

# Optimisation of Performance of 4G Mobile Networks in High Load Conditions

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- Overview
- Statement
- Target
- Solution
- Execution

# Overview

## Technology

LTE and Self-Organising Networks functionalities

## Problem

Major: overload of control channels.

Other: congestion in traffic channels, non-optimal load distribution.

## Target

Under a load that exceeds the installed capacity:

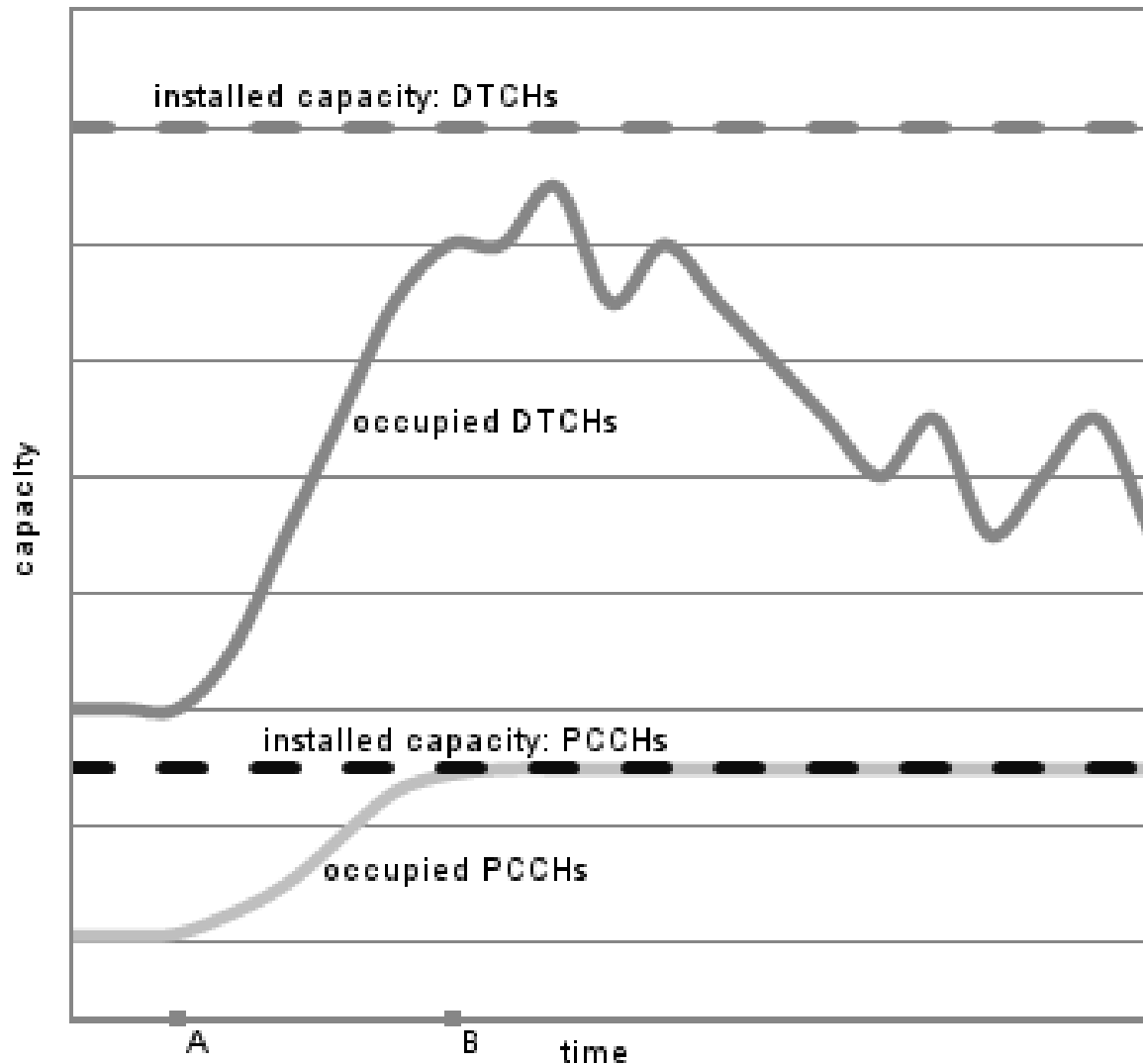
1. Guaranteed network operation,
2. Utilization of close to 100% of the installed traffic capacity,
3. Transitions in network operation without human intervention.

