

TCP for Seamless Vertical Handoff in Hybrid Mobile Data Networks

Sung-Eun Kim, John A. Copeland
Georgia Institute of Technology, Atlanta
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Speaker: Hicks Chen



Outline

- Introduction
- Challenges on Vertical Handoff
- Overview of TCP for Wireless Networks
- TCP for Seamless Vertical Handoff
- Performance
- Conclusion

Introduction

- This paper propose a TCP scheme for seamless vertical handoff between wireless networks having drastically different characteristics
- It is not mandatory to change all of the TCP senders for compatibility
 - Since it uses an optional field in TCP header.

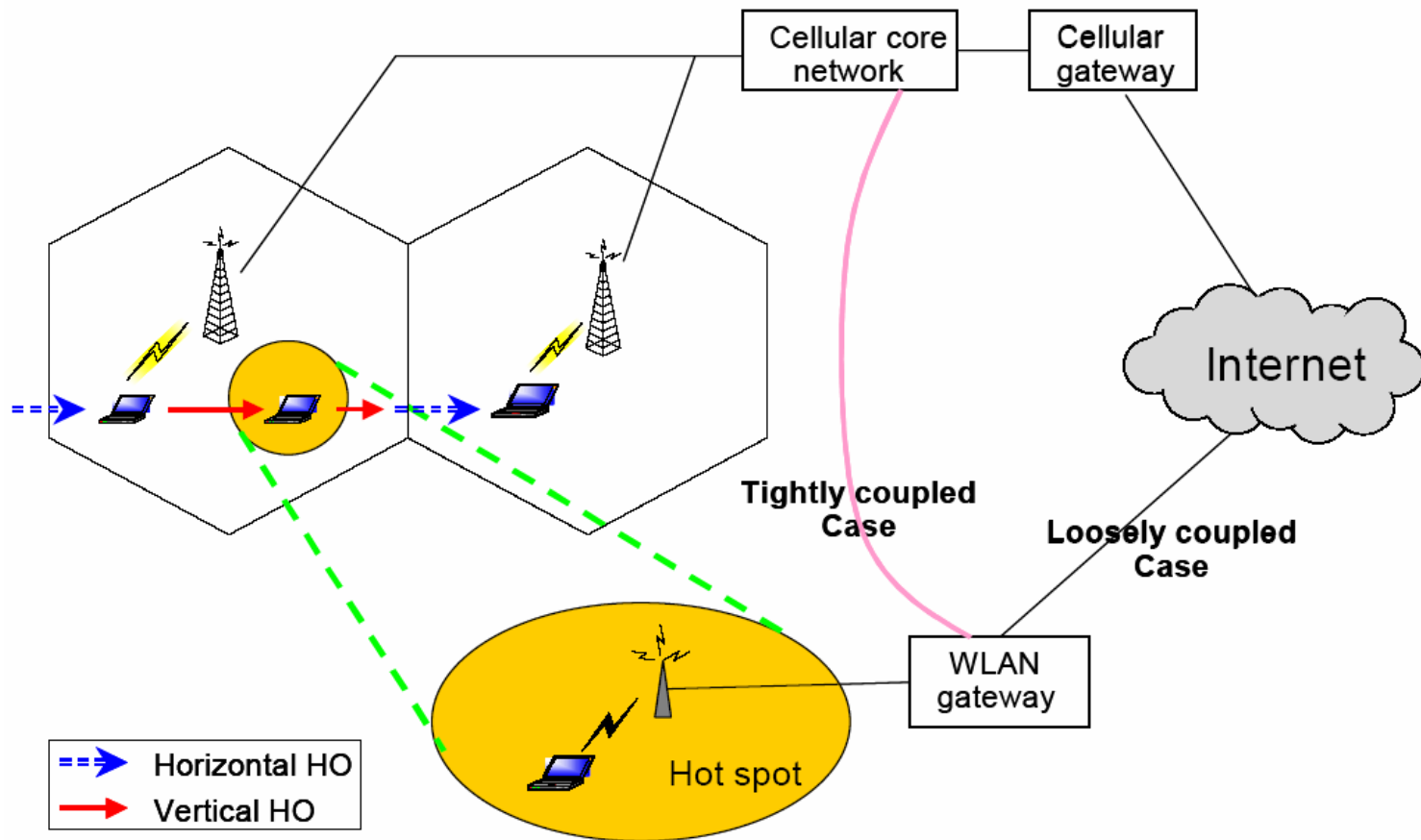
