Handoff for Multi-interfaced 802 Mobile Devices
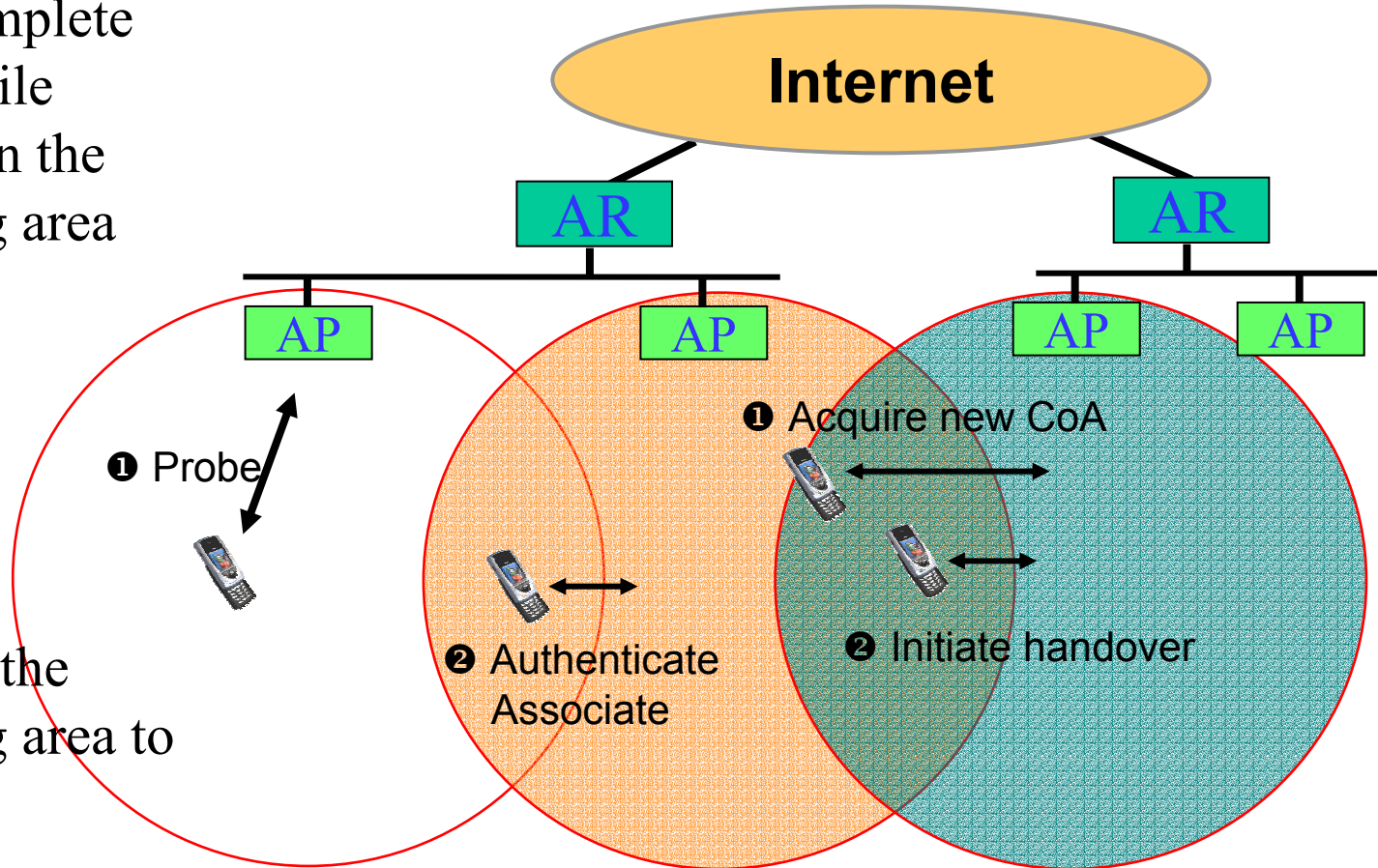
Paul Lin

Intel Corp

May'03, Dallas

How Does MN with Multiple Interfaces Help?

