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A Study on Forward Handover in Ultra Dense Network

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Abstract

To handle the massive data needs of future cellular networks, an ultra-dense network strategy is being implemented to minimize Base Station coverage and boost frequency reuse, but many difficulties like increased Handover failure rates, Handover delays and ping-pong rate, high energy consumption, high packet losses, and user have to suffer terrible experience in high-speed user equipment circumstances. Various ways have been presented for an efficient handover. The triggering of handover is hugely reliant on the user equipment speed. It implies that if the user equipment speed varies, so does the handover triggering duration. It indicates that speedy user equipment has a substantially handover failure ratio than low-speed user equipment. A significant difficulty is determining a more precise handover triggering point. For making handover more effective, parameters of handover must be carefully selected and optimized. Each of these systems has advantages and downsides, and each performs better than the others under particular conditions. The papers describe these approaches.

Declaration by author

This thesis is composed of our original work, and contains no material previously published or written by another person except where due reference has been made in the text. We have clearly stated the contribution of others to our thesis as a whole, including statistical assistance, survey design, data analysis, significant technical procedures, professional editorial advice, financial support and any other original research work used or reported in our thesis. The content of our thesis is the result of work we have carried out since the commencement of Thesis.

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Keywords

Forward Handover, Pico cell, Macro cell, Femto cell, Self Organizing Network, Handover Failure, Ultra Dense Network, Time to Trigger, Ping Pong Effects, Heterogeneous Network.

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List of Abbreviations and Symbols

Abbreviations	
3G	Third Generation
3GPP	3rd Generation Partnership Project
4G	Fourth Generation
5G	Fifth Generation
LTE	Long Term Evaluation
MIMO	Multiple Intput Multiple Output
OFDM	Orthogonal Frequency Division Multiplexing
GPRS	General Packet Radio Service
WLAN	Wireless Local Area Network
RAN	Radio access networks
SON	Self Organizing Network
eNB	eNodeB
OAM	Operation and Management
SLA	Service Level Agreements
ANR	Automatic Neighbor Relations
QoS	Quality of Service
RLF	Radio Link Failure
SINR	Signal to Interference Noise Ratio
UDN	Ultra Dense Network
HO	Handover
P-M	Pico-to-Macro
M-P	Macro-to-Pico
UE	User Equipment
BS	Base Station
HOF	Hand Over Failure
HOM	Hand Over Margin
TTT	Time to Trigger
LPN	Low Power Nodes
IoT	Internet of Things

NAS	Non-Access Stratum
LTE-A	Long Term Evaluation Advanced

Chapter 1

Introduction

The growth of wireless communications has undergone a massive transformation in recent years. A decade earlier, the primary goal of using mobile phones were for making phone calls and delivering text messages via short message service (SMS). However, the introduction of 3G, which enabled the use of broadband data to access the internet, and later 4G, which offers faster speeds, led to the development of mobile broadband and data-oriented devices like smartphones as well as USB modems. These gadgets are fueling a fast surge in mobile data consumption. In addition, the usage quantity of mobile, laptops is rising quickly which is leading a rise in mobile data traffic. Monthly worldwide cellular data use will exceed around 77 Exabytes within 2022, while yearly congestion will outreach approximately one Zettabyte [r19,]. Mobile networks must accommodate the expansion in the amount of connected devices, combined with customer requests for better speeds, in order to support real-time video streaming and online gaming. Consequently, mobile networks must change to accommodate these needs. In previous years, the desired increase in connectivity would have been met by adding additional macro nodes. However, the high price and space requirements for such a strategy provide a significant challenge for operators [Damnjanovic et al., 2011]. Furthermore, per-link spectral efficiency is approaching theoretical limitations [Pedersen et al., 2013]. To accommodate the growing number of devices, 4G was deployed. 4G is the term for fourth generation wireless, the phase of mobile broadband communications that followed 3G (third generation wireless) and was overtaken by 5G (fifth generation wireless). Bandwidth speeds and network capacity have improved in each new version of wireless cellular technology. 4G subscribers receive speeds of up to 100 Mbps, whilst 3G users were promised 14 Mbps. Multiple Input Multiple Output named as ”MIMO” and Orthogonal Frequency Division Multiplexing called as ”OFDM” enables 4G's transmitting and receiving capabilities. MIMO and OFDM allow for greater capacity and bandwidth than 3G. 4G has some issues too. In modern communication systems, 4G networks confront numerous obstacles during handover. Specifically, if a mobile user is undergoing a handover procedure between communication systems such as from GPRS to WLAN, there is a danger of breakdown in communication that might leave the user dissatisfied. 5G is the fifth mobile network generation. 5G is expected to deliver faster peak data rates, ultra-low latency, higher reliability, wider available bandwidth, enhanced attainability. In wireless data networks, handover is one of the most crucial factors that might hinder the performance of system connections. Handovers are utilized so that users can maintain network connectivity when moving from one network access point to another. The fundamental purpose of the handover method is to enhance the overall network utilization and guarantee the greatest possible communication connectivity for the user. Due to forward handover failure low latency, packet data loss, call dropping and many more. Handover is a crucial step for enabling users can freely navigate the network while remaining connected and receiving significant services. Due to the fact that customer satisfaction is reliant on its success rate, it is important that this activity be carried out quickly and effectively. Therefore, it is justifiable that at the very least, key network functions, such as handover, should be supported by the mobile operator. In addition, comparable difficulties may develop as a consequence of network latency when the forward handover technique is applied straight to handle handovers among picocell and macrocell. To increase the efficiency of picocell to macrocell handovers, it is necessary to reduce the quantity of subprocesses of the forward handover procedure that rely on IP backhaul networks. Nevertheless, a method that can adequately address all the obstacles of high-speed mobility is not yet available. This paper attempts to give a brief about forward handover so that it can be explored further and reduce the challenges.

