Comparing different Cellular IP with Hawaii handoff schemes

3G Mobile Communication Technologies, 8-10 May 2002, Conference Publication No. 489 IEE2002

謝志峰

2003/1/9

Outline

- Cellular IP Protocol
- Hawaii Protocol
- Handoff Evaluation
- Cellular IP And Hawaii Comparison
- Conclusions

Cellular IP Protocol(1/6)

- The Cellular IP proposal from Columbia University and Ericsson supports **fast handoff** and **paging** techniques.
- The protocol is intended to provide **local mobility** and **handoff support**.
- MH's **home address** serves as its unique(location) identifier in the foreign domain.

Cellular IP Protocol(2/6)

- A mobile host may sometimes wish to maintain its **routing cache mapping** even though it is not regularly transmitting data packets.
- To keep its routing cache mappings valid, the mobile host transmits **route-update packets** on the uplink at regular intervals called the **route-update time**.
- **Route-update** messages do not leave the Cellular IP access network and will filtered in the gateway.

Cellular IP Protocol(3/6)

- Cellular IP supports three types of handoff scheme:
  - Cellular IP **hard handoff**
  - Cellular IP **semi-soft handoff**
  - Cellular IP **indirect handoff**

Cellular IP Protocol(4/6)

- **Cellular IP hard handoff:**
  - It is based on a simple approach that trades off some packet loss in exchange for **minimizing handoff signaling** rather than trying to guarantee zero packet loss.
  - Hard handoff causes packet losses proportional to the **round-trip time** and to the **downlink packet rate**.

Cellular IP Protocol(5/6)

- **Cellular IP semi-soft handoff:**
  - It exploits the notion that some mobile hosts can **simultaneously receive packets from the new and old base stations during handoff**.
  - During semi-soft handoff a mobile host may be in contact with either the old or the new Base Station and receives packets from them.
  - Packets intended for the mobile host are **sent to both Base Stations**, so when the mobile host eventually moves to the new location it can **continue to receive packets without interruption**.

Cellular IP Protocol(6/6)

- Cellular IP indirect handoff:
  - It is assumed the network can **obtain the IP address of the new BS**.This is the case in many cellular networks.
  - When the mobile host decides to make a handoff, instead of sending a route-update packet to the new BS directly, **it sends the packet to the current BS**.
  - This packet will have as its destination IP address, the IP address of the Base Station.

Hawaii Protocol(1/2)

- Handoff-Aware Wireless Access Internet Infrastructure(Hawaii) is a **domain-based** approach for supporting local mobility.
- It uses path set-up schemes based on **caching**.
- MH obtains a unique co-located **care-of address** and retains this address throughout the domain.

Hawaii Protocol(2/2)

- The Hawaii protocol defines two schemes for implementing confirmed handoff procedures within base stations:
  - **Forwarding**:Packets are forwarded from the old base station to the new. It is optimised for networks where the mobile host is able to listen/transmit to **only one base station** as in the case of **TDMA** network.
  - **Non-forwarding**:They are **diverted** at the **Crossover router**. It effectively implements route diversity and is optimised for networks where the mobile host is able to listen/transmit to **two or more base stations** simultaneously, as in the case of **CDMA** network.

Handoff Evaluation (1/6)

- To compare different handoff schemes on Cellular IP, they used CIMS codes implemented in **ns-2** to compare the three schemes for **TCP** and **UDP** applications.

Handoff Evaluation (2/6)

- During the simulation the mobile host receives **512** byte **UDP** packets at rates from **50Kbps** to **1.2Mbps** while making handoff from **BS1** to **BS4** and vice versa.