- Initiate/Complete handoff while traversing in the overlapping area

Internet

AR

AR

AP

AP

AP

AP

❶ Probe

❶ Acquire new CoA

❷ Authenticate Associate

❷ Initiate handover

- How big is the overlapping area to be useful & practical?
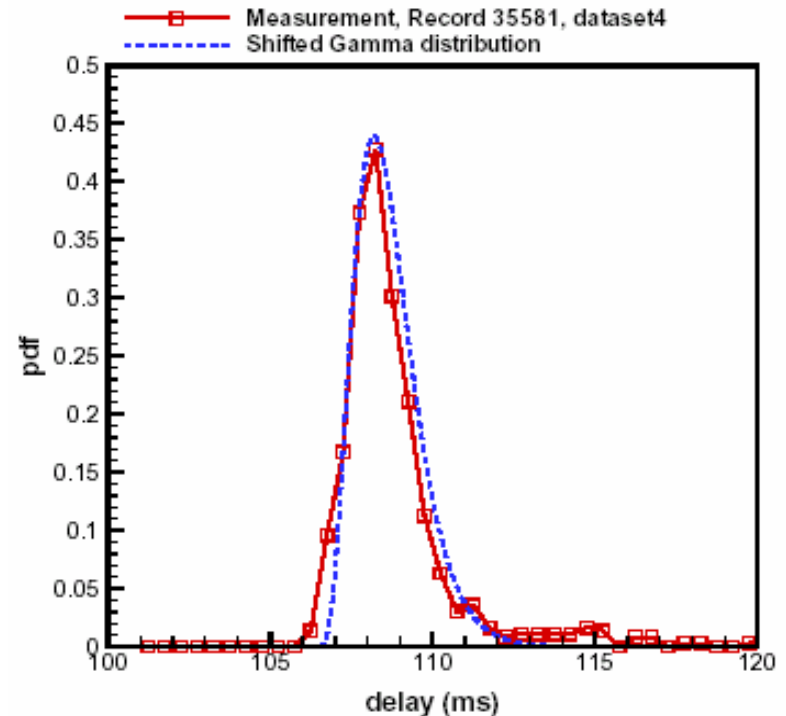
 Huai-An (Paul) Lin, Intel Corp

Handoff Distance

- Definition: distance traversed by a MN from acquiring a new CoA or initiation L2 handoff to completion of the handoff

- Function of
  - End-to-end delay
  - User speed
  - Packet loss rate
  - handoff scheme (route optimization)
  - Processing (non-transport related) delay

