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Review on Self Organizing Networks (SON) in LTE-Advanced HetNets

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Abstract: However, global service suppliers consider continuous interworking with available networks as the most significant factor, it is most likely that LTE-Advanced of 3GPP is chosen as international standard for 4G wireless communication. Self Organizing Networks (SON) based on service self-organization which offers subscribers with service continuity even when mobile subscribers have session mobility and terminal mobility, and enable service suppliers to carry out "heterogeneous multi-network of integrated" which assures better service with respect to transmission speed, wireless communication access and Quality of Service (QoS). It is also required to permit fast handover service i.e. VOD and streaming in LTE-Advanced system. Furthermore, this review paper describe various SON features and releases that conducting joint research and technology transfer in the future.

Keywords: SON, Service Continuity, Service Self-Organization, Heterogeneous Networks.

I. INTRODUCTION

For developing to 4G mobile communication, the requirement to evolve the systems towards providing support to a broader range of telecommunication applications, including multimedia service, is increasingly achieving significance. Consequently, ITU continues 4G technique as IMT-Advanced, and defines high network convergence, data rate, ubiquitous and continuous connection as features. In turn, mobile operators now face the issue of maintaining these increasingly complicated networks composed of several Radio Access Technologies (RATs), various cell types and subscribers with a variety of QoS needs. The income of the mobile operators is, generally, degrading simultaneously. Hence, it is significant that combining and operating novel and available network nodes need minimal manual attempts to control OPEX. Accordingly, considerable industry momentum has made currently to establish Self-Organizing Network (SON) characteristics that can control mobile network deployment, operation and management. Within the 3rd Generation Partnership Project (3GPP) Long Term Evolution (LTE) standardization, SON was among the early system needs; SON characteristics were involved in the first 3GPP LTE Release, Release 8 [1, 2]. SON operate in 3GPP has been inspired by available SON studies and the set of needs described by the operators' bond, Next Generation Mobile Network [3]. As a technique which fulfils above specified situations, LTE -Advanced is in the importance now [1-3]. As indicated in Fig 1, 3G LTE utilizes backbone depending on ALL-IP, interworking with various networks continuously. The service provided from 3GPP LTE-Advanced is always linked with data rate of over higher 100Mbps and lower delay; it is possible to continuously interwork with available facilities in HSDPA and WCDMA networks. In case of choosing 3GPP LTE-Advanced, it is possible to connect available 4G and 3G networks, so all of communication services could be utilized with only one mobile terminal. The most unusual method for this is service continuity technique by seamless connection [4-8].

LTE-Advanced should offer high-speed data communication primarily in hot-spot region, and provide service continuity during session mobility and terminal mobility with only a mobile terminal. Since, in LTE-Advanced where several networks available, it is actually complicated to offer service continuity effectively [9-11]. And because every resource in LTE-Advanced system and the network state i.e. bandwidth, error rate change variably, it is assumed that it is impossible to control service continuity with artificial, procedural, and static control method employed to the available voice service. As a solution for this, we propose a self-organizing network (SON) concept in LTE-Advanced. it is targeted at building heterogeneous networks expand more stably and effectively through employing self-organization concept that various networks unite and interact for better impact, so that it has obtained a lot of care as core technology to employ commercial system of future mobile communication networks after 4G as well as LTE-Advanced [11-13]. As of yet, it mostly concentrates on development of physical aspect i.e. performance enhancement, setting up base stations and capacity expansion, but it is viewed that if a mechanism which confirms service continuity depending on self-monitoring method is developed, it will play a primary role in market expansion of LTE-Advanced; self-monitoring is a technique for performing traffic control and enhancing resource capacity by examining some context information about neighbouring terminals and cells, which is the central technology of SON [14-15].

