TEJAS Journal of Technologies and Humanitarian Science
ISSN-2583-5599
Vol.03, I.02 (2024)
**https://www.tejasjournals.com/**
https://doi.org/10.5281/zenodo.12057472

# Interpretation of Huge Mobile Data Science using Handover Approach

Ambrish Kumar Mishra[a], Bineet Kumar Gupta[b], Satya Bhushan Verma[c]

[a,b,c] Shri Ramswaroop Memorial University, Barabanki, India, 225003

ambrish.kumar.mishra@gmail.com[a], bkguptacs@gmail.com[b], satyabverma1@gmail.com[c]

KEYWORD

*Mobility management, handover control parameters, handover margin, self-optimization, heterogeneous networks*

ABSTRACT

*Enabling seamless connectivity through user mobility is a critical challenge in mobile heterogeneous networks (HetNets). Future deployments of Fifth Generation (5G) and other mobile networks are predicted to exacerbate the situation and result in Ultra-Dense HetNets. The use of millimeter waves (mm Waves), the exponential growth in connected mobile devices, overlapping network deployments, and the utilization of dual High mobility speed possibilities are supported by connectivity (DC), carrier aggregation (CA), the proliferation of connected drones, and the widespread deployment of tiny cells. These are only a handful of the important elements that are behind this. There will thus be a higher probability of changeover failure, handover ping-pong, unnecessary handovers, interruption delays, and throughput degradation. The exponential growth in mobile connections is another expected challenge for next-generation mobile networks. The amount of linked mobile devices is increasing exponentially.IoT devices are also multiplying in number. A ubiquitous connection and additional network capacity will be required once a large number of mobile devices are added. Therefore, in organize to increase connectivity and decrease coverage gaps, it is recommended that various types of micro cells be employed in mobile networks in the future.*

## 1. Introduction

As stated in a June analysis published by Ericsson, the progress of mobile devices and sophisticated applications has resulted in a noticeable increase in data traffic. By 2025, there could be up to 9 billion people use mobile phones globally, 88% of whom have mobile broadband connections. There will be billions more internet-connected mobile phones and home appliances. The requirement for mobile data will therefore increase 1000 times during the next five years. Years This will lead the spectrum gap to widen even further, requiring the creation and application of new spectrum bands. Seamless handover becomes increasingly challenging after HetNets are deployed. Handover is a switching technique used in mobile cellular networks that ensures seamless cell-to-cell movement.

Through this process, a mobile device can switch connections between cells; ideally, there is no interruption as the data offloads. The handover decision is an significant part of mobility management in mobile networks. In future HetNet generations; handover will significantly affect the system's performance due to the frequent switching between cells.For instance, the overall throughput that 5G and subsequent cellular phone networks are intelligent to attain would fall accordingly if the amount of handovers between small cells increased.Many handover approaches have been offered in the literature by numerous researches to decrease the frequency of handovers, ping-pong effects, and rate of handover failures, handover time, handover disturbance, and energy usage.A variety of handover techniques are examined, with an emphasis on key elements of potential future decisions on handover

**Corresponding Author: Ambrish Kumar Mishra, Shri Ramswaroop Memorial University, Barabanki, India, 225003**
**Email:** ambrish.kumar.mishra@gmail.com

TEJAS Journal of Technologies and Humanitarian Science
ISSN-2583-5599
Vol.03, I.02 (2024)
**https://www.tejasjournals.com/**
https://doi.org/10.5281/zenodo.12057472

over DC in LTE-A and 5G mobile networks. We analyze recently emerging tactics for solving mobility-related problems, as well as machine learning (ML)-based methods.
GSM and other digital cellular technologies enable mobile communication. It operates in four distinct frequency bands: 900 MHz, 1800 MHz, 1900 MHz, and 850 MHz. It makes use of FDMA and TDMA together. The entire GSM architecture and operation are covered in this article.