Challenges on Vertical Handoff

- Horizontal handoff is between Base Stations (BSs) that are using the same type of wireless network interface
- Vertical handoff is between BSs that are using different wireless network technologies
 - Upward vertical handoff
 - Downward vertical handoff

Challenges on Vertical Handoff

- Depending on the degree of inter-dependence between a WLAN and 3G cellular networks, the network architecture can be defined as
 - Tightly-coupled
 - loosely-coupled

Challenges on Vertical Handoff

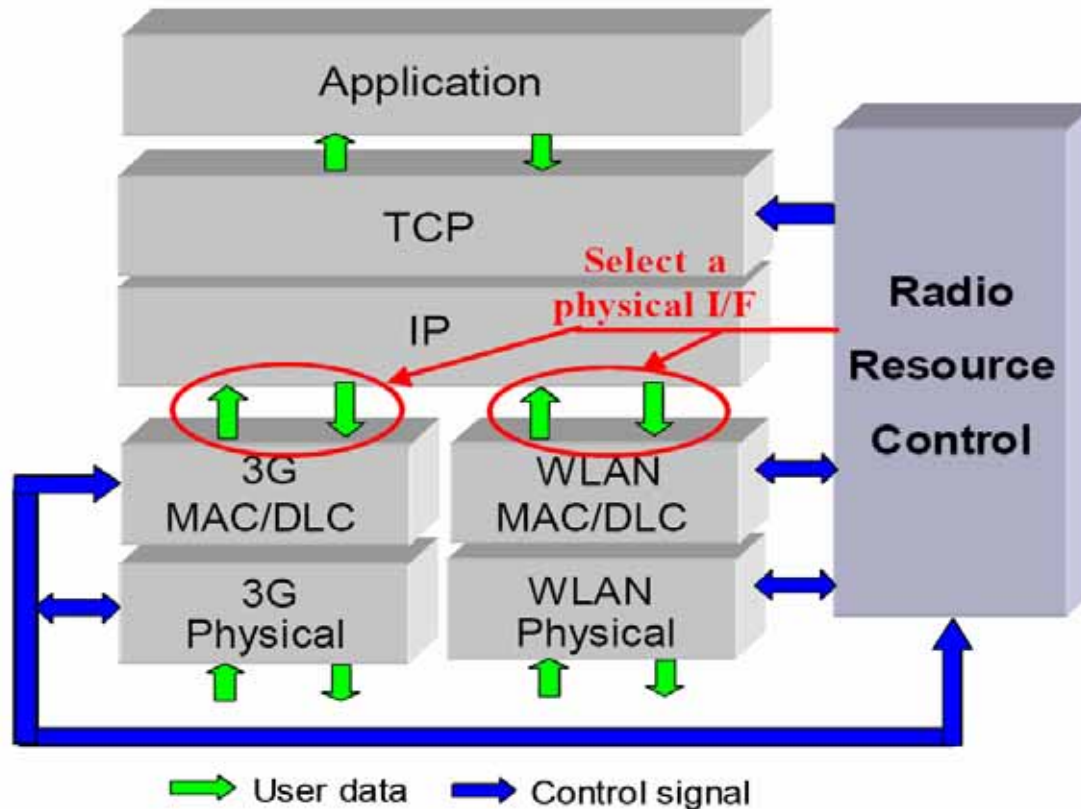




Challenges on Vertical Handoff

- The handoff triggering time is an important issue.
- It is determined by Received Signal Strength (RSS) , velocity, etc.

