

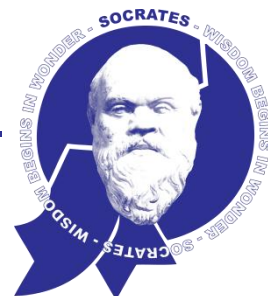
Embedding Multiple Self-Organisation Functionalities in Future Radio Access Networks

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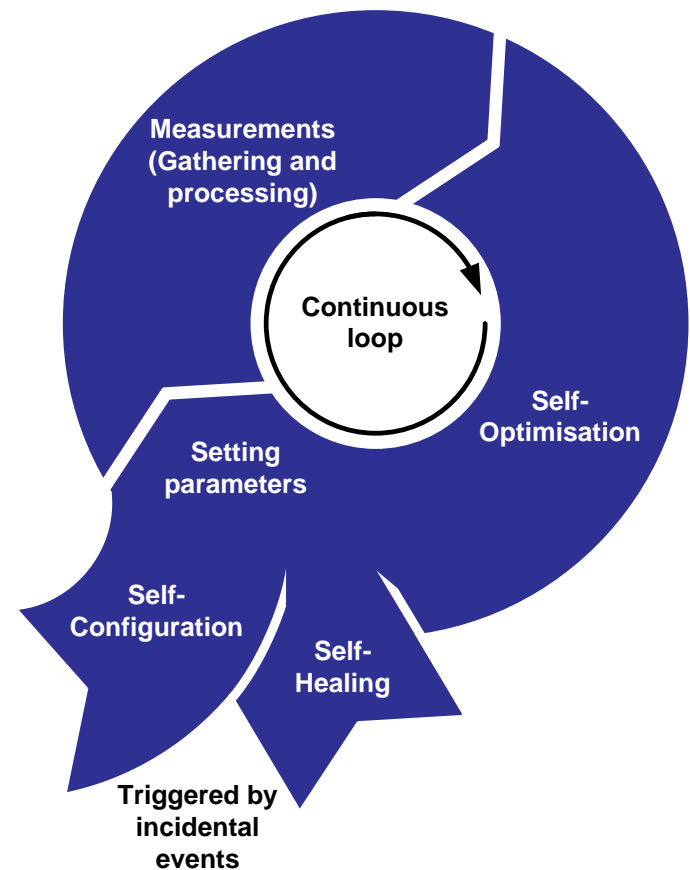


1. Introduction
2. Dependencies between control parameters
3. Interactions between SON functionalities
4. SON Control and Coordination



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



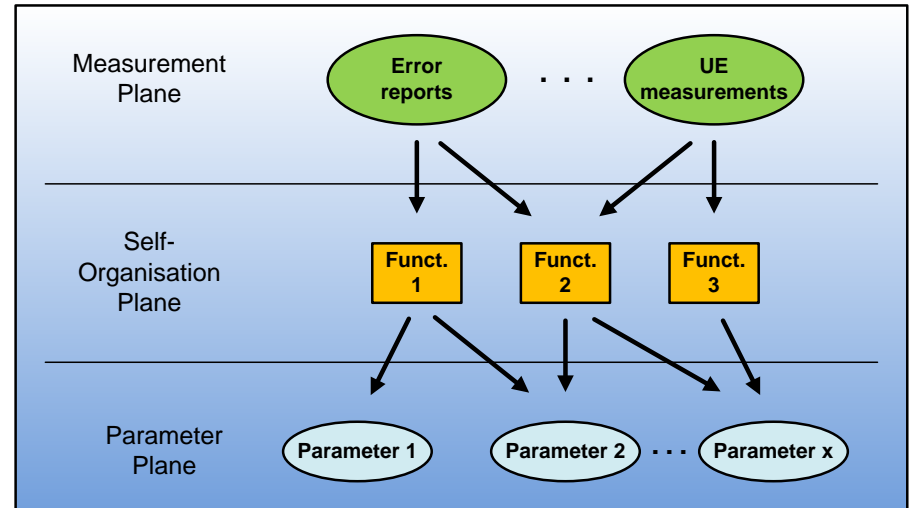
- SOCRATES investigated 24 use cases
 - Use cases address situations where self-organisation may be of benefit
 - Divided into 3 categories [1]
 - Self-Optimisation
 - Interference coordination
 - Handover optimisation
 - SO of home eNodeB
 - ...
 - Self-Configuration
 - Automatic generation of default 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

