## A Review: INTER-SYSTEM HANDOFF IN 4G NETWORKS

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**Abstract**

WiMax and WiFi are key technologies in the realm of wireless communication, facilitating data transmission through diverse methods. In large-scale wireless networks using these technologies, it is common practice to segment the network into clusters to manage its extensive reach more effectively. Each cluster is managed by a base station or cluster head, responsible for the nodes within its domain. As nodes move within the network, they may exit the range of their current cluster head, requiring a transfer of control to a new cluster head, a process known as handover.

The aim of the proposed system is to tackle this challenge by developing a strategy to select the most appropriate cluster head for a node, focusing on reliability and efficiency. This system is particularly concerned with heterogeneous networks that incorporate both Broadband wireless network and Wireless connectivity technologies. The process of switching between these distinct networks is known as inter-network handoff. The primary goal is to fine-tune inter-network handoff. by enhancing both efficiency and reliability. Selection of base stations will involve adjusting various parameters to ensure optimal performance.

1. **Introduction**

**Introduction** The vision for future wireless networks revolves around seamlessly integrating various types of wireless access, like Wi-Fi, WiMAX, and UMTS, into an Internet Protocol (IP)-based framework. These mixed networks aim to work together to provide users with a consistent experience marked by great Quality of Service (QoS) and smooth transitions between different networks.

Researchers are concentrating on enabling cooperation between different wireless access networks. Each type of wireless technology has its own way of managing mobility, ensuring security, and maintaining QoS. So, it's vital to address these differences to create efficient ways for Wireless Mesh Networks (WMNs) to interact with other wireless networks.

In WMNs, mesh routers are key players. They combine the functions of 802.11 access points and 802.16 base stations. When a device switches between different network types, it only changes the link between the device and the mesh routers, keeping the connection with the same router. However, traditional methods like Mobile IP can cause delays and signaling overheads during handoffs. That's why new handoff methods are needed to make transitions fast and smooth.

When it comes to vertical handoffs, deciding when to switch networks is crucial. Unlike traditional handoffs, which mostly rely on signal strength, vertical handoffs consider things like service cost, network traffic, distance to the device, QoS needs, and user preferences. Developing a good algorithm for vertical handoff decisions is tricky—it has to maximize radio resources while ensuring QoS.

Vertical handoffs might happen not just at the periphery of a cellular coverage area but also in accordance with things like network congestion or user preferences. So, we need smart algorithms to decide when to switch based on network performance and QoS, to use resources efficiently and minimize unnecessary handoffs. In this scenario, changes are made to certain parameters when selecting base stations, considering things like data speed and delay. Analyzing these parameters helps make better handoff decisions, using resources well and making sure users have a great experience with future wireless networks.

1. **Literature Review**

Wonjun Lee,” Movement-Aware Vertical Handoff of WLAN and Mobile WiMAX for Seamless Ubiquitous Access”, IEEE Transactions on Consumer Electronics 0098 3063/07 © 2007 IEEE

The seamless integration of heterogeneous wireless networks has garnered significant attention in the pursuit of ubiquitous computing environments. Among the diverse array of wireless technologies, IEEE 802.16 WiMAX has emerged as a promising solution, particularly with the advent of the IEEE 802.16e Mobile WiMAX standard, which addresses mobility challenges.

However, the effective interworking between IEEE 802.11 WLAN and IEEE 802.16e Mobile WiMAX remains relatively unexplored in the existing literature. Previous research predominantly centers on vertical handover mechanisms between WLAN and 3G networks, with approaches primarily classified into radio signal strength (RSS)-based and policy-based strategies.

Zhiwei Yan,” An Adaptive Multi-criteria Vertical Handover Framework for Heterogeneous Networks”, 978-1-60558-089-0

The literature review on LTE networks and handoff processes presents a multifaceted exploration of research endeavors spanning network architecture, deployment strategies, and mobility management. Scholars have meticulously dissected LTE architecture, delineating the intricate interplay of network components, protocols, and interfaces to optimize packet data transmission and minimize operational costs. Deployment strategies have garnered attention for their role in maximizing spectral efficiency and mitigating network congestion, with a concerted effort to balance data usage and maintenance expenditures.

