Mobile Proxies for Proactive Buffering in Wireless Internet Multimedia Streaming

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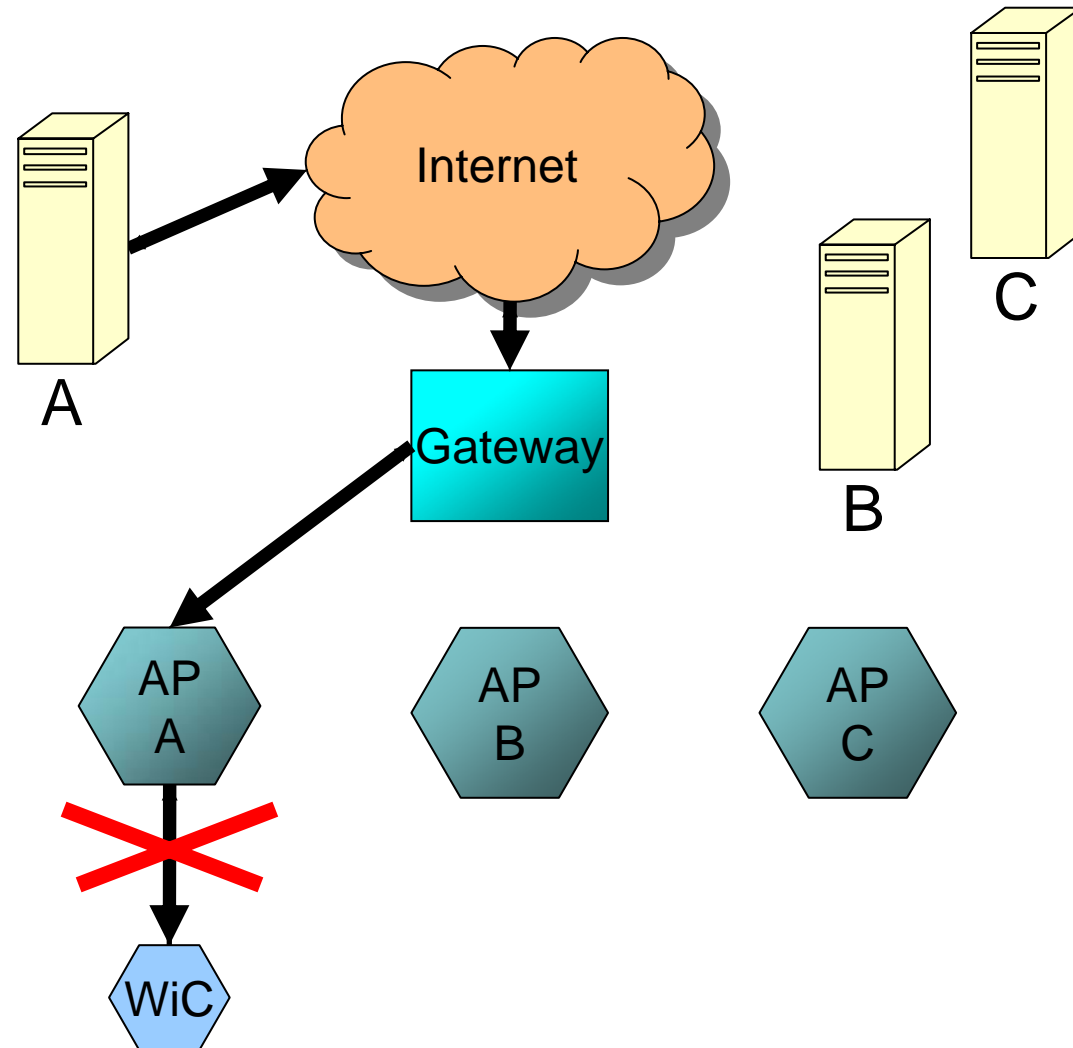{pbellavista, acorradi, cgiannelli}@deis.unibo.it