Challenges on Vertical Handoff



Possible Protocol stack of MH

Overview of TCP for Wireless Networks

- Traditional TCP does not work efficiently in the wireless networks
 - Since it can not distinguish and isolate congestion losses from wireless link losses.
- Many approaches to address this problem have been proposed. We categorize these approaches as 3 types:
 - Link layer solution
 - Split connection approach
 - End-to-end protocol

Overview of TCP for Wireless Networks

- Link layer solution
 - Snoop protocol
- Split connection approach
 - I-TCP, M-TCP
- But these schemes have some drawbacks:
 - The BSs should have a large buffer and a high processing capacity
 - Tremendous data overhead and packet loss during handoff

Overview of TCP for Wireless Networks

- End-to-end protocol
 - Freeze-TCP
- Freeze-TCP scheme is designed to avoid degrading performance due to handoffs.
- Receiver sends a Zero Window Advertisement to the sender when handoff is impending
 - To prevent timeouts at the sender and a shrink its congestion window size to 1.

TCP for Seamless Vertical Handoff

- In our proposed TCP scheme, the sender temporarily halts data transmission and stops its timeout timer similar to Freeze-TCP.
- However, our scheme differs from Freeze-TCP by:
 - Starting in the slow start state when the handoff is completed, and
 - Using the option field in a TCP header for indicating an impending HO.