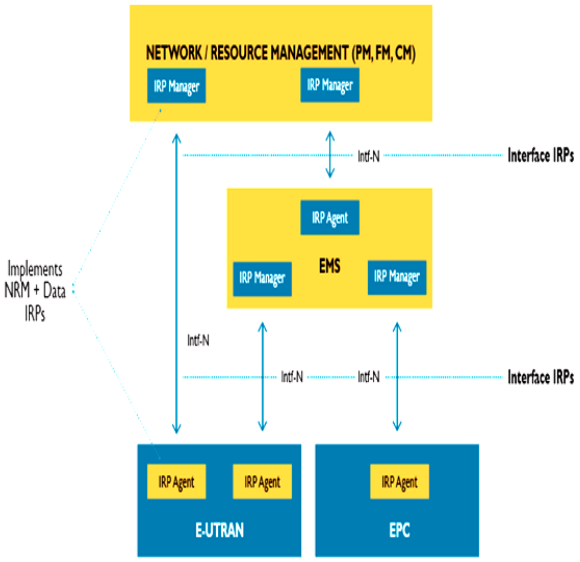

Figure 1. 3G LTE network structure

We suggest a service self-organization technique to support the service continuity efficiently depending on SON, in which a mobile terminal gathers some information about its current state of every cell and a base station, depending on the information gathered by maintaining inner or neighbouring cells, controlling service continuity on its own and shares related data and converges. In other words, related information of cells and mobile terminals varies, the operation of context functions i.e. cell selection, ISHO, load control, source allocation and QoS mapping is followed; every function is proper into the change, exchanges the phenomenon of reorganization, and interacts; these actions go toward to fulfil service continuity.
In current literature, SON has been defined in [4] and [5]. SON relates to Minimization of Drive Tests (MDT) [6].
An important driver for mobile operators implementing SON is to reduce OPEX and CAPEX in all stages of the network engineering life cycle: planning, deployment, and operation. The SON characteristics also targeted to improve network performance. The utilization of SON is necessary, if not inevitable, for most operators operating multi- vendor, multi-RAT and multi-layer networks in which an overloading no. of parameters has to be assembled and analyzed. For SON to be attractive to mobile operators, its advantages, involving both performance enhancement and OPEX/CAPEX degradation, should outweigh the cost to implement and maintain SON-related services. Towards this objective, operators have a no. of high-level aims for every stage of the network engineering life cycle:
1 ***Planning*** of new sites (or extension of available ones) should be as easy, time- and cost efficient as possible, lead to the fewest no. of sites (or the most cost-efficient deployment) for a required performance, and depend on sufficiently right information.
2 Deployment of new sites should be as easy as possible with the less cost and effort— i.e, "plug and play"—and with no interoperability problems.
3 Operation of the network(s) should also be as easy as possible with the less cost and effort, permit for rapid and efficient identification of an issue and its reason, assure immediate (and preferably automatic) reaction to issues (for example, self-optimization and self-healing), and results the best possible performance and optimum usage of the deployed resources. A summary of SON services and where they are suitable in the network engineering life cycle is overviewed in Fig. 1. This fig represents that operational efficiency for mobile operators is required to increase as new SON characteristics become existed. By operational efficiency, we mean efficiency in effort and cost spent in deployment, planning and operation, as well as network performance. This article offers a summary of SON 3GPP standardization, involving its relation to MDT and its required usage in the three network engineering stages. First, available SON solutions in 3GPP (up to Release 11, finished in early 2013) are explained. Following that a summary of ongoing SON standardization (such as Release 12, required to be completed at the end of 2014) and a future vision for SON is shown. At last, we offer a point of view on how these solutions are related to mobile operators, involving potential issues.

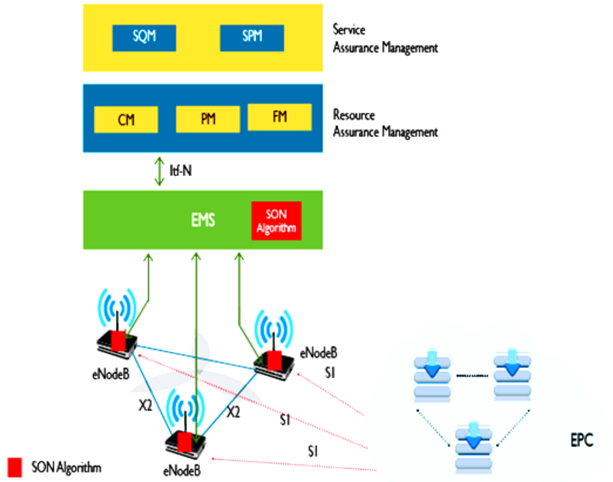

Figure 2: SON Algorithm

II. PREVIOUS WORKS

3GPP is an organization for standardizing LTE which is known as 3.9th generation with GSM, HSDPA, WCDMA employed by current 89% of mobile communication users. It has been carried out the standardization of LTE-Advanced for fulfilling the system need of IMT-Advanced by complement of LTE technology. Though it is difficult to expect that LTE-Advanced is more developed in epochal technology as compared to LTE, it is suggested to be enhanced in the area of broadband support, , network cooperative communication, multiple antenna expansion, SON technology. The study on the idea of common radio resource management, whose aim is to maintain every access network in a synthetic manner to supply ISHO function and to evaluate the performance in several heterogeneous access networks, is being conducted actively. Particularly, 3GPP proposes a network structure for combined radio resources management in TR25.881 the technique standard text and common radio resource management (CRRM) the mechanism of the combined radio resources management to support that, and several projects to change and complement the weak point of CRRM are being suggested.
SON is targeted to organize the network effective, stable and scalable utilizing the idea of self-organization. Particularly,

