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Re:	None
Abstract	This contribution is to promote the discussion on provision of self-x functionalities e.g. self-configuration and self-optimization within the corresponding IEEE 802.16 Task Groups in order to minimize the operator's effort to install, setup, optimize and maintain an 802.16 based network.
Purpose	Call for discussion on provision of self-x functionalities in IEEE 802.16 networks.
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Provision of self-x functionalities in IEEE 802.16 networks - e.g. self-configuration and self-optimization -

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1 Introduction

Some of the major troublesome and costly tasks carried out by operator when introducing a new telecom infrastructure includes network planning, deployment and operational efforts. As today, deployments of telecom networks lack support of tools and procedures to install and setup network entities with minimum operational efforts. The efforts to setup and optimize the new system are significant and traditionally lead to lengthy periods in getting an optimum and stable system setup. It is thus essential to support self-configuration and self-optimization mechanisms not only in order to minimize CAPEX/OPEX but also to increase the network performance based on efficient and effective automated processes.

Initial deployment of IEEE 802.16 systems should profit from the experience gained in the deployment of other wireless cellular networks. For example, UMTS lacked performance because operators needed time to find the setting to get the best user experience as well as satisfactory performance efficiency ratios out of the newly deployed system [4]. Recently, 3GPP already started to work on self-configuration and -optimization procedures in the working groups dealing with the long term evolution of 3GPP systems [4-12].

The main reasoning of this contribution is to highlight this problem to the IEEE Standard for Local and metropolitan area networks and promote the discussion on the requirements (from an operator's point of view) that minimize the efforts to install, setup, optimize and maintain an IEEE 802.16 based system. Provision of the envisioned self-x functions should be already available in the initial deployment phase of 802.16 systems.

2 Discussion

The ability to reduce the deployment and operational costs is important for a network with a large number of 802.16 entities (e.g. base stations, subscriber stations). If the base stations (BS) could possess the ability to automatically interact with other 802.16 entities and, for example, be aware of other BS's activities, detect coverage holes in the network, configure themselves appropriately at the time of deployment and after any changes to the network, the deployment and operational costs and efforts could be significantly reduced. In the following, principles and high level requirements to simplify the setup and optimization of the system are discussed. Figure 1 illustrates an example of two proposed self-x functionalities, the self-configuration and the self-optimization.

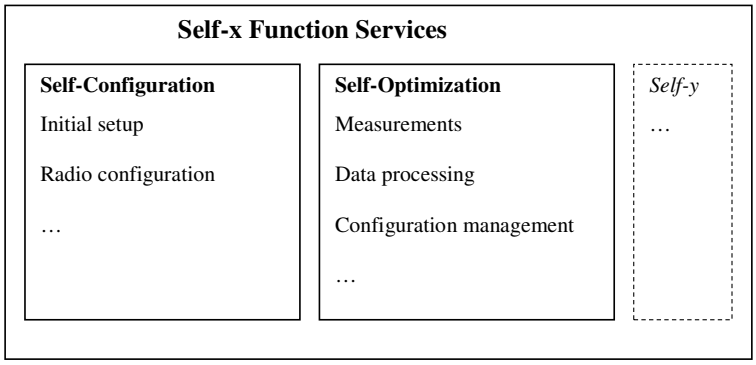

Figure 1—Illustration of the discussed self-x functionalities (informational)

2.1 Support of self-configuration

The 802.16 system should be able to support self-configuration of new deployed BS in a “plug-and-play” manner. Self-configuration can be defined as the process where a newly deployed BS is configured by automatic installation procedures to get the necessary basic configuration for system operation. This requires automatic initial configuration of connectivity on the management interfaces and neighbor base stations interface as well as the configuration of an optimal radio parameter set.

2.1.1 Initial setup

Goal of this stage is having the BS register itself with the Network Control and Management System (NCMS) [1] in order to agree its own settings with the controlling entity in the network. Basic configuration could include initial setup tasks such as discovery and authentication of other 802.16 entities, attachment to the NCMS, downloading of initial configuration SW, IP address and physical access configuration, upstream routing path discovery, etc. IEEE Std. 802.16-2004 [3] covers the option for SS to download configuration settings from a server. In this stage, the support for a similar functionality is desired for the BS initial setup.

2.1.2 Radio configuration

This stage involves all the functions required to setup the radio related parameters in the base station. These configurations could include for example, the neighbor BS list, the OFDM power control, the uplink and downlink parameters or the antenna tilting angle.

By setting the radio parameters automatically at initial base station installation, appropriate levels of coverage, capacity and inter-carrier interference (ICI) and do not required to be adjusted carefully later on during operation.

The BS shall support means to allow automatic creation of neighbor cell lists and provide neighbor cell information. The configuration management [2] should support the required primitives for managing the neighbor BS list, the channel information of neighbor BS’s like the downlink and uplink channel descriptors (DCD/UCD) or the power control. Automatic generation of neighbor lists could be achieved for example, using geographical information or collecting MS/SS or BS measurement reports.

2.2 Support of self-optimization

Self-optimization implies the self-tuning of relevant radio parameters during operation in order to adapt to the environmental changes. Even if the radio parameters are initially set to their optimal values, the impacts of base station failures or heavy traffic bias to a particular BS could be minimized by defining self-optimization methods. Parameters like transmission power or sub-channel allocation have significant impact on the coverage and capacity of a certain region operated by a set of 802.16 entities. Therefore, a dynamic control of these parameters in adaptation to environmental changes is ambitioned. For example, [10] describes optimization scenarios that include mechanisms for cellular network optimizations based on pilot power optimizations, combined power control and scheduling in downlink, dynamic adjustment of admission control thresholds and of resources between real-time and non real time traffic. A concept of network self tuning process can be found in [9] and includes use cases for day/night coverage optimization or handover improvements. A self-optimization function shall have means for measurements collection, data processing and configuration management.

