

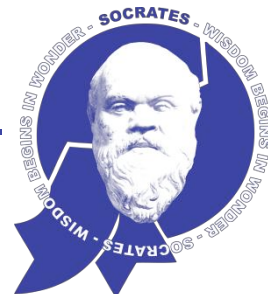
# Embedding Multiple Self-Organisation Functionalities in Future Radio Access Networks

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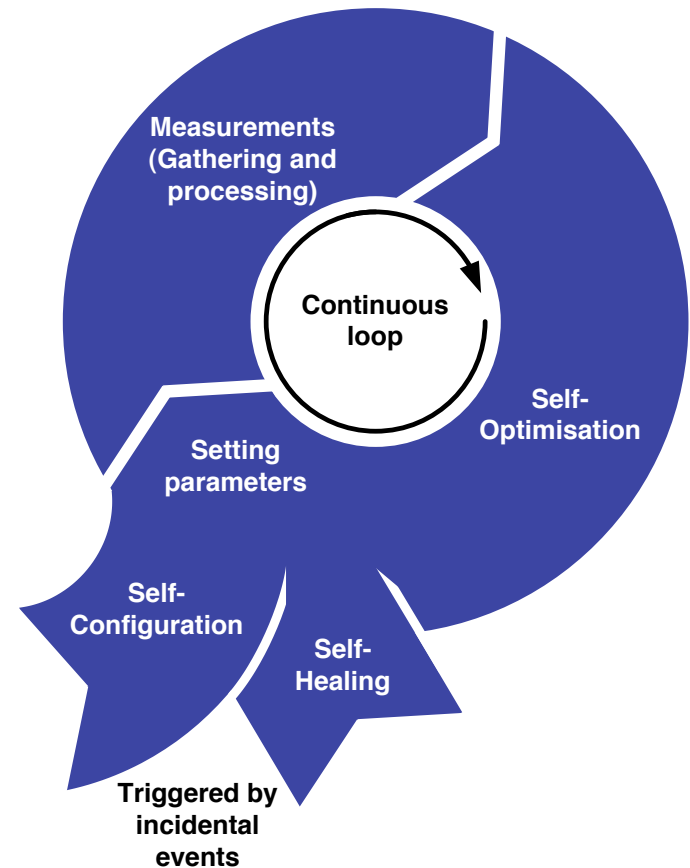


1. Introduction
2. Dependencies between control parameters
3. Interactions between SON functionalities
4. SON Control and Coordination



# Objectives of the SOCRATES-Project

- Increase the network performance
  - Quality of service, System capacity, Throughput, ...
- Reduce the effort of human intervention
  - Automate optimisation processes
  - Fast adaptation to network conditions
- Reduce operating costs
  - Energy consumption
  - Operational expenditure (OPEX)
- Continuously collecting measurements
  - UE measurements
  - Cell measurements
  - Information exchange between eNodeB's