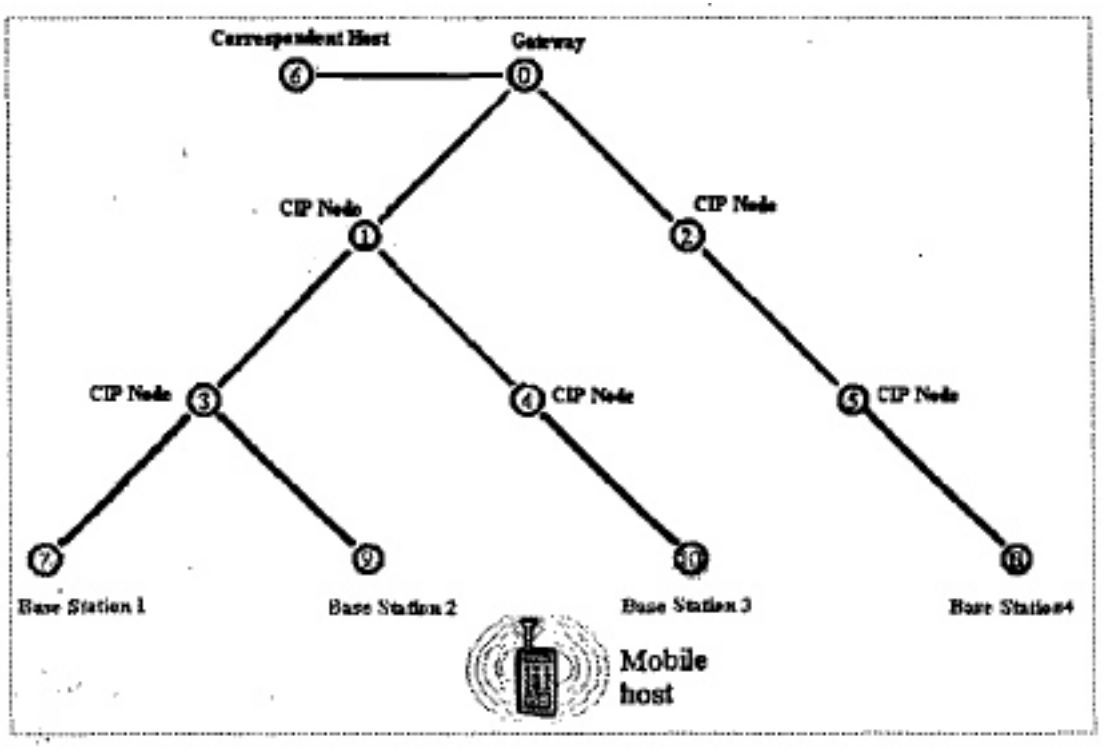
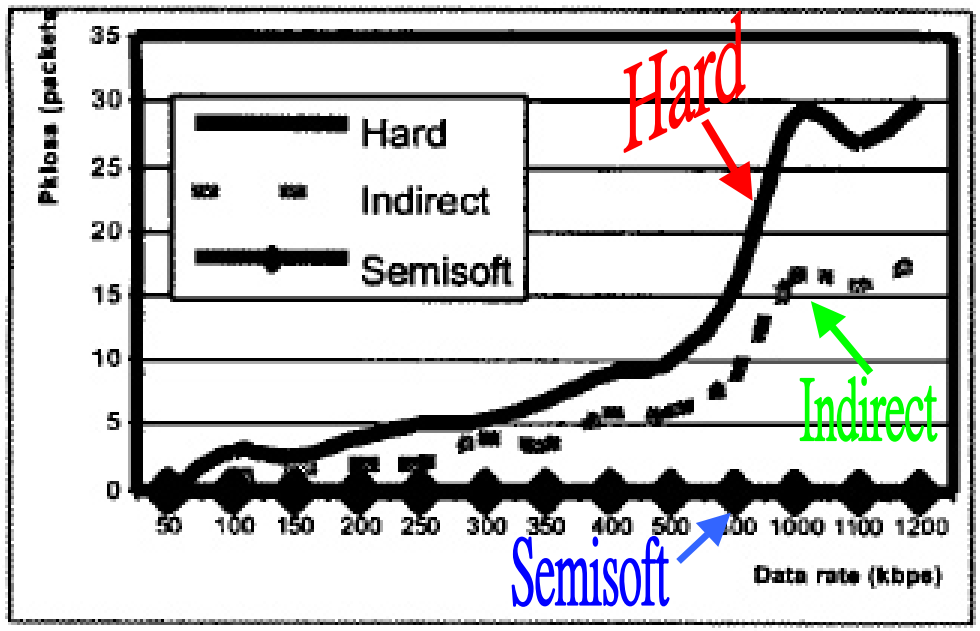