with introduction of femto cell and next generation 4G projected in mobile communication system, SON which involves the automated functions i.e. self-configuration or self-organization is estimated as a primary technique of commercialization. It is because SON technology, which is capable to observe the convenience and reduction of operation, simplification of management, and increase of capacity, support cost and so on, is taken as an optimal alternative with decrement of total cost of ownership and enhancement of managerial efficiency evolved as key words of service suppliers. Particularly, every major equipment company also formulates SON technology and devotes all their attempts to secure service suppliers which require curtailing the cost because of explosive increase in the amount of utilizing data and a flat rate system. Because the sections which self-organization can be employed are really various in the mobile communication area, the idea of self-organization can be utilized for the individual management algorithm and the optimization method according to the features and kinds of network which is proposed to organize in self-organization. on the LTE Evolved UTRAN (E-UTRAN) specification. The work has materialized as needs and

• ***NM-centralized*** **SON** works to meet centralized schemes described in the NM, reconfiguring NE parameters depending on network information fed back from the NEs. It depends on the indicators of performance and schemes described in the OAM specifications in 3GPP.

• ***Distributed SON*** is enforced in the NEs (generally eNBs in the situation of E-UTRAN, and the Radio Network Controller (RNC) for the UMTS Terrestrial Radio Access Network (UTRAN)). Schemes are obtained from, and KPIs offered to, the NM via the DM over the Itf-N/S interfaces. Inter-NE signaling occurs over standardized interfaces.

• ***Hybrid SON*** is necessarily a integration of both distributed and NM-centralized SON functional components.

III. SON CHARACTERISTICS

***A* .Self-Configuration:** The initial configuration of network elements in a mobile network is complicated by a large no. of parameters maintaining configuration manually is difficult and time consuming. This is an apparent candidate for automation because network nodes normally have common values for large portions of the configuration settings. In self-configuration network elements may be related with an initial set of site-specific parameters in an optional planning phase. This collection of parameters may be assembled via the 3GPP automatic radio configuration data-handling function (ARCF), and may involve pre-configured neighbor relations, cell identities, transmit power levels, antenna configurations, operational carrier, etc. The ARCF, together with any software upgrades, are transmitted to the eNB in the self-configuration installation mechanism once connectivity has been developed. After self-testing, the eNB is operational and ready to support mobile terminals.

B. Automatic Neighbor Relations (ANR): Conventionally, a major optimization/configuration cost for operators has been the manual generation of neighbor relations among cells. This is based on the LTE ANR function positioned in the eNB. It helps in management of neighbor cell relations within E-UTRAN, between UTRAN and EUTRAN and from E-UTRAN to GERAN and CDMA2000 cells. Depending on the UE ANR characteristic, an RNC or an eNB can request a UE to decode neighboring cell system information and inform the decoded information back. Depending on this information, the eNB can identify a unique cell identifier for the neighboring cell. This implies that the supporting eNB has enough information to start a handover to the detected cell. Alternatively, the eNB may further utilize the unique cell identifier to fetch connectivity information from the neighboring base station through S1 eNB/MME configuration-transfer mechanisms and start development of an X2 interface. The evident benefit of ANR is that by utilizing UEs to generate and update neighbor relations the entire procedure can be finished automatically. Provided the no. of UEs in a network, this procedure is faster, more flexible an nd cost efficient as compared to manual configuration or drive tests.

C. Automatic Cell Identity management: Mobility in 3GPP networks depend on UE guided reporting of physical cell identifiers (PCIs) that rather should be temporary unique. Non-unique PCIs can cause to *confusion* (a cell has two or more neighboring cells with the same cell identifier) or *collision* (neighboring cells have the same cell identifier). PCI collision/confusion can be determined through the UE ANR mechanism. The OAM system, observed of the determined PCI collision/confusion, can start a centralized PCI re-assignment procedure. This introduces a new PCI to the cell depending on the neighbor-relation information in the OAM system. Optionally, the OAM system may offer the eNB with a set of existed PCIs to choose from, and authenticate the eNB to choose an optional PCI, in consideration of allocated PCIs in environment eNBs.