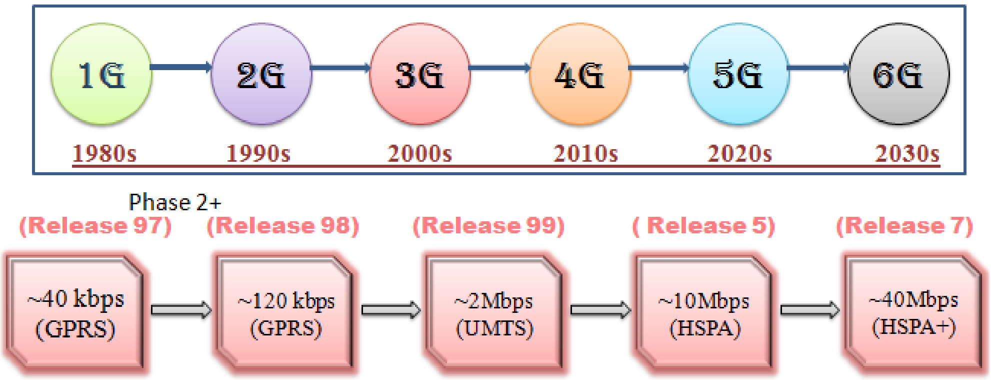


Figure 1: Generations of GSM Network

### A GSM network is made up of numerous functional components which is as below:-

- The Mobile Station (MS)
- The Base Station Subsystem (BSS)
- The Network Switching Subsystem (NSS)
- The Operation Support Subsystem (OSS)

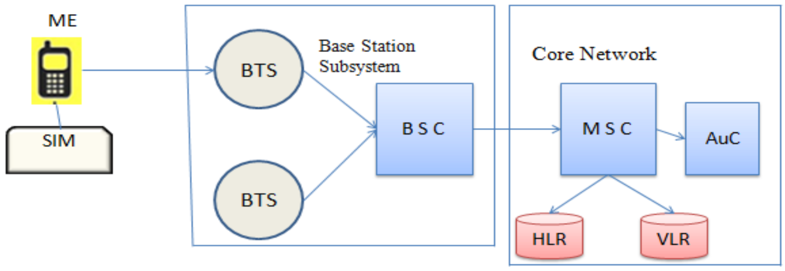


Figure 2: Architecture of GSM

## 1.1. Objectives of the Proposed paper

### a). Handover decision procedures:

A key idea in wireless cellular communication is a handover, which allows the user equipment to transfer between cells without lose the session. One of the most significant portions of the handover process is the effective transfer of user equipment (UEs) between cells. Handover is therefore essential to the 5G HetNet's evolution.

Even when the UE moves between cells, it maintains its network connection. Additionally, it keeps energy consumption efficiency, load balancing, cost effectiveness, and signal strength. Soft handover and harsh handover are the two primary forms of handover. The UE connects to an old cell during the Hard Handover process and instantly establishes a new connection. A different name for this device is a break-before-connect mechanism.

Before the former connection is closed, a new one is made during the Soft Handover process. An additional term for this is the connect-before-break method. Horizontal Handover (HHO) and Vertical Handover (VHO) are two additional handover types. A UE switches inside the same network while the HHO procedure is underway. Users can transfer networks seamlessly thanks to the VHO. The advent of new technologies means that the VHO is now essential to 5G and other future wireless networks.

TEJAS Journal of Technologies and Humanitarian Science
ISSN-2583-5599
Vol.03, I.02 (2024)
https://www.tejasjournals.com/
https://doi.org/10.5281/zenodo.12057472

To lessen handover failure and the ping-pong effect, an inventive handover judgment algorithm was implemented in the extremely dense 5G HetNet. The hysteresis margin of the authors' fuzzy logic system was dynamically determined. The new technique performs enhanced than the old ones, according to the results. A number of strategies were put up to reduce call drops, RLF, and the ping-pong effect. They offered a fuzzy logic approach to cell selection. The suggested approach verifies UE uplink conditions, resource block utilization, and selection criteria measurements prior to starting a handover procedure. In arrange to reduce ping-pong impact and handover failure, this strategy increases capacity.

