Self-optimization in 3GPP LTE networks

Irina Balan

Supervisor(s): Ingrid Moerman

I. Introduction

This paper presents an introduction in self-optimization processes and algorithms that will be applied especially in LTE (Long Term Evolution or E-UTRAN) mobile networks. As a particular example, we will be looking at the optimization of the handover procedure, which is a vital part for any mobile network.

High peak data rates, low latency, seamless mobility are just a few of the ingredients needed for delivering high quality services to the end user. This forces the industry to be constantly searching for newer and better ways of keeping up with the client's needs and demands. LTE is the new 3GPP standard [1] that rises to the challenge.

II. LTE networks

LTE has been designed to offer 3G services with peak rates up to 260 times higher than UMTS (100 Mbps in downlink and 50 Mbps in uplink), latencies under 5ms and to accommodate users with high speeds (up to 350 km/h), all in a fully automated, self-organizing environment.

LTE promises increased spectrum flexibility, with spectrum slices varying between 1.25 MHz up to 20 MHz and supports both FDD and TDD operation. It should support at least 200 mobile terminals in the active state when operating in 5 MHz. In wider allocations than 5 MHz, at least 400 terminals should be supported.

The proposed air interfaces are OFDM for downlink and SC-FDMA for uplink, with QPSK, 16 or 64 QAM modulation. LTE will use advanced antennas: 2x2 / 4x4 MIMO which will translate into higher data rates by transmitting parallel streams to a single user.

III. Self-optimization

A. What is it and why do we need it?

Following the current trend of "IP goes mobile" initiated by WiMAX (IEEE 802.16e), LTE takes the reverse route offering a new flat, all-IP architecture. New network elements will be designed in a plug-and-play fashion, thus reducing the manual planning and deployment effort. Self-x functionalities (-configuration, -optimization, -healing) assure a flexible system and at the same time help reduce the OPEX and the overall cost.

B. How does it work?

Self-configuration will provide initial settings for the network elements upon deployment, depending of the specifics of the site. Constant measurements of key parameters (e.g. handover thresholds and timers, scheduling parameters, power settings, antenna tilt) will be extracted from the live network and fed to a series of self-optimizing algorithms that will allow the network to react to traffic and environment changes. These self- optimizing algorithms will constitute a separate layer, placed on top of the algorithm running in the network. Self-healing can be triggered by incidental events (such as a site failure) and will minimize its negative effects.

Figure 1[2] illustrates the principles explained above.

I. Balan is with INTEC Broadband Communication Networks Research Group (IBCN) , Ghent University (UGent), Gent, Belgium. E-mail: irina.balan@intec.UGent.be

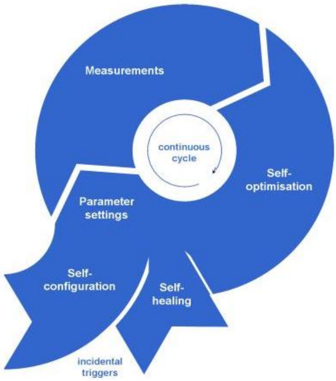

Figure 1 Self-x functionalities

IV. Handover Optimization

A. Main drivers of handover self-optimization

Handover (HO) is the core procedure for assuring mobility of the users in any mobile network and its success rate is a key indicator of user satisfaction.

In current mobile networks, handover optimisation is done manually on a long timescale, e.g. weeks or months. By introducing an online self-optimising algorithm that will tune the parameters of the HO process, the overall network performance and user QoS will be improved. The main targets are reducing the number of HO failures and 'ping-pong' HOs (back and forth HOs of a user between two cells).

B. Overall description of the optimization process

In the self-optimizing algorithm, the network will be constantly monitored and several measurements and statistics will be retrieved. Based on the analysis of this information, the self-optimizing algorithm will automatically adjust the parameters controlling handover. Architecture wise, there will be no major modification to the current structure, except possibly extra information exchange over the interface between base stations.

C. Input measurements and control parameters

The various physical layer measurements (e.g. received signal strength and signal-to-noise ratio) and statistics (handover success ratio, 'ping-pong' handover ratio, etc), together with the user history will constitute the input data for the self-optimising algorithm. In turn, values for the control parameters (e.g. thresholds, hysteresis parameters, offsets, time-to-trigger, etc.) will be the output of this algorithm and the means through which we can implement the needed changes.

D. Simulation

The simulations that will be conducted will focus on establishing the impact changes to various HO parameters have on the overall process and network. Later, the performance of the algorithm will be evaluated using several performance metrics such as HO success ratio, ping-pong handover ratio, call blocking/ dropping at handover ratio, HO delay, HO interruption time. So far we are in the development stage, for both the simulator and self-optimizing algorithm, investigating different approaches.

V. Conclusions

The self-optimization of handover parameters aims at minimizing the occurrence of undesirable effects of this procedure, such as call drops and 'ping-pong' effects between two cells. Based on monitoring of the network by means of several measurements and statistics, the self-optimizing algorithm will automatically adjust the parameters to control the handover, consequently increasing the network performance.

References

[1] http://www.3gpp.org
[2] www.fp7-socrates.eu