Figure 1. The Cellular IP platform

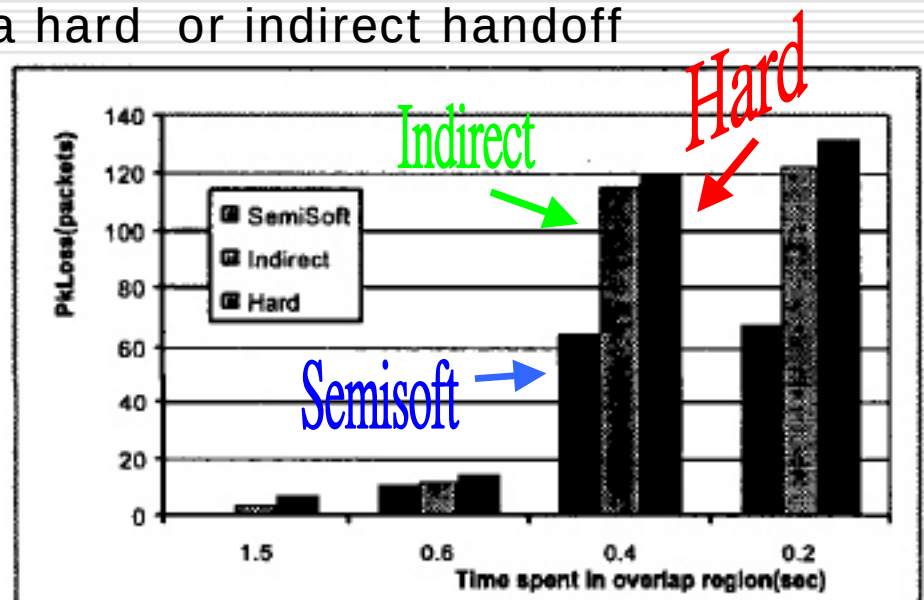
Handoff Evaluation (3/6)

- Number of **packets lost** when **data rate is increasing** for three handoff schemes in cellular IP.
- For higher data rates a **hard handoff** scheme loses up to **30** packets.
- For wireless network that cannot use a **semi-soft** scheme to decrease packet loss, indirect handoff could be used.



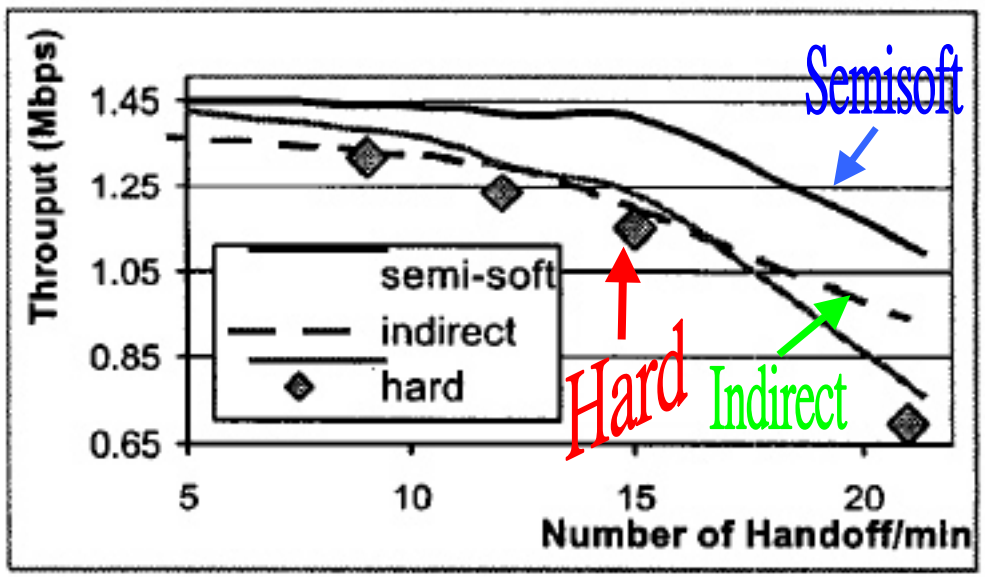
Handoff Evaluation (4/6)