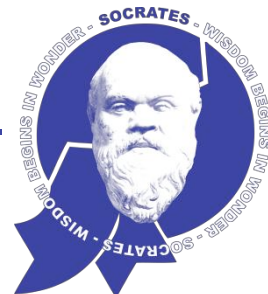


# SON functionalities considered for LTE

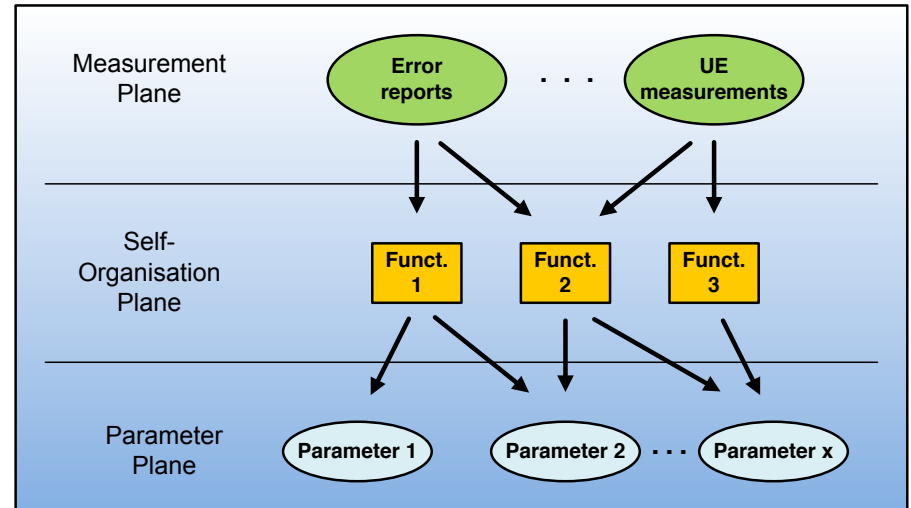
- SOCRATES investigated 24 use cases
    - Use cases address situations where self-organisation may be of benefit
    - Divided into 3 categories [1]
  - **Self-Optimisation**
    - Interference coordination
    - Handover optimisation
    - SO of home eNodeB
    - ...
  - **Self-Configuration**
    - Automatic generation of default parameters
    - Intelligently selecting site locations
    - ...
  - **Self-Healing**
    - Cell outage detection
    - Cell outage compensation
    - Coverage hole management
    - ...
- 
- SON algorithms will be developed in every use case group

 Multiple SON functionalities will be active at the same time

[1] Reference: TD (08)616, “**Use Cases, Requirements and Assessment Criteria for Future Self-Organising Radio Access Networks**”, COST2100, Lille, France, October 2008

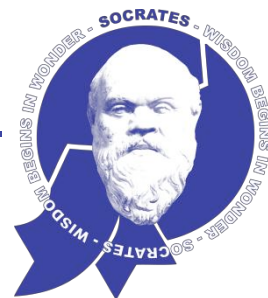


- SON functionalities
  - Alter some parameter settings
  - Interact with other SON functionalities
- Problems
  - Different SON functionalities alter the same parameter settings
    - for the same reason
    - for different reasons
  - Overall performance depends on multiple SON functionalities



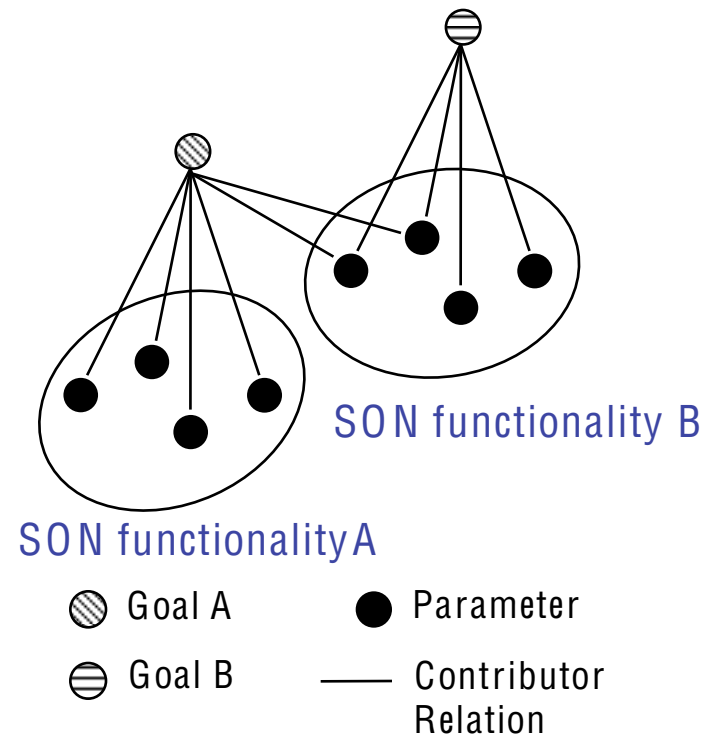
It is necessary to analyse the interaction of the SON functionalities based on the **control parameters** and **interaction with other use cases** that follow the same purpose to identify the functionalities that need to be **coordinated** and **simulated together**

