# Performance Analysis of Handoff Techniques Based on Mobile IP,TCP-Migrate, and SIP

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# Outline

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- Classification of applications
- Qualitative handoff performance analysis of existing mobility management protocols
- Analytical modeling
- Handoff performance comparison
- Summary and conclusion

# Introduction

- Next-generation wireless systems(NGWS) integrate different wireless networks to provide ubiquitous “always best connection” to mobile users.
- In NGWN, mobile users are connected to the best available networks that suit their service requirements and switch between different networks based on their service needs.

# Introduction

- Efficient mobility management protocols are required to support mobility across heterogeneous access networks.
- To answer the question “What is the suitable mobility management protocol for a particular application class?”

# Mobility management

- Location management
  - Enabling the system to track the locations of mobile users between consecutive communications.
- Handoff management
  - The process by which users keep their connections active when they move from one base station (BS) to another.

# Classification of applications

- Class A Applications:
  - TCP or UDP applications that are short lived and originated by a mobile node (MN).
  - Therefore, these applications do not require location or handoff support.
- Class B Applications:
  - TCP applications that are long lived and originated by an MN such as Web browsing and telnet sessions.
  - These applications do not require location support but require handoff support.
- Class C Applications:
  - TCP applications that are long lived and terminated at an MN such as telnet sessions.
  - Location and handoff support are required.

# Classification of applications

- Class D Applications:
  - UDP applications that are long lived and originated by an MN such as mobile telephony where MN is the calling party.
  - These applications require only handoff support.
- Class E Applications:
  - UDP applications that are long lived and terminated at an MN such as mobile telephony where MN is the called party.
  - these applications require both location and handoff support.

# Classification of applications

- The results of our analysis advocate：
  - The use of transport layer mobility management for Class B and Class C applications.
  - Mobile IP for non-real-time Class D and Class E applications.
  - Session Initiation Protocol-based mobility management for real-time Class D and Class E applications.

# Qualitative handoff performance analysis of existing mobility management protocols

- Parameters:
  - Handoff latency
  - Packet loss during handoff
  - Throughput degradation time
  - End-to-end delay
  - Transport-layer transparency

# Network Layer (Layer 3) Mobility Management Protocols

- Mobile IP registration introduces a significant amount of latency during handoff.
- Mobile IP triangular routing increases the end-to-end delay.
- Mobile IP handoff is transparent to the applications and the transport layer connections are kept intact during a handoff.

