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Comparative Study 1st, 2nd, 3rd, 4th, Generations from Handoff Aspects

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Abstract: ***Mobility is the most important feature of a wireless cellular communication system usually; Continuous service is achieved by supporting handoff (or handover) from one cell to another. To enhance the quality of service, its failure can result in ongoing call termination. So handoffs are necessary for providing an enhanced QoS to users and provide a ubiquitous coverage. handoffs have deferent criteria and It's effected on System performance so chosen one criteria of handoff is precise task, and There are numerous methods for performing handoff, as well as the kinds of network entities, The decision-making process of handoff may be centralized or decentralized (i.e. the decision may be made at the MS or network).at least there are three different kinds of handoff decisions. Network-Controlled or Mobile-Assisted, Mobile-Controlled Handoff, also handoff can be Failures if no channel available on selected BS or Handoff is denied by the network for reasons such as lack of resources. For example, no bridge or no suitable channel card, the MS has exceeded some limit on the number of handoffs that may be attempted in some period of time. It takes the network too long to set up the handoff after it has been initiated. The target link fails in some way during the execution of handoff. Aim of a good handover strategy includes, the number of drop-outs should be minimum, the number of handovers should be minimum, Quick switch over of the call without any disturbance to the call [2]. For mentioned above use certain criteria of handoff and making decision to depended on a certain method to control handoff are complicated task, so the mobile cellular networks used a deferent types of handoff (hard, soft and softer) through a deferent generations. In this paper we flowing the generations of mobile networks from 1st generation up to4th generation networks, we investigated theses generations from handover point because each type has own benefits and drawback as we see for example with the GSM, then finally we compared theoretically this generations network standard in two tables.***

Keyword: Handoff, handover, mobility, mobile generation, handoff decisions

1. Introduction

Changing the point of connection while communicating is Very Important point in a cellular systems, When a mobile user travels from one area of coverage or cell to another cell within a call's duration the call should be transferred to the new cell's base, This concepts are calls handover /handoff, Handoff is the process of changing the channel (frequency, time slot, spreading code, or combination of them) associated with the current connection while a call is in Progress. It is often initiated either by crossing a cell boundary or by deterioration in quality of the signal in the current channel, the basic reasons which make handover necessary, within a mobile cellular communication Networks are mobility and User preferences, handovers are occur and initiated when received signal level drops below a certain threshold value, It's Not as simple as it seems, Actually consider a time average of the received signal instead of the instantaneous level. In a simplest cause handover flows the flowing theory.

Define: PMIN_USABLE as the minimum usable signal level**, PHANDOFF** as the threshold received signal level at which a handoff will be initiated [3]

Δ = PHANDOFF – PMIN_USABLE

The value of Δ must be optimized, if It's Too large => too many handoffs and if it's Too small => too many lost calls Value of Δ depends on Environment, Expected mobile speeds and Time required to Perform a handoff. Figure 1 shows handover in a success cause while figer2 shows unsuccessful handover. Handoffs are broadly classified into two categories—hard and soft handoffs usually, the hard handoff can be further divided into two different types intra- and inter-cell handoffs, while The soft handoff also can be divided into two different types multi-way soft handoffs and softer handoffs

Hard handoff: The network decides a handover is required dependent upon the signal strengths of the existing link, and the strengths of broadcast channels of adjacent cells. The link between the existing NodeB and the UE is broken. A new link is established between the new NodeB and the UE. A hard handoff is essentially a ―break before make" connection. Under the control of the MSC, the BS handoff the MS's call to another cell and then drops the call. In a hard handoff, the link to the prior BS is terminated before or as the user is transferred to the new cell's BS; the MS is linked to no more than one BS at any given time. Hard handoff is primarily used in FDMA (frequency division multiple access) and TDMA (time division multiple access), where different frequency ranges are used in adjacent channels in order to minimize channel interference. So when the MS moves from one BS to another BS, it becomes impossible for it to communicate with both BSs (since different frequencies are used). as figure (3) below shows.