2.2.1 Measurements collection

Measurements collection involves the acquisition of OFDMA-based PHY performance data from 802.16 entities. The performance of the self-optimization algorithms heavily relies on the amount and quality of the

available data. The performance data could include data signal strength measurements, spare capacity reports, throughput and numerous other performance measurements collected at the BS that can be pushed to data processing unit (e.g. self-optimization service in the NCMS). Supported radio measurements and reporting are defined in [1] and its primitives could be used to report and share current radio resource usages. Additional new data, not captured as today for normal 802.16 system operation, or new standardized interfaces between network entities could be required for self-configuration and dynamic optimization purposes and could be collected from each the BS and the MS or SS. Examples of extended measurements suggested for the optimization of cellular networks are presented in [11].

2.2.2 Data processing

Data processing refers to the algorithmic computations that would be required to process the collected data and to e.g. determine the capacity/coverage of the network for radio and system parameters. Then, an optimum value for the tunable parameters could be determined. If an external entity exists for self-optimization (e.g. an optimization server as part of the NCMS), standardized means and procedures should exist to allow conveying the measurement results from the base station to that entity. Decision algorithms and network action processes are outside of the standardization scope and should be based on operator and vendors experience [9].

2.2.3 Configuration management

Configuration management is covered in [1] as part of the Network Control and Management System (NCMS). For self-optimization purposes it should simple provide the interface to configure parameters for 802.16 entities and perform parameter cross-checks before actual configuration is activated. An open method to obtain and set relevant data (e.g. optimized parameter set) of 802.16 entities should be available. The Integration Reference Point (IRP) model [2] for 802.16 could serve for these purposes.

2.3 Integration example into the network control and management system

An abstraction of the NCMS has been introduced in [1]. Figure 2 shows an example of the different functional elements that could be provided within the NCMS. Entities such as the envisioned self-x function services may be centrally located or distributed across the network. The exact functionality of these entities and their services is clearly outside the scope of the NETMAN task groups; however information elements and their protocol primitives are exposed using primitives via Service Access Points (SAP) and allow the support for the proposed self-x services.

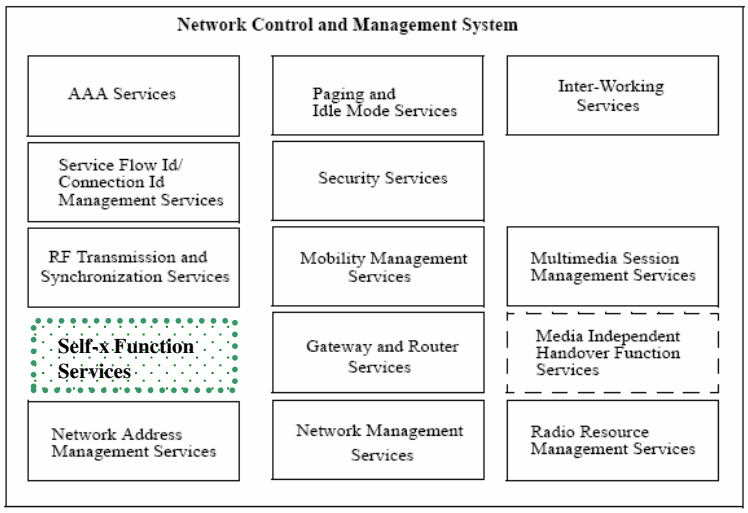

Figure 2—Illustration of the NCMS (informational), adapted from [1]

There is a need for a study regarding the requirements on support for self-x functionalities. It should include reviewing available network management services (e.g. configuration, network entry, radio resources) and the correspondent management (M_SAP) and control SAP (C_SAP) defined in [1] with regards to the capabilities of the available service primitives, its parameters and the Integration Reference Point (IRP) model in [2].

A feasibility study on provision of self-x functionalities should also include an analysis of required MS/SS and BS measurements to carry out the identified tasks for self-optimization or self-configuration. The expected output includes the identification of the new required methods or attributes to be standardized that enable the effective development of such self-x functions.

3 Conclusions

The motivation to provide self-x functionalities of 802.16 entities was outlined. As an example, self-configuration and self-optimization functions have been introduced. Furthermore, a possible development scenario of the envisioned self-x services integrated into the NETMAN framework has been presented to reveal that a further study is required to determine how support of the proposed functionalities could be provided and its impacts to the standardization activities of 802.16.

This contribution intended to initiate the discussion regarding the support of self-x functionalities within the 802.16 standardization group. As an output of the discussion it is expected to know the position of 802.16 with regard to the proposed automated processes. Aspects like the concrete algorithms that are needed for deriving various parameter values do not require standardization and let room for vendor specific optimization solution. But, in order to ensure the support of such self-x functions in a multi-vendor environment some standardization efforts would be necessary to ensure information exchange and agree on required interfaces, primitives, specific measurements or value formats. We would appreciate discussion on e.g. whether a self-configuration function should be implemented as a NCMS functionality and clarification of the impacts on standardization to support self-optimization processes.

4 References

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