Policy-Based SON Management Demonstrator

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***Abstract*—A Self-Organising Network (SON) represents an approach where the optimisation of a mobile radio network is automated through a set of independently operating SON functions. These SON functions, however, require to be configured in order to allow for an optimised network performance with respect to technical objectives defined by the network operator. The SEMAFOUR demonstrator shows a concept for SON management based on operator objectives, where the SON function configuration is performed in an automated way. The demonstrator illustrates the different aspects and complexity of the management of SON in a heterogeneous network.**

Keywords—self-organising networks; network management; policy-based management

I. Introduction

A Self-Organising Network (SON) function is implemented through a closed control loop [1] that acquires measurements (e.g., performance counters and timers, alarms, or radio measurements) from the network (e.g., cells, network elements or user equipment). From the analysis of these measurements dedicated performance shortcomings are identified, and new network element configurations are computed and deployed in order to overcome these shortcomings. The SON functions themselves can be configured through SON function Configuration Parameters (SCPs), where different SCP Values (SCVs) lead to differing behaviour of the SON function with respect to the impact on the network's Key Performance Indicators (KPIs). Since the overall goal of the mobile network operator is not to optimise a set of individual measurements in the network, but actually to improve certain technical objectives (i.e., KPIs that may be prioritised and depend on a dedicated operational context), finding the optimal SCVs that contribute to achieving these objectives is essential. The European research project SEMAFOUR [5] developed an approach for Policy-based SON Management (PBSM) [4] that allows for an automated configuration of the SON functions according to operator-defined technical objectives, by merging these objectives together with models of the implemented SON functions and deriving the appropriate, context-specific sets of SCVs therefrom. This PBSM approach is presented through the SEMAFOUR demonstrator described in this paper.

II. Demonstrator Description

The SEMAFOUR demonstrator consists of four components showing the management of mobile radio networks. (i) The *Operator Panel* provides an interface enabling human operators to specify requirements for the network in terms of technical objectives. It furthermore shows the current configuration of SON functions in a SON policy as well as the current network performance, i.e. how far these SCV sets fulfil operator defined objectives. (ii) The *KPI Panel* shows how the available network KPIs perform compared to a reference system that is not objective-driven. (iii) The *Network Panel* illustrates radio base stations and how the operation of SON functions affects the mobile radio network. (iv) The *Cell View Panel* allows having a deeper look into specific cells with respect to their properties, the assigned cell, and the configuration of its SON function instances.

A. Simulator Foundation

The concepts described above have been simulated [3] in the SONlab framework [2] that enables different clients to connect to the framework and join the simulation. These clients include several SON functions (namely Mobility Load Balancing (MLB), Mobility Robustness Optimisation (MRO), LTE-Wi-Fi Traffic Steering (TS) and High Mobility users (HM) optimisation), a handover client, a SON Objective Manager (SOM) client computing a SON Policy based on the operator objectives and SON Function Models, and a Policy System client evaluating the SON policy and deploying the SCV set to the SON functions. The scenario shown in the demonstrator covers a 10x10 km^2 area in the city centre of Hannover, Germany, with a single-layer, single-technology network topology with 195 LTE-1800-Macro cells. The cells belong to different types of cell classes depending on their location (urban, rural) and their user mobility profiles (high-speed for the highway in the north and normal mobility in the remaining parts). 2000 unique users with different mobility behaviour are shown: vehicular, pedestrian, static, railway, and highway users (Figure 1). In order to simulate different types of traffic, user behaviour changes from normal traffic to busy-hour (and vice versa).

B. Demonstration Setup

In this section, the previously introduced panels of the demonstrator, i.e. the network panel, the operator panel, the KPI

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panel and the cell view panel will be described in more detail. The *Network Panel* illustrates the scenario with all cells and users. By means of colour codes, several properties can be displayed that indicate, e.g. the location, mobility type, load situation, or the SON function configurations of a cell. The network panel is shown in Figure 2.