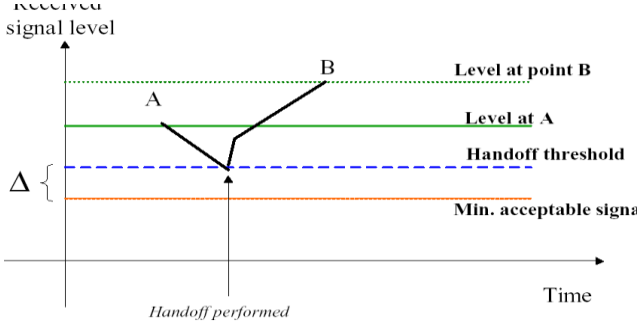

Figure 1: handover in a success cause

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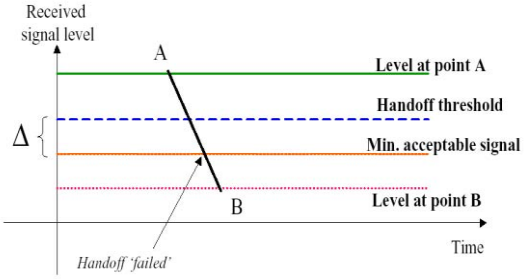

Figure 2: handover in an unsuccessful cause

Types of Hard Handover: There are three types of hard handover;

Inter-cell Handover, Intra-cell Handover, Microcellular handover

Soft handoff: In a soft handover, a terminal is connected simultaneously to more than one base station via several handover branches. The group of base stations communicating with the terminal during soft handover is called the active set. Based on signal strength decisions involving various thresholds, branches can be added to or removed from the connection at any time, in other words base stations can be added to or removed from the active set. Such actions are referred to as "active set update" procedures. Look at the figure (3) below.

Softer handoff: A softer handover is performed between two adjacent sectors of the same base station. In downlink, soft and softer handover is very similar from the terminal point of view. In uplink, there is a major difference between soft and softer handover.
In soft handover branches, signal replicas can only be combined within the Radio Network Controller (RNC).

Handoff steps: The major steps in the handoff pressures are measurement, decision, execution. Measurement criteria signal strength (between mobile and current base station as well as between mobile and neighboring base stations), distance, reports exchanged between mobile and base station. Handoff Decision There are numerous methods for performing handoff as well as the kinds of network entities.

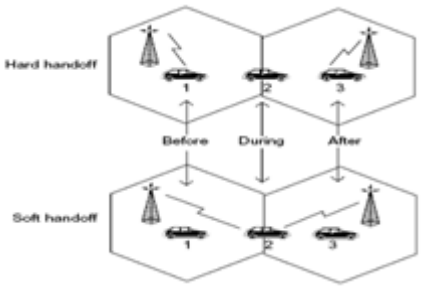

Figure 3: shows hard and soft handoff

Network-Controlled Handoff: In a network-controlled handoff protocol, the network makes a handoff decision based on the measurements of the MSs at a number of BSs. In general, the handoff process (including data transmission, channel switching, and network switching) takes 100–200 MS. Information about the signal quality for all users is available at a single point in the network that facilitates appropriate resource allocation. Network-controlled handoff is used in first-generation analog systems such as AMPS (advanced mobile phone system), TACS (total access communication system), and NMT (advanced mobile phone system). [3]

Mobile-Assisted Handoff: In a mobile-assisted handoff process, the MS makes measurements and the network makes the decision. In the circuit-switched GSM (global system mobile), the BS controller (BSC) is in charge of the radio interface management. This mainly means allocation and release of radio channels and handoff management. The handoff time between handoff decision and execution in such a circuit-switched GSM is approximately 1 second.

Mobile-Controlled Handoff In mobile-controlled handoff, each MS is completely in control of the handoff process. This type of handoff has a short reaction time (on the order of 0.1 second). MS measures the signal strengths from surrounding BSs and interference levels on all channels. A handoff can be initiated if the signal strength of the serving BS is lower than that of another BS by a certain threshold. Finally to done hand off completely mobile or base station Executed the handoff flowing, Handover signaling, Radio resource allocation, Re-establishing connections in core and access networks.