One-way latency distribution
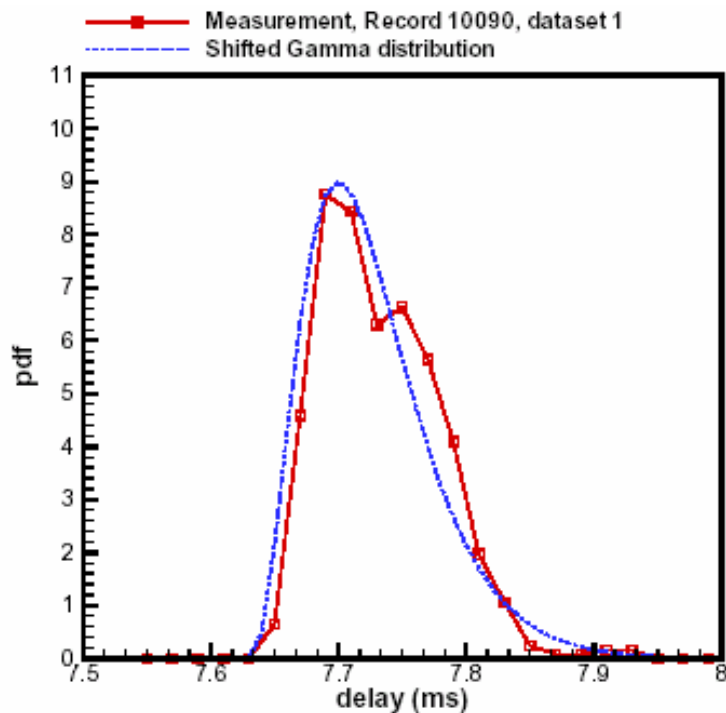
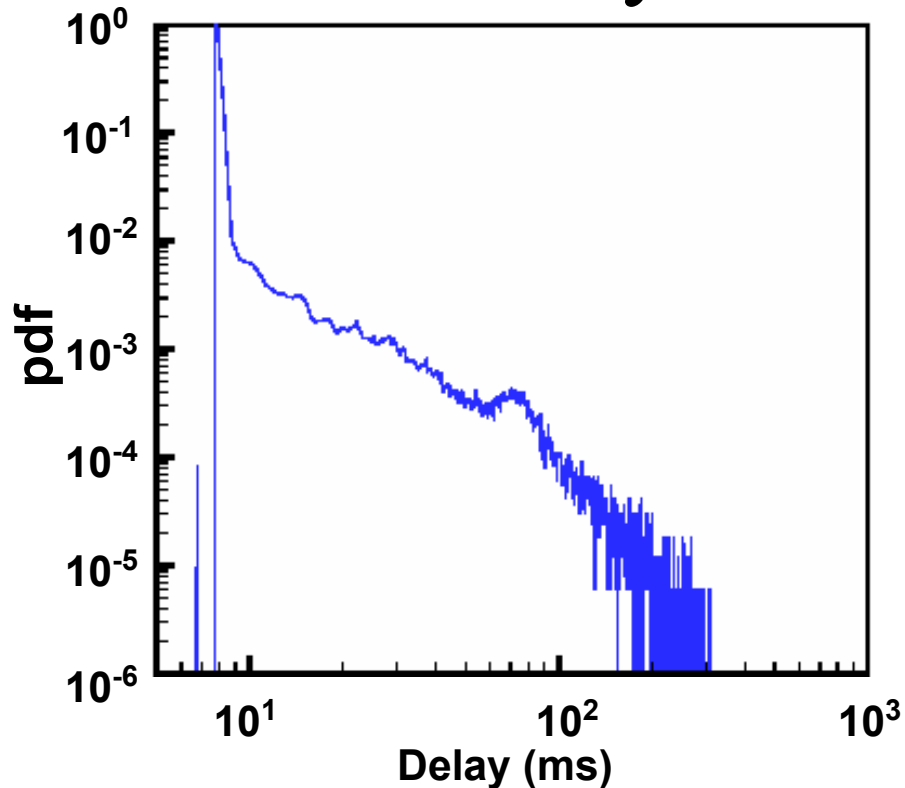