R. Good,” A Multilayered Hybrid Architecture to Support Vertical Handover between IEEE802.11 and UMTS”, IWCMC’06, 1-59593-306-9/06/0007

The literature review in the paper delves into the intricate realm of mobility management within heterogeneous network environments, with a particular focus on the interplay between Mobile IPv4, or Mobile IP, and the Session Initiation Protocol (SIP). It begins by outlining the formidable challenges encountered during vertical handovers, especially when transitioning between WLAN and UMTS networks, necessitating meticulous adjustments in Mobile IP implementations.

Gracieth Valenzuela, Isac Ferreira, Paulo Cunha," Vertical Handover Decision Based on Quality of experience in Heterogeneous Wireless Networks

Prior research in the field of heterogeneous wireless networks has predominantly focused on network selection mechanisms and their impact on user experience. Traditional approaches to network selection often rely on technical metrics such as signal strength, network availability, and load balancing. While these metrics are essential for maintaining network stability and performance, they may not fully capture the subjective aspects of user satisfaction, particularly in multimedia-rich environments.

M. Ghaleb and N. A. Abbasi, "A comprehensive review on vertical handover decision algorithms in heterogeneous wireless networks," Journal of Network and Computer Applications, vol. 35, no. 3, pp. 877-892, 2012.

The introduction sets the stage by highlighting the rapid development of wireless systems and the need for a unified technology infrastructure to serve various wireless applications effectively. It emphasizes the importance of future wireless systems communicating via heterogeneous technologies such as WiFi, WiMAX, UMTS, and mobile applications like Web 2.0 and location-based services.

1. **Methodology**

In today's wireless landscape, meeting the diverse service demands of mobile users—such as high data rates, low latency, and seamless coverage—poses a significant challenge. To address this, integration among various wireless technologies is essential to ensure users always have the best possible connection, regardless of their location. This integration necessitates the smooth transition, or handover, between different radio access technologies.

There are two primary types of handover scenarios: horizontal handoff and vertical handoff. Horizontal handoff occurs within the same wireless network, while vertical handoff involves transitioning between different wireless access technologies. This distinction is crucial because the nature of handover differs between these scenarios.

Extensive research has been conducted on vertical handover, as documented in numerous studies within the literature. This body of work explores strategies and protocols to facilitate seamless transitions between disparate wireless technologies, ensuring uninterrupted connectivity for mobile users.

**REQUIREMENT OF VERTICAL HANDOFF**

Efficiency and reliability are crucial for any connectivity. Within rapid networking, data loss can become a significant issue when problems arise. One of the primary hurdles in these fast networks is handover, especially vertical handover, which occurs between different types of networks.

This work addresses the issue of data loss during vertical handovers. To manage a WiMax network effectively, we describe a hybrid network with a defined quantity of nodes and clusters. To achieve this, we must gather information about the network scenario, including:

* No of Nodes
* Mobility
* Cluster Definition
* Channel Type
* Propagation
* Transmission Speed

To ensure precise depiction of these parameters, gathering pertinent scenarios is essential. Additionally, information on parameters that influence cluster head selection criteria which may include factors like proximity (distance) and load considerations should be collected. This configuration will be determined through an examination of existing literature.

**PROPOSED ALGORITHM**

Efficiency and integrity are paramount for any network, and the challenges are even more critical in wireless networks. The decision to trigger a handover will stem from a specific crucial element, electing the base station with the highest operational efficiency as the subsequent base station post-handover. This Mechanism aims to deliver seamless handover with high reliability and minimal energy consumption.