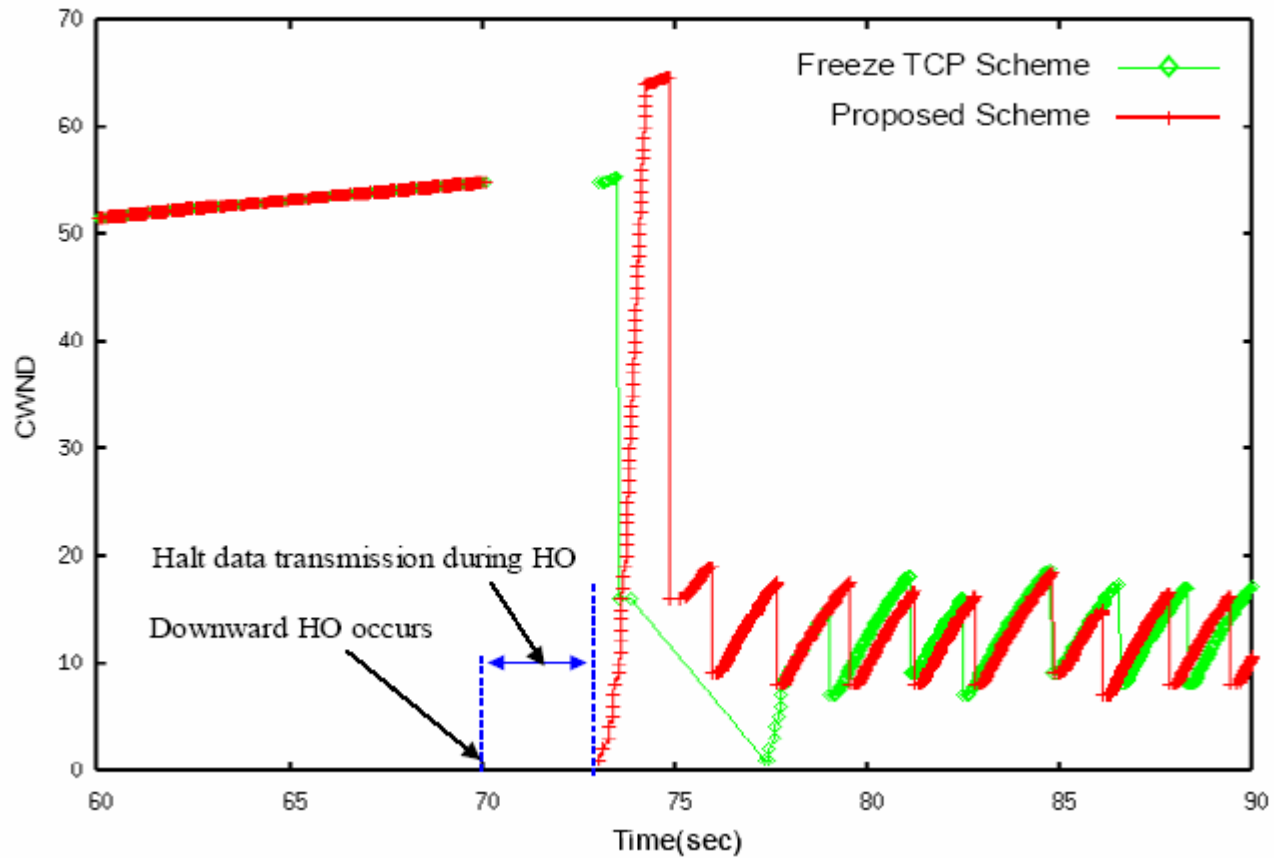
TCP for Seamless Vertical Handoff

- TCP uses an optional field in TCP header to identify the handoff situation.
- The optional field is defined as following:
 - HO optional field = 00 : no HO
 - HO optional field = 10 : horizontal HO
 - HO optional field = 11 : vertical HO

Performance