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# Definitions used for parameter grouping

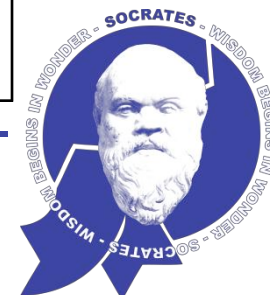
- Definition of a *Goal*
  - Example: minimise inter-cell interference, maximise capacity
- Definition of *Parameter*
  - Example: transmission power, antenna parameters
- A parameter affects one or several goals through a *Contributor* relation
- Goals and controlled parameters defined for all use cases
- Objective: Determine the parameters that need to be coordinated





# Identifying the parameters

Goal	Parameter(s)
Minimise interference	<ul style="list-style-type: none"> <li>• Transmit power</li> <li>• RB assignment</li> <li>• Adjust beam forming parameters</li> <li>• CQI thresholds for schemes switching</li> </ul>
Maximise/Optimise coverage	<ul style="list-style-type: none"> <li>• Transmit power</li> <li>• Antenna parameters</li> </ul>
Balance load	<ul style="list-style-type: none"> <li>• Transmit power</li> <li>• Antenna parameters</li> <li>• HO parameters</li> <li>• Cell reselection parameters</li> </ul>
Minimise energy consumption	<ul style="list-style-type: none"> <li>• Transmit power</li> <li>• Antenna parameters</li> <li>• Number of used Tx antennas</li> </ul>
Maximise cell capacity	<ul style="list-style-type: none"> <li>• Transmit power</li> <li>• Admission control threshold</li> <li>• Congestion detection and resolution parameters</li> <li>• Scheduler parameters</li> <li>• Link level retransmission scheme parameters</li> <li>• Tracking area parameters</li> <li>• Switching point configuration</li> <li>• CQI thresholds for schemes switching</li> </ul>

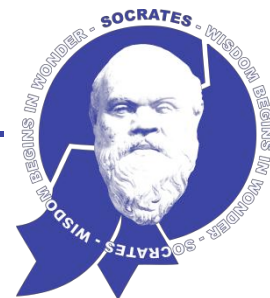


# Forming the parameter groups

Parameter Group	Goal(s)	Parameter(s)
A	<ul style="list-style-type: none"> <li>• Minimise interference</li> <li>• Balance load</li> <li>• Minimise energy consumption</li> <li>• Maximise cell capacity</li> <li>• Maximise/optimize network coverage</li> <li>• Maximise HO performance</li> </ul>	<ul style="list-style-type: none"> <li>• Transmit Power</li> <li>• Antenna parameters</li> <li>• RB assignment</li> <li>• HO parameters</li> <li>• Admission control threshold</li> <li>• Congestion detection and resolution parameters</li> <li>• Scheduler parameters</li> <li>• Link level retransmission scheme parameters</li> <li>• Cell reselection parameters</li> <li>• Number of used Tx antennas</li> <li>• Switching point configuration</li> <li>• Adjust beam forming parameters</li> <li>• CQI thresholds for schemes switching</li> <li>• Tracking area parameters</li> </ul>
B	<ul style="list-style-type: none"> <li>• Minimise error rate</li> </ul>	<ul style="list-style-type: none"> <li>• Channel power control parameters</li> </ul>
C	<ul style="list-style-type: none"> <li>• Maximise access probability</li> </ul>	<ul style="list-style-type: none"> <li>• RACH configuration</li> </ul>