1. Handoff in 1st G:

In first generation handoffs, a signal strength measurements are made by base stations and are supervised by MSC, handoff decision was made by network, (Network-Controlled Handoff)

Handoff initiation: Base station 1 notices mobile station's signal is weakening (when the received signal strength goes below a certain threshold value Base station 1 sends a handoff measurement request message to its MSC. MSC requests neighbor base stations to report their reception of mobile's signal strength.MSC pick neighbor base station with highest received signal strength.

Advantages/ Disadvantages: First generation support only hard handoff which only uses one channel at any time, also in hard handover there is a break during handover and therefore the chances of success of handover becomes less that's why it, high probability of loss connection or dropped call during handoff (unsuccessful handoff) [2].

2. Handoff in 2ed G:-

In second generation, handoff decision was mobile assisted. Every mobile station measures the received power from surrounding base stations and continually reports the results of the measurement for base station.

Types of GSM handover: Within the GSM system there are four types of handover **Intra-BTS handover** This form occurs if it is required to change the frequency or slot being used by a mobile because of interference, or other reasons. In this form of GSM handover, the mobile

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remains attached to the same base station transceiver, but change the channel or slot. **Inter-BTS Intra BSC handover** This occurs when the mobile moves out of the coverage area of one BTS but into another controlled by the same BSC. In this instance the BSC is able to perform the handover and it assigns a new channel and slot to the mobile, before releasing the old BTS from communicating with the mobile. Inter-BSC handover: When the mobile moves out of the range of cells controlled by one BSC, a more involved form of handover has to be performed, handing over not only from one BTS to another but one BSC to another. For this the handover is controlled by the MSC. **Inter-MSC handover** this form of handover occurs when changing between networks. The two MSCs involved negotiate to control the handover, form of GSM handover is known as Mobile Assisted Hand off (MAHO). The network knows the quality of the link between the mobile and the BTS as well as the strength of local BTSs as reported back by the mobile. It also knows the availability of channels in the nearby cells. As a result it has all the information it needs to be able to make a decision about whether it needs to hand the mobile over from one BTS to another. [1]

Handoff 2.5G (GPRS):

There are three states to manage handoff in GPRS, Idle: MS is not attached to GPRS, Standby: Subscriber is attached to GPRS mobility management, MS performs RA and cell selection locally, reports RA changes, Data, signaling or page response move the MS to READY, Detach procedures moves the state to Idle, Ready: Cell selection may be done locally or by network control, State supervised by a timer Location.

Advantage/Disadvantage: By using NACC, the MS handover time can be greatly reduced(less than 5ms), The reliability is improved and MS can achieve a lower frame rate, however all of that benefits but there are some problems face these systems, The more APS that are Integrated [5].

(EDGE 2.75G) handover:

EDGE system support most w-CDMA handovers and measurement to collection information about the system from the new cell and Assistant to controlling handover is MS is responsibility of MS, the benefit of handoff in EDGE system is reduce unnecessary handover probability in addition to balance in traffic in network, but handover in EDGE can also Increase connection break down probability.

Handoff in 3rd G (UMTS):

UMTS handover is performed seamlessly so that the user is not aware of any change. Any failures within the UMTS, handover procedure will lead to dropped calls which will in turn result in user dissatisfaction and ultimately it may lead to users changing networks.