# Transport Layer (Layer 4) Mobility Management Protocols

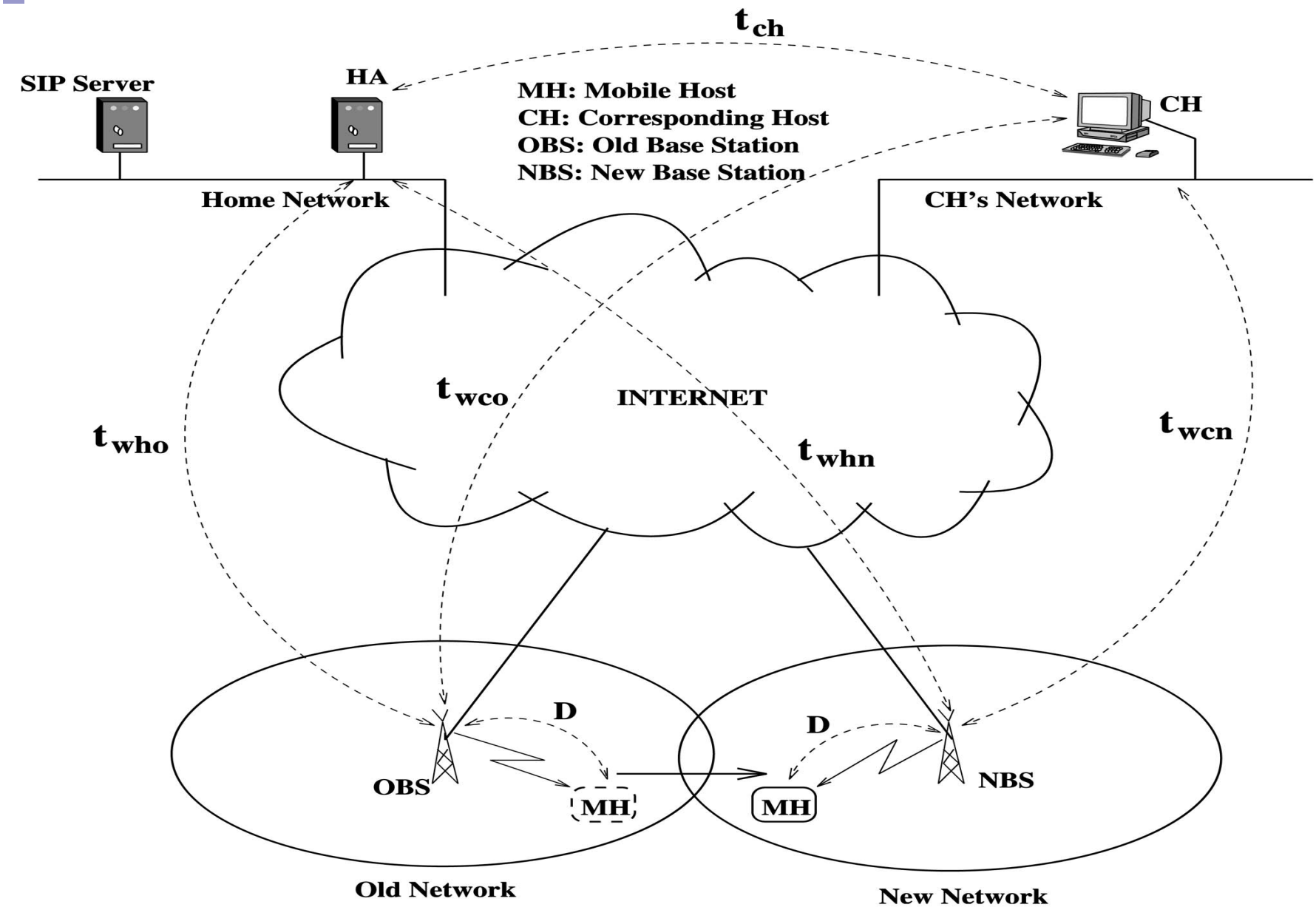
- The communicating end points are involved in the handoff process, the latency is often lower than that of Mobile IP.
- The packets that are lost during the handoff can be recovered because of TCP retransmission.
- As a transport layer connection is reactivated upon handoff, the applications remain transparent to mobility.

# Application Layer (Layer 5) Mobility Management Protocols

- Because redirecting agents are used during handoff, the handoff latency of SIP is comparable to that of Mobile IP but is higher than the transport layer mobility protocols.
- The packets during the handoff signaling procedures are lost, making handoff packet loss comparable to that of Mobile IP handoff.
- SIP mobility is not transparent to TCP protocol.

TABLE 1
Qualitative Performance of Mobility Management Protocols

| Performance parameter | Layer 2 | Layer 3 | Layer 4 | Layer 5 |
|---|---|---|---|---|
| Handoff latency | Worst | Worse | Weak | Worse |
| Handoff packet loss | Worst | Worse | Weak | Worse |
| End-to-end delay | Good | Weak | Good | Good |
| Transport-layer transparency | Weak | Good | Good | Weak |
| Security | Good | Good | Good | Good |