Chapter 2

Self-Organizing Network

2.1 Self-Organizing Network

Radio access networks (RANs) which can organize, configure, regulate, optimize and heal themselves are defined as self-organizing networks. Self-configuration, self-optimization, self-healing, and self-protection are some of the automatic services that SONs can provide. By allowing the establishment of a plug and play environment, including both basic and complex network operations, SONs aspire to make difficult network management, an aspect of the past. The traditional cellular wireless networks that are implemented in enterprises, a majority of them feel the necessity for teams of professionals for maintenance, management, and optimization.

2.1.1 SON Architecture

An automatization subsystem In OAM (Operation And Management) is developed to handle eNB (eNodeB) self-configuration. They can be placed in OAM, eNB, or both for self-optimization functions. Hence, SON could be categorised into three forms relying on the placement of optimization techniques. These are Centralized SON, Distributed SON and Hybrid SON.

Centralized SON

The OAM System executes optimization algorithms in Centralized SON. In certain solutions, SON functionality is concentrated in a few spots at a top standard of the structure. Figure 2.1 depicts a case of Centralized SON.

Every SON operations of Centralized SON are placed within OAM system, making them simpler to set up. However, because each vendor has its radical OAM system, there must be minimal assist for optimization instances across providers. However it does not enable such straightforward and rapid minimization situations. The preexisting Itf-N protocol must be enhanced in order to implement Centralized SON.

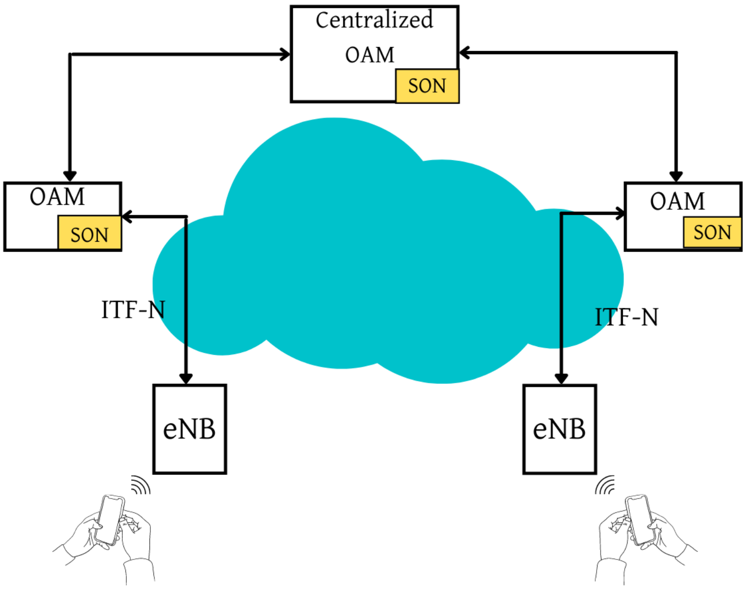

Figure 2.1: Centralized Son Example

Distributed SON

eNB is where optimisation algorithms are executed in Distributed SON. In these kind of solutions, SON functionality is distributed throughout the architecture at a low level.

Figure 2.2 illustrates a Distributed SON instance.