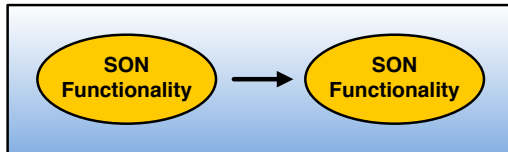
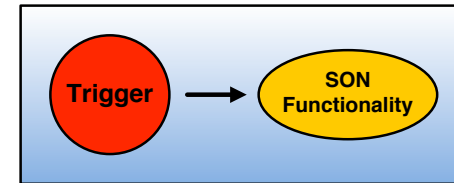
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# Definitions used to determine the interaction of SON functionalities

- **Trigger**

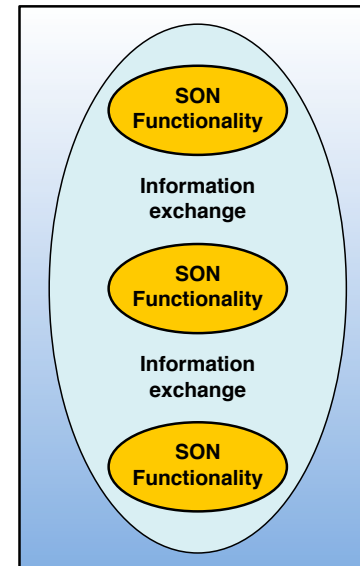
- A trigger initiates a SON functionality



- SON functionalities **trigger** each other
  - One SON functionality finished the optimisation and triggers another one

- **Co-Operate**

- Several SON functionalities are activated at the same time to counteract the same system performance degradation