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- Wireless Internet

- Middleware for service tailoring

- Continuous Services without interruption even if WiC handovers

  – Mobility Prediction

  – Data pre-fetching
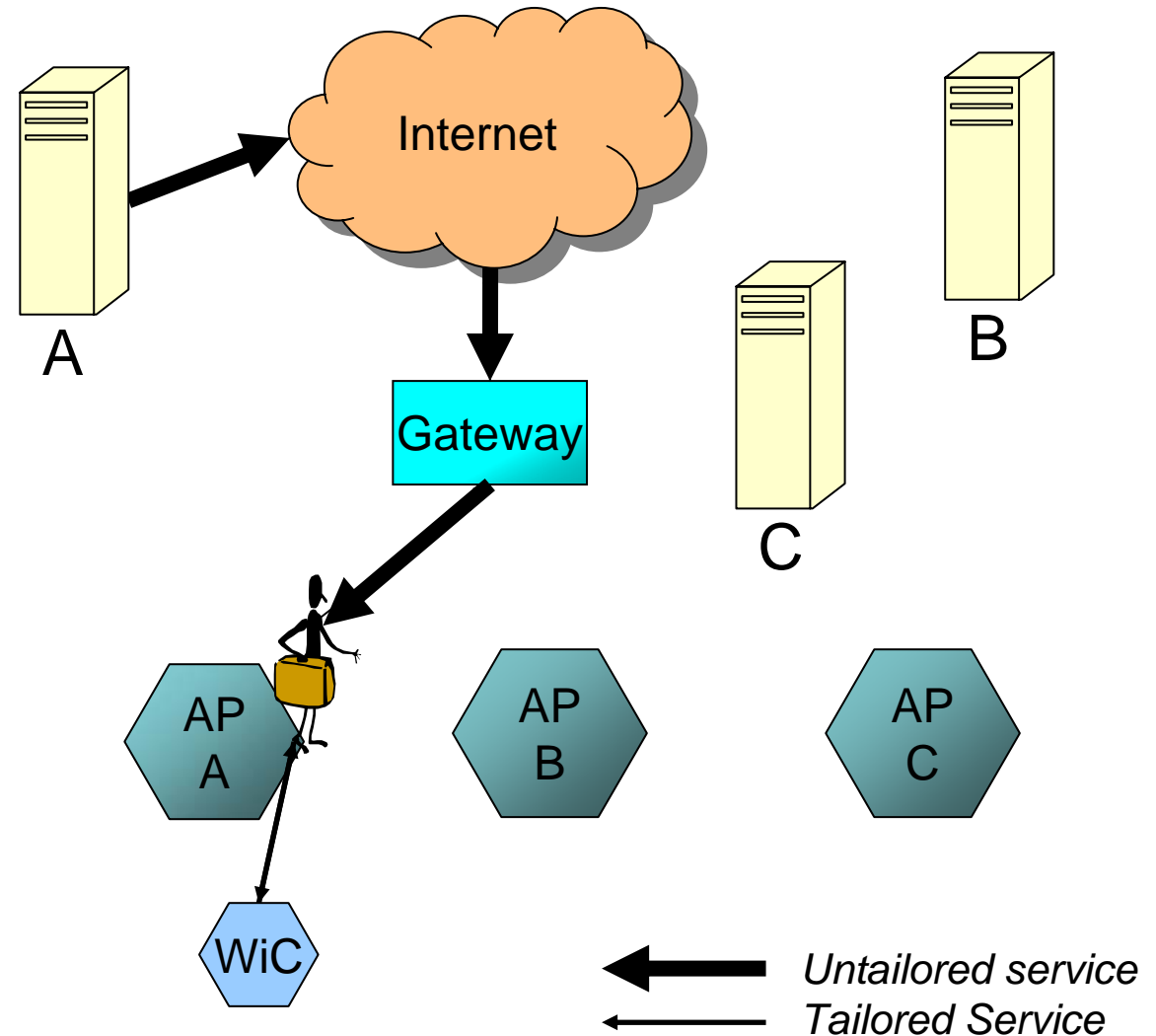
- Experimental results