- Both end points at Irvine, CA
- 11 hops

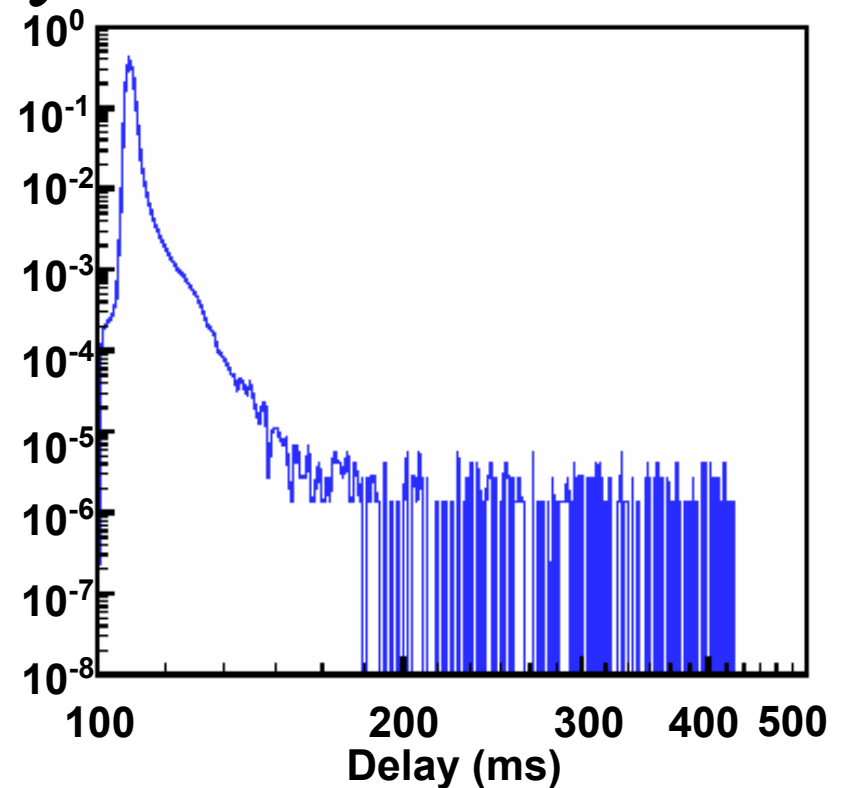- End points at Irvine and London
- 22 hops

Source: Andrew Corlett, et al, "Statistics of One-Way Internet Packet Delays," 53*rd* IETF, Minneapolis, March 18 2002

- sharp peaked distributions (shifted Gamma)
- most delay values clustered within about 10% of both the mean and minimum values

One-way Latency Distribution

Irvine – Irvine   **Irvine – London**
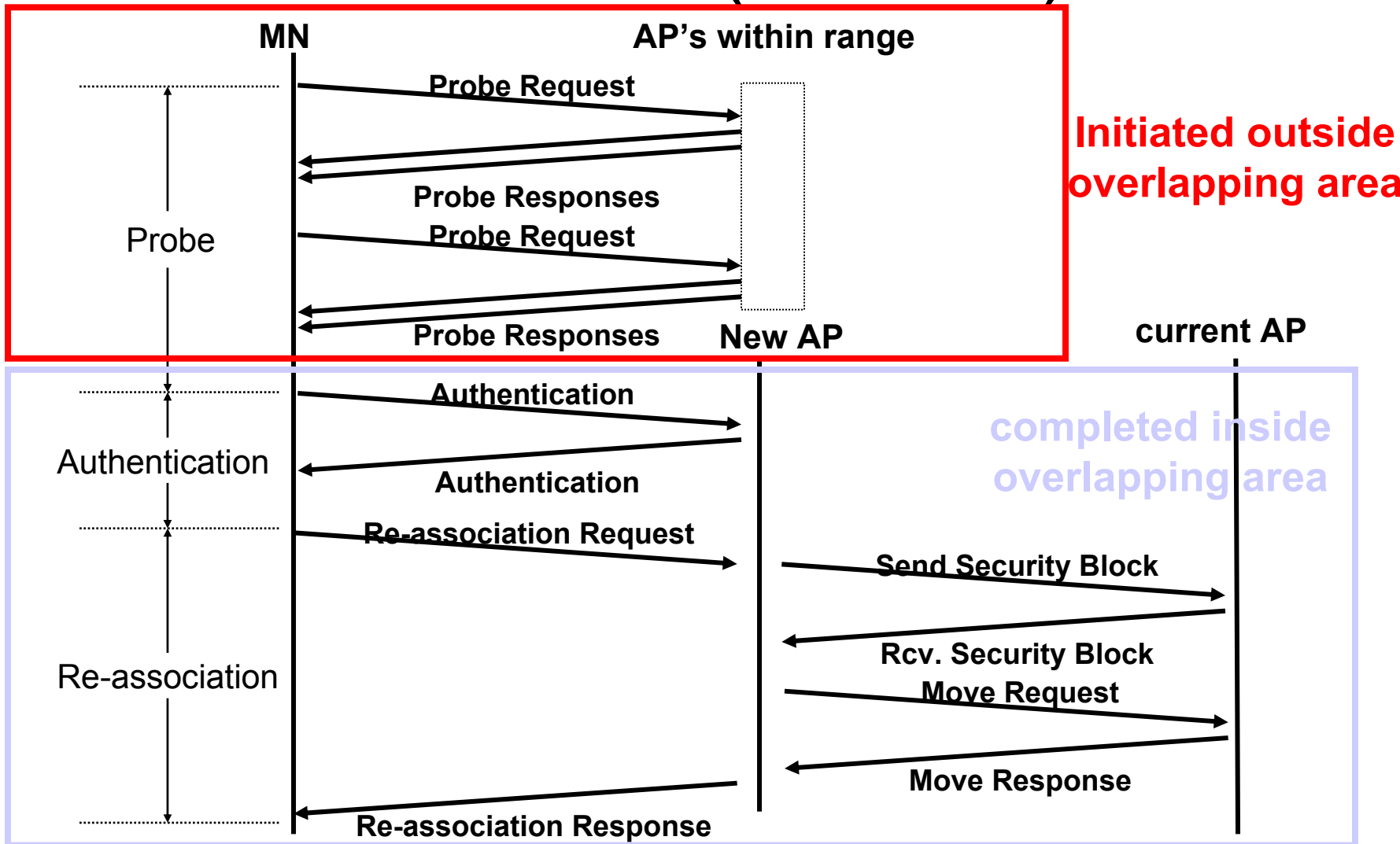
99.9% of delays occur within 30 ms and 115 ms