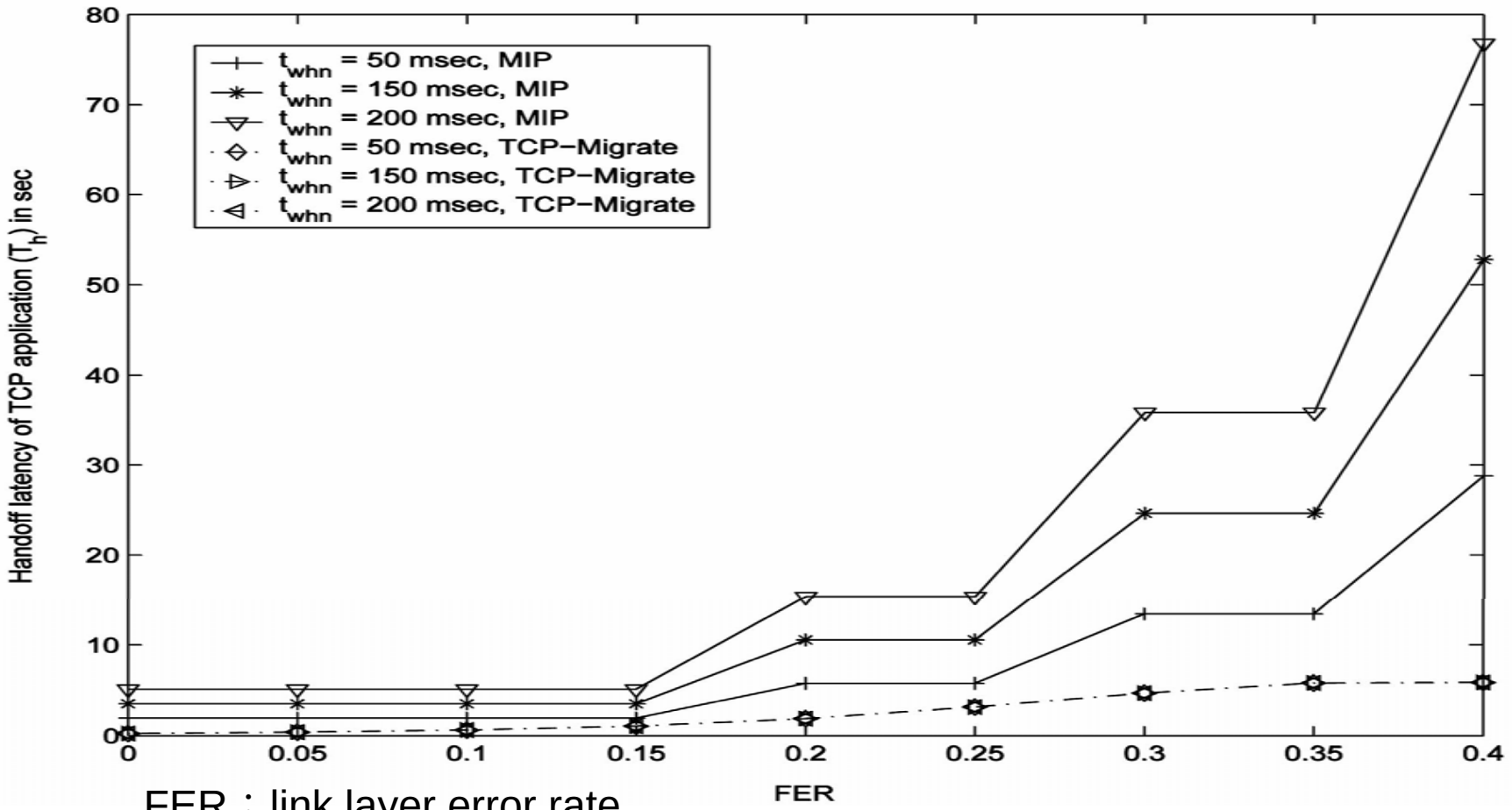



D: the link-layer access delay

# Analytical modeling

- End-to-End Packet Loss Probability
  - with Radio Link Protocol(RLP) and without RLP
- End-to-End Packet Transportation Delay
- Average Signaling Packet Transportation Delay Using UDP
- TCP Retransmission Timeout Duration
- Time for TCP Slow Start