- Number of **packets lost** when mobile host is moving with **different speeds** for three handoff schemes in cellular IP.
- As the mobile host moves faster, it spends less time in the overlap region so the **packet loss increases**.
- Unlike the **semi-soft** scheme, a hard or indirect handoff mobile host can only send and receive packets to one base station at a time so it cannot receive all the packets send to it and **loses more packets**.



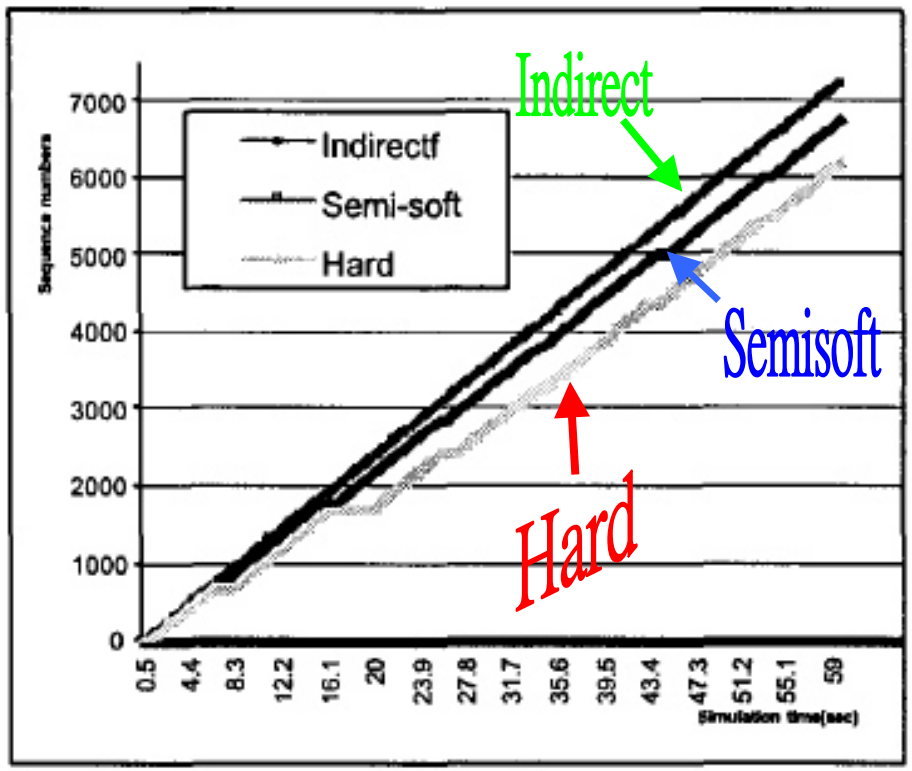
Handoff Evaluation (5/6)

- **TCP** Performance
- **Throughput** in **TCP** Newreno with **different speed** of mobility for CIP handoff schemes.
- We can observe that **semi-soft** handoff **reduces packet loss** and significantly improves the **transport throughput** in relation to the hard and indirect handoff schemes.



Handoff Evaluation (6/6)

- **Packet sequence number** sent in TCP Newreno during 6 handoffs.
- The packet loss is reduced in indirect handoff implemented compared to the hard handoff scheme, as,within the same simulation time, the maximum sequence number achieved in **indirect handoff is higher**.