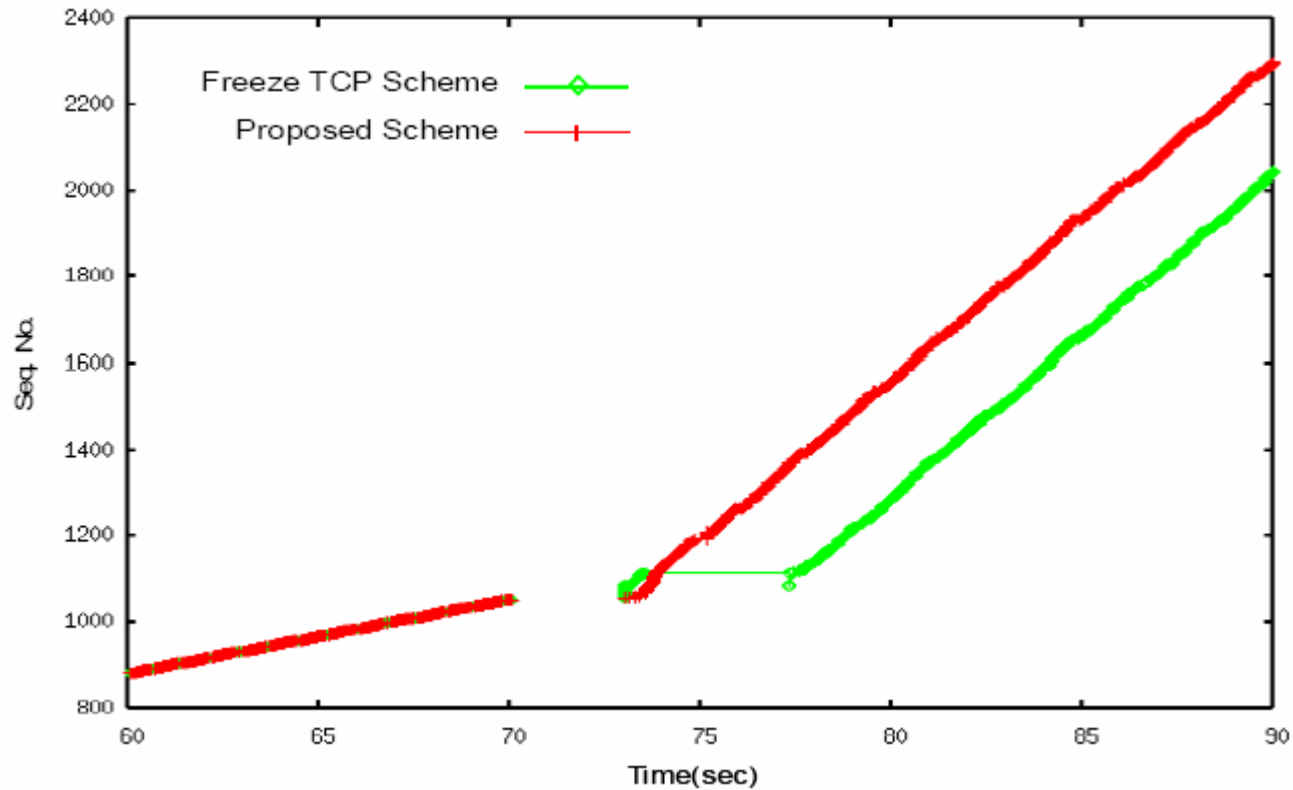
- We evaluate the performance of the proposed TCP scheme using *ns-2*.
- In this simulation, we assume
 - Data rate within a 3G cellular network is 144kbps
 - End-to-end RTT over a 3G cellular network is 300msec
 - Data rate within WLAN is 2Mbps
 - End-to-end RTT over a WLAN network is 100msec