Soft handover: This form of handover is a more gradual and the UE communicates simultaneously with more than one NodeB or base station during the handover process. Softer handover not a full form of UMTS handover, but the UE communicates with more than one sector managed by the same NodeB. **UMTS GSM inter RAT handover** This form of handover occurs when mobiles have to change between Radio Access Technologies. Each of the different types of handover is used on different Occasions dependent upon the conditions. UMTS hard handover the radio links are broken and then re- established. Although hard handover should appear seamless to the user, there is always the possibility that a short break in the connection may be noticed by the user. The basic methodology behind a hard handover is relatively straightforward. The network decides a handover is required dependent upon the signal strengths of the existing link, and the strengths of broadcast channels of adjacent cells. The link between the existing NodeB and the UE is broken. - A new link is established between the new NodeB and the UE. Although this is a simplification of the process, it is basically what happens. The major problem is that any difficulties in re-establishing the link will cause the handover to fail and the call or connection to be dropped. One of the issues facing UMTS hard handovers was also experienced in GSM. When usage levels are high, the capacity of a particular cell that a UE is trying to enter may be insufficient to support a new user. To overcome this, it may be necessary to reserve some capacity for new users. This may be achieved by spreading the loading wherever possible - for example UEs that can receive a sufficiently strong signal from a neighboring cell may be transferred out as the original cell nears its capacity level. UMTS soft handover: occurs when a UE is in the overlapping coverage area of two cells. Links to the two base stations can be established simultaneously and in this way the UE can communicate with two base stations. By having more than one link active during the handover process, this provides a more reliable and seamless way in which to perform handover. In view of the fact that soft handover uses several simultaneous links, it means that the adjacent cells must be operating on the same frequency or channel as UEs do not have multiple transmitters and receivers that would be necessary if they were on different frequencies. When the UE and NodeB undertake a soft handover, the UE receives signals from the two NodeBs and combines them using the RAKE receiver capability available in the signal processing of the UE. In the uplink the situation is more complicated as the signal combining cannot be accomplished in the NodeB as more than one NodeB is involved. Instead, combining is accomplished on a frame by frame basis. The best frames are selected after each interleaving period. The selection is accomplished by using the outer loop power control algorithm which measures the signal to noise ratio (SNR) of the received uplink signals. This information is then used to select the best quality frame. Once the soft handover has been completed, the links to the old NodeB are dropped and the UE continues to communicate with the new NodeB. As can be imagined, soft handover uses a higher degree of the network resources than a normal link, or even a hard handover. However this is compensated by the improved reliability and performance of the handover process. However with around 5 to 10% of handovers falling into this category, network operators need to account for it.

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3G (UMTS) softer handover: A form of handover referred to as softer handover is really a special form of soft handover. It is a form of soft handover that occurs when the new radio links that are added are from the same NodeB. This Occurs when several sectors may be served from the same NodeB, thereby simplifying the combining as it can be achieved within the NodeB and not require linking further back into the network, UMTS softer handover :is only possible when a UE can hear the signals from two sectors served by the same NodeB. This may occur as a result of the sectors overlapping, or more commonly as a result of multipath propagation resulting from reflections from buildings, etc. In the uplink, the signals received by the NodeB, the signals from the two sectors can be routed to the same RAKE receiver and then combined to provide an enhanced signal. In the downlink, it is a little more complicated because the different sectors of the NodeB use different scrambling codes. To overcome this, different fingers of the RAKE receiver apply the appropriate de-spreading or de-scrambling codes to the received signals. Once this has been done, they can be combined as before. In view of the fact that a single transmitter is used within the UE, only one power control loop is active. This may not be optimal for all instances but it simplifies the hardware and general operation. Inter-RAT / Intersystem or iRAT handover: In many instances it is necessary for the UMTS radio access network to handover to the 2G GSM network. These handovers are given a variety of names including Inter-RAT handover as they are handing over between different forms of Radio Access Technology, Intersystem Handover, and UMTS / GSM Handover. These handovers may be required for one of a variety of reasons including: Limited UMTS coverage UMTS network busy whereas spare capacity is available on GSM network The most common form of intersystem or inter-RAT handover is between UMTS and GSM. There are two different types of inter-RAT handover or iRAT handover [8].

UMTS handover methodology: The decisions about handover are generally handled by the RNC. It continually monitors information regarding the signals being received by both the UE and NodeB and when a particular link has fallen below a given level and another better radio channel is available, it initiates a handover. As part of this monitoring process, the UE measures the Received Signal Code Power (RSCP) and Received Signal Strength Indicator (RSSI) and the information is then returned to the node B and hence to the RNC on the uplink control channel. Have to change between Radio Access Technologies. [2]

3.5 G (HSDPA) handoff:

Since UMTS was introduced in 3GPP Release 99 (R99) the need for improved support for Download data services has increased. Higher bitrates and lower delays were strong driving forces for the introduction of HSDPA in Release 5, at which point it was also decided that node changes should be kept to a minimum, and both R99 as well as HSDPA mobiles should be served in the same network. To be able to make fast decisions on radio channel allocation, adapt to varying channel quality, and to reduce delays some functions had to be added closer to the radio interface, i.e. in NodeB Scheduling, select which UE(s) is/are to use the radio resources at each Transmission Time Interval (TTI), where one TTI is 2ms.