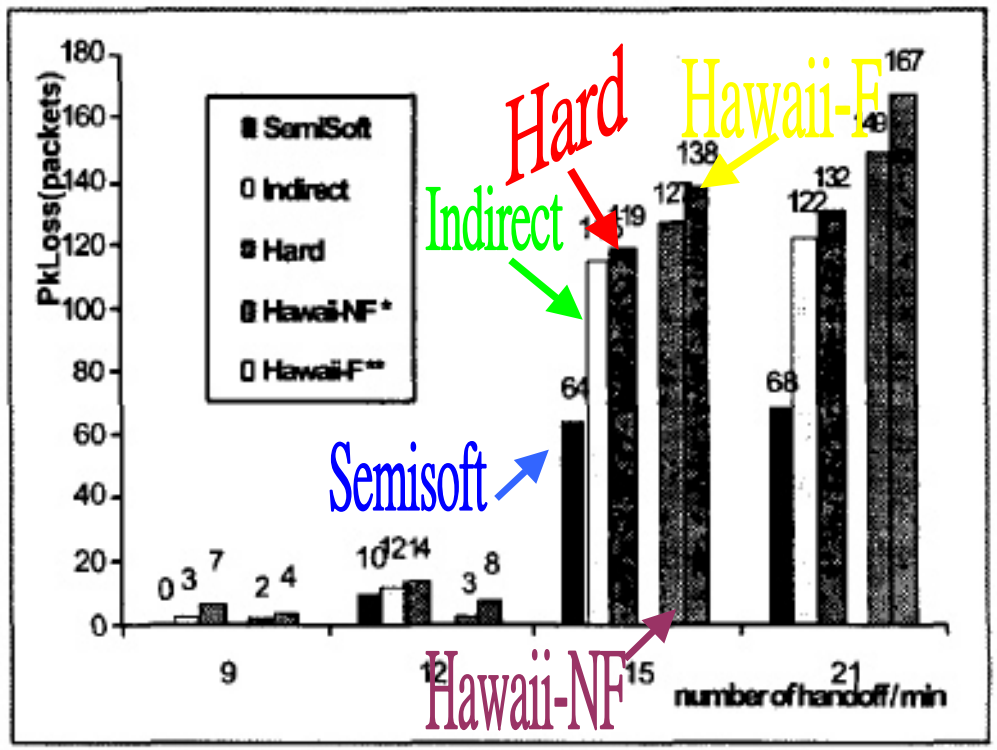


Cellular IP and Hawaii Comparison(1/5)

- The major difference between the two approaches is related to **handoff procedures** and to **path refresh**.
- Hawaii involves **dynamic routing** whilst only selected nodes implement the mechanisms for **path Caching**.
- In comparison with Cellular IP, Hawaii only uses **one cache refresh frequency**, and the user data is not involved in cache management.

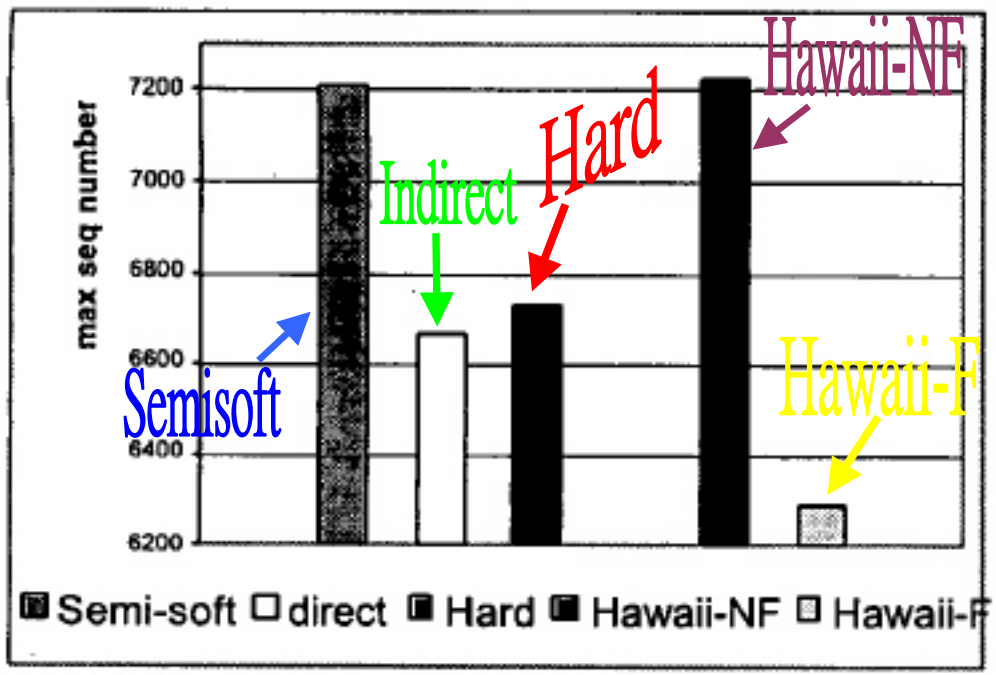
Cellular IP and Hawaii Comparison(2/5)

