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# A Survey : Handover scheme of High-Speed Train Environment

**Sandip D Girhepunje[1], Harsha A Bhute [2]**

[1] PG Student Department of computer Engineering
Sinhgad College of Engineering, Pune - 41, India.
[2] Assistant Professor Department of computer Engineering
Sinhgad College of Engineering, Pune - 41, India.

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**Abstract -** *In mobile communication, a handover is a process in which cellular data session is transferred from one cell site (base station) to another without disconnecting the session. Cellular services are based on mobility and handover, allowing the user to be moved from one cell site range to another or to be switched to the nearest cell site for better performance. Network mobility has a very challenging issue of long handover latency and QoS as the mobile devices moving with vehicular speed. In high speed train existing number of MT required the high quality communication and internet access services. As train speeds increases, wireless communication between MT in the train and the device mounted on the train encounters difficulties. In such case maintaining communication quality is a major challenge. The proposed system can resolve this issue by using an LTE femtocell based network mobility scheme that uses multiple egress network interface to support seamless handover for high speed train and avoid packet loss in network during handover.*

***Key Words***: Handover, LTE , Femtocell, Base station.

## 1.INTRODUCTION

The rapid increase in the number of wireless access and increased capability of mobile handheld devices actively change the landscape of mobile networking. The mobile networking change from voice to data service. In communication wide band (sufficient to communication) is needed as well as the speed of network is essential for better communication, performance of network. The next generation having both of this key services. In Long Term Evolution (LTE) of 3rd generation partnership project for wireless access enhance the spectral and power efficiency and improved the peak data rate in their releases.

Long Term Evolution (LTE) has been designed to support only packet-switched services. LTE aims to provide seamless Long Term Evolution (LTE) has been designed to support only packet-switched services. LTE aims to provide seamless Internet Protocol connectivity between user equipment (UE) and the packet data network (PDN), without any disruption to the end users' applications during mobility. It consisting Evolved Packet System (EPS). EPS uses the concept of EPS bearers to route IP traffic from a gateway in the PDN to the UE. A bearer is an IP packet flow with a defined QoS between the network condition, system performance and user preferences for making the decision. gateway and the UE. The EPS element as shown in fig 1.As the Core network consisting of mobility management entity(MME), Packet data Network Gateway (PDN-GW), Serving Gateway (S-GW).

(a) P-GW – The PDN Gateway is responsible for IP address allocation for the UE as well as QoS enforcement and flow-based charging according to rules from the Policy Charging and Rules Function (PCRF). PCRF is responsible for the filtering of downlink user IP packets into the different QoS-based bearers. It is performed based on Traffic Flow Templates (TFTs). The P-GW performs QoS enforcement for guaranteed bit rate (GBR) bearers, also serves as the mobility anchor for interworking with non-3GPP technologies such as CDMA2000 and WiMAX networks.

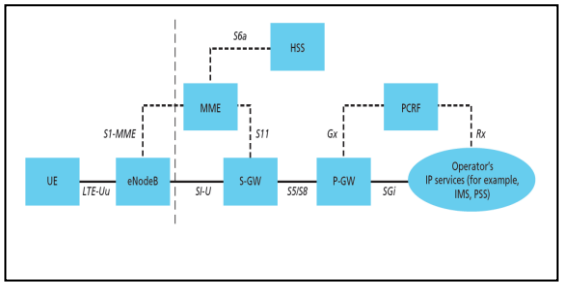


**Fig -1** : LTE architecture

(b) S-GW – All user IP packets are transferred through the Serving Gateway, which serves as the local mobility anchor for the data bearers when the UE moves between eNBs. S-GW also retains the information about the bearers when the UE is in the idle state and temporarily buffers downlink data while the MME initiates paging of the UE to reestablish the bearers. In addition, the S-GW performs some administrative functions in the visited network such as collecting information for charging and lawful interception. It also serves as the mobility anchor for interworking with other 3GPP technologies such as general packet radio service (GPRS) and UMTS.

(c) MME – The Mobility Management Entity (MME) is the control node that processes the signaling between the UE and the CN. The protocols running between the UE and the CN are known as the NAS protocols.

### 1.1 Handover:

Handover is process that transfer an ongoing call from one cell to another as a user move through the coverage area of a cellular network. Handover provide continues connection and good QoS. For example fig 2 shows user move from one base to other base station .

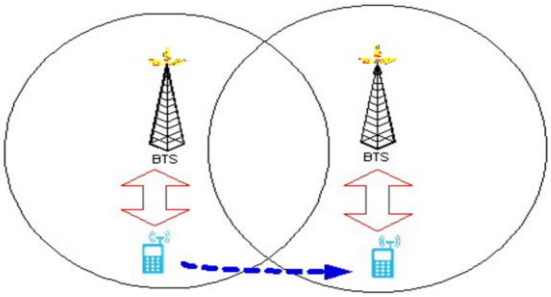


**Fig- 2** : Handover scenario

Type of handover :

There are basically two types of handover as:

- Horizontal-

The transformation of an ongoing session from one cell to another cell having the same access technology is called Horizontal Handover .For example if user equipment is connected with the radio ink with the GSM network the horizontal handover must be from GSM to GSM. Similarly the handovers between two UMTS network is the horizontal handover.