• Link adaptation, setting of channel coding rate and modulation (QPSK or 16QAM), in order to utilize the resources effectively. Decisions are based on Channel Quality Information (CQI) provided by the UE, UE category, as well as the type of services. Exactly one Transport Block (TB) is delivered in each TTI. [4]

3.9G (LTE) handover:

LTE–support mobility across the cellular network for various mobile speeds up to 350Km/h or perhaps up to 500km/h depending on the frequency band, it also provided high system throughput and low handover latency for real time applications, LTE is providing seamless mobility for the user and at the same time keeping the network measurement simple [5].

2. Handoff in 4th G (LTE –Advanced):

Mobility enhancement is an important aspect for the Long Term Evolution technology since it should support mobility for various mobile speeds up to 350km/h or even up to 500km/h. With the moving speed even higher, the handover procedure will be more frequent and fast; therefore, the handover performance becomes more crucial especially for real time services. One of the main goals of the LTE radio network is to provide fast and seamless handover from one cell to another while simultaneously keeping network management simple. in LTE uses hard handover (break-before-make in LTE since it uses hard handover (break-before-make) Hence, optimizing the handover procedure to get the required performance is considered an important issue in LTE networks. Depending on the required QoS, a seamless handover or a lossless handover is performed as appropriate for each radio.

Types of Handover: the LTE supports **Intra LTE** Handover, both the origination and destination eNB's are within the LTE system. In this type of handover, the RRC connection reconfiguration message acts as a handover command. The interface between eNodeB's is an X2 interface. Upon handover, the source eNodeB sends an X2 handover request message to the target eNodeB in order to make it ready for the coming handover.

Handover Procedure: Handover procedure in LTE can be divided into three phases: handover preparation, handover execution and handover completion. The procedure starts with the measurement reporting of a handover event by the User Equipment (UE) to the serving evolved Node B (eNB). The Evolved Packet Core (EPC) is not involved in handover procedure for the control plane handling, i.e. preparation messages are directly exchanged between the eNB's.That is the case when X2 interface is deployed; otherwise MME will be used for HO signaling.

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Handover preparation: During the handover preparation, data flows between UE and the core network as usual. This phase includes messaging such as measurement control, which defines the UE measurement parameters and then the measurement report sent accordingly as the triggering criteria is satisfied. Handover decision is then made at the serving eNodeB, which requests a handover to the target cell and performs admission control. Handover request is then acknowledged by the target eNodeB.

Handover execution: Handover execution phase is started when the source eNodeB sends a handover command to UE. During this phase, data is forwarded from the source to the target eNodeB, which buffers the packets. UE then needs to synchronize to the target cell and perform a random access to the target cell to obtain UL allocation and timing advance as well as other necessary parameters. Finally, the UE sends a handover confirm message to the target eNodeB after which the target eNodeB can start sending the forwarded data to the UE.

Handover completion: In the final phase, the target eNodeB informs the MME that the user plane path has changed. S-GW is then notified to update the user plane path. At this point, the data starts flowing on the new path to the target eNodeB. Finally all radio and control plane resources are released in the source eNodeB [10].

Handover Measurements: The handover procedure in LTE, which is a part of the RRM, is based on the UE's measurements. Handover decisions are usually based on the downlink channel measurements which consist of Reference Signal Received Power (RSRP).

3. Result

The tables below are appear as results of the study and it's discussing the mobile generations from 1st G up to 4th G from handover issues, Table1 Explain with any generation the characteristics of handoff and it incremental feature while table2 summarize this characteristics to compare between them.