- Comparing Hawaii and Cellular IP for **UDP** applications.
- The performance of both the forwarding and the non-forwarding schemes in **Hawaii are worse** than for any of the handoff schemes in Cellular IP.
- The reason for greater packet loss in the Hawaii handoff scheme is due to **the longer handoff delay** compared to Cellular IP handoff delays



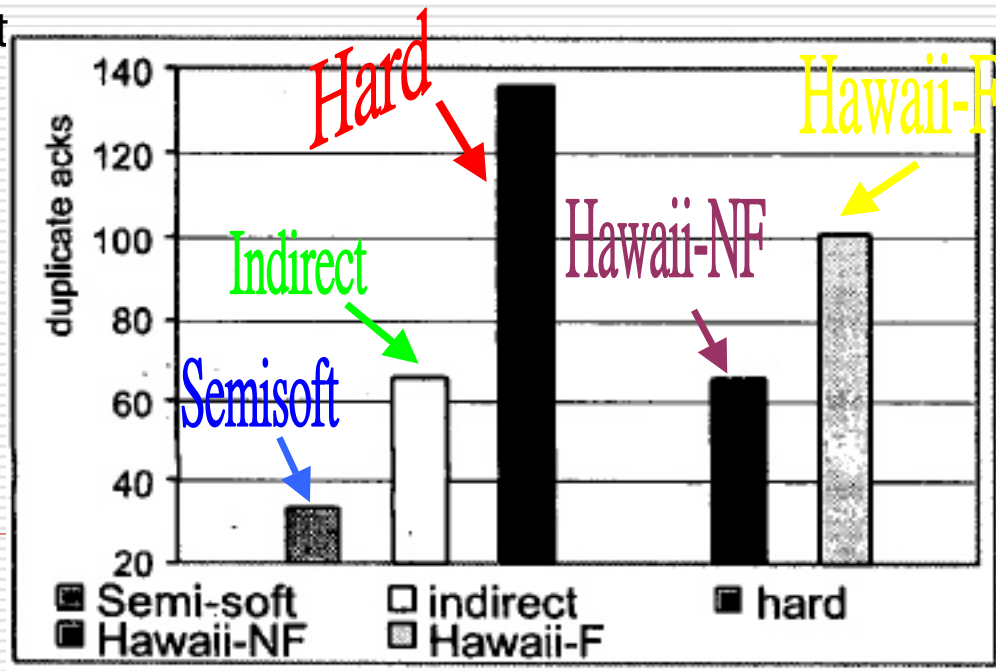
Cellular IP and Hawaii Comparison(3/5)

- **Maximum sequence number** for TCP Newreno flow control.
- The **Semi-soft** handoff and the **non-forwarding** scheme have approximately the same performance whereas Hard and Indirect handoff in Cellular IP perform better than the
  scheme in Hawaii.