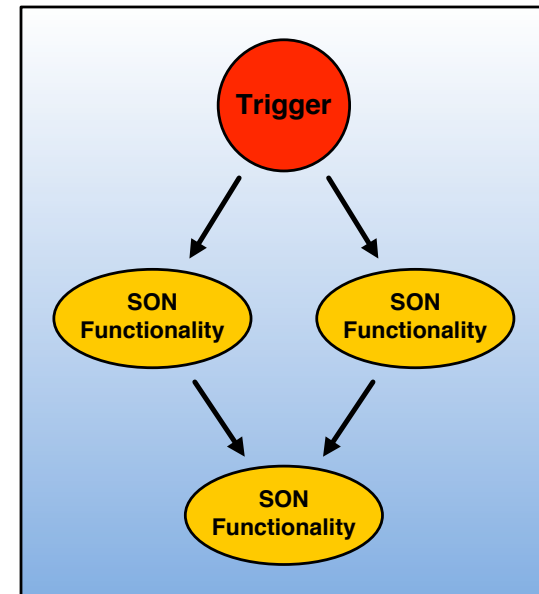


- **Co-Act**

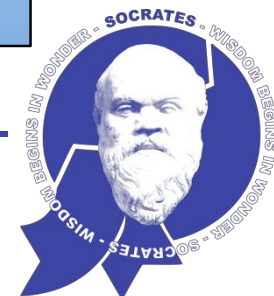
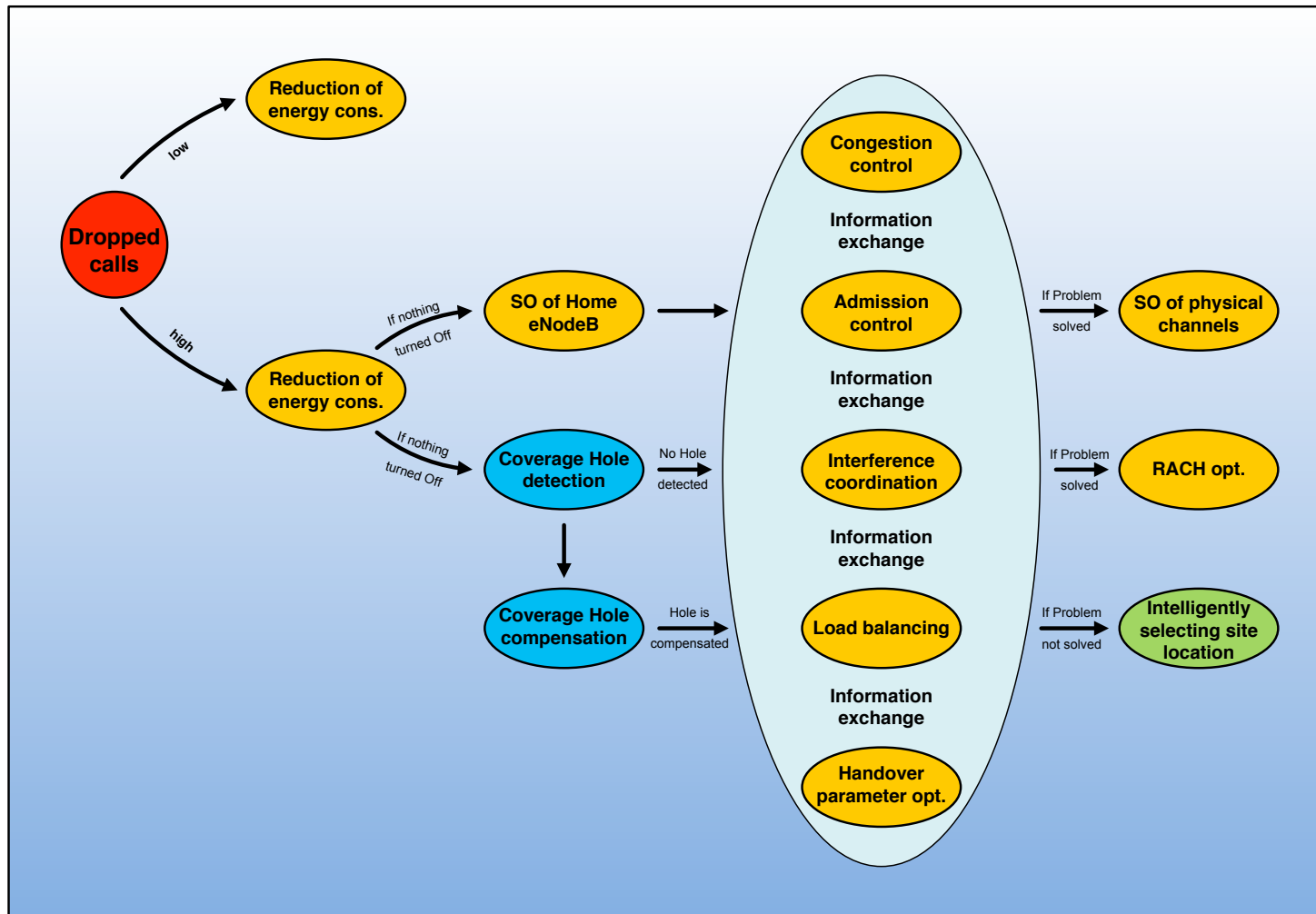
- SON functionalities have been initiated by different triggers and influence the same parameter settings for different purposes

# Interaction of SON functionalities

- *Co-Operating* and *Co-Acting* SON functionalities
  - need to be coordinated
  - need to be simulated together
- Analysis of interaction is based on *Triggers*
  - Low / High Blocking
  - Low / High Dropping
  - Low / High Quality of service
  - Low / High / Imbalanced Traffic load
  - Low / High Cell capacity
  - New site
  - Cell outage
  - Coverage hole
- Which SON functionalities need to be initiated ??