**The types of Handovers are as below:**
**1. Hard Handover -Inter-Cell Handover**
**2. Soft Handover-Intra-Cell Handover**

Table 1. Types of Handovers in mobile Communications

| Inter Cell | Intra Cell | Hard Handoff-(Break before Make) | Soft Handoff-(Make Before Break) |
|---|---|---|---|
| Source & Target are different cell s(source & target both are changed). | Source & Target are same cells (only used channel is changed). | Channel in Source cell is released & only than channel in target cell is engaged. | Channel in Source cell is retained & used for while in parallel with channel in target cell. |

## b). Hard Handover -Inter-Cell Handover:

A hard handover in telecommunications happens when the mobile device completely disconnects from the current base station and then reconnects to the destination base station. This is also known as a break-before-make handover. When the mobile device switches between cells during a hard handover, the communication session is momentarily disrupted.

When the network determines that the current base station's signal strength or quality has declined, the hard handover procedure is started. When a mobile device is detected, the network alerts it to disconnect from the current base station. The mobile device then locates and connects to the appropriate base station. This process causes a brief loss of signal during the handover.

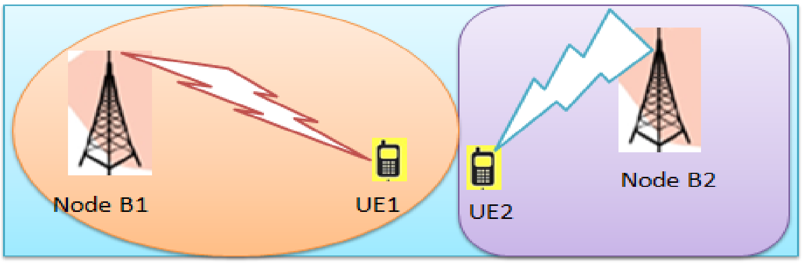


Figure3. Hard Handover

## c). Soft Handover-Intra-Cell Handover:

During a changeover procedure, a mobile device can connect to various base stations or sectors simultaneously thanks to a sophisticated telecom method called soft handover. Unlike normal hard handover, which entails an abrupt transition in the connection between base stations, soft handover allows overlapping coverage regions, enabling a smooth transfer without noticeable interruptions to the communication session. Throughout a soft handover, the mobile phone device maintains links with both the old and new base stations, allowing for simultaneous data transmission and reception across several pathways. With this redundancy, the reliability and quality of the connection are enhanced since the signal strength or quality of one base station can be compensated for by the other.

TEJAS Journal of Technologies and Humanitarian Science
ISSN-2583-5599
Vol.03, I.02 (2024)
**https://www.tejasjournals.com/**
https://doi.org/10.5281/zenodo.12057472