## Instruments

Adjust capacity of control channels in operation,

Manage processing of the messages sent on control channels

# Problem



**Offered load  
surges but  
installed capacity  
is not utilised?**

# Level: network segment

## Outage of a daisy chain with 2 sites.



### Expectation

- Normal operation of the network segment in the part that remains in service

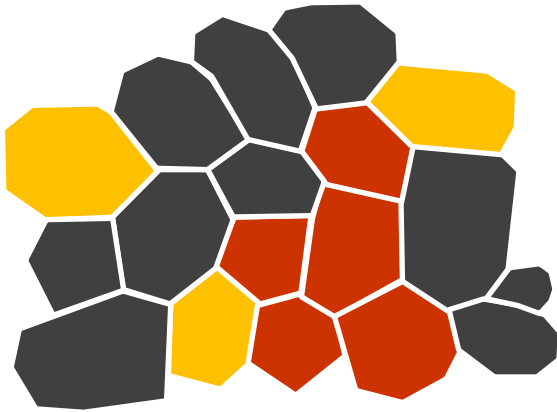
### Reality

In the tracking area:

- Served incoming traffic decreases
- Call setup success rate drops

# Level: cell

## Outage of a daisy chain with 2 sites.



### Expectation

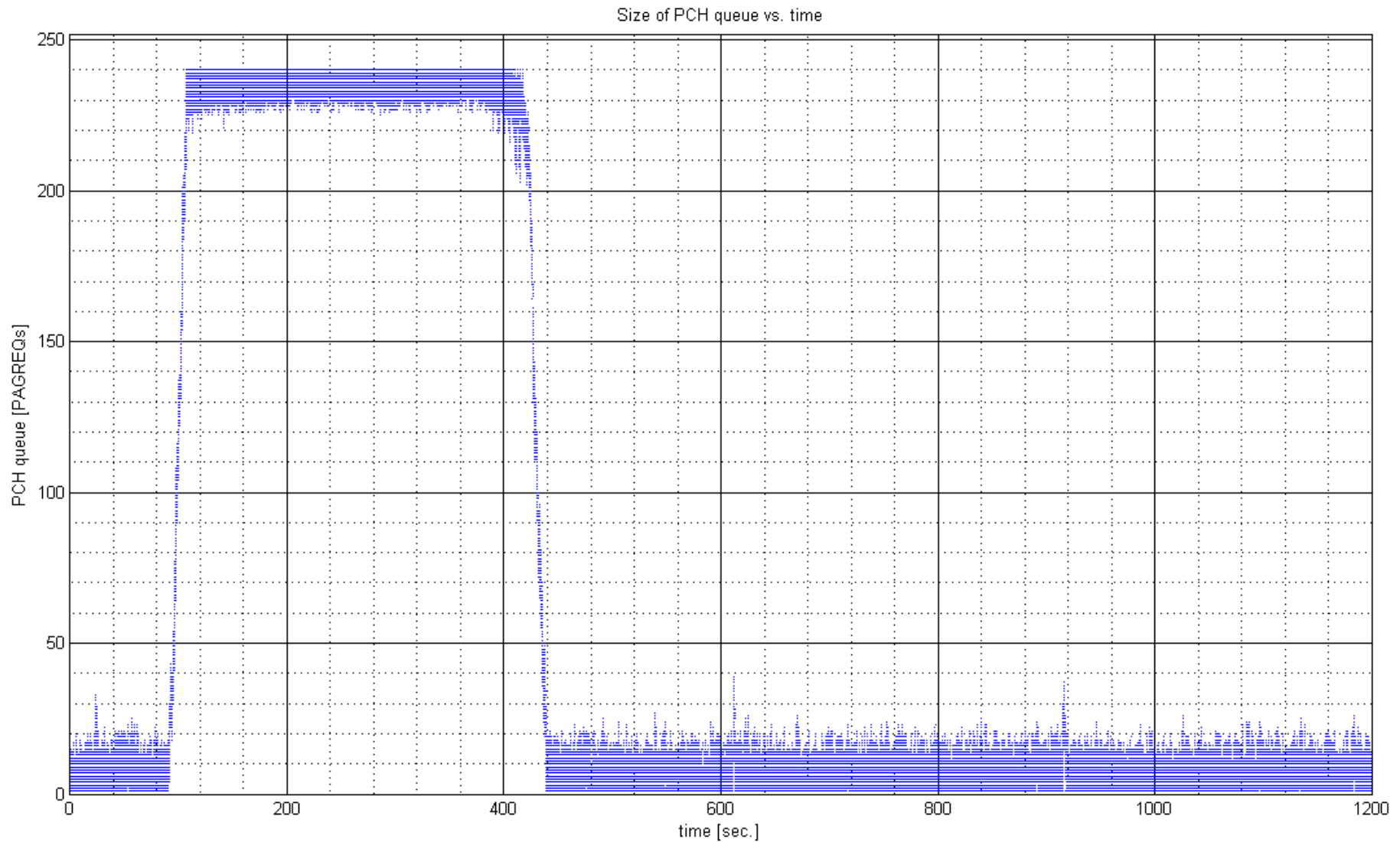
- Increase in offered load in the neighbouring cells
- Eventual blocking of traffic channels

