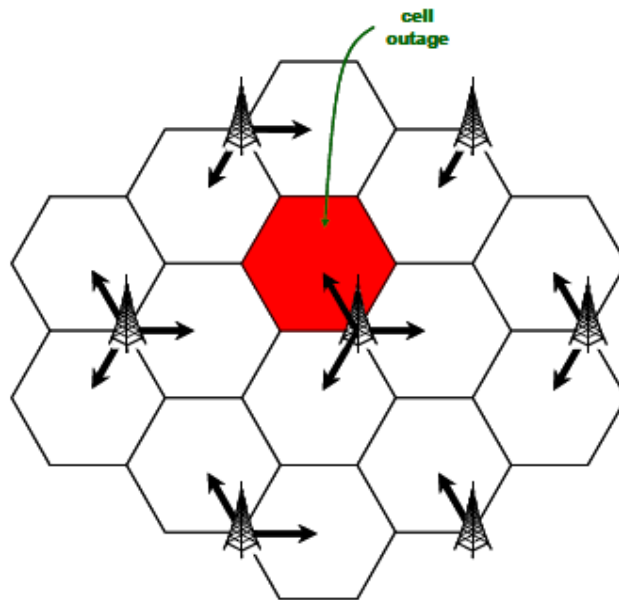
# SELF-HEALING: Cell Outage Management 2/2

- **Control Parameters (Coverage & Capacity trade-off)**
  - **Power settings, antenna settings (tilt, azimuth, beam-steering), Home eNodeB (FFS)**
- **Assessment Criteria**
  - **Blocking, dropping, throughput, coverage, convergence time, etc**

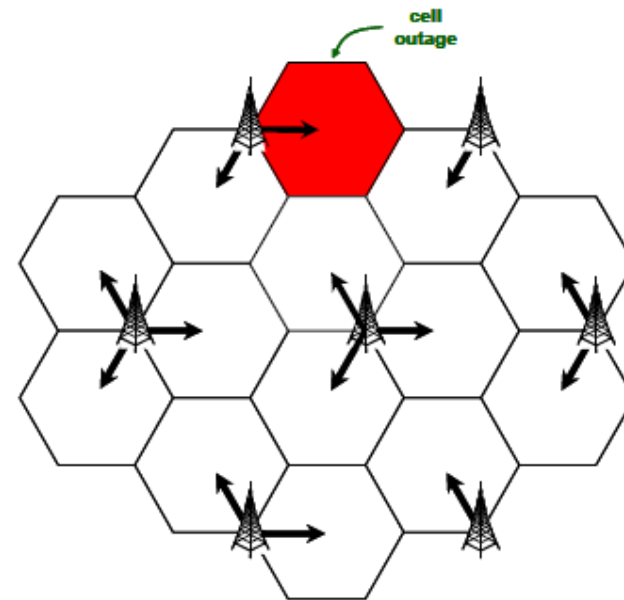


# SELF-HEALING: Cell outage compensation scenarios

- Different deployment options
  - Inter-site distance, cell outage location, UE power class
- Different traffic options
  - Traffic level, type, spatial distribution



CELL OUTAGE AT ISLAND'S CORE



CELL OUTAGE AT ISLAND'S EDGE

# FUTURE WORK & CHALLENGES

## • Future Work

- Simulators ready (Q2 2009)
- Algorithm design and evaluations (Q4 2009)
- Final algorithm recommendations (begin 2010)
- Integration of SON use cases (throughout 2010)
- Publications, reports and input to NGMN/3GPP (throughout 2009/2010)

## • Challenges

- **Input/Measurements (interaction with 3GPP):**
  - what can we measure, how often can we measure, robustness to input inaccuracy, delayed feedback (impact from parameter adjustments), network 'state', etc.
- **Self-optimisation design (interaction with NGMN, FP7):**
  - multi-objective optimisation, conflict resolution, mapping of operator's policies, trusted operation (robustness, stability, gradual automation), etc.
- **Architecture design (interaction with 3GPP):**
  - new/updated interfaces and protocols, centralized vs distributed SON functionality, etc.