D. Random Access Optimization: The main aim of the random access mechanism is for UEs to observe their existence to the network and set up uplink time synchronization with it. In the mechanism, the UE will choose an access slot, a preamble waveform and a transmission power. These parameters are subjected to optimization to satisfy needs in terms of:

• ***Access probability***, which is the possibility of a UE having finished access after a particular no. of random access attempts, or

• ***Access delay (AD) probability***, where access delay is described as the time duration for a random access mechanism to complete once it is started by a UE.

To support RACH performance estimation and optimization, the UE can be assisted to offer a RACH report to the eNB after a finished access attempt. This solution depends on UE reports because the UE can manage radio-related problems which the network may not be known of. Thus, same as the ANR function, this characteristic makes usage of UE reporting and monitoring abilities.

E. *Mobility Robustness Optimization (MRO*): Robust mobility support is central to mobile networks and MRO is a key SON characteristic. MRO needs for intra-LTE mobility are mentioned with respect to acceptable mobility failure rates while neglecting unessential handovers as much as possible. The corresponding handover needs can also be developed among any RAT or between any two RATs. The LTE MRO function can be positioned in the eNB. The handovers are UE-guided, which means that the UE is

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configured by its supporting eNB to forward a Measurement Report (MR) once a reporting criterion is fulfill. Upon obtaining a measurement report involving information about the candidate cell triggering the report, the supporting eNB may start the handover mechanism to the target cell through S1 or X2 signaling. If the handover fails, the UE will attempt to re-establish the link to the radio access network or move to idle mode and reconnect at a later phase. Current additions to UE Radio Link Failure (RLF) reports in Release 11 involve feedback about the time elapsed since failure (such as for removal of stale reports) and information and signaling to determine inter-RAT mobility failures. Similarly, a handover (HO) report can be forwarded from a different RAT to E-UTRAN to show an unessential inter-RAT HO. In such situations, upon indication from the source E-UTRAN and after a completed handover, the target RAT enforces the UE with inter-RAT cell measurements in the source RAT (E-UTRAN). If the coverage of one or more E UTRAN cells is measures as acceptable for a particular time after the HO, then the inter-RAT HO is assumed unessential. The same procedure permits E-UTRAN to configure a timer in a aimed RAT to determine inter-RAT ping pongs. Namely, if an inter-RAT HO towards E-UTRAN happens within such a pre-described time window, the HO is assumed “too early”. The MRO solution integrates events monitored by UEs which are not appeared directly from the network together with information from numerous eNBs to determine the main cause of failure. Observe that from Release 10, MRO enables UE signaling of RLF Reports after active-idle transitions, which is specifically useful in inter- RAT mobility failure resolution.

IV. MOBILITY LOAD BALANCING (MLB)

The purpose of MLB is to maintain uneven traffic distributions, while reducing the no. of required HOs and redirections. The thresholds triggering an offloading action can be enabled by general cell overload and associated load-performance indicators. To neglect jeopardizing mobility robustness, the same targets mentioned for MRO can also be assumed. The MLB service is in the eNB.

A problem with heterogeneous networks is that small cells may pull too little traffic, which calls for macro cell offloading mechanism. One such mechanism is cell range expansion, where a Range Expansion Bias (REB) is taken for small cells when measuring measurement-report triggering standard for some or all UEs.

The compromise of the REB can be viewed as mobility load balancing. These adjustments require to consider UE-particular aspects i.e. detection abilities and recent traffic-load contributions because of the volatile behavior of interference in the range-expansion region. In 3GPP, eNBs can share resource status information through X2. Energy is an important cost in running mobile networks. The only standardized procedure to decrease energy consumption is to deactivate cells that are locally not required. To provide network energy saving, signaling support is mentioned among BSs as well as among RATs. If an eNB has switched off a particular cell to decrease energy consumption, it may observe neighboring eNBs through a deactivation indication over X2. Moreover, an eNB can request a neighboring eNB to re-activate a prior switched-off cell through a cell activation request. Release 11 has proposed some inter-RAT support, where it is possible to transfer cell activation/deactivation information among RATs (for example UTRAN) through SON transfer messages. The latter technique decreases complexity while managing interoperability.

V. SON FOR RELEASE 12 AND BEYOND

Following the work performed on SON and MDT in recent 3GPP Releases, a new study item [7] to explore SON initiated in early 2013 and concluded in mid-2014. Specification work started thereafter and is required to finish by the end of 2014. In the following sections we describe the Release 12 developments further. Possible developments beyond Release 12 are then also explained.

Release 12 SON: Current specifications enable mobility settings among different UEs to be distinguished. The aim of the “SON for UE types” task is to measure if such differentiation can have a negative effect on interoperability. If this is so, then solutions to the interoperability issues are assumed. One issue detected is the ping-pong handovers caused by various mobility settings in neighboring cells.