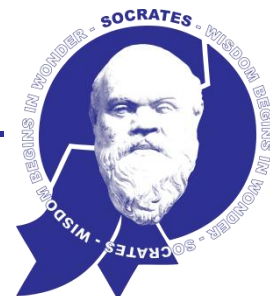


- SON functionalities
 - Alter some parameter settings
 - Interact with other SON functionalities
- Problems
 - Different SON functionalities alter the same parameter settings
 - for the same reason
 - for different reasons
 - Overall performance depends on multiple SON functionalities



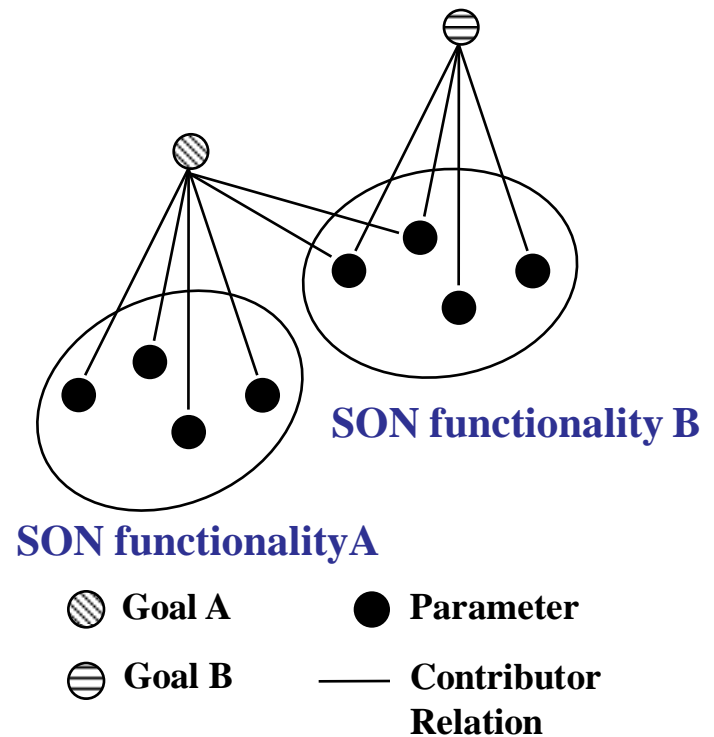
It is necessary to analyse the interaction of the SON functionalities based on the **control parameters** and **interaction with other use cases** that follow the same purpose to identify the functionalities that need to be **coordinated** and **simulated together**