- Limited bandwidth

- Limited hardware

- Heterogeneous software

- Limited battery life

The Wireless Internet + Proxy

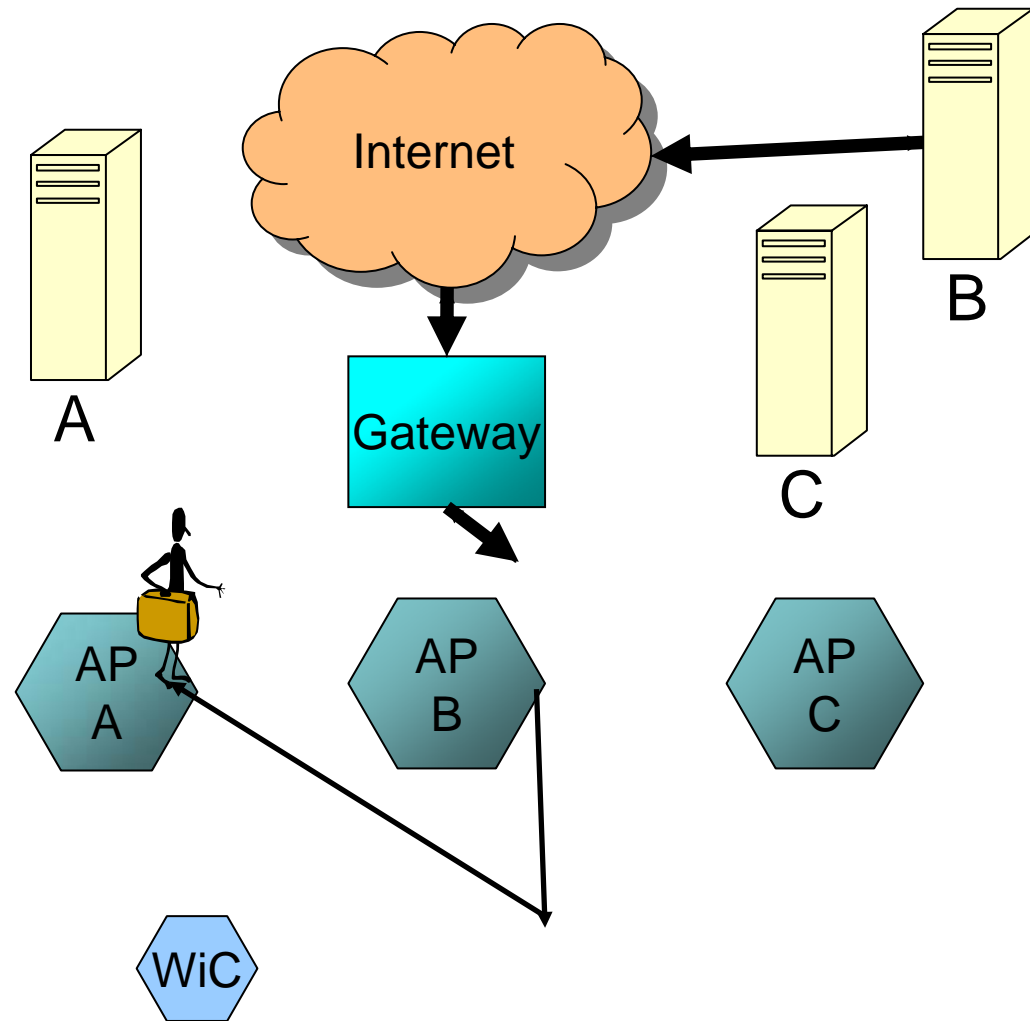- Mobile agent based proxy tailors services to WiC software/ hardware capabilities and bandwidth availability
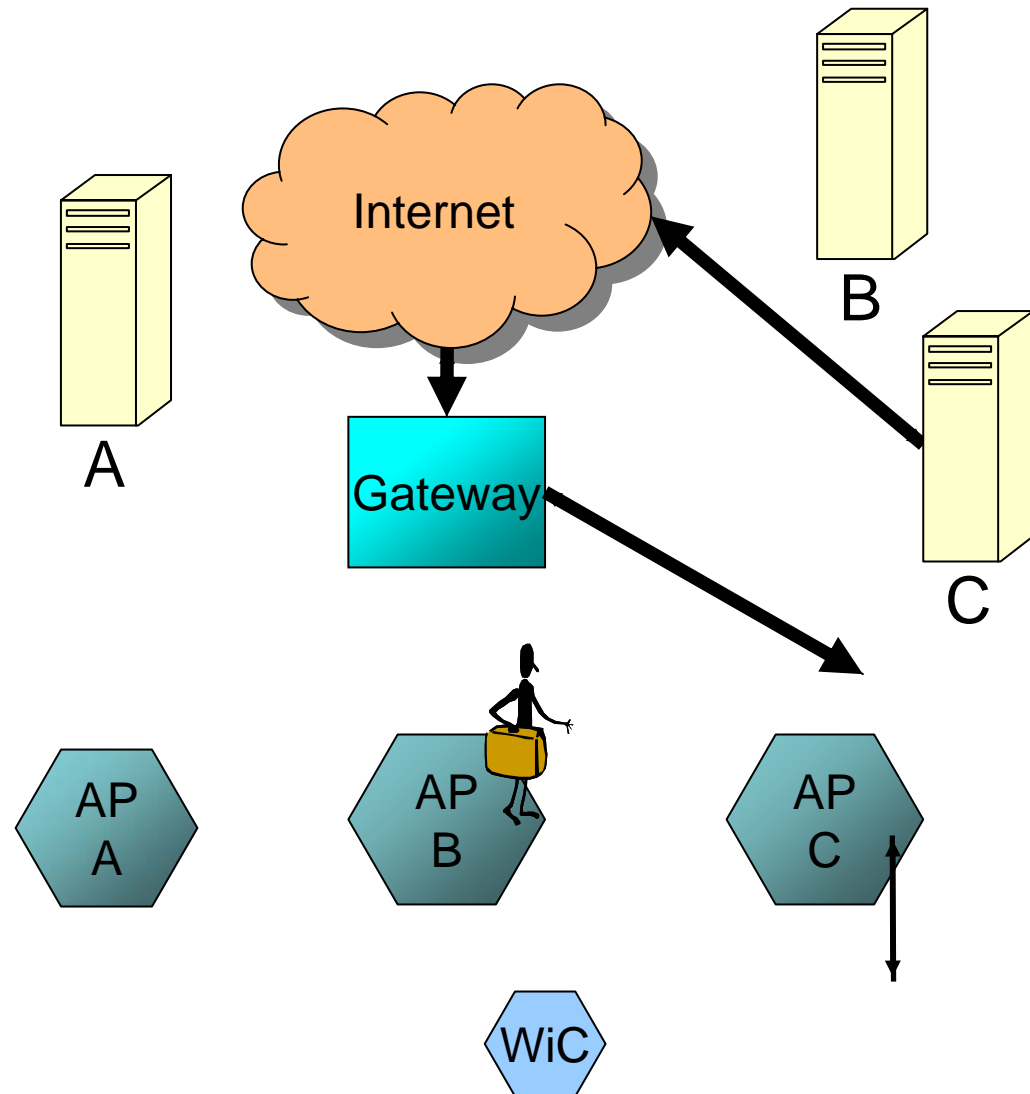
Internet