# Handoff Performance Comparison of Mobile IP and TCP-Migrate for a TCP Connection

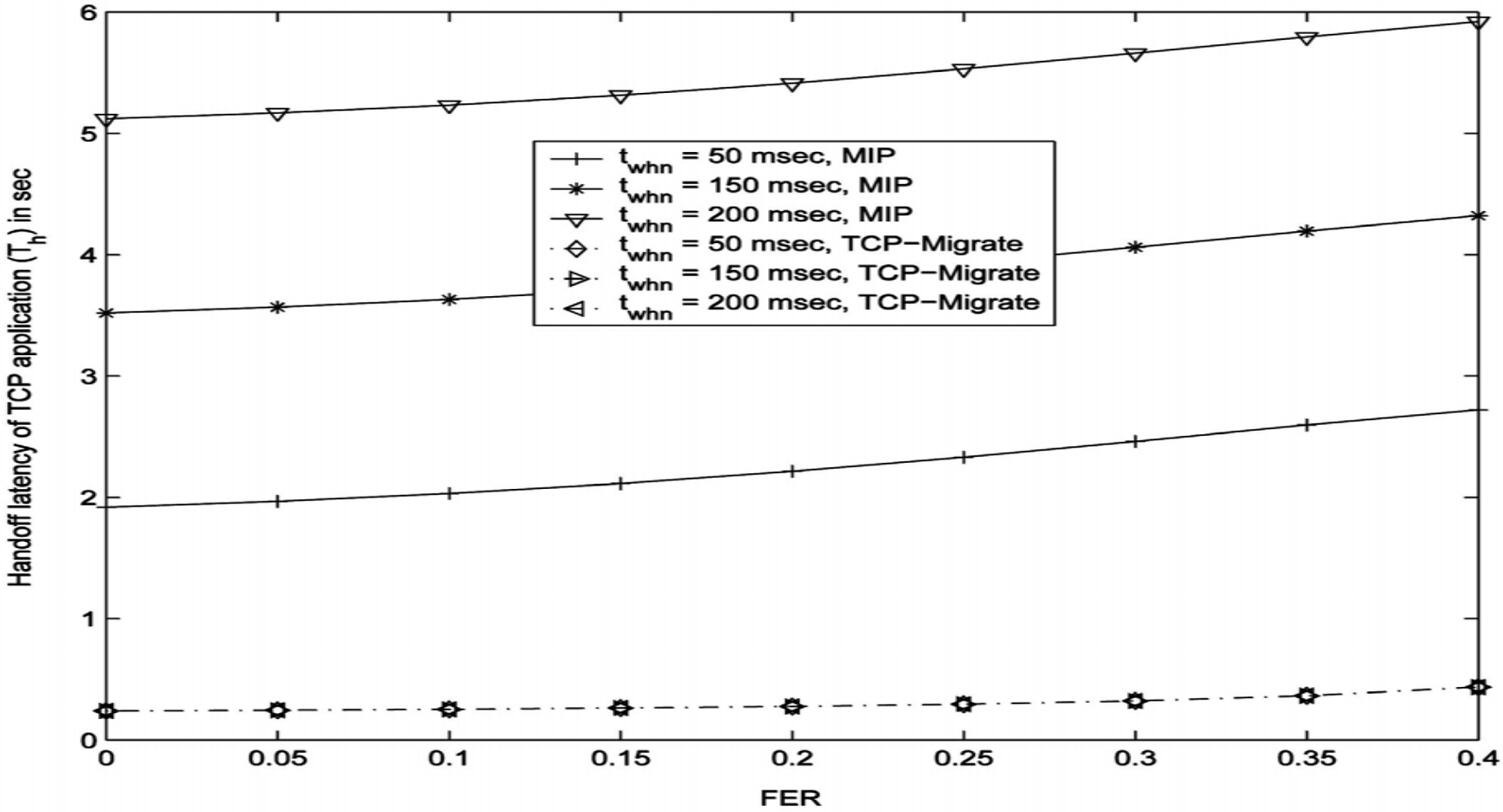



FER：link layer error rate

no RLP(Radio Link Protocol)