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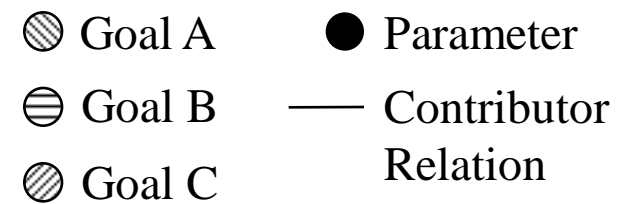
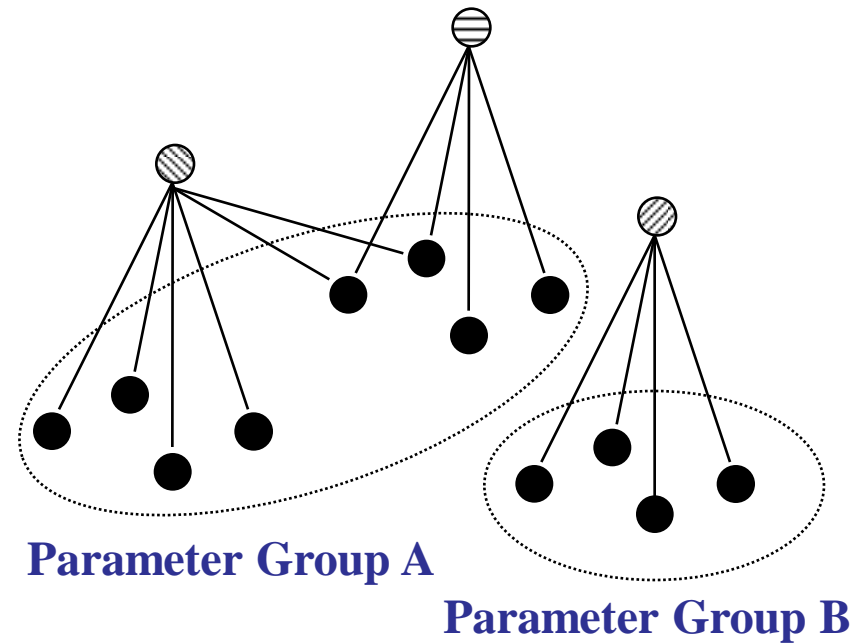
Definitions used for parameter grouping

- 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



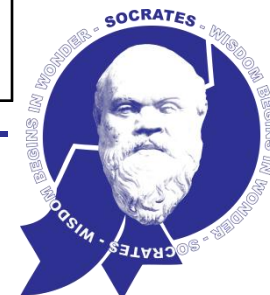
Coupling between groups and forming the groups

- A group consists of
 - Goals that are coupled through a contributor relation
 - Parameters of coupled groups
- Parameter in one group **does not affect** the goals of other groups
- **No coupling** between the group A and group B
- Coordination is
 - required within group
 - Not required between groups
- Methodology for deriving the groups
 1. Inventory of the goals
 2. Identify the parameters that affect the goals
 3. Form the parameter groups



Identifying the parameters

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



Forming the parameter groups

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

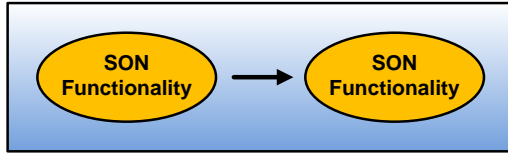
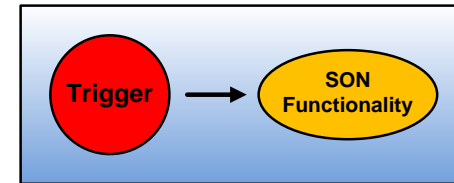
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Definitions used to determine the interaction of SON functionalities

- **Trigger**

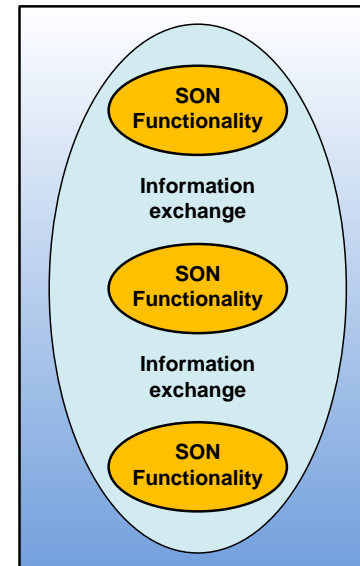
- A trigger initiates a SON functionality