A

B

Gateway

C

AP A

AP B

AP C

WiC

Untailored service
Tailored Service

1. WiC handovers

2. WiC triggers proxy migration

3. Proxy rebinds to service

4. Proxy supplies service to WiC

A

Internet

Gateway

B

C

AP A

AP B

AP C

WiC

- To assure a prompter response, proxy must anticipate WiC handover

- Proxy-Server rebinding delayed since WiC handover finishes

We want to predict when a client change AP and which is its next AP

■ Handover triggering based on visible AP RSSI (Received Signal Strength Indication)

$\Rightarrow$ Mobility Prediction based on monitoring and comparing visible AP RSSI
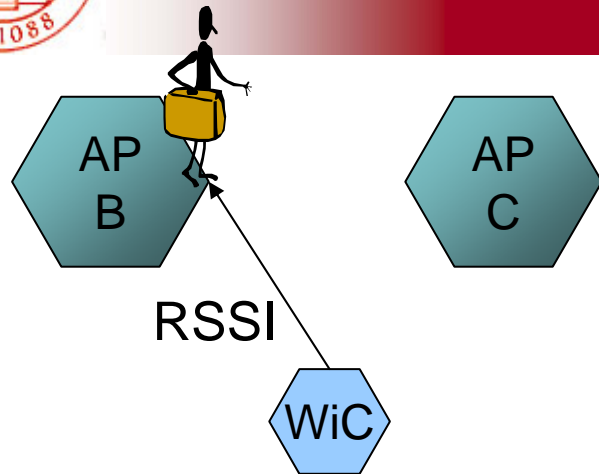
Handover Strategies