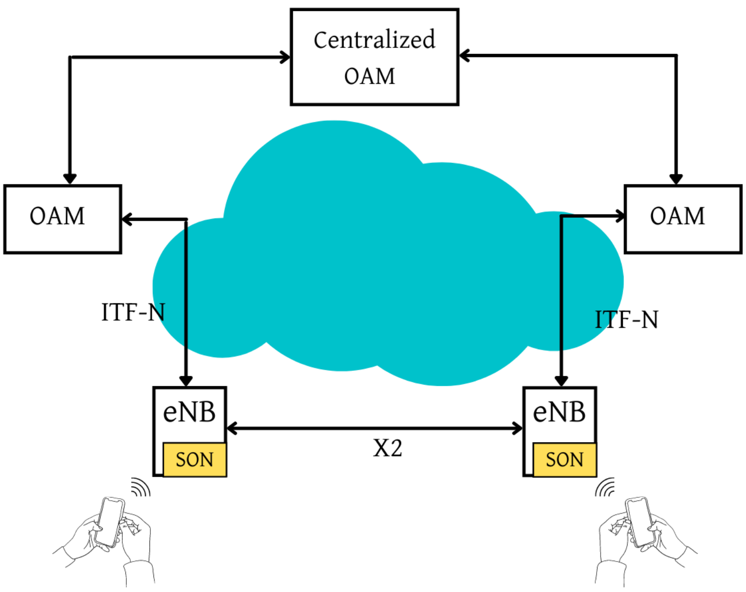

Figure 2.2: Distributed Son Example

As all SON functions of Distributed SON are placed within eNB, it requires a significant amount of implementation effort. It can also be challenging to handle complicated optimization strategies that necessitate the coordination of a great amount of eNBs. However, considering Distributed SON, it's indeed convenient to accommodate instances involving just one or more eNBs while requiring speedy optimization outputs. The X2 interface must be expanded for Distributed SON.

Hybrid SON

Part of the optimization techniques in Hybrid SON are performed within the OAM platforms such as the complex ones, while others are operated in the eNB such as the easy ones. Hybrid SON is depicted in Figure 2.3. As a result, it is very adaptable to different types of optimization cases. It also allows for

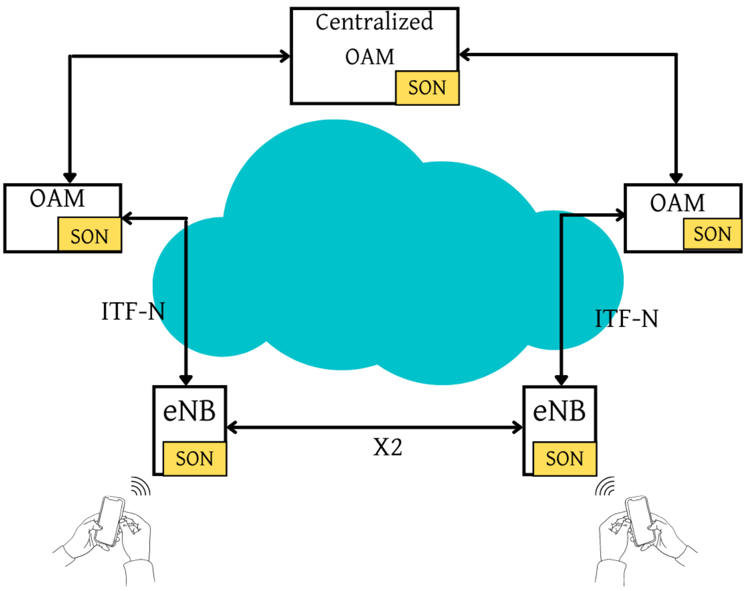

Figure 2.3: Hybrid Son Example

optimization amongst various suppliers through the X2 interface. On the contrary, this necessitates a significant amount of implementation effort and interface expansion work [Feng and Seidel, 2008].

2.1.2 SON Functionality

Auto-configuration, auto-optimization, auto-healing, and auto-protection are some of the few roles that SON can do. Artificial intelligence, predictive analytics, and pre-optimized software algorithms enable these capabilities. The SON can instinctively detect and register new access points / base stations. To avoid congestion and enhance capacity and coverage, nearby radios simultaneously modify their emission rate and other technical parameters. Son adjusts the technical parameters of base stations for a certain purpose. For instance, in times of over traffic, high device density, and changing spectrum availability, a self-optimizing network could optimize wireless airtime resources to ensure certain service level agreements (SLA) per device and application group are sustained. When base stations fail and connectivity is lost, SON can autonomously mend it's own. Self-healing networks adjust the settings of surrounding cellular parameters ensuring that impacted users get continuous service or at least minimal degradation. Self-organizing network's capacity to defend itself against unauthorized users refers the self-protection capability. Self-protection's main purpose is to ensure network security and data integrity. As a device moves through a cellular network, Automatic Neighbor Relations (ANR) makes it easier to transfer a seamless signal from cell to cell. This has always been a difficult and time-consuming process for human operators, but SONs can now perform it. To ensure prompt, dependable, and efficient handovers, ANR constantly analyzes and communicates with nearby cells.