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

- **Co-Operate**

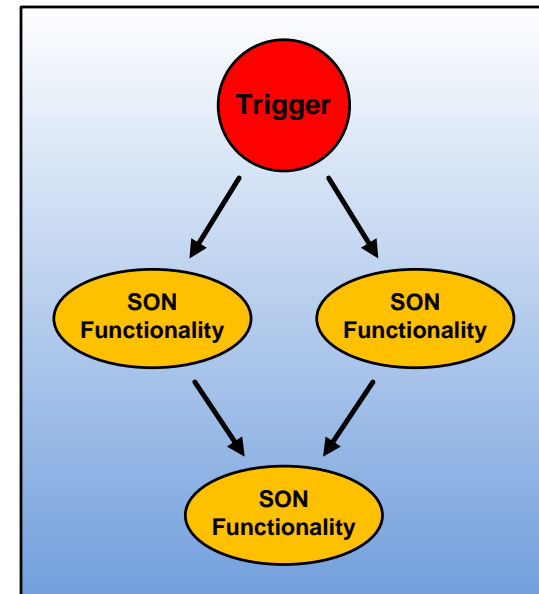
- Several SON functionalities are activated at the same time to counteract the same system performance degradation



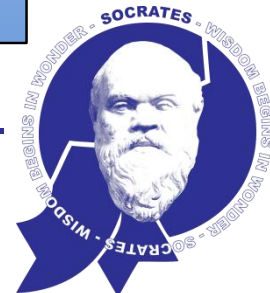
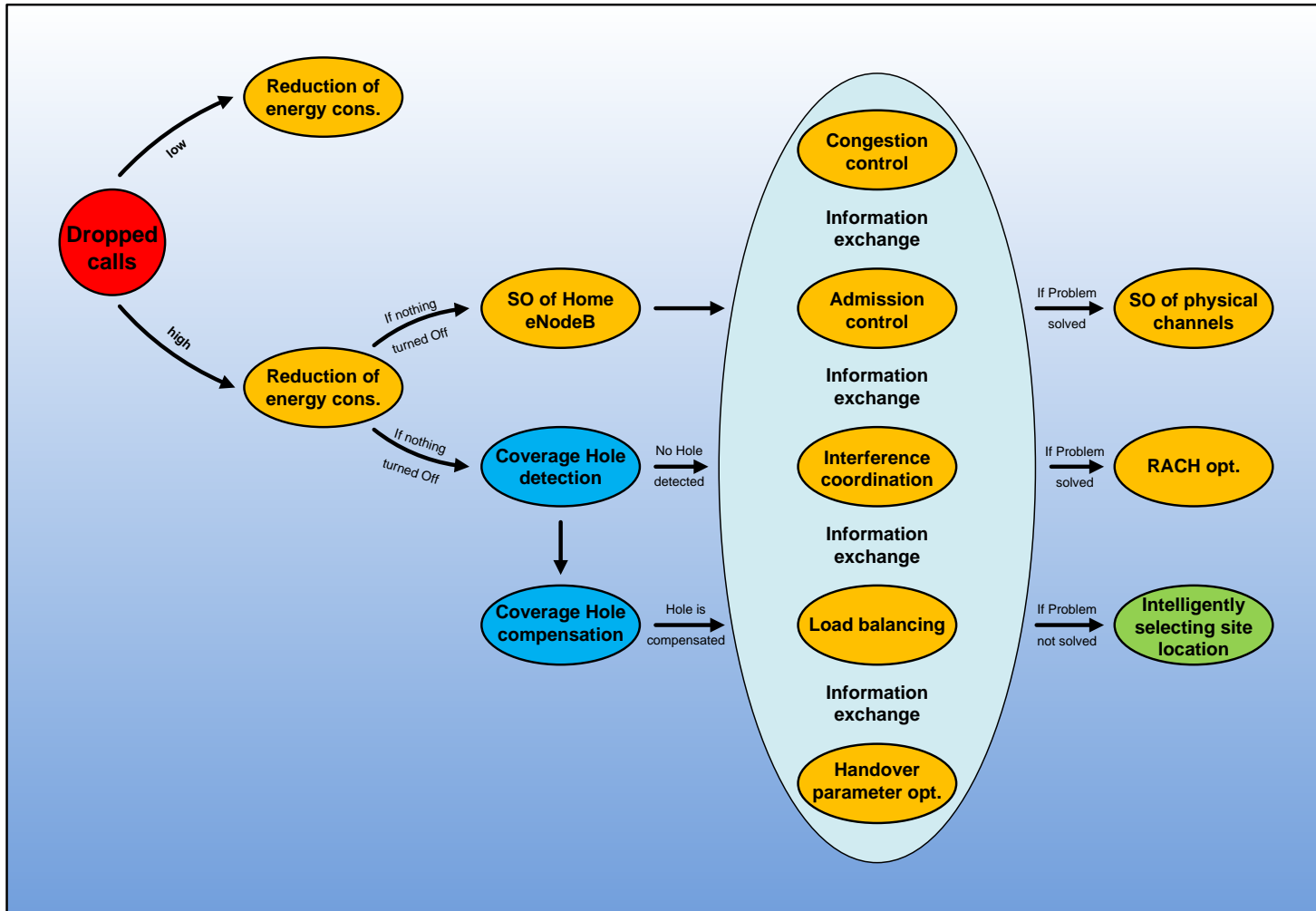
- **Co-Act**