- **Reactive:** when signal is lost

- **Proactive:** before signal is lost
  - Hard Proactive: compares visible AP RSSI
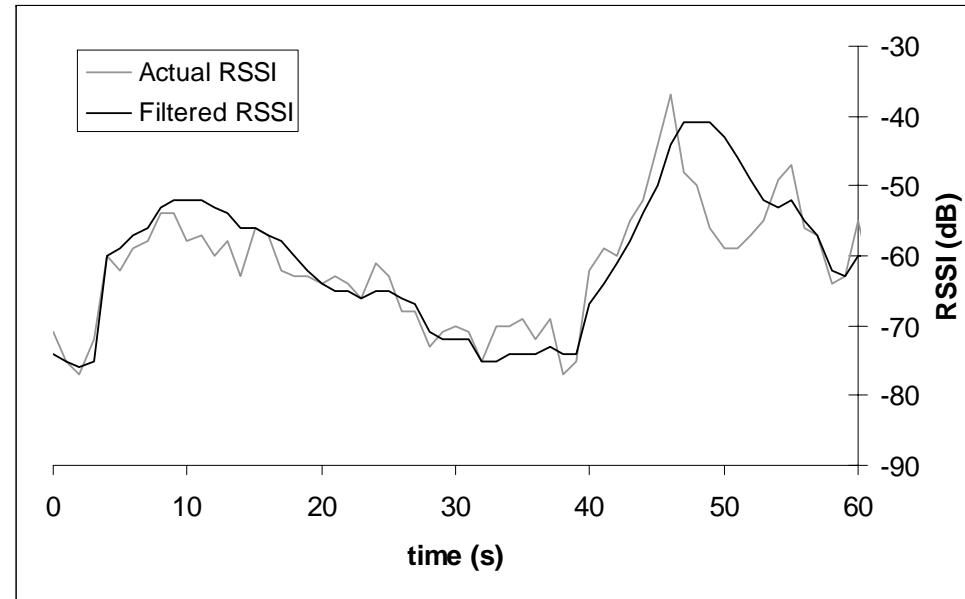 - Soft Proactive: HP + current AP RSSI is below a threshold
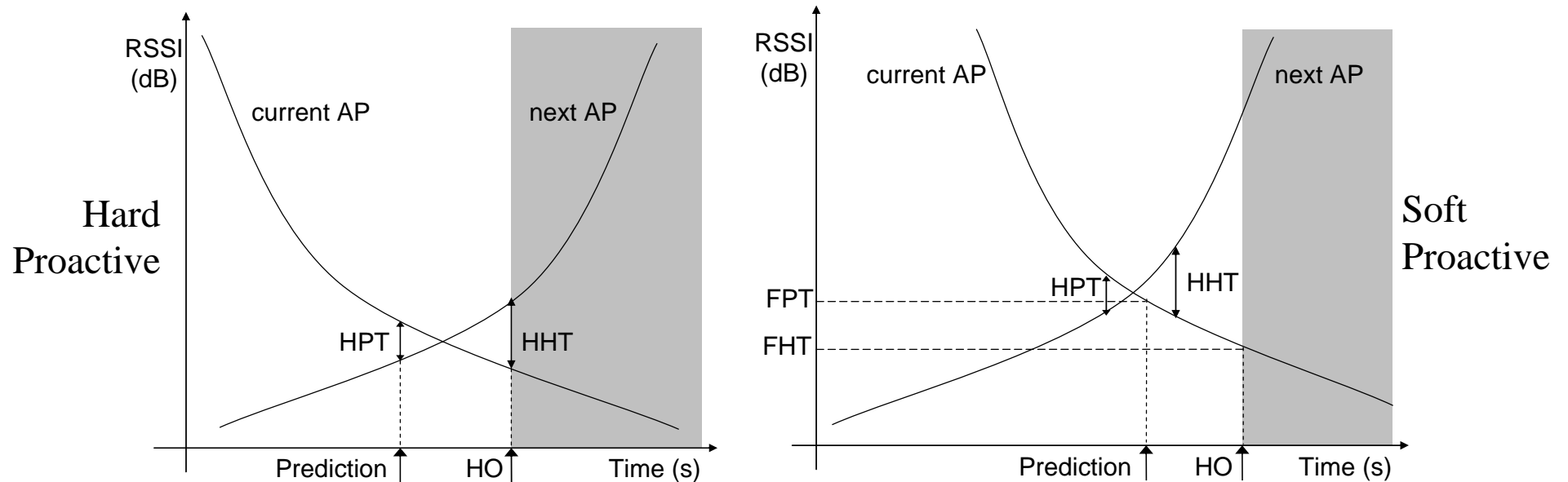
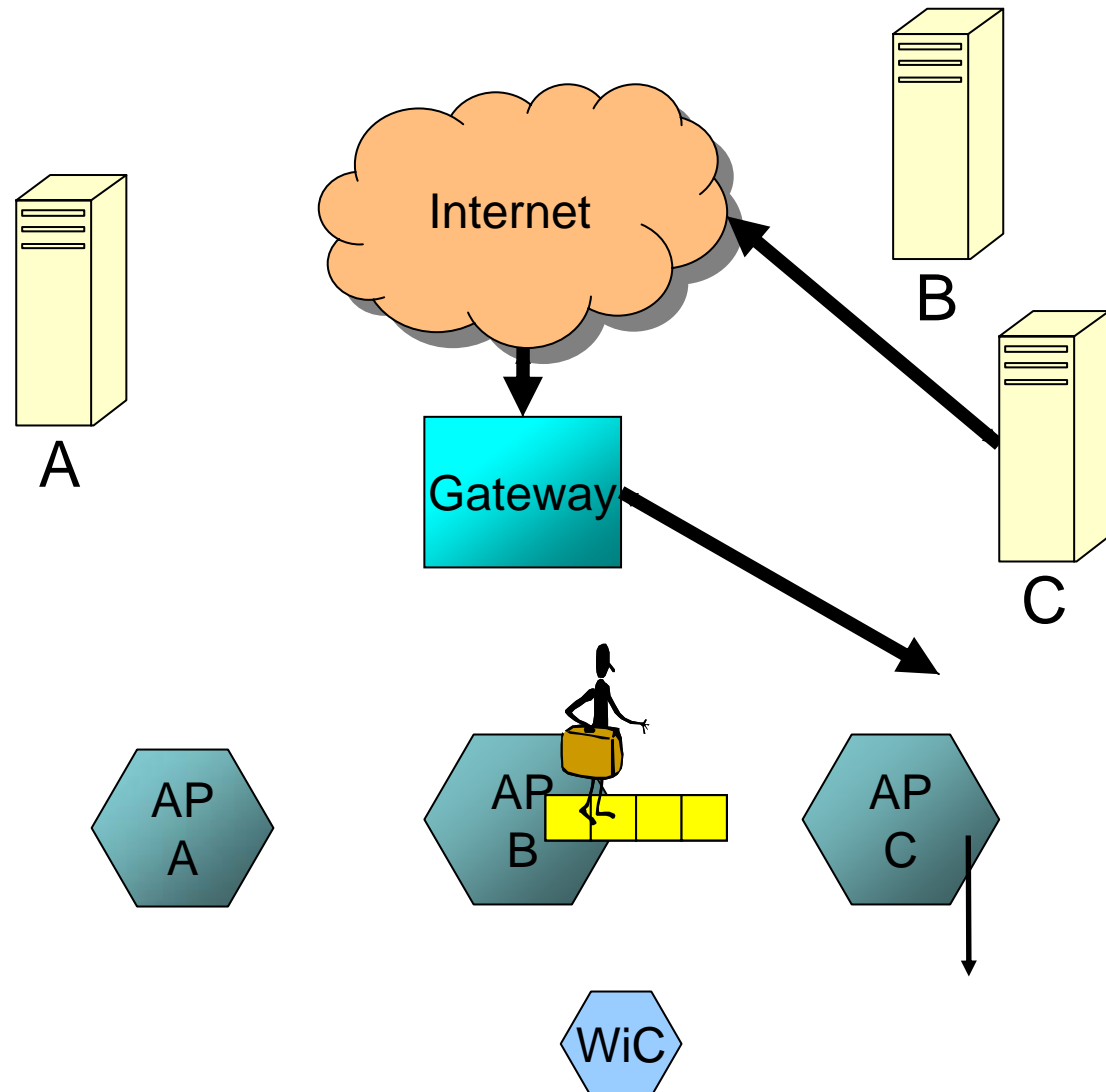$$pr(i) = \left(r_1(1) - \frac{u}{a} \right) e^{-ak} + \frac{u}{a}$$