Mobility Management

Ultra-dense network deployment has been recommended as a crucial technology to make the capacity objective achievable to gain better area spectral efficiency so that frequency reuse becomes more efficient [Kamel et al., 2016] [Yunas et al., 2015]. Nevertheless, even if the advantages for stable users in ultra-dense networks are obvious, the support of mobile users needs particular management in order to maintain an acceptable Quality of Service (QoS) along their route. Commonly, mobile users change connections every time they reach a new cellular cell; this procedure is referred to as handover. Despite the fact that approach assures a user remains inside service throughout its route, each handover execution costs in system resources [Pollini, 1996]. This is due to the delay in connection switching, that consequently impacts the user's QoS [Racz et al., 2007]. Compared to ordinary networks, ultra-dense networks are built of a higher number of tiny cells. Therefore, in such networks, handover executions occur more often as a user traverses more cells along it's route and travels within each cell for a short duration. In this instance, the handover cost grows dramatically and becomes critical for a mobile users' efficiency in terms of mean throughput. The users are consequently compelled to dedicate most of their resources for the handover operations instead for data traffic, which dramatically affects their QoS [Wu and Fan, 2016].

Radio Link Failure

Radio link failure (RLF) is a typical issue in UDN when the radio channel signal strength is poor to proceed with the application. RLF is a local event recognized by UE instantly and network nodes get to know afterwards. It is also tough to recover for the UE owing to poor signal. Therefore, RLF needs to be treated with by the UE.

Radio link failure (RLF) happens in a mobile device when it suffers interference and/or low signal strength resulting to disconnection from the base station. This leads to cessation of the Handover process. Radio connection breakdown leads in the abrupt rise in SINR (Signal to Interference & Noise Ratio). Radio connection failure happens due to lack of radio coverage or unacceptable amount of interference in the air interface between the mobile and network [Hämäläinen et al., 2012].

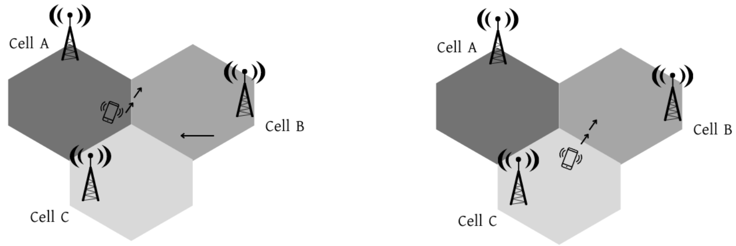

Figure 2.4: Unnecessary handovers ping-pong

Ping Pong Effects

Handover decision algorithms produce a ping pong effect caused by the inadequacy of the network handover measurements which do not include the desired end user performance. The ping-pong movement in LTE is one of the most critical difficulties which lower the quality of the connection and damage the efficiency of the handover. Figure 2.4 displays two ping-pong scenarios.

Handover Failure

The Handover (HO) efficiency wasn't as excellent just like in simple macro implementation. Of the four Handover kinds, Pico to Macro (P-M) handover exhibits the lowest efficiency and Macro to Pico (M-P) handover displays only marginally improved. The User Equipment velocity has a considerable influence upon the Handover efficiency. The pattern of simulated findings discovered that high velocity User Equiments incur substantially greater Handover Failure percentage than low speed User Equipments [3GPP, 2017]. In a simulated outcome, ignoring User equipment velocity reliant Handover parameter optimization, a Handover Failure percentage is approximately fifty percent in P-M Handover case and about 23-36 percent in M-P Handover instance. Handover failure rate is about 35 percent in P-M HO instance and roughly 21percent in M-P HO instance With User equipment speed reliant Handover parameterization [Park et al., 2013]. In typical 'macro only' homogeneous networks, the User equipment generally employ the very identical range of handover variables like as Handover Margin (HOM) and Time To Trigger (TTT) across the network. In order to reduce the influence of fading, Time To Trigger is applied to produce measuring data presented by User Equipment with adequate instability. Thus, within UDNs, there is also a requirement for 'cell specific' or 'User Equipment specific' handover parameter optimization. Moreover, whenever high velocity User Equipment transfers from pico cell to macro cell, it might travel far within LPN coverage zones before the TTT designed for macro cells expires, thereby suffering handover failure owing to decreased downlink signals.