# Interaction of SON functionalities for the Trigger Dropped Calls




# Interaction of SON functionalities for all Triggers

Trigger	Co-Operating SON functionalities
Blocking	<ul style="list-style-type: none"> <li>Admission control, Load balancing, Handover parameter optimisation, RACH optimisation</li> </ul>
Dropping	<ul style="list-style-type: none"> <li>Congestion control, Admission control, Interference coordination, Load balancing, Handover parameter optimisation</li> </ul>
Quality of Service	<ul style="list-style-type: none"> <li>Congestion control, Interference coordination, TDD UL/DL switching point, Link level retransmission scheme</li> </ul>
Traffic load	<ul style="list-style-type: none"> <li>Congestion control, TDD UL/DL switching point, Load balancing</li> </ul>
Cell capacity	
New site	<ul style="list-style-type: none"> <li>Interference coordination, Load balancing, Handover parameter optimisation, Coverage hole detection</li> </ul>
Cell outage	
Coverage hole	

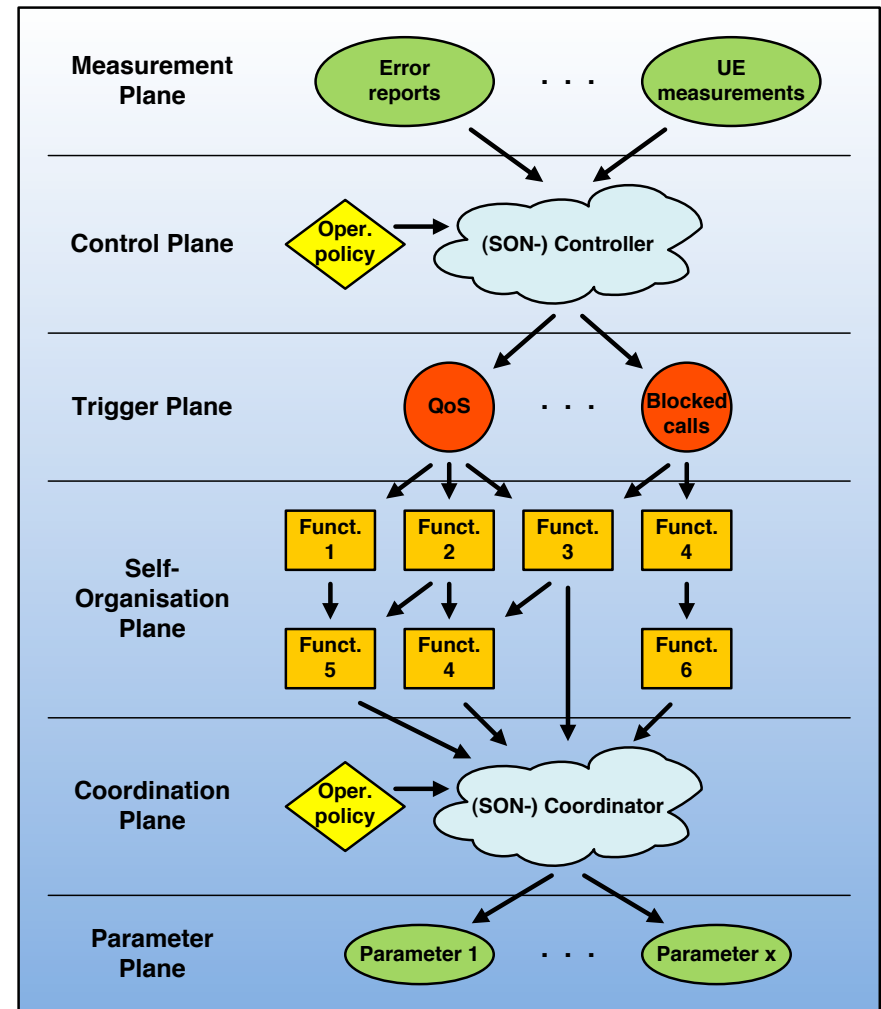


# SON control and coordination

- Coupling between parameters
  - Changed parameter settings affect several SON goals
- Interaction of SON functionalities
  - Several SON functionalities cooperate to counteract the system performance degradation

 Control and Coordination of SON functionalities is essential

- Approach for managing interaction and coordination



**Thank you very  
much for  
your attention**