Table 1: mobile generation and handoff characteristics

Generations	*Handover characteristics*	*Incremental features*
1st G	Only hard handover supports and uses one channel at any time, high probability of loss connection or call. a signal strength measurements are made by base stations and are supervised by MSC, Handoff decision was made by network, (Network-Controlled Handoff) Base station notices mobile station's signal is	The base stations are responsible for every handoff processes steps (measurement, detection, decision, execution……)
2nd	Support variety of profiles HO. handoff decision was mobile assisted. Every mobile station measures the received power from surrounding base stations and continually reports the results to base station, Initiation by the network, providing New channels, Power level, Physical channel establishment, procedures, Timing advance, Cipher mode setting.	The new future here is depend on a mobile station to measure signal strength then send report to base station to initiation and control the handoff, other
2.5tG	Mobility management in GPRS starts at handoff initiation. The MS listens to the BCCH and decides which cell it has to select. The MS measures the RSS of the current BCCH and compares it with the RSS of the BCCH of the adjacent cells and decides on which cell to attach it to. There is an option for handoff similar to GSM (MAHO).Handoff procedure is very similar to mobile IP. When an MS changes a routing area (RA), it sends an RA update request containing cell identity and the identity of the previous routing area, to the new SGSN. The new SGSN asks the old SGSN to provide the routing context (GGSN address and tunneling information) of the MS. The new SGSN then updates the GGSN of the home network with the new SGSN address and new tunneling	GPRS increases some Addison future over the GSM including handoff aspect in it MS listens to the BCCH and decides which cell it has to select. The location is updated with a routing update procedure
2.75 G	EDGE system support most w-CDMA handovers and measurement to collection information about the system from the new cell and Assistant to controlling handover is MS is responsibility of MS, the benefit of handoff in EDGE system is reduce unnecessary handover probability in addition to balance in traffic in network, but handover in EDGE can also Increase connection break down probability.	Depend on MS to collected information about all system to assisted in handoff, also MS can make balance of traffic inside the network.
3G	UMTS, unlike in GSM, all UEs use the same frequency all the time. To every pair of communicators a code is assigned so that the data of those can be extracted of the whole data sent by all UEs. Normally a soft handover is done. During a handover phase an UE connects to several	Change of the UMTS cell level from a macro cell to a satellite or another change of the radio access technology (inter RAT handover) for example from UMTS to a WLAN or GSM
3.5G	Serving HS-DSCH cell change procedure is initiated when a link in (DCH) active set becomes higher in strength and stays stronger for certain period of time, referred as time-to-trigger, measurement report is sent from the UE to the Node B, which forwards it to the RNC. then give the consent for the UE to make the handover by sending so called Signaling Radio Bearer (SRB)	Handover con differentiate between both downlink channel and uplink this lad control and measurement of channels are easer, also there are buffers to reduces dropped call or

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	(re)configuration message. In the case of intra Node B handover, the HARQ processes (transmissions) and Node B buffers can be maintained and thus there is only minimal interruption in data flow	blocking probability greatly
3.9G	The handover is triggered by the eNodeB, based on the received measurement reports from the UE, Depending on the required QoS, a seamless handover or a lossless handover is performed as appropriate for each radio bearer, , based on the received measurement reports from the UE The handover can start and end in the E-UTRAN, it can start in the E-UTRAN and end in another Radio Access Technology (RAT), or it can start from another RAT and end in E-UTRAN	Handover become more accurate and better assurance and it doesn't effect by the variations of net work s, it can and end in the E-UTRAN or start in the E-UTRAN and end in another Radio Access and it can start from another RAT and end in E-UTRAN
4G	LTE radio network is to provide fast and seamless handover from one cell to another while simultaneously keeping network management simple. LTE technology is designed to support mobility for various mobile speeds up to 350km/h or even up to 500km/h. With	measurement report is sent by the UE after it is triggered based on some rules The decision for handover is taken by the source eNB based on measurement report Handoff is being more smoothes