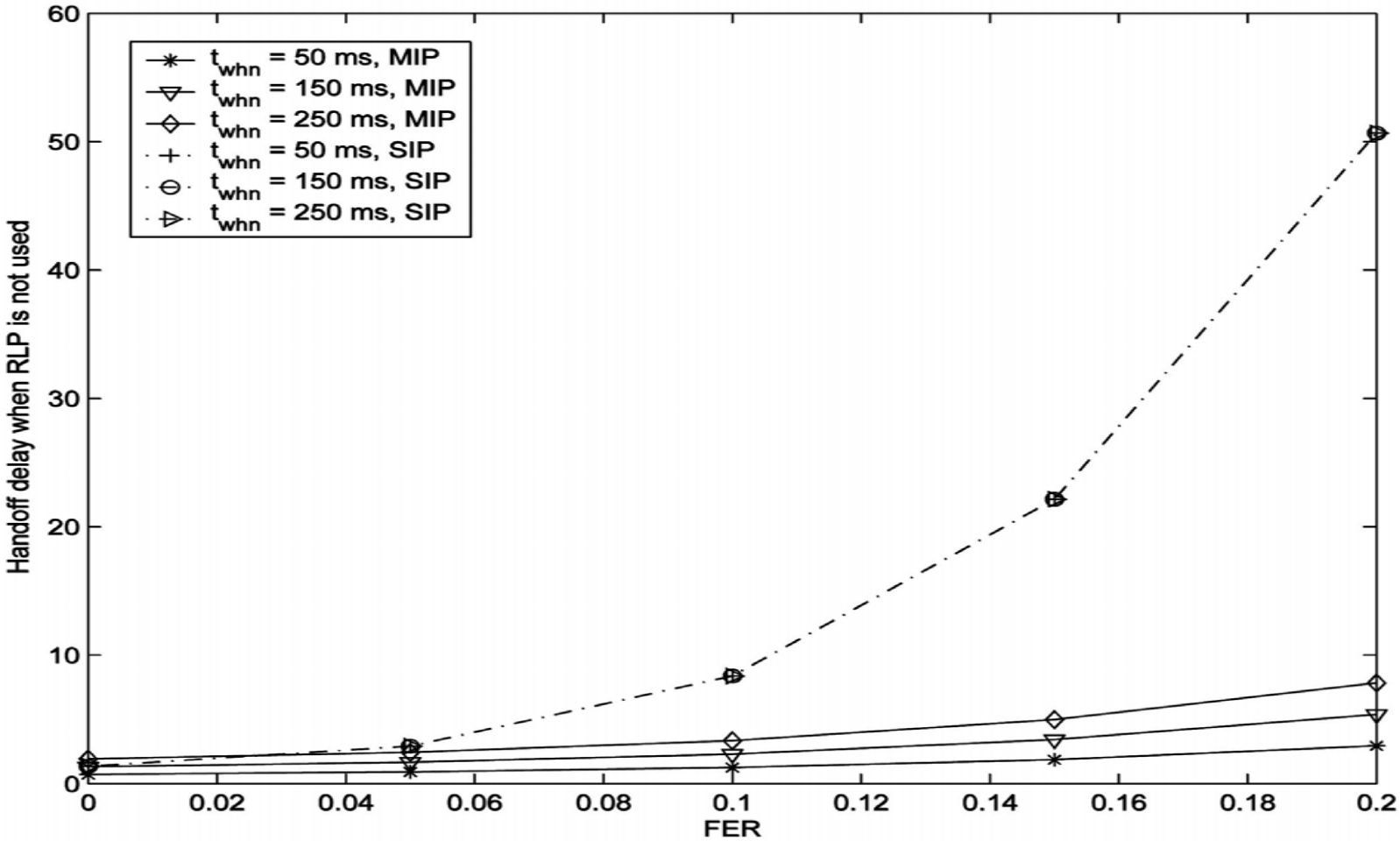
$t_{whn}$ : delay between the home agent and new base station