Active Antenna Enhancements*:* Active antenna systems are one way to enhance the capacity of available networks. Currently, deployments tend to be comparatively fixed, generally just adding vertical sectorization. Since, the technique does enable the possibility of more dynamic usage, including cell shaping, UE-specific beam forming, cell splitting and merging. The case where the no. of cells and the cell coverage change over time is illustrated in Figure 3. Such splitting and merging can be utilized to adapt system capacity based on traffic situations. It can be viewed as a way to offer more reliable coverage/capacity management. Since, the capability to split and merge cells dynamically builds the actual management of these systems increasingly complicated. With this in mind the work in Release 12 targeted at enabling support for network deployments depending on the generic characteristics of active antennas. More particularly it studied whether available SON characteristics for deployment automation can be explored to deal with dynamic changes possible with active antennas i.e. cell splitting or merging. The main concentration on the study item related to connection failures because of cell splitting and merging, as well as effects on MRO. The work will continue with a Release 13 work item.

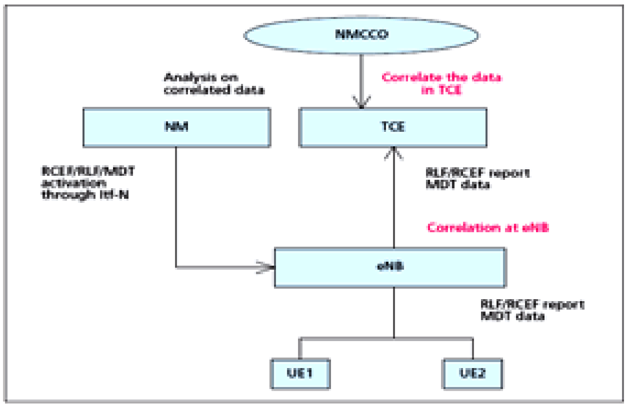

Figure 3: Input data (RLF/RCEF and MDT) for CCO at network management

Pre-Release 12 Small Cells Enhancements — The term *small cells* widely explains low power, operator-controlled, radio-access nodes. Small cells, which involve pico-, femto-, metro- and micro-cells, have a range from tens to hundreds of meters. They're often deployed by operators wherever *extra* capacity is required. Particular SON functions for small cells may decrease network planning efforts, improve network optimization and address issues and scenarios particular to small-cell deployment. Mobility robustness is a challenge, particularly because moving UEs may switch frequently among small cells. The introduced Release 12 improvements are designed to offer the network extra information (such as further RLF reports if failure happens after re-establishment and UE time-to-trigger (TTT) information), which can be utilized during MRO analysis so that better corrective actions can be considered. In addition to, OAM and S1-based solutions have been introduced to simplify inter-RAT RLF reporting in "LTE island coverage" scenarios where there is no LTE coverage environment the small cells.

Multi-Vendor Network Element Plug and Play — The Release 12 work item covered scenarios where an eNB is linked to the protected operator network either through an external network or a non-protected operator network. Server addresses required for several configurations are achieved through domain name servers [11].

VI. OPERATOR PERSPECTIVE ON SON

The trend in network operations is to slowly move from "semi-manual" toward autonomous planning, deployment, and optimization (Figure 1). An open-loop or semi-manual operation means that SON services recommend configurations which are first sanctioned by the operator before being enforced. Autonomous network operation, also called closed-loop, means that sanctioned by the operator is ignored. Instead, the operator simply describes high-level performance objectives (in the form of a scheme) and monitors to what degree the scheme is satisfied in the network.

In the **planning phase**, the DSS and CCO functions, with the support of MDT, can decrease the operator's attempt in planning (i.e., decrease OPEX) and choosing optimum network extensions (i.e., decrease CAPEX). Operators will still require an initial planning attempt to deploy the coverage layer, but this attempt will decrease as the coverage layer is enlarged (or completed) and has to be explored with a capacity layer. It is needed that the DSS and CCO functions will be centralized and will generally operate at the NM level. This is because DSS and CCO analyze and optimize a cluster of BSs and the dynamics of the suggested reconfigurations or extensions are comparatively slow such as up to a few reconfigurations per day or week for CCO or long-term extensions deployed over several months for DSS.

To involve NM-centralized SON in the planning stage successfully, operators must address the following issues:

1 **Availability and accuracy of input data for proper NM-centralized SON decision-making**

Input data offered to NM-centralized SON functions may be in the form of KPI and MDT reports/traces, enriched with geographic coordinates. Gathering this data is provided by UE and eNB characteristics that are only optional. Because of this and the availability of legacy BS s and UEs, the existence of input data may be restricted. A considerable portion of input data may be offered by vendor-proprietary solutions.