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

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




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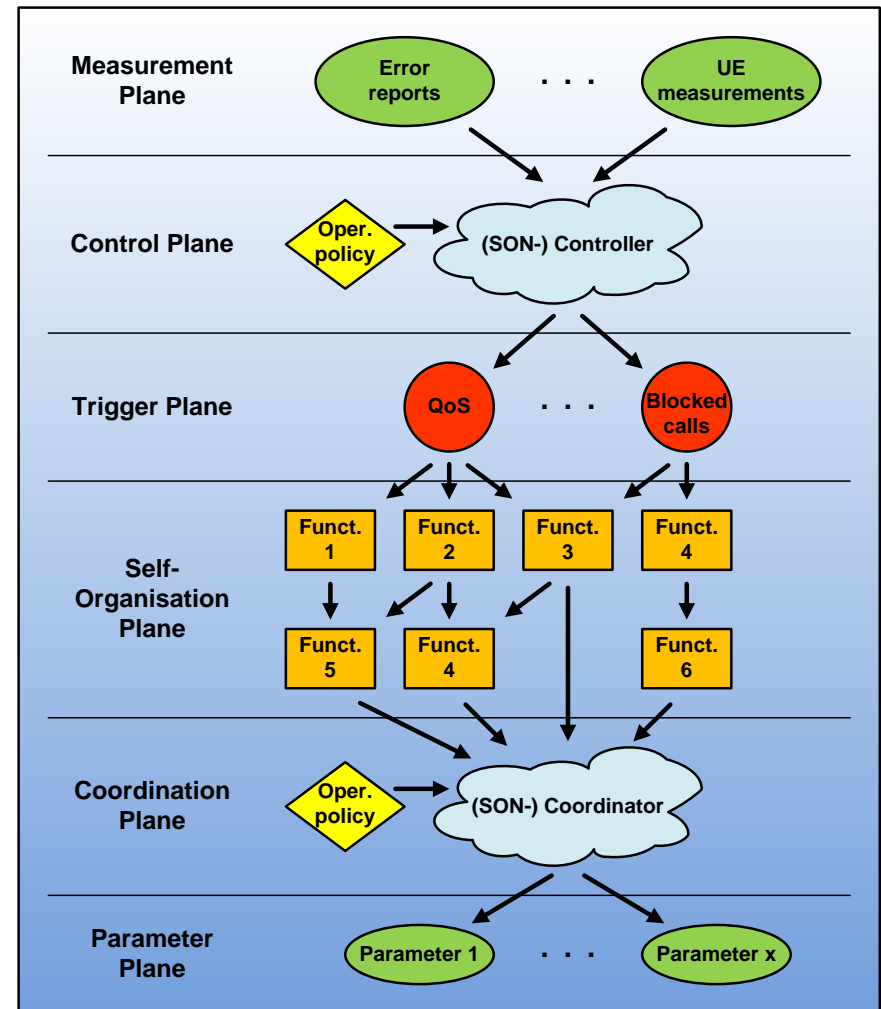


SON control and coordination

- 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



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