Table 2: theoretical comparison of generations from handoff Aspects

G	*Handoff types*	*Methodology*	*Advantages*	*Disadvantages*
1st	**Hard**	decision was made by network measurements are made by base stations	only uses one channel at any time	High probability of dropped call (loss connection)
2end	Intra BTS handoff, Inter-BTS Intra BSC handoff, Inter-BSC handoff, Inter-MSC handoff	MAHO) as mobile measurement but network-controlled decision established in advance through the network before changing over	reduces the ―ping-pong'' effect – Less load on the network from handoff signaling and Overhead. Smoother user communications	Additional network Resources are used during a soft handoff. These become unavailable for use elsewhere. • Soft handoff is more complex. • Downlink interference
2.5th	BS-to BS handoff, BS-to-AP handoff, AP-to-BS handoff, AP-to-AP handoff	Decision can be normal cell reselection or Network Assisted Cell, Ms collect all system information then send report to BS	By using NACC, the MS handover time can be greatly reduced(less than 5ms). The reliability is improved. MS can achieve a lower frame rate.	The more APS that are needed to Integrated
2.75th	W-CDMA handovers	MS responsible for measurement and Assistant to controlling handover	Reduce unnecessary handover probability, Balance of network traffic	Increase connection break down probability
3rd	**Intra-system Handoff** **Intra-frequency HO** **Inter-frequency HO** **Inter-system HO**	The decisions about handover are generally handled by the RNC. It continually monitors information regarding the signals being received by both the UE and NodeB	* Power control is introduced. * Better quality of service achieved in soft handover. * Lesser delay is required because no hysteresis is involved.	The major problem is that any difficulties in re-establishing the link will cause the handover to fail and the call or connection to be dropped
3.5th	Intra-BTS HS-DSCH HS-DSCH, inter-system handoff,	The RNC controlled the handoff process	Improved support for Download data services has increased. Higher bitrates. lower delays.	Difficulty in acquiring available bandwidth information, increase new application blocking rate
3.75th	w-CDMA handovers	The measurement is done by MS to providing information about channel quality by UE, Decision are made by the MS depend on channel quality information	High system throughput, low handover latency for real time apps	Downlink interference (to other users) and co-channel interference
4th	intra-frequency intra-LTE - inter-frequency intra-	measurement report is sent by the UE after it is	providing seamless mobility for the user	Increases the complexity of the network and the UE.

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	LTE - inter-RAT towards LTE - inter-RAT towards UTRAN - inter-RAT towards GERAN - inter-RAT towards cdma2000 system	triggered based on some rules The decision for handover is taken by the source eNB based on measurement report	operate in spectrum allocations of different sizes	Radio interface resource consumption and network topology can be considered as network complexity