A. Corlett, et al., "Statistics of One-Way Internet Packet Delays," 53rd IETF, Minneapolis, March 2002.

L3 Handoff Distance

Handoff Distance (in meters)		Max MN Moving Speed w/o route optimization				Max MN Moving Speed with route optimization			
		10 Km	60 Km	120 Km	180 Km	10 Km	60 Km	120 Km	180 Km
Max one-way packet delay	50 ms	0.6 (m)	3.3	6.7	10.0	1.4 (m)	8.3	16.7	25.0
	75 ms	0.8	5.0	10.0	15.0	2.1	12.5	25.0	37.5
	115 ms	1.3	7.7	15.3	23.0	3.2	19.2	38.4	57.5

For 99.9+% Packet Delivery

L2 Handoff (Generic)

MN   **AP's within range**

Probe
- Probe Request
- Probe Responses
- Probe Request
- Probe Responses

New AP   **current AP**

Initiated outside overlapping area

Authentication
- Authentication
- Authentication

Re-association
- Re-association Request
- Send Security Block
- Rcv. Security Block
- Move Request
- Move Response
- Re-association Response

completed inside overlapping area

L2 Handoff Distance

Max MN Moving Speed	10 Km/h	60 Km/h	120 Km/h	180 Km/h
• L2 Handoff Distance (in meters)	2.4 (m)	13.3	26.7	40.0

For 99.9+% Packet Delivery

Practicality & Implications

- Can the overlapping region be practically engineered? Seems OK, considering
  - Macro cell: typically ~20 miles in diameter
  - Micro cells: a mile or so in diameter
    - Serve regions of high-traffic density
  - Pico cells: diameter of a few hundred meters or less
    - Provide mobile service in highly congested areas like shopping centers, exhibition centers, office buildings, etc.
  - 802.11: 150-2000 feet without special antenna
    - Hot-spot, low-speed roaming users
  - 802.16: 5 Km
    - Metropolitan, low-, medium- and high-speed roaming users
- Simultaneous AP associations or IP connections for multi-interfaced mobile nodes can simplify and expedite handoff
- Suggest to include corresponding handoff procedure(s) and network planning in the scope

Huai-An (Paul) Lin, Intel Corp