To identify a more precise handover triggering point is a significant problem considerably decreases the failure risk of handover. Premature handover triggering will generate ping-pong effect difficulties since the User equipment attempts to change to the source cell again immediately after a prosperous handover to the destination cell. Too early handover triggering happens due of a breakdown in the targeted cell radio link after a handover has been accomplished. The User Equipment attempts to reinstate its radio contact with the originating cell. Radio link failure in the destination cell during the changeover procedure is another cause for too early handover [Tanzil Bin et al., 2016a].

Consequently, belated handover triggering would also result into handover failure. In this circumstance, the User Equipment travels faster than the handover parameter values, as a result the handover process in the source cell is begun too late. Therefore, the signal strength is too weak to reach the UE which is positioned now in the target cell when the HO order from the serving cell is broadcasted. Eventually, connectivity is lost. To maximize the success probability of turnover and to minimize handover overheads, it's very important to locate an accurate handover triggering point and many researches focused this point.

Chapter 3

Forward Handover in UDN

3.1 Introduction

This chapter focuses first on describing Ultra Dense Cellular Networks, explaining its architecture and most relevant features. After that, Forward Handover in Ultra Dense Cellular Networks depicted.

3.2 Ultra-dense Cellular Networks

In wireless communications, the need for speed is rising briskly. There will be trillions of devices connected wirelessly with the emerging Internet of Things (IoT). For the future of mobile networks, ultra-dense networks were introduced.

A huge number of small cells were deployed to form 5G ultra-dense cellular networks by the help of developing massive MIMO antenna and millimeter wave communication technologies in 5G mobile communications systems [Hoydis et al., 2013]. The conventional cellular network architecture is a type of tree network architecture, where every macro cell BS is controlled by the BS managers in the core network and the given gateway forwards all blackhaul traffic to the core network. A hybrid architecture is presented for conventional cellular networks with microcells deployment where the microcell network is also setup as a form of tree network architecture and microcell BS managers control each microcell BS in the core network, and microcell BS backhaul traffic is transmitted to the core network through broadband Internet or fiber cables. Microcell BSs can deliver high-speed wireless transmission in indoor and hotspot environments, as opposed to macro cell BSs. the macro cell BS and the microcell BS both can transmit user and management data to related users independently. Users can handover in macro cells and microcells depending on the requirements. Furthermore, macro cell and microcell managers in the core network oversee the handover process [Ge et al., 2016]. Figure 3.1 illustrates Ultra Dense Network.