4. Dissection

In this paper we documented to mobile generations networks to compared theoretical from handoff aspects and we followed the features of handover through that are generations as thought from table above first generation doesn't focus on handoff issues and it supports hard handoff only, which only uses one channel at any time, it has high probability to loss of connection and dropped call, all handover processes was done by the net work Base station (BS). The second generation (2G) which famous as GSM support a various types of handover (Intra-BTS handoff, Inter-BTS Intra BSC handoff, Inter-BSC handover, Inter-MSC handover) and it added a lot of features to handover which enhanced the mobility at the cellular system, in the second generation measurements are made by base stations with feedback from MS and network made decision and controlled it, Soft handoff reduces/eliminates the ~~–~~ping-pong'' effect, This results in Less load on the network from handoff signaling and overhead, Smoother user communications without the ~~–~~elicks'' typical of hard handoff when speech transmissions are stopped momentarily during handoffs, although all of benefits mentioned above, second generation has some limitations. Additional network resources are used during a soft handoff. These resources thus become unavailable for use elsewhere, Soft handoff is more complex, Downlink interference (to other users), With **2.5G** (GPRS) the handover is enhanced and network depend on MS to measurements, decision and controlling handover, there are two way to deciding and controlling handoff within the GPRS system, normal cell reselection and Network Assisted Cell Change (NACC), The MS here is responsible for measurements to collected all system Information then send a report to the BS Accept reselection to new cell. By using NACC, the MS handover time can be greatly reduced(less than 5ms), The reliability is improved, MS can achieve a lower frame rate, the big challenge that face GPRS system is more APS that must be Integrated. The **2.75 G** (EDGE) Collection information about system from the new cell by the MS. **The third** generation (UMTS) support various type of handover, Intra-system Handover, Intra-frequency HO, Inter-frequency HO, Inter-system HO, There are a number of basic stages of a hard handover in UMTS system, The network decides a handover is required dependent upon the signal strengths of the existing link, and the strengths of broadcast channels of adjacent cells. The link between the existing NodeB and the UE is broken, a new link is established between the new NodeB and the UE, UMTS hard handovers have benefit at flowing Instances When moving from one cell to an adjacent cell that may be on a different frequency, When implementing a mode change, e.g. from FDD to TDD mode, for example When moving from one cell to another where there is no capacity on the existing channel, and a change to a new frequency is required, The benefits of the soft hand off over hard handover is as Power control is introduced, Better quality of service achieved in soft handover, Lesser delay is required because no hysteresis is involved, Less overhead with respect to signaling on network, It eliminates the ping pong effect, Also other advantages like (speech quality, power saving), UMTS has a lot of benefits also it isn't exculpated from fonts especially in handover, The major problem is that any difficulties In re-establishing the link will cause the handover to fail and the call or connection to be dropped. The 3.5G (HSPA) support The flowing type of handover, Intra-BTS serving HS-DSCH cell change. Inter-I-HSPA adapter hard handover, or serving HS-DSCH cell change, Inter-domain or inter-system handover, between the I-HSPA network and 3G or 2G Networks. The RNC is in charge of everything relating to handling of radio resources; scheduling as well as selection of transport format and setting of target for power control (outer loop power control) in order to provide the data rate required for the specific service for the connected UEs. The Transport format indicates the number of TBs as well as size of TBs per TTI, which in R99 is 10ms. Note that in R99 resources are allocated for the duration of the service – a connection is set up, even though channel switching is possible, while in HSDPA resources are allocated per TTI. In 3.5G the Decisions are based on Channel Quality Information (CQI) provided by the UE, UE category, as well as the type of services. Exactly one Transport Block (TB) is delivered in each TTI.It improved support for Download data services and increased higher bit rates and lower delays. The 3.9G (DC-HSPA, LTE) Decision are made by the MS depend on channel quality information, The measurement is done by MS to providing information about channel quality by UE. The fourth generation 4G (LTE-A) is support - intra-frequency intra-LTE handover, inter-frequency intra-LTE handover, inter-RAT towards LTE handover, inter-RAT towards UTRAN handover, inter-RAT towards GERAN handover, inter-RAT towards cdma2000 system handover, The handover is triggered by the eNodeB, based on the received measurement reports from the UE, The handover can start and end in the E-UTRAN, it can start in the E-UTRAN and end in another Radio Access Technology (RAT), or it can start from another RAT and end in E-UTRAN. The decision for handover is taken by the source eNB based on measurement report, with LTE Advanced Without handover the end-user cannot experience seamless mobility and may lose connectivity while leaving a cell and entering another cell. The objective in networks like LTE is providing seamless mobility for the user, and at the same time keeping the network management simple, but Increases the complexity of the network and the UE. Radio interface resource consumption and network topology can be considered as network complexity in the LTE-A.

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5. Conclusion

In this work We aimed to provide information about the mobile generation 1, 2.5, 2.75, 3, 3.5, 3.9, 4 G from handover aspects, with some details about handover characteristics and features, in that generations especially where have rare information hereunder handover view, we started by introduced general information in handoff definition, theory, feature, characteristics and criteria of handoff then reason which lad handoff failed in introduction part, with any generation we explain multiple access technique because it has direct effects on handover, type of handover with most popular standard, Then clarified the methodology and measurement to verified the best way to achieve mobility process, on table(1), we explain briefly the mechanism and techniques to achieve handover process, then later on a table(2) we clarified with some details that characteristics of handoff with any generation. This paper compared theoretical between mobile generation and viewed advantages and disadvantage in addition to incremental futures.

6. Future Work

The work in handoffs still need to more investigate for more information especially with recent version of cellular networks so we recommend studying the effects of handover on quality of services parameters in this generation and compared it, to show the steps of development on mobile generation from handoff view.

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