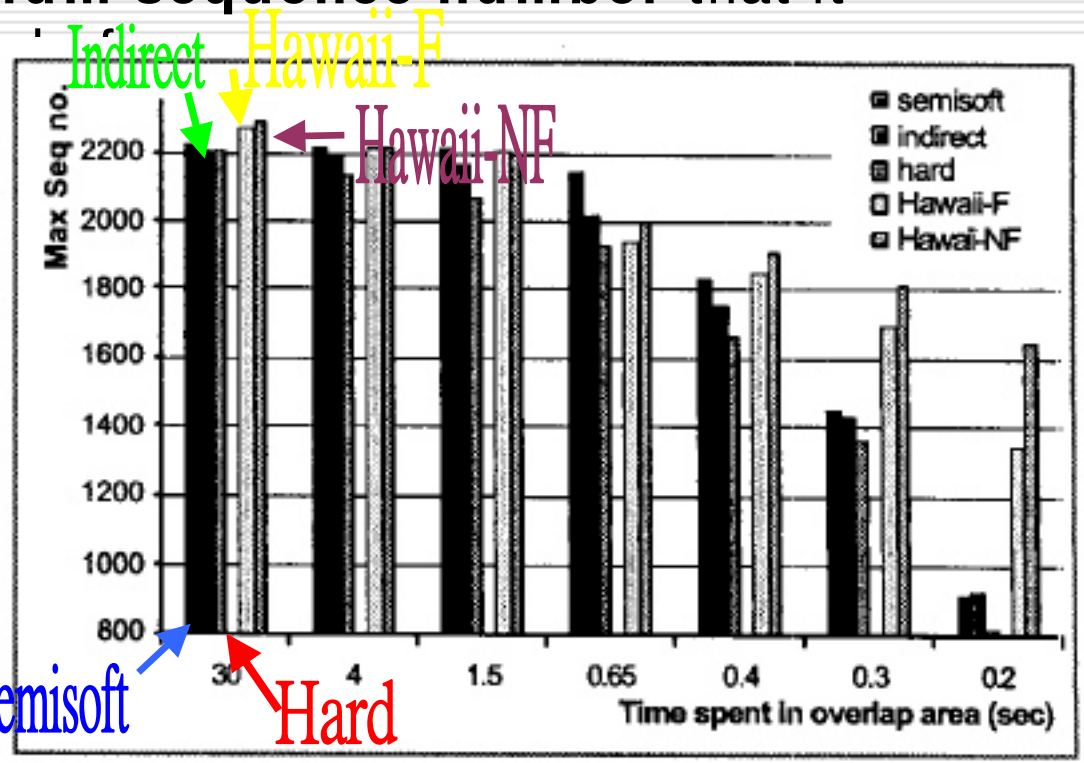
Cellular IP and Hawaii Comparison(4/5)

- **Number of duplicated acknowledgements** the mobile host sends when it receives disordered packets.
- The number of non-sequential packets arriving at the mobile host is higher in **Hard** handoff than in the other two schemes in Cellular IP.
- In Hawaii, we can see that the number of duplicate acknowledgements is greater in the forwarding scheme.



Cellular IP and Hawaii Comparison(5/5)

- Comparing the **effect of speed** on Cellular IP and Hawaii handoff schemes.
- The **Hawaii** protocol performs **better** than Cellular IP in terms of the **maximum sequence number** that it can transmit by the er ' f the same simulation time.



Conclusions(1/2)

- The greater the handoff distance, the more packet loss results in all handoff schemes in Cellular IP.
- They lose more packets at higher rates.
- If the handoff delay is less than the time that the mobile host spent in the overlap region then the **Semi-soft** handoff scheme has the best performance for Cellular IP protocol.

Conclusions(2/2)

- The **longer handoff delay** in the **Hawaii** handoff scheme causes **greater packet loss** than in Cellular IP handoffs.

- **Hawaii** is more **reliable** and, compared with Cellular IP, has **less control signaling** in the nodes upper than the Crossover router compared to Cellular IP.