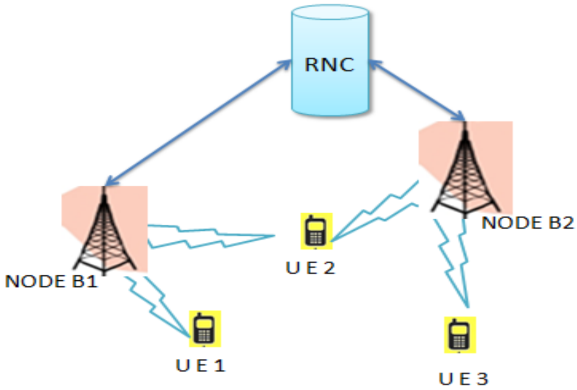


Figure 4. Soft Handover

## 2. Related Works

The authors methodically discuss the Machine Learning algorithms and the characteristics of identity to organize networks in their overview of applications for Machine Learning to self-organize networks for Mobile Communication. These were published in the authors, described the Machine Learning applications to Mobile phone networks using the three primary functionalities of self-organizing networks: self-arrangement, self-enhancing, and self-curing. An inclusive picture of machine learning implementations for cellular networks was created by offering multiple use-cases for each of the appearance that was previously mentioned. Therefore, the main goal of this framework was to develop a comprehensive structure for Machine Learning applications to multi-domain mobile cellular networks, with radio supply management, anomaly detection, back hauling, etc., even though it focused on Machine Learning implementations and integrated a short discussion on Handover management. Rather than concentrating on 5G technology Handover management. The applications of mobility and incorporated a detailed examination of the methodology used along with the features of mobility approaches, such as client location, mobility predictability, emerging output long with functional metrics. Although the analysis was written with a wider audience in mind than only machine learning, it may be categorized as Machine Learning -focused because the approaches discussed mainly deal with Machine Learning algorithms. Despite being one of the use cases, visual data driven Handover management is mostly ignored, and Handover management is not the primary focus of the endeavor. The authors provided a succinct introduction to 5G networks and a few of the enabling technologies, such as machine learning, software-defined networking, mm-wave communications, and heterogeneous networks (HetNets). A survey on Handoff management in 5G technology was also made available by them. The study is largely concerned with Handoff supervision in the next generation of mobile cellular Communication that they looked over the journalism without going in-depth. While there were extensive Machine Learning implementations offer a comprehensive analysis of Machine Learning potential application to Handoff management in 5G. Moreover, they completely ignored the visual information that helped with Handoff administration and Handover in urgent situation. After some challenges connected with the Handover decision process in two-tier mobile phone communications were identified, a thorough assessment of the existing Handover decision processes was conducted. Even though this study's target audience was 5G networks, because mobility supervision was not addressed directly in 5G networks, the main story started with LTE networks. Additionally, the range was extremely constrained because only Handover decision methods were addressed while Machine Learning was mentioned in part of the linked literature, Machine Learning was not the main topic. In their concise summary of Handover oriented mobility management, the authors provided incredibly broad descriptions of Handover mechanisms and mobility in Het-Nets. Specifically location managing and Handover supervision were divided into two groups under mobility management. Then, more details on each group were given. Nevertheless, neither 5G cellular networks were provided, nor was any particular Handover management scheme—such as Machine Learning -based Handover management—offered. Consequently, our current study on intelligent Handover management is more advanced than the previous one in terms of style, technique, and breadth. The first presentation covered the evolution of networks of cells from 1G to 5G. Discussions about the design of 5G networks and mobility management within them came after. Another brief review on cell phone management in 5G networks came next. Handoff management was also looked at by presenting several Handover sorts and Handover criteria. Still, the presentations were a little too short, and neither 5G networks nor mobility management were fully explained. Moreover, the survey about the use of machine learning in handover management was not intended for publication by the author. In their thorough examination of mobility management, the authors voice concerns about whether the state-of-the-art technologies available now

TEJAS Journal of Technologies and Humanitarian Science
ISSN-2583-5599
Vol.03, I.02 (2024)
**https://www.tejasjournals.com/**
https://doi.org/10.5281/zenodo.12057472

are suitable for the upcoming 5G cellular network generations. Following the identification of the mobility management specifications for the upcoming generation of cellular networks, particular qualitative performance metrics for the mobility management systems that are presently in use were given.

They also examined the research projects needed to meet these requirements and the standards' suitability and effectiveness for legacy networks and 5G. Finally, unlike our current work, a thorough analysis of current obstacles and possible enabling technologies was conducted.

i) The writers' focus was not restricted to Handover management.

ii) Although deep knowledge was briefly mentioned, it was not the major center of attention of the ML applications.

iii) There wasn't any discussion of how to manage Handover in an emergency or how to employ visual data help in Handover management.

# 3. Results and Findings

In the interpretation of vast amounts of mobile data using a handover approach, the results and subsequent discussions are pivotal for understanding the efficacy and implications of the approach. The outcomes and discussions phase usually goes like this:

Data Analysis: The first step involves analyzing the collected mobile data using the handover approach. The goal of this analysis is to derive pertinent insights about user mobility patterns, signal strength variations, handover success rates, and handover latency.