### Reality

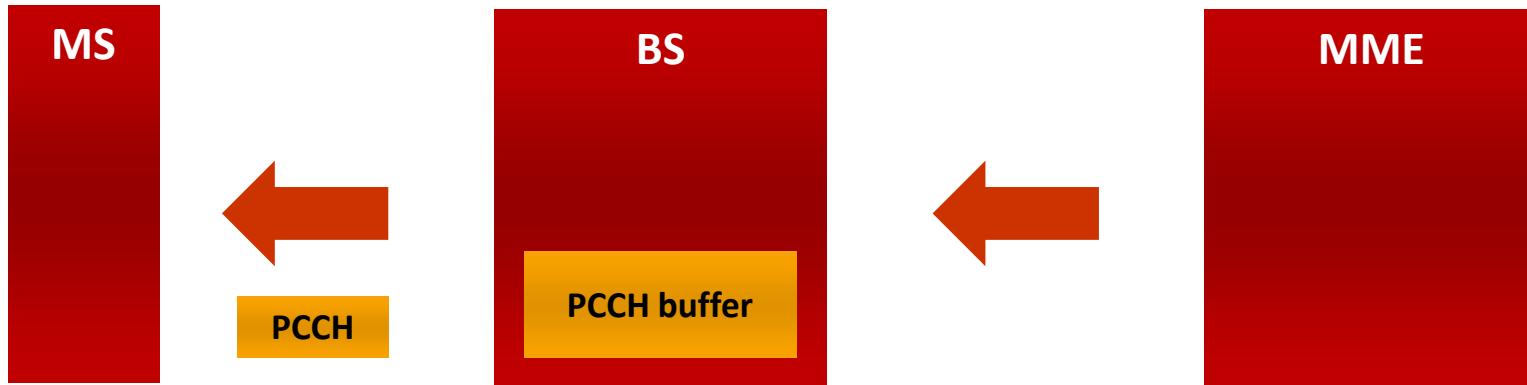
- Blocking of signalling channels
- Repetitive paging
- PCCH buffer overflow
- Degradation of KPIs in cells throughout the tracking area

PCCH = paging control channel  
KPI = key performance indicator

# PCCH queue



# Case: Signalling in paging channel



## Radio interface

1. Increase PCCH capacity

## BS

1. Adjust size of buffer
2. Remove expired paging commands
3. Priority passing to access grant messages (relevant for combined buffer)

## MME

1. Adjust timeout

## Location management

1. Remove unreachable mobile identities

MME = mobility management entity  
BS = base station, MS = mobile station  
PCCH = paging control channel

# SON: self-organising networks

## Planning

- Coverage
- Capacity
- Equipment
- RF, radio parameters
- Backhaul

## Optimisation

- Handovers
- Power control
- Management of neighbour lists
- Channel acquisition

## Deployment

- Allocation of physical cell identifiers
- Automatic neighbour relation setting
- Configuration of new cells

## Operation

- Outage compensation
- Real-time performance management



# SON: neighbour lists

## Standard way

Each base station has a neighbour list.  
Neighbour lists are defined by engineers.

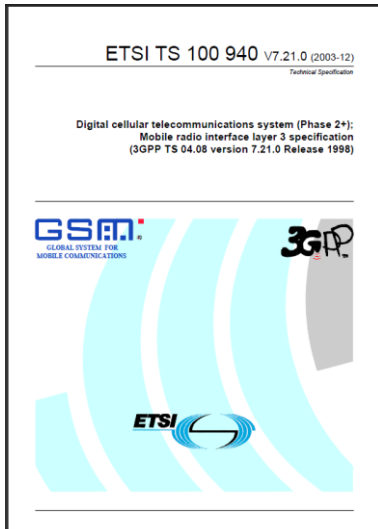
## SON proposition

Base station: upon initialisation discovers its neighbours.  
Automated setup of neighbour lists at base stations.  
Automated update of neighbour lists.

# Solution

- 1. Technology specifications allow modifications**
- 2. Incorporate SON functionalities into the equipment**
- 3. Preferred approach: software of network entities**
- 4. Software: Matlab and Simulink**
- 5. Level: small-scale models of logical channels, cell or tracking area level**
- 6. Implementation: centralised and distributed**

# Solution



**Design  
algorithms  
in Matlab**



**Simulate  
logical  
channels  
in Simulink**

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- Technology: LTE and SON
- Focus on: signalling subsystem
- Target: reliable network operation
- Solution: SON software features