

# Chapter 22

## SRMIP: A Software-Defined RAN Mobile IP Framework for Real Time Applications in Wide Area Motion

**Walaa Farouk Elsadek**

*American University in Cairo, Computer Science and Engineering Department, Cairo, Egypt*

**Mikhail N. Mikhail**

*American University in Cairo, Computer Science and Engineering Department, Cairo, Egypt*

### **ABSTRACT**

*Existing mobility protocols suffer from multimedia and data transfer disruption when crossing cities' boundaries by trains or cars. Session continuity in wide area motion is an officially raised goal by 5G-PPP vision. This research adopts 5G methodology by using software defined networking to propose a new mobile IP framework that facilitates seamless handover and ensures session continuity in standard and wide area coverage. The same uninterruptible experience is used to extend smart indoor services with effective offload mechanism to avoid core network congestion. Performance excels existing protocols in setup and handover delays as of eliminating 4G LTE bearer setup/release out-band signaling and isolating user's packets in OpenFlow virtual path that is recursively established in-line with IP address allocation. Handover cross cities in wide area motion becomes feasible with lower latency than LTE handover inside city. Throughput is instantly restored after handover while standard packets are wire speed forwarded as of tunnel headers' elimination and OpenFlow hardware abstraction.*

### **INTRODUCTION**

The European 5G PPP (5G Infrastructure Public Private Partnership) researches recognizing Software Defined Networking (SDN) as an emerging key technology for next generation networks pave the way for operators to launch new series of rich customized data and multimedia services. Tremendous innovation in smart homes, offices, remote health care, and multimedia streaming services raise an urgent need for

DOI: 10.4018/978-1-7998-7708-0.ch022

continuous connectivity to real time indoor services. Effective solutions are required with optimal cost structures through the benefits gained by leveraging automation to ensure seamless coverage in high mobility situations as crossing wide geographically separated locations (Odini et al., 2015; 5G-PPP, 2015). Session continuity associated with user's motion in train or car crossing cities' boundaries is one of the raised problems by 5G Automotive Vision. The ultimate goal is tremendous users experience in high challenging mobility situations (5G-PPP, 2015; Abdulhusein et al., 2015). 4G Long Term Evolution (LTE) exhausted several trials to provide an effective solution that guarantees session continuity in wide area motion with uninterrupted access to residential, enterprise, and internet services. Unluckily, existing solutions suffer dramatically from inefficient data forwarding that leads to Evolved Packet Core (EPC) congestion and induces high latency in services offered. LIMONET trials in 3GPP releases from 9 to 12 as well as the IETF Multipath TCP, discussed in section III, highlight these problems (ETSI, 2016; Gupta & Rastogi, 2012; Hampel, Rana, & Klein, 2013; Wang, 2015).

This research proposes a novel network based Mobile IP (MIP) framework using SDN, called SRMIP, which ensures session continuity in normal and challenging situations. SRMIP guarantees uninterruptible accessibility to indoor services with an effective offload mechanism. A prototype is established to assess framework feasibility, ensure seamless handover, and wire speed forwarding of Mobile Node's (MN) packets without congesting core networks. Experimental results show strong improvements in mobility setup delay for standard and wide area motion over LTE total bearer setup time in Proxy Mobile IP (PMIP). Handover delay inside city becomes equivalent to L2 handover in Software-Defined Wireless Networks (SDWN) that is highly better than LTE. SRMIP ensures session continuity during handover cross cities that is currently unfeasible in LTE as of the highlighted EPC congestion problem. The clue is replacing LTE bearer in PMIP and GPRS Tunneling Protocol (GTP) with OpenFlow virtual paths. SRMIP eliminates LTE out-band signaling as PMIP/GTP-C control messages associating bearer setup/release during MN's join/handover through recursive establishment of SDN-OpenFlow virtual paths in-line with the allocation of MN's IP address.