2 **Facilitating the collection and processing of data. Because of** the large no. of base stations and subscribers, as well as frequent logging and reporting of related information, a large amount of data required to be managed by the operator's network management system. This needs enough Itf-N transport network capacity, processing capacity and data storage capacity for the NM-centralized SON algorithms.

3 **Linking and synchronizing the NM-centralized SON functions functions with an operator's existing planning tools and Processes, as well as BSS/OSS systems.** It is significant that the same, up-to-date input data is existed to all tools/processes included in the planning stage. Discrepancies in input data among various processes and tools at the time of planning might result in sub-optimum configurations and network instabilities.

VII. PROPOSED SCHEME

If LTE-Advanced becomes 4G-integrated standard, and a commercialization, service suppliers which have several access networks, could integrate a variety of access networks depending on IP core network without another networks investment. This paper, with this industrial background, proposes a layered technique for providing support to service continuity utilizing SON, which is central part for commercial system application in LTE-advanced distributed networks. Fig 4 indicates a two-layered control method for the service of self-organization depending on SON.

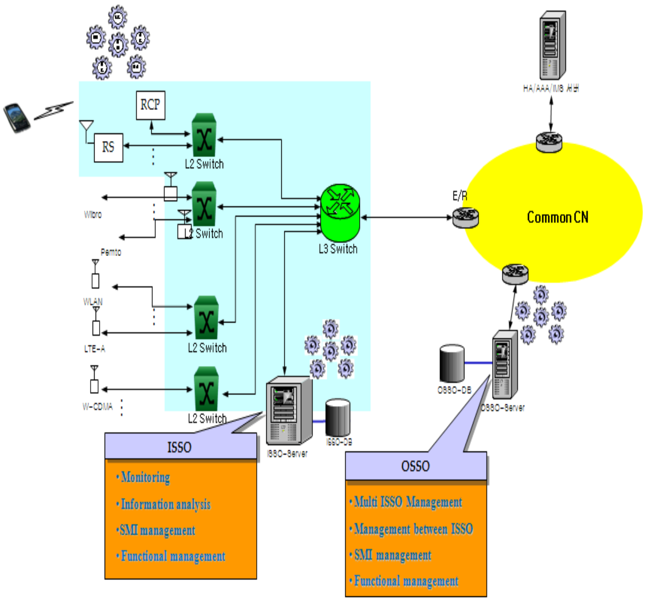

Figure 4: Two-layered control mechanism for service self-organization [2]

7.1. SON based service control mechanism: The self-organization service, which employs a SON-based control technique different from CRRM (TR25.881), is the overlaid control technique depending on distributional control by two-layered structure to be supportable for both loosely coupling and tightly coupling network capable to be organized with respect to service supplier's network configuration.

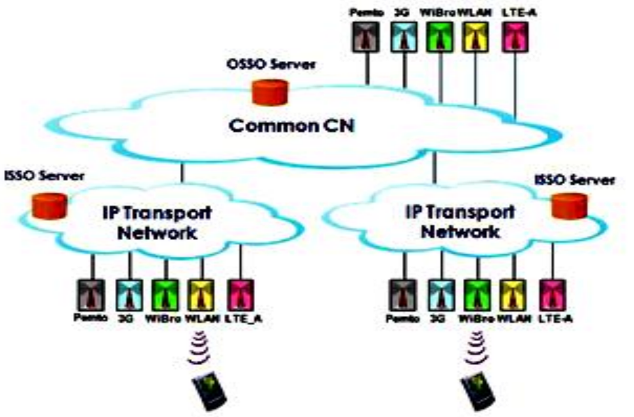

Figure 5: Two-layered control mechanism for service self-organization

As illustrated in Fig 5, the inner-service of self-organization (ISSO) is positioned in local networks to support service continuity for continuous mobility happening between tightly coupling sub-networks in LTE-Advanced effectively; the outer-service of self-organization (OSSO) is positioned in external network to maintain the ISSO majority and to support service continuity between loosely coupling sub-heterogeneous networks.
Figure 4 illustrates the suggested control hierarchical control structure to provide support to the self-organization service in LTE-Advanced. All functions are positioned at ISSO of LTE-Advanced access network and OSSO of LTE-Advanced central network; every function is as described; Service Management Index (SMI) rule maker which explains SMI of service suppliers, SMI monitor which gathers the conditions employing to SMI, and SMI firer which deals with functions the control system should carried out directly by Lego method.