Presentation of the Results: Tables, charts, graphs, and statistical summaries are frequently used to exhibit the data analysis results in an understandable and structured way. The key findings and takeaways from the mobile data analysis are emphasized in this presentation.

Interpretation: Next, a detailed exploration of the interpreted results is conducted to provide context and meaning. This involves explaining the significance of the findings, identifying any patterns or trends observed, and discussing any unexpected outcomes or anomalies encountered during the analysis.

Comparison: The findings may be compared to prior studies, industry norms, or benchmarks to assess their validity and relevance. This comparison helps to contextualize the findings and illuminates the relative performance of the handover methodology compared to alternative methods or systems.

Implications: The results' practical ramifications for resource management, mobile network optimization, and user experience improvement are examined. This discussion may also touch on the prospects, limitations, and potential downsides of the handover technique.

Future Directions: Lastly, recommendations for future lines of inquiry and study topics are frequently made to wrap up a conversation. This could involve suggestions for improving the handover procedure, investigating fresh approaches, or resolving issues that arose from the mobile data's interpretation.

Through the methodical presentation and discourse of the outcomes of analyzing huge amounts of cellular phone data through a handover technique, scholars and professionals can acquire important knowledge, propel mobile data science forward, and ultimately enhance the efficiency and dependability of mobile networks.

The results and findings from the handover approach's analysis of large amounts of mobile data make available valuable insights into the operation and behavior of the network. Some common results and deductions that could be drawn from this type of interpretation are as follows:

Handover Success Rate: It is feasible to determine what proportion of handovers was successful in keeping mobile users connected when they encouraged between different association areas or cells. This compute shows how well the handover strategy ensures smooth communication.

Handover Latency: The analysis may provide the typical quantity of occasion that passes between a mobile device starting the handover process and its completion. Reduced handover latency values indicate quicker and more effective handover processes, which improves user satisfaction.

Signal intensity Variation: The results might draw attention to variations in the signal intensity that mobile devices go through during handover situations. Comprehending these variances is necessary to maximize handover choices and reduce the possibility of missed calls or deteriorated service quality.

Mobility Patterns: Common routes or heavily traveled places may be identified by the study as patterns in user movement. By anticipating future demand and facilitating more efficient resource allocation, these insights can support network design and optimization initiatives.

Impact of Environmental elements: The interpretation might evaluate the ways in which handover performance is impacted by environmental elements including topography, structures, or meteorological conditions.

Comparison with Benchmarks: To assess how well the handover technique performs in relation to predetermined criteria, the results may be compared with industry benchmarks or standards. This comparison aids in evaluating the suggested solution's competitiveness and efficacy.

Challenge Identification: The results may point out problems where the handover technique wants to be improved,

TEJAS Journal of Technologies and Humanitarian Science
ISSN-2583-5599
Vol.03, I.02 (2024)
**https://www.tejasjournals.com/**
https://doi.org/10.5281/zenodo.12057472

such as instances of poor resource allocation, high latency, or handover failures. Resolving these issues can get better the efficiency and dependability of the system.
User Experience Assessment: Lastly, depending on variables such as perceived network responsiveness, data throughput, and call quality, the interpretation may evaluate the entire user experience. Good user experiences boost user happiness and retention and are a sign that the handover technique has been used effectively.
Researchers and practitioners can learn a great deal about the behavior and performance of mobile networks by presenting and debating these facts and conclusions, which will spur innovation and ongoing development in the ground of cell phone data science.

# 4. Conclusion

In arrange to make best use of the transition and performance between these two generations of wireless technology, enormous volumes of data created by mobile networks must be analyzed. This is ended by interpreting vast mobile data science utilizing a handover strategy between 4G and 5G. These are the main elements and things to think about:
Data Science for Mobile Networks
Massive Mobile Data: Volume: Data produced by millions of users, measured in petabytes. Variety: A range of data kinds, including call logs, browsing and location data, and measurements for network performance. Velocity: Instantaneous handover decisions depend on real-time data processing. Veracity: Having reliable and accurate facts is essential for making well-informed decisions. By utilizing real-time processing, machine learning, and advanced data analytics, the handover strategy between 5G and 4G can be utilized to understand immense amounts of mobile data science and take full advantage of network presentation while maintaining seamless connectivity. This technique addresses both technological and data-related concerns and provides significant benefits in a variety of applications.