# Handoff Performance Comparison of Mobile IP and TCP-Migrate for a TCP Connection



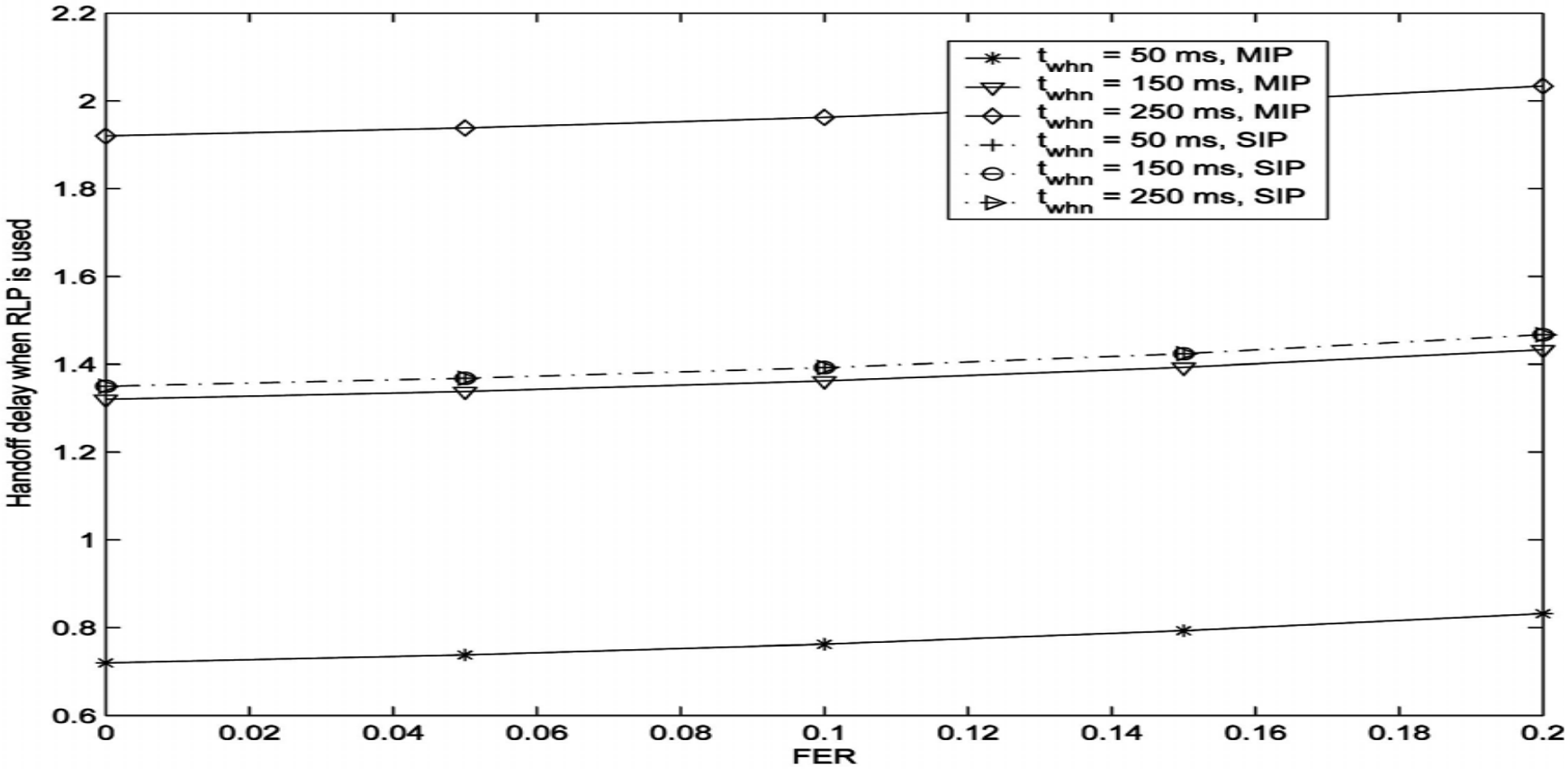

RLP enabled

# Handoff Performance Comparison of Mobile IP and SIP for a UDP Connection




no RLP

# Handoff Performance Comparison of Mobile IP and SIP for a UDP Connection




RLP enabled

# Summary and conclusion

- our analysis shows that the handoff performance of a mobility management protocol depends on the following factors:
  - Type of application
  - Link layer frame error probability
  - Signaling delay
  - Link layer access technologies
- The use of application-adaptive mobility itself is not enough to support seamless mobility management.
- Information sharing between different layers to enhance the performance of mobility management.