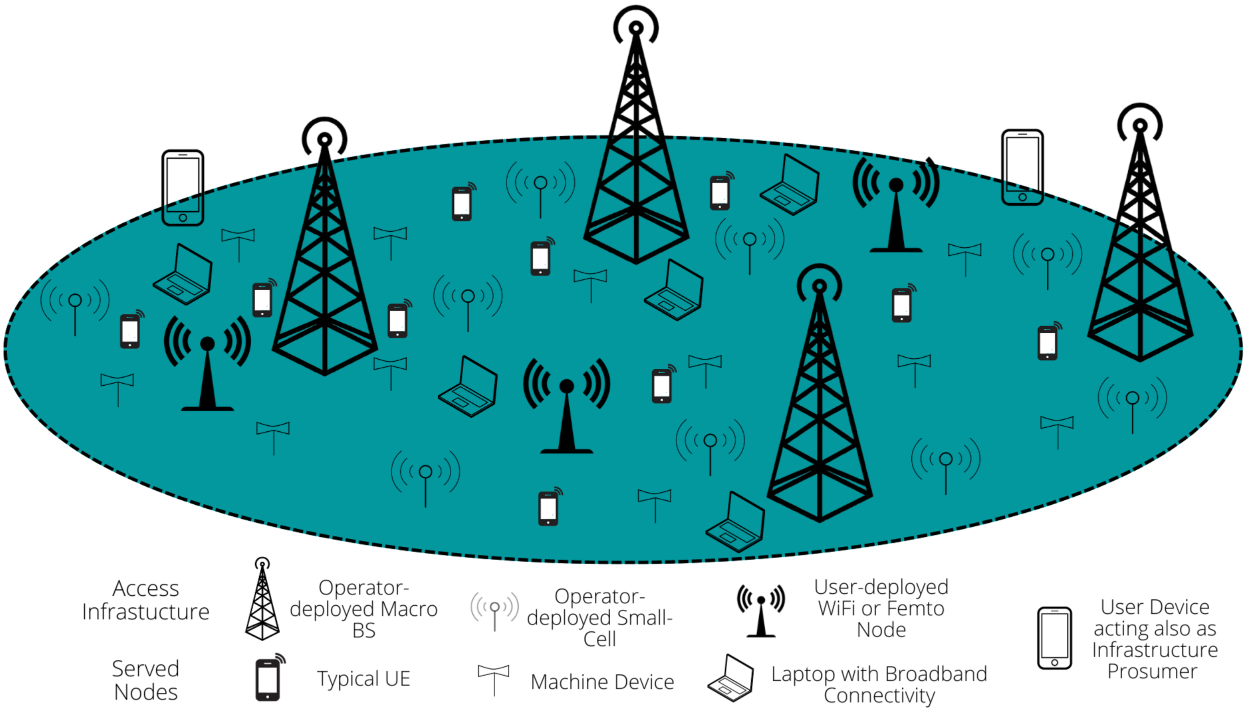

Figure 3.1: Ultra Dense Network

3.3 Forward Handover in UDN

Fast and flawless handover from a root cell to the targeted cell is indeed a top priority for LTE. In wireless data networks, one of the most critical variables that might decrease the performance of system connections is handover. Handovers are used so that the users can keep connection to their network even when they shift from one network access point to another. The primary purpose of the handover procedure is to optimize the overall network utilization and ensure the best possible connectivity to the user during communication.

User Equipment (UE)-based mobility can be defined as forward handover. After the target BS, referred as eNodeB (eNB) in LTE receives an UE context from the source eNB, handover relevant data is transferred among the User Equipment and the target eNB through the new radio system. For this reason the 'forward' terminology has been used.

Despite the fact that the radio circumstances are not sufficient for the source eNB to interpret the Measurement Report from the User Equipment and assemble the targeted cell, forward handover is successful. Forward handover is successful even when signaling with the source eNB is completely lost as it facilitates forward handover resistant to quickly changing signal strength circumstances.

When the User Equipment identifies radio connection difficulties, it initiates the Radio Link Failure timer, as it does with the other types of handover processes. As the cost of RLF is lowered, the supplier may set the RLF timer frequency vigorously (e.g., 50 ms versus 500 ms or 1000 ms). This is dissimilar to RLF handover and Non-Access Stratum (NAS) recovery procedures. Furthermore, the service provider does not need to use extensive drive tests to enhance the RLF timing setting. The User Equipment seeks for a relevant targeted cell when the RLF timer expires then attempts to re-connect with the targeted cell while being in connected state. If the targeted cell isn't ready, the targeted eNB uses source eNB to acquire the UE's context. In comparison to the backward handover technique, this will result in an additional delay and, as a result, a longer service outage. Furthermore, to choose a more aggressive RLF timer value in between the Radio Link Failure handover and NAS recovery, the forward handover approach would lead into a shorter disruption in operations. Furthermore, data transfer in order delivery guarantee that almost no data delayed when the source eNB is disconnected.

The sole distinction from the aspect of the eNB is that whenever the User Equipment attempts to re-build its connection with the targeted cell but if the targeted cell isn't yet available, the targeted eNB must get the User Euipment's information from the origin eNB. This extended transmission to get the User Equipment's circumstances (step 3 in 3.2) is already classified as component of the Self Optimizing Network (SON), which was proposed for 3GPP Release 9 specifications [r4, 2010].