Performance



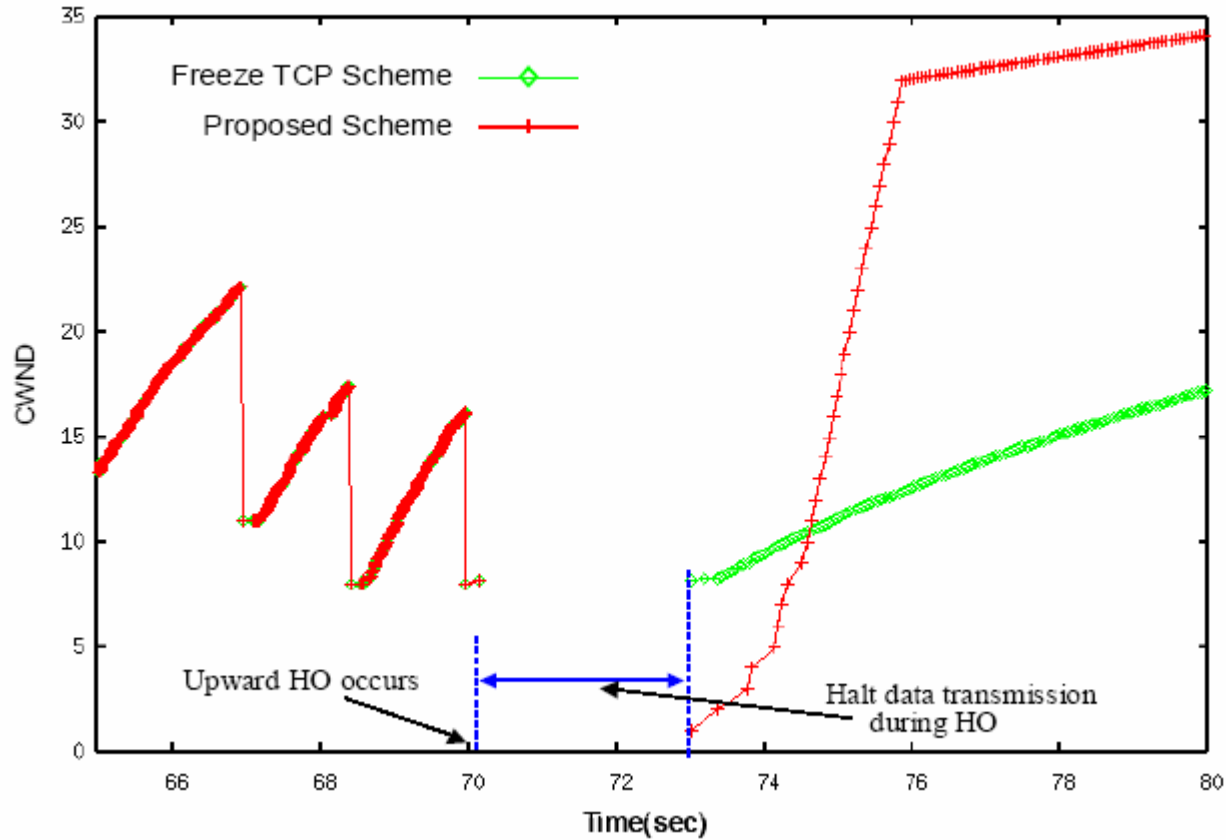
Downward vertical handoff

Performance



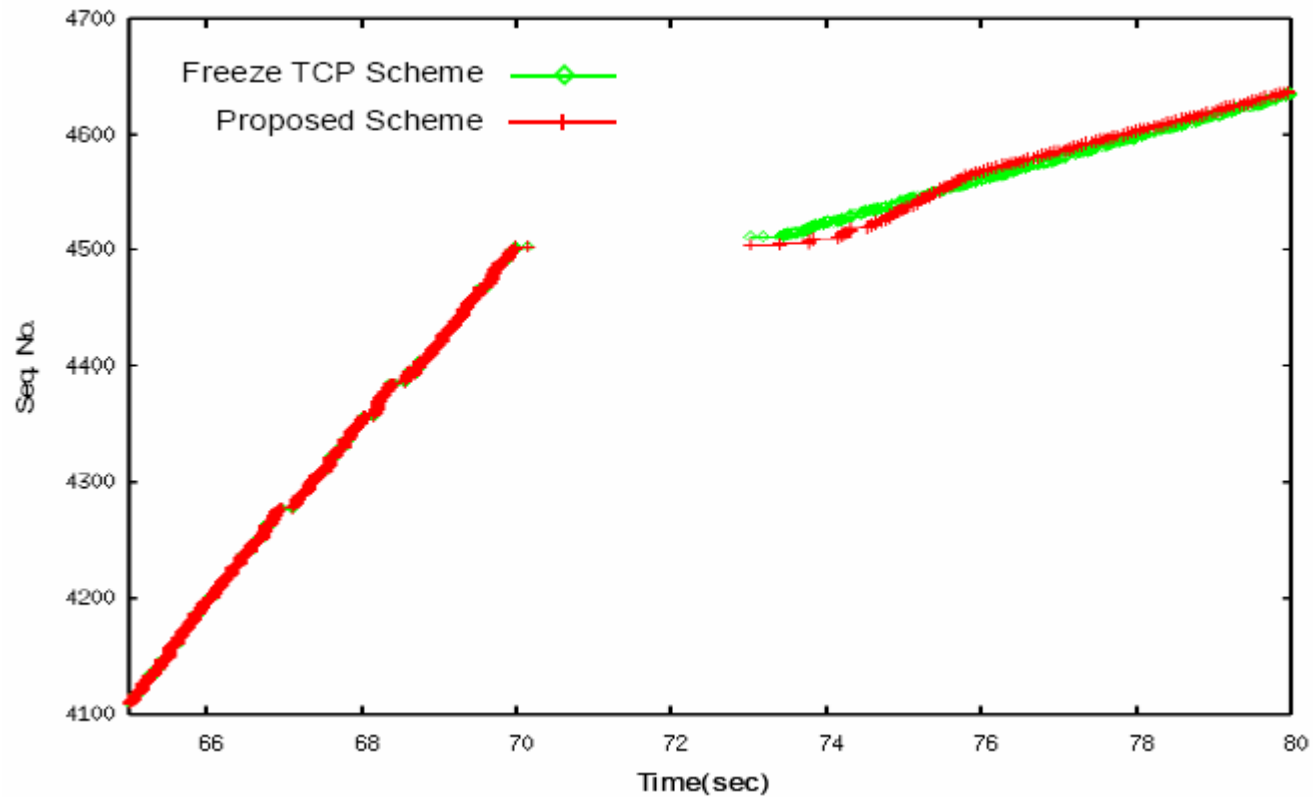
Downward vertical handoff

Performance



Upward vertical handoff

Performance



Upward vertical handoff

Conclusion

- We proposed a TCP scheme for a seamless vertical handoff in an integrated network, of a WLAN and a 3G cellular network.
- in contrast with a horizontal handoff in which keeping the same data rate produces better performance.