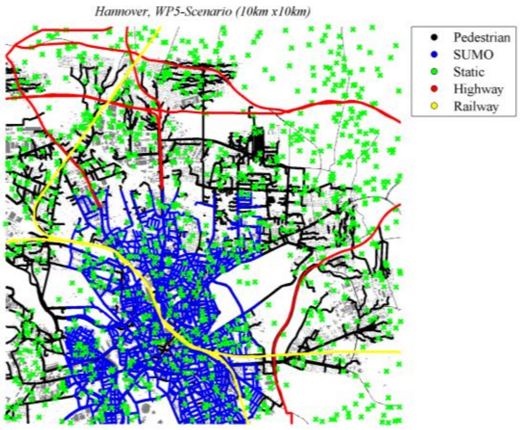

Figure 1: Simulation scenario with different user mobility classes

The *Operator Panel*, depicted in Figure 3, supports three aspects of network management. First of all, it allows the human operator to define targets for KPIs and an order indicating their relative importance. In addition, three predefined, static objective sets can be deployed interactively. Second, the currently active SON policy, i.e. the set of rules applying a certain set of objectives, is shown. For each possible cell class in the network, one policy rule exists indicating which SCV sets are deployed to the SON functions. Third, the achieved satisfaction of the objectives with the currently deployed objective set is shown for each cell class in the network. This is calculated by comparing the current network performance with the objectives thereby considering the the objectives' weights.

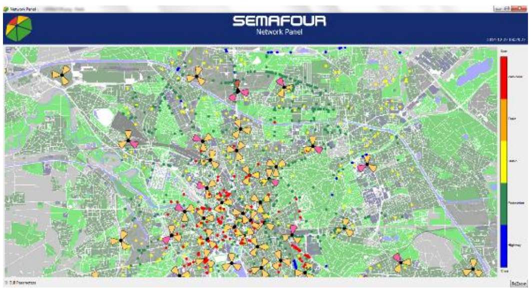

Figure 2: Network Panel

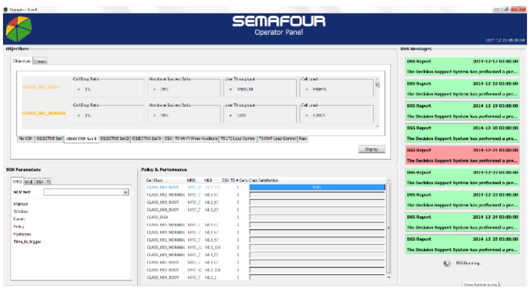

Figure 3: Operator Panel

The *KPI Panel* shows the current values of all KPIs from the network as depicted in Figure 4. It also illustrates the potential network performance without SON functions so that the difference to the active objective set can be seen.

Finally, by opening the *Cell View Panel* for a specific cell, a detailed description about the cell's properties, the class it belongs to according to these properties, and the SCVs of the SON functions is presented.

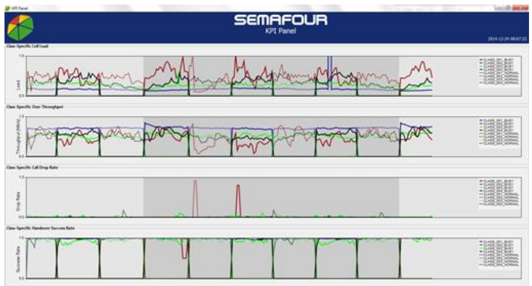

Figure 4: KPI Panel

III. Potential Impact on the Audience

The SEMAFOUR demonstrator enables a human operator to manage and improve a SON-enabled mobile radio network on a high level of abstraction. Since the operator only has to define objectives, i.e. weighted and context-specific KPI values that should be achieved in the network, he or she must not have knowledge about SON functions' parameters and how they have to be configured in order to fulfil the operator's desires. However, by illustrating all the different aspects to be considered for the improvement of the network behaviour, the demonstrator also shows the complexity of managing a mobile radio network.

Acknowledgement

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