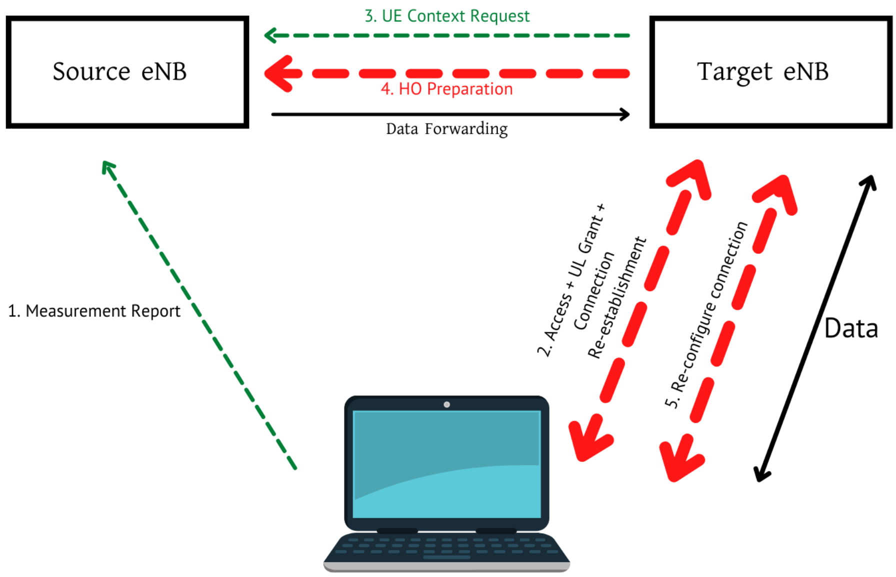

Figure 3.2: LTE Forward Handover Procedure

Chapter 4

Methods For Forward Handover

Several Handover Procedure has been presented to increase overall Handover efficiency with relation to HOF rate. There are three major approaches. One of the solution is built on present methods that based on speed and aims to strengthen such processes. Another solution tries to focus on the radio characteristics themselves. Again another solution believes there isn't any severe issue and examines just minor improvements. Although, for establishing handover strategies in LTE macro networks there has been a great emphasis; so far for developing femto-macro vertical handover procedures, a very little consideration has really been garnered. Following that, for Ultra Dense Networks we quickly discuss the existent handover approaches in the literature. Long Term Evolution Advanced (LTE-A) is totally reliant on hard handover, which itself is network controlled and enabled by UE [Kim et al., 2010] [Shayea et al., 2012]. The downsides with hard handover includes severe data loss, longer interruption duration, and high outage possibility. Additionally, the Quality Of Service is considerably degraded in hard handover, leading into challenges in relocation of eNBs.

the signaling between the UE is needed for such a handover. In the forward handover technique, The targeted eNB is transmitted via a newly created connection among UE and the targeted eNB [Dampage and Wavegedara, 2013a].

One of the primary issues in LTE femtocell networks are rapid and flawless vertical handover owing to the lack of a proper communication connection across femtocells and macrocells.

LTE femtocell networks offer both inbound and outward mobility. Inbound handover happens whenever an User Equipment switches from a macro to a femto system, while outbound handover occurs whenever an User Equipment switches from a femto to a macro system [Bae et al., 2011], [Shbat and Tuzlukov, 2012].

The handover decision in [Bae et al., 2011] is reliant upon failure of radio link and percentage of ping pong. The technique improves handover characteristics in femtocells during outgoing movement at user velocities ranging from three to fifteen km/h. In order to reduce radio link failures, the method assigns varying handover margins based on neighboring cell setups and User Equipment velocity levels. The authors initially assess the percentage of ping pong and radio link failure for UEs traveling at a constant speed by altering the hysteresis margin values. Then, for all UE speeds, a hysteresis range of one to eight dB and a set time-to-trigger value of 160 ms are used. The main advantage of this technique is that instead of employing the cell type adjustable handover margin whilst keeping the percentage of ping pong fixed, the rate of radio link failure and handover effectiveness ratio may be noticeably enhanced. The technique, however, will get more sophisticated when it is applied to a greater variety of speed levels. The downlink signal strength is the proposed scheme's handover criterion.

Here are also some related works' consideration and their KPI 4.1.

Reference	Consideration	KPI
[Dampage and Wavegedara, 2013b]	Temporary Area Partners (TAP), Temporary Area Network (TAN)	Latency performance, Minimizing re-transmission requirement
[Monil et al., 2013]	Signal Strength, Distance from Base station, Cell Traffic Load, Speed and Direction	Ping pong avoidance
[Taha et al., 2017]	Capacity of Base Station, Mobile Nodes Movement, Signal strength, MUs traffic	Throughput Improvement, decrease the latency of MUs, and limits packet loss
[Inzerilli et al., 2008]	Location, Goodput measurement	controlling the ping-pong effect, Minimum interval of time
[Haque et al., 2021]	PN sequence detection	Reducing unnecessary ping-pong handovers
[Lee et al., 2010]	RSS-based TCS and load-based TCS	HFR (handover failure rate) performance
[Aibinu et al., 2017]	Fuzzy Logic, Artificial Neural Network (ANN)	Avoiding ping-pong impact
[ICT-SOCRATES,]	Values of the hysteresis and Time-to-trigger	Reducing ratio of handover failure, call dropping and ping-pong
[Tanzil Bin et al., 2016b]	Handover between Low Power Cell to Macro cell	Reduce RLF and HO failure

Table 4.1: Related Works

Chapter 5

Findings

5.1 Challenges in Forward Handover

In the contemporary world, the rapid development of high-speed metro rail and highway communication systems necessitates more responsive requirements for cellular network communication throughout these transport systems. Despite the fact that some regions have already begun deploying 5G standard technologies since 2019 [Horikoshi and Kawakami, 2018], 5G remains inconvenient for many use cases, such as rural areas, highways, and railroads. Even when compared to a few years ago, the global data traffic is currently enormous. This case is now more apparent to the general public. The global pandemic that began spreading in December 2019 had such a huge impact on the world that it forced businesses, offices, and institutions that previously required the physical presence of their employees to switch to virtual presence. These virtual meetings and projects necessitate increased and accelerated data traffic. This massive data traffic must be retained and satisfactory in accordance with the 3GPP standards currently in place. While network service can be guaranteed adequately for stationary or ’slow speedy’ or ’medium speedy’ users, there is still a concern of network service deterioration for UEs in high mobility states with the existing systems.