- vertical handover -

The transformation of an ongoing session or call from one cell to another cell having different access technologies is called Vertical Handover. For example a mobile user is moving from GSM based network to the UMTS network, here the access technologies are changed so the handover in this case is the vertical handover.

The rest of the paper is organized as follows. Section 2 describes the related work. Section 3 consists of proposed system design and assumptions. Section 4 consists of proposed selection decision module. Section 5 consists of conclusion and future work.

## 2. RELATED WORK

Transferring of connectivity to achieve uninterrupted service among different types of wireless technologies is called vertical handover. Handover consists of four phases: handover initiation, network discovery, handover decision and handover execution. The MN knowing about the neighbor networks information such as available bandwidth of the network, delay packets, security and packet loss in the network discovery phase. During the decision phase, by using the information obtained from neighboring networks, the MN decides which network it will be connected. After that in the handover execution stage, the MN carries out handover to the target network.

Radio over fiber link : Author propose [10] The standard WiMAX access in high speed railway (HSR). using radio over fiber(RoF) link. The most of WiMAX-RoF optical link consisting of a headend (HE) and several distributed remote antenna units (RAUs) and that are separated by a span of optical single mode fiber (SMF). The architecture of WiMAX-RoF transmission system providing high quality broadband services to the HST for the ground-to-train connection. The downlink WiMAX signal is broadcasting from each base station through the distributed remote antenna unit by using the proposed RoF system along the railway. The downlink WiMAX signal can be received by the train access point (TAP) worked as as intermediate access between ground-to-train and intra-train. The train access point is act as the gateway to the train. Finally, the Intra-train RoF network provides both external broadband internet services and internal on-demand select services to the individual passenger using wireless access to each carriage. In which only focus on simply increase the coverage not consider other attribute constraints and may chance failure handover in critical situation.

Single frequency network [11]: In SFN all cell in cellular network operate same frequency using concept of co channel. Author proposed [11] Co-ordinated multiple point transmission (CoMP) a seamless soft handover scheme utilizing CoMP joint processing and transmission technology. SFN significantly improve the handover performance when the train moves through the overlapping areas. as the front on-vehicle station enters into the overlapping area, the source eNodeB activates the cooperative transmission set (CTS) composed of serving eNB and target eNB. The two or more eNBs communicating with MRSs simultaneously are called CTS. The cooperative transmission set activation is based on the measurement information reported by the moving train and the position information supplied by the communication. Based train control system (CBTC). Once the CTS is activated, the source eNB shares all the user plane data of users inside the train to the target eNB by the high-speed backhaul of LTE network. The two adjacent eNBs both use the same frequency resource to communicate with the train. Signals from the eNBs in the cooperative set are in phase superposed by precoding, which provides a diversity gain and power gain. It should be noted that CoMP CTS always contains two eNBs in the linear coverage topology of high-speed railway.

Moving cell: A moving cells is proposed in [12] A Cell Array smartly organizes a number of cells along the railway. As shown in fig 3. Consider the high speed train is in Cell A, of the Cell A, B, and C form Cell Array. If the HST has passes the cell A and entered into Cell B completely, Cell A will be

removed from Cell Array I, and new Cell D is added in cell array. Then Cell B, C, and D form Cell Array II. There are several moving, LTE femtocells which are equivalent to evolved Node B In the interior of the HST. The femtocell aggregates service traffic within one train carriage. Since the moving direction and speed information of the high speed train is generally known, the Cell Array predicts the target LTE cell to achieve seamless handovers. it also well resists to network and traffic dynamics.

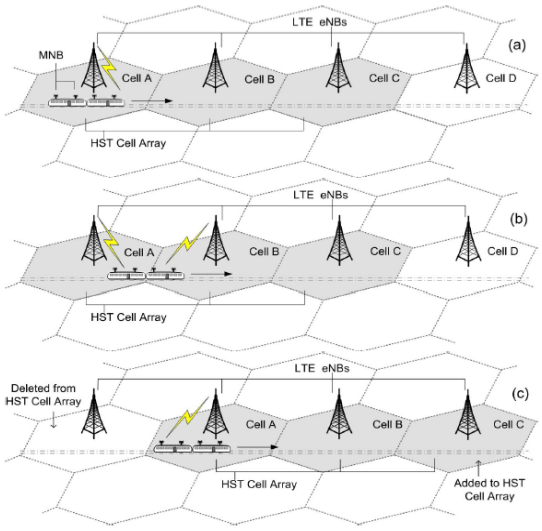


**Fig -3** : Cell Array

Thus, it can provide uninterrupted services. We find that this Cell Array actually has only two active cells. So the 3-cell configuration is a bit redundant. However, this redundant configuration has the robustness for network dynamics. But in high speed environment for the seamless handover need fast handover mechanism to uninterrupted service provide. and for the cell array need more hardware required to establish a whole network.

