Introduction to mobile communication - 34330
SON - Self-Organizing Networks

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CHAPTER 1

SON - Introduction and overview

1.1 Introduction

This report will be taking a closer look at SON (Self-Organizing Networks) and what it means for the industry of telecommunications. The features of SON aims to improve end user experience and reduce the costs entailed with providing a network, while still increasing the quality and efficiency of the network. These features, along with their impact will be explored later in the report

1.2 Overview

All mobile networks need to be managed and as systems become more and more complex, the need for better and easier ways to manage them are important as ever. LTE (Long Term Evolution) is the newest technology and also the most complex. Therefore, in LTE, management needs to be as good as possible. SON (Self-Organizing Networks) is a very promising area for providers, as it makes network-management cheaper, more efficient and easier. This is also why SON is most prevalent in LTE networks, simply because the demands of LTE are much higher and therefore LTE networks are quite complex.
The goal of SON is basically to reduce the need for technicians and increase the network capabilities, such that the network will be as good as possible in regards to coverage, capacity and user experience. Generally, SON has three main areas; self-configuration, self-optimization and self-healing. These will discussed in depth later.

1.3 Why SON?

The reasons for using SON are very obvious from a provider standpoint. First of all, the cost of a Self-Organizing Network should be much lower

CHAPTER 2

Self-configuration

2.1 Main idea and overview

The first area of SON is self-configuration. The main idea behind the self-configuration part of SON is to automate the setup of eNBs (eNodeB). This allows a plug and play type of setup, which saves the network owner a lot of time and money, since you would usually need a technician to setup new eNBs, which could take a lot of time. The self-configuration also reduces the risk of incorrect installation and integration of eNBs into the existing network. The amount of needed cells is also rising with the increase in network usage.

2.2 Features of self-configuration

There are three main features of self-configuration in LTE; self-configuration of eNB, Automatic Neighbour Relations and automatic configuration of Physical Cell ID (PCI).
Another small but important feature of self-configuration is Dynamic Radio Configuration (DNC). In order for the eNB to configure itself correctly, it will need to alter the planned data a little. This is done automatically by the eNB itself by performing measurements and thus adjusting initial power, antenna tilt etc.

2.2.1 Process of eNB self-configuration

One of the key ideas of self-configuration is self-configuration of a new eNB trying to connect to the network. The eNB is in this case not connected to anything but the network management subsystem and Serving-Gateway (SGW). The following steps are performed in order to connect the new eNB to the network.

- First, the eNB is powered on and plugged in where necessary, then it will have an already established connection, which it will use until the radio frequency transmission is turned on.
- The DNS/DHCP server will now provide an IP address to the eNB.
- Now, the self-configuration subsystem of the of operation and management information is sent to the eNB.
- A gateway is now configured to the eNB such that it can now connect and communicate with other internet nodes through IP packets.
- The eNB will provide its own information e.g. hardware, ID, supported technologies etc. to the self-configuration subsystem in order to get identified and authenticated.

- The eNB will now be able to download the correct software and radio-configuration information.
- After this download, the eNB configures itself according to the downloaded transport and radio configuration information.
- Now, the eNB can connect to the Operation Administration Management (OAM) for other management functions.
- The S1 interface is then established, giving the eNB connection to the Evolved Packet Core Network (EPCN). The X2 interface is also established and the eNB is now connected to other eNBs in the network. [1]

2.2.2 Automatic Neighbour Relations (ANR)

Automatic Neighbour Relation (ANR), is the process of managing the neighbour relations, such that the cells know who their neighbouring cells are and what technologies they support. It is crucial that this information is updated and is correct, otherwise handovers might fail and thereby result in dropped calls. If the neighbouring cells support different technologies e.g. one might support HSPA and its neighbour LTE, the user needs to know this so it know what frequencies to listen on.
Generally the ANR process looks a bit like this:

- UE detects unknown PCI and reports it to the serving eNB by sending a Radio Resource Controller (RRC) reconfiguration message.
- The serving eNB will now request the UE to send E-UTRAN Cell Global ID (ECGI) of the unknown eNB. The UE then does this by reading the BCCH.
- The serving eNB will now retrieve the IP address from the MME based on the ECGI of the unknown eNB. This allows the serving eNB to correctly setup the X2 interface, since that hasn't been done, because the unknown eNB is unknown.
- The functions will now be extended to cases of inter-Radio Access Technology (inter-RAT) and inter-frequency. [1]

2.2.3 Automatic configuration of Physical Cell ID (PCI)

Every cell in the network will have its own PCI, which is in the SCH, to be used when synchronizing with UE on downlink. In the E-UTRAN there are only 504 PCIs, therefore they have to be reused, however they need to be unique within specific regions. There are two rules which has to be obeyed when configuring PCIs: Neighbouring cells must not share PCI. All neighbours of one cell must have different PCIs. [2]

CHAPTER 3

Self-optimization

3.1 Main idea and overview

After the network has self-configured it should also be able to adapt according to load and other factors. This is where self-optimization comes in. To ensure effective management and operation of the network, the network should, after configuring itself, have algorithms and processes to make decisions in regards to efficiency and performance. If implemented correctly this will increase performance and stability while keeping cost and energy at a minimum. This is done by taking measurements from both UEs and eNBs and using these to regulate the network.

3.2 Features of self-optimization

There are several important features of self-optimization, which all contribute to making SON much better.

3.2.1 Mobility Load Balancing (MLB)

Mobile Load Balancing (MLB) is especially relevant in cases where a cell with high load and a cell with low load are neighbours. Here MLB uses automated algorithms and functions to avoid cell overloading and consequent degradation of performance. This is achieved by having the algorithms adjust parameters to balance the load between cells, these algorithms also prevent other issues that could arise in these situations e.g. ping pong handover. Simply put, MLB tries to balance load relatively evenly between neighbouring cells, improve network capacity by regulating cell congestions and manage the network efficiently such that performance is as high as possible.

3.2.2 Mobility Robustness Optimization (MRO)

3.2.3 Minimization of Drive Tests (MDT)

MDT Management and Reporting

3.2.4 Energy Savings

3.2.5 Coverage and Capacity Optimization

3.2.6 RACH optimization

CHAPTER 4

Self-healing

CHAPTER 5

Conclusion

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