For regular pedestrian or slowly or moderately moving UE vehicular situations, each base station provides a handover margin that is intelligently sufficient. The UE sends the source eNodeB handover measurement reports for all neighboring cells in these instances,. The network sends the handover command to the user equipment (UE) if it determines that a target cell is superior to the serving cell by a suitable margin after obtaining measurement reports for a maximum defined duration of time.

When the user is in a high speed moving state, the parameters (hysteresis, TTT, etc.) and protocols used for a normal or medium mobility state UE are not enough for the network to handle the device, mostly because the protocols themselves slow down the handover process. In case of event-triggered measurement reporting, the network usually sets a specific TTT period. After that, the UE starts sending measurement reports at a certain interval until a certain maximum number of reports have been sent. But most of the time, users who move around a lot leave the cell boundary long even before TTT ends. The signal strength in between source eNB and the UE can drop during this overall delay in handover, which can lead to Radio Link Failures (RLF) and presumably ping-pong events. This causes the handover to fail in the end. In this case, the UEs may have a very low cell edge SINR because of something called the ”dragging effect,” which is caused by a weak signal coming from the base station and a numerous congestion from the target cell [r23,].

There is indeed a solution for users who need a lot of speed. In case of a handover while the user is in a high-speed state, the TTT can be changed. In that situation, the network keeps track of how many handovers happen within a certain period of time. If there are a lot of handovers during that time, it means that the user is moving quickly. So, the network changes the TTT to match. But this method of scaling is not strong enough. If the TTT is cut too short for high-speed users, a neighboring cell might send a strong radio signal during that short time, which would start the handover process right away instead of waiting for a long time. Thereafter, the former source eNodeB's signal strength in that small-scaled TTT might seem strong enough until it becomes a source eNodeB again. So, a ping-pong match can happen. So, LTE doesn't cut TTT too much to avoid ping-pong events. But because TTT isn't shortened as much, UEs that are in a high-mobility state pass through the cell boundary a long time before the handover happens. In that case, the worst thing that could happen is that the UE would lose contact with the source eNodeB before the handover to a new cell could happen, which would cause RLF. And after that, it might not be able to get over RLF. So, there would be a loss of data.

5.2 Scope For Improvement

To prevent these problems an alternative scheme should be proposed. A scheme that modify the network to support the adaptive network functions that high-speed users need should be proposed.

Forward handover is considered as UE-based mobility because the information in between UE and the root eNB is sent over the new radio path. Even though radio conditions as a whole are bad, Forward Handover works. Since the UE decides how the handover process works in Forward Handover, it can be added to make the handover happen more quickly. In this circumstance, however, things are more complicated because the decision is not made by the same group that keeps things in sync. The eNB has to get everything ready ahead of time, and after the handover is performed, the data path has to be changed.

More than one eNB must be ready to connect with the user equipment (UE) in forward handover. As well, UE will knock on more than one eNB to connect. As UE will decide when the handover will happen and when the handover will happen. Hence, the whole process of handing over will be up to UE. For high speed state user when they cross one eNB area to another eNB, the UE knocks more than one eNB. If we can implement these system in cloud based system, the time to connect with eNB may decreased. As a result, it will reduce time delay, call dropping and will provide a smoother connection to the user.

Chapter 6

Conclusion

This paper provides brief discussion forward handover algorithm. The contents provide an overview of forward handover, classification of handover, complexity involved, desired handover features, handover algorithms, ultra dense network and forward handover in ultra dense handover. This paper also includes self organizing network, it's architecture and functionality. It has been discovered that handover algorithms are becoming highly complicated, and that complexity grows significantly in ultra dense networks.

Still there are some issues with current forward handover scheme. The current ultra dense technologies are insufficient to handle difficulties for users in high-speed transportation.

However, there is still opportunity for development. This paper will hopefully help to research about the problem areas in future. Future study should focus on reducing the handover delay even further, more efficiently discriminating between regular and high-speed vehicles. These difficulties will motivate our future work, and we will endeavor to find more alternatives in this area.

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