Train Relay station: The author [13] proposed the dual link handover scheme based on two hop architecture. In TRS two antennas are installed on the train one is on front end other is on the rear end. When moving train is at the cell boundary, the front antenna performs handover to targeted base station (target eNB). While the rear antenna still communicating with serving eNB. Maintain the connection during entire handover mechanism In that use of bi-casting method to supports the lossless handover. As shown in fig 4 bi-casting from serving gateway to serving eNB and target eNB during handover. In which some delay may occur due to same data forwarding to both station as serving and also target eNB.

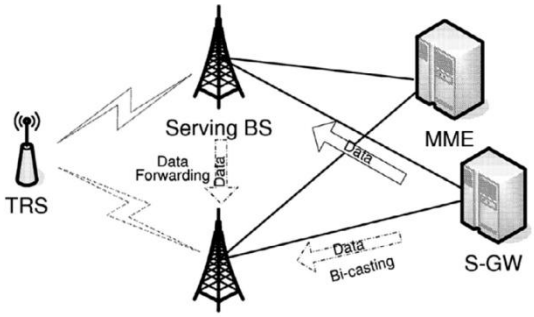


**Fig -4** : TRS

**Table -1:** Analysis handover in train

| Scheme | Technique | Cost | Complexity |
|---|---|---|---|
| Radio over fiber link [10] | Optical switch use to changing path. | High | low |
| Single frequency network [11] | FDMA, CoMP for sharing frequency band among with large number user | High | Moderate |
| Moving cell[12] | Cell array is fully overlapped structure to provide uninterrupted service | High | High |
| TRS[13] | Bi-casting forwarding signal to both eNBs | Middle | High |

## 3. PROPOSED LTE FEMTOCELL BASED HANDOVER IN TRAIN

For seamless handover propose network mobility protocol for high speed train. Use the LTE femtocell for seamless handover. Solve the IP routing using LTE femtocell with multiple egress network interface. Also include pre handover mechanism for reduce handover latency and avoid packet loss.

In fig 5 deployed Enhance HeNB on train to serve the user equipment (UE) in train. Enhance HeNB is act as small base station as well as big UE on train. Interface the HeNB with the multiple evolved node B, as serving eNB as well as the targeted eNBs.

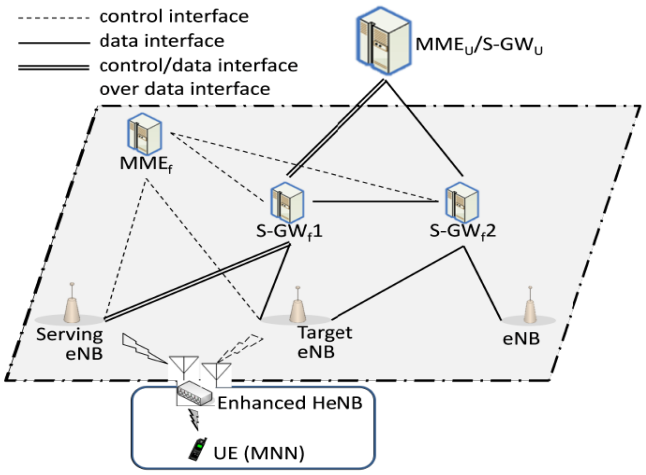


**Fig- 5** : Enhanced HeNB Handover system

The enhance HeNB egress interface has two antenna, one deployed on the head carriage and one deployed on trail carriage to provide seamless handover. Only one IP address allocate by egress interface. This address used by enhance HeNB to connect MME and S-GW of user. eNB is recognize by Enhanced HeNB by eNBs IDs. The communication monitoring by head antenna for handover condition.

## 4. CONCLUSION

Improvements in high train speeds are rapidly increases up against similarly impressive achievements in smart mobile device technology. Customers are increasingly desiring and expecting uninterrupted mobile Internet access, even on long train rides. Providing wireless communication to high speed trains relies on the precision of BS planning, which requires high monetary and manpower costs. The Enhanced HeNB scheme effectively alleviates the problem of improper BS-planning, and is easy to deploy. By considering the protocols and capacities in both the train (local) network and the wide-area wireless access technology, and estimating the future train to infrastructure wireless link quality. Addition, by deploying two Antenna under E HeNB, and designing new messages and functionality in the IPv6-based infrastructure, the handover latency as well as packet loss is reduced while adding negligible extra data transmission delay.

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