# References

[1] P.-J. Hsieh, W.-S. Lin, K.-H. Lin, H.-Y. Wei, Dual-connectivity prevenienthandover scheme in control/user-plane split networks, IEEE Transactions onVehicular Technology 67 (4) (2017) 3545–3560.

[2] K.Kanwal, G.A. Safdar, Energy efficiency and superlative TTT for equitable RLFand ping pong in LTE networks, Mobile Networks and Applications 23 (6)(2018) 1682–1692.

[3] A.Pompigna, R. Mauro, Smart roads: A state of the art of highwaysinnovations in the Smart Age, Engineering Science and Technology, anInternational Journal 25 (2022) 100986.

[4] Ericsson, ‘‘Mobile Subscriptions Outlook (Mobility Forecasting Report),” Ericsson Limited, 2021, vol. 2021. Accessed: 2021

[5] M. Pätzold, 5G Is Going Live in Country After Country [Mobile Radio], IEEEVehicular Technology Magazine 14 (4) (2019) 4–10.

[6] Shayea, M. Hadri Azmi, T. Abd. Rahman, M. Ergen, C. Tien Han, A. Arsad,Spectrum Gap Analysis With Practical Solutions for Future Mobile Data TrafficGrowth in Malaysia, IEEE Access 7 (2019) 24910–24933.

[7] Shayea, T. Abd. Rahman, M. Hadri Azmi, C. Tien Han, A. Arsad, Predictingrequired licensed spectrum for the future considering big data growth, ETRIJournal 41 (2) (2019) 224–234.

[8] Shayea, L.A. Nissirat, M.A. Nisirat, A. Alsamawi, T. Abd. Rahman, M. HadriAzmi, M. Abo-Zeed, I. Trrad, Rain attenuation and worst month statisticsverification and modeling for 5G radio link system at 26 GHz in Malaysia,Transactions on Emerging Telecommunications Technologies 30 (12) (2019)e3697.

[9] Shayea, T. Abd. Rahman, M. Hadri Azmi, M.R. Islam, Real measurementstudy for rain rate and rain attenuation conducted over 26 GHz microwave 5Glink system in Malaysia, IEEE Access

6 (2018) 19044–19064.

[10] T.S. Rappaport, S.u. Sun, R. Mayzus, H. Zhao, Y. Azar, K. Wang, G.N. Wong, J.K.Schulz, M. Samimi, F. Gutierrez, Millimeter wave mobile communications for5G Network: It will work!, IEEE Access 1 (2013) 335–349

[11] Shayea, M. Ergen, M. Hadri Azmi, S. Aldirmaz Colak, R. Nordin, Y.I. Daradkeh,Key Challenges, Drivers and Solutions for Mobility Management in 5GNetworks: A Survey, IEEE Access 8 (2020) 172534–172552.

[12] M.H. Alsharif, A.H. Kelechi, K. Yahya, S.A. Chaudhry, Machine learningalgorithms for smart data analysis in internet of things environment:taxonomies and research trends, Symmetry 12 (1) (2020) 88.

[13] Y. Kim, F. Sun, Y.i. Wang, Y. Qi, J. Lee, Y. Kim, J. Oh, H. Ji, J. Yeo, S. Choi, H. Ryu,

[14] H. Noh, T. Kim, New Radio (NR) and it's Evolution toward 5G-Advanced, IEEEWirelessCommun. 26 (3) (2019) 2–7.

[15] A.M. Al-Samman, T.A. Rahman, M.H. Azmi, I. Shayea, Path loss model andchannel capacity for UWB–MIMO channel in outdoor environment, WirelessPersonal Communications 107 (1) (2019) 271–281.