Algorithm

1. Define a network with N nodes, including detection radius and supplementary factors relevant variables.
2. Describe the cornerstone stations considering their rate of recurrence ranges and capacities.
3. Conduct wireless communication with a designated node, N1..
4. Check if handover is needed:
   * + If the separation between the base station (BS) and Node N1 exceeds the range.
     + Print "Handoff required"
5. **Objective of work**

The objectives of this thesis encompass a comprehensive exploration of clustered WiMax and WiFi networks, with a focus on optimizing vertical handover mechanisms and incorporating insights from existing literature. The primary goals are multifaceted and aimed at addressing the complexities inherent in wireless network management. The objectives are delineated as follows:

1. Literature Review and Synthesis:
   * Conduct a thorough review of existing literature related to clustered WiMax and WiFi networks, vertical handover mechanisms, and optimization techniques.
   * Synthesize findings from relevant papers and studies to inform the design and implementation of the research methodology.
   * Identify gaps, challenges, and opportunities in the existing body of knowledge to guide the research direction and contribute to the advancement of the field.
2. Implementation and Design of WiFi and WiMax Clustered Networks in Different Scenarios:
   * Develop a variety of clustered network configurations using WiMax and WiFi technologies based on insights gleaned from the literature review.
   * Design scenarios that replicate real-world conditions to provide a robust understanding of network behavior and facilitate experimentation and analysis.
3. Study of Parameters Affecting Handover:
   * Conduct an exhaustive analysis of parameters influencing handover efficiency within clustered WiMax and WiFi networks, drawing upon insights from the literature review.
   * Investigate factors such as signal propagation characteristics, network congestion dynamics, and node mobility patterns to elucidate their impact on handover performance.
4. Implementation of Proposed Algorithms for Seamless Handover between Clusters:
   * Develop innovative algorithms tailored to optimize the vertical handover process, informed by the findings of the literature review.
   * Design algorithms capable of selecting the most suitable base station or cluster head based on considerations of reliability, efficiency, and network dynamics.
5. Performance Evaluation and Comparative Analysis:
   * Conduct rigorous performance assessments to measure the efficacy of the proposed algorithms under varying conditions, informed by insights from existing research.
   * Evaluate critical metrics such as effective throughput and latency to gauge the performance of the handover mechanisms accurately.
   * Compare the performance of the proposed algorithms against existing handover mechanisms identified in the literature to demonstrate their superiority.
6. Scalability and Adaptability Assessment:
   * Scrutinize the scalability and adaptability of the proposed algorithms across various network architectures and deployment scenarios, considering insights from relevant studies.
   * Assess the algorithms' ability to accommodate changes in network topology, size, and density while maintaining optimal performance.
7. Validation through Simulation Studies and Prototyping:
   * Validate the proposed algorithms through extensive simulation studies and prototyping endeavors conducted within authentic network environments, guided by insights from existing research.
   * Verify the viability and efficacy of the algorithms in practical implementations, ensuring alignment with real-world deployment scenarios.
8. Documentation, Dissemination, and Collaboration:
   * Comprehensively document the findings of the research, including methodologies, results, and insights, integrating relevant findings from the literature review.
   * Disseminate the research outcomes through publications in relevant academic journals, conference presentations, and technical reports, acknowledging the contributions of existing research.
   * Foster collaboration and knowledge exchange within the broader research community through active engagement in academic forums and collaborative research initiatives, building upon the insights gained from existing literature.
9. Socio-Economic Implications and Policy Relevance:
   * Highlight the broader socio-economic implications of enhanced wireless network management, informed by insights from existing studies and research.
   * Provide insights for policymakers, industry leaders, and regulatory bodies based on the synthesis of existing literature to inform evidence-based policies conducive to sustainable network development.
10. **Conclusion**

A Hybrid network architecture supports all usage models (fixed, mobile & nomadic). It also supports high capacity real time and non real time voice, data and multimedia services while maintaining the appropriate QoS. Moreover it supports idle mode operation and paging for the mobile station. Its network reference model supports interoperability.

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