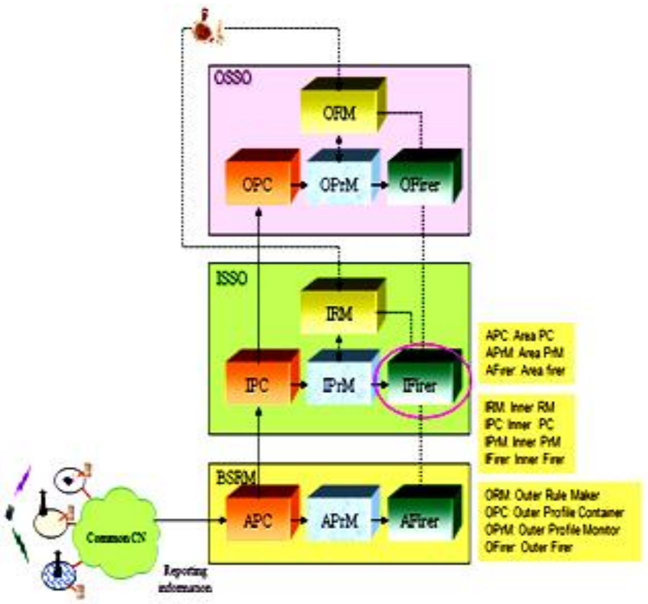

Figure 6: Hierarchical structure for service self-organization [2]

OSSO/ISSO is designated so that both loosely and tightly coupling network can be supportable, and the self-organization technique service is formulated depending on regional distribution and integration control of OSSO/ISSO. For this, ISSO is formulated to be capable of removal of unessential function and summation of function by conducting the embedded module type interconnecting with protocol.

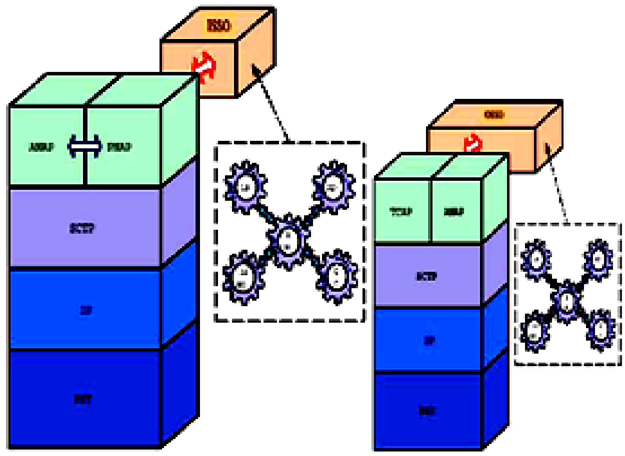

Figure 7: Interworking structure for service self-organization

7.2. Gearing method

To follow the dynamically varying environment around cells and mobile terminals, it should be able to build self-control/adaptation/reconstruction of functions. As illustrated in Fig 8, the control interface depending on Gearing is designated so that every function for service self-organization can be integrated according to utilization case. After every algorism is planned as module to be capable to carry out independently in real-time processing of information sharing, service continuity and dynamic adaptation are composed for all functions to adjust and share the information for excluding the confused link in the coordination between the functions and to delete the bottleneck reason. For this, the facility of self-adaptation technique and the facility of self-monitoring technique are taken. The service of self-monitoring examines the current state depending on external information and internal information gathered through monitoring cells and mobile terminals. The functions to operate in every use case are chosen from the circumstantial judgment result. The self-adaptation service is carried out to control the related parameter automatically to be fit for situations. Every function with operation techniques interacts, reciprocating the mechanism to adjust and reconstruct to changes.