The paper is organized as follows; Section II gives an overview on existing mobility protocols and performance degradation associating tunneling. Section III describes the inefficient data forwarding plan of existing mobility protocols that induces core congestion problem and limits session continuity in real deployments of wide area motion. Section IV briefs OpenFlow SDN-based technology and states related research. Section V presents SRMIP framework, highlights LTE gained advantages from being OpenFlow SDN-based, illustrates the key design concepts and states how the described problems are solved. Section VI analyzes SRMIP experimental results and compares them to SDWN and PMIP. Section VIII highlights research conclusion and contributions.

## **MOBILE IP (MIP): OVERVIEW**

Mobility management is divided into two main categories; host-based and network-based architectures (Al-Surmi, Othman, & Ali, 2010). The former enforces MN's involvement in mobility signaling while the later carries signaling through the network transparent from MN. MIP was defined in RFC 3344 as a way for enabling mobile user to keep the same IP address while traveling to different networks for continuous communication (Perkins, 2002). The initial proposed MIP was host based. Its deployment required MN's kernel modification and introduced inefficient data forwarding, called triangle problem, that hindered its applicability in large deployments (Esmat, 2000; Mikhail, 2001; Weyland, 2002). Later,

23 more pages are available in the full version of this document, which may be purchased using the "Add to Cart" button on the publisher's webpage:

[www.igi-global.com/chapter/srmip/270206](http://www.igi-global.com/chapter/srmip/270206)

## Related Content

---

### Source and Channel Coding Techniques for Cooperative Communications

John M. Shea, Tan F. Wong, Chan Wong Wong and Byonghyok Choi (2010). *Cooperative Communications for Improved Wireless Network Transmission: Framework for Virtual Antenna Array Applications* (pp. 135-186).

[www.irma-international.org/chapter/source-channel-coding-techniques-cooperative/36548](http://www.irma-international.org/chapter/source-channel-coding-techniques-cooperative/36548)

### State of the Art on Ontology Alignment

Maria Vargas-Vera and Miklos Nagy (2016). *Mobile Computing and Wireless Networks: Concepts, Methodologies, Tools, and Applications* (pp. 2254-2280).

[www.irma-international.org/chapter/state-of-the-art-on-ontology-alignment/138378](http://www.irma-international.org/chapter/state-of-the-art-on-ontology-alignment/138378)

### A Mobility-Based Routing Protocol for CR Enabled Mobile Ad Hoc Networks

Yan Sun, Jingwen Bai, Hao Zhang, Roujia Sun and Chris Phillips (2015). *International Journal of Wireless Networks and Broadband Technologies* (pp. 81-104).

[www.irma-international.org/article/a-mobility-based-routing-protocol-for-cr-enabled-mobile-ad-hoc-networks/125820](http://www.irma-international.org/article/a-mobility-based-routing-protocol-for-cr-enabled-mobile-ad-hoc-networks/125820)

### A Dynamic Model for Quality of Service Evaluation of Heterogeneous Networks

Farnaz Farid, Seyed Shahrestani and Chun Ruan (2020). *International Journal of Wireless Networks and Broadband Technologies* (pp. 17-42).

[www.irma-international.org/article/a-dynamic-model-for-quality-of-service-evaluation-of-heterogeneous-networks/257777](http://www.irma-international.org/article/a-dynamic-model-for-quality-of-service-evaluation-of-heterogeneous-networks/257777)

### An MPEG-DASH Methodology for QoE-Aware Web3D Streaming

Kostas Kapetanakis, Markos Zampoglou, Athanasios G. Malamos, Spyros Panagiotakis and Emmanuel Maravelakis (2014). *International Journal of Wireless Networks and Broadband Technologies* (pp. 1-20).

[www.irma-international.org/article/an-mpeg-dash-methodology-for-qoe-aware-web3d-streaming/125873](http://www.irma-international.org/article/an-mpeg-dash-methodology-for-qoe-aware-web3d-streaming/125873)