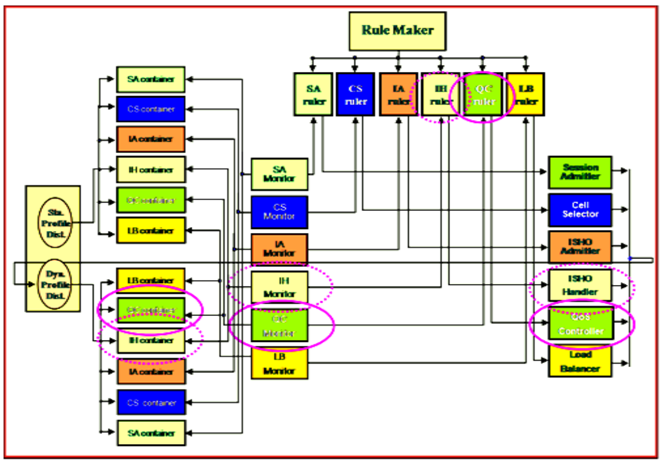

Figure 8: Service self-organization mechanism based on gearing method

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7.3 Lego method

For effective implementing the self-organization service and commercialize it, coping adaptively with the management direction of every service suppliers, Lego based function integration is taken into consideration. By this, modularity, open interface, commonality, flexibility can be fulfilled simultaneously. This employs the modularization technique employed in mechanical engineering, and is an epochal lego-style treating mechanism which enables adaptive combination and separation of various functions by dichotomizing and stratifying interface with lego-style followed between the functions. Fig 9 illustrates an example of the combinable function with respect to use case. For instance, in spite of the new session need, functions to use are chosen by firing SMI conditions and monitoring some information i.e. near base station, user terminal and radio condition. The optimal result in current situation can be achieved by making various parameters between the shared functions.

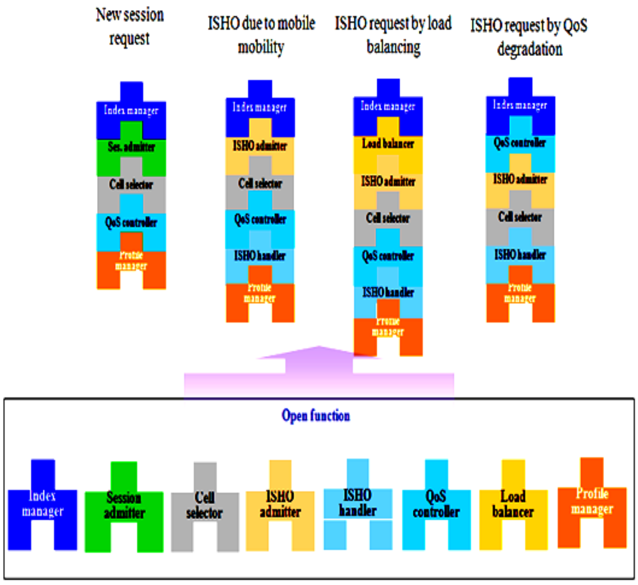

Figure 9: Examples of the combinable functions by Lego method

Lego based function integration is planned for acting in every parameter suitable for service region where mobile terminals are positioned, by deciding action of every function and analyzing separately only with local information with respect to distributed processing concept of the self-organization service. For this, Lego based function combination requires three element techniques from the technical perspective. Those three element techniques are as described; dynamically interconnecting scheduler which integrates functions with respect to use case putting lego based function combination to utilization; interconnecting structure by function which excludes composition factors of every function, such as system elements including base station, terminal elements, wireless network element, and develops their correlation with respect to use case; interconnecting structure by parameter for effective adaptation of related parameter with respect to environmental change; task-based design for analyzing operation as well as reducing behaviour phenomenon. Fig 10 illustrates interconnecting structure for assignment of shared value at the time of cell selection, in situation of terminal mobility.

Title	MISHOCellSelection
Subject	ISSO
Initiator	MT
Target	MT
On	MT == Mobility
Value	If (ISHO == MISHO) Then (Cell Average Delay ::= MTI) && (Packet Loss ::= I) && (Mobile Speed ::= I) && (Cell Load ::= LTI) && (Maximum Bit Rate ::= MEI);

Figure 10: An example of the combinable function for cell selection

CONCLUSION

Network automation typically and SON particularly offer the most predicting paths for mobile network operators to manage the increasing pressure to offer ever-higher-performing services, while decreasing costs at the same time. A considerable no. of SON services has been standardized in 3GPP to provide automation of deployment, planning and optimization for mobile operators. There is a clear direction that network operations are shifting from manually intensive and fixed (or gradually changing) network configurations toward (semi-) automated and dynamic/pro-active network operations. SON functions standardized up to Release 11 involve self-optimization and self-configuration characteristics. These characteristics are supported by MDT, which provides the collection of measurements from UEs. In Release 12, to be completed in December 2014, further SON improvements have been investigated. These can make capable operators
to have tailor-made optimization depending on UE groups, provide dynamic shaping of the cell coverage region (involving cell splitting) for eNBs fitted with adaptive antenna systems, and help in the planning stage with the NM-centralized CCO function deployments. Operators must fulfil several issues if they're to incorporate NM-centralized SON services successfully. Also IPR is also required to become significant. Initial development of LTE-Advanced related technology developed depending on this mechanism would provide us a beneficial location for developing other related techniques - standardizing them, and pre-empting evolving technology. Consequently, we would be capable to respond promptly to the international research trend and patent application by gathering all the related techniques needed for the service continuity in LTE-Advanced system and demonstrating source technology depending on them.

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