1. WiC achieves visible AP RSSI

2. WiC sends data to proxy

3. Proxy exploits Grey Model to predict/filter visible AP RSSI

4. Proxy performs mobility prediction in a lightweight, portable, and completely decentralized manner, only based on RSSI data.

- To enable service continuity, proxy must anticipate WiC handover and carry pre-fetched data

Buffer Management

- To ensure fixed host memory saving,
  proxies pre-fetch data just before migration

- When handover finishes,
  proxies start delivering pre-fetched data immediately

- Pre-fetched data must ensure continuous service
  delivering since proxy-server rebinding lasts

Simulated environment

- Gaussian random trajectory

- WiC speed between 0.2 and 2.5 m/s

- RSSI standard deviation at 3 dB
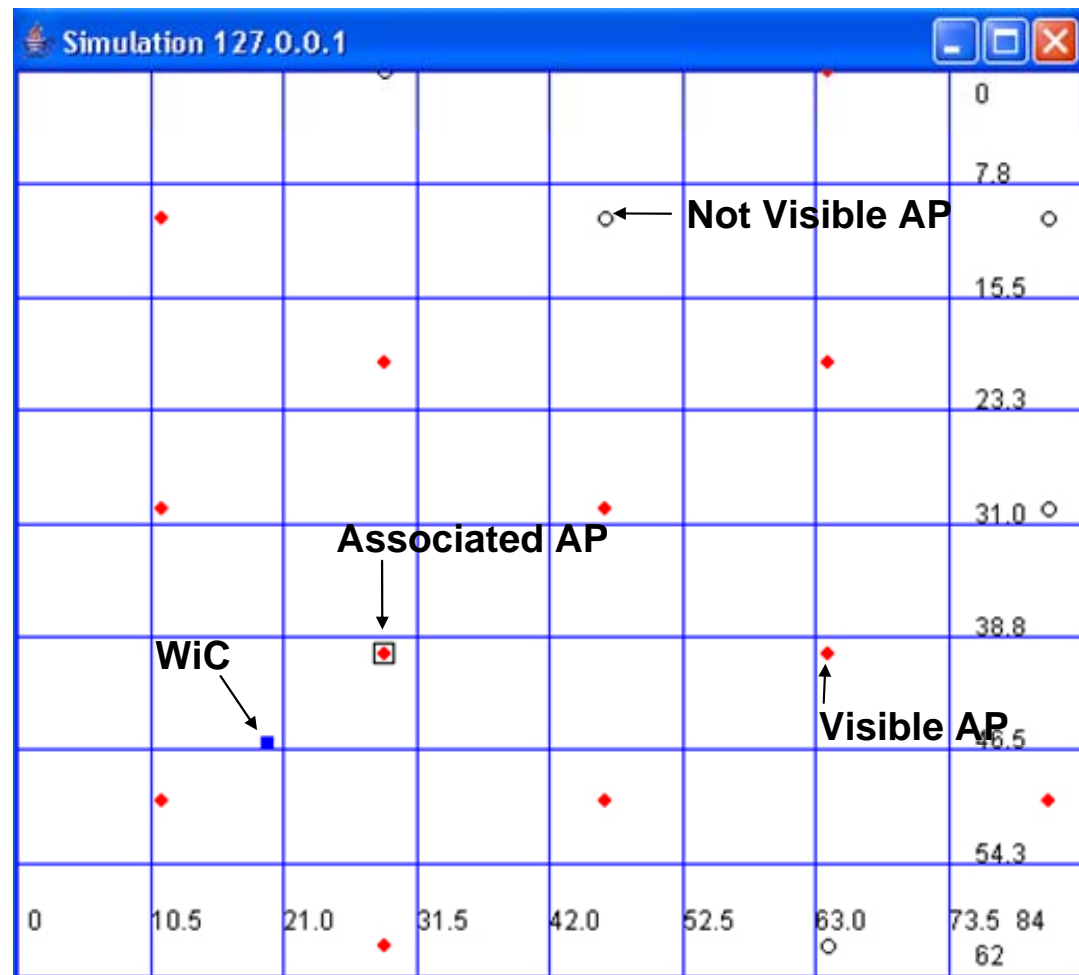
1. Average Buffer Size (ABS) = $\dfrac{1}{T}\displaystyle\int_0^T BS(t)\,dt$

2. Successful Handover (SH%) = $\left(\dfrac{PH}{NH}\right) * 100$

   PH number of handover correctly predicted

   NP number of actual WiC handovers

3. Useful Buffered Data after handover (UBD)

4. Waiting for Service after handover (WfS)

- Player 1000 Kbit/s

- Wireless link 1500 Kbit/s

Predictor	ABS (KB)	SH%	UBD (KB)	WfS (s)	
HP	360	83.3	499.2	0.17	4.64
SP	400	88.0	540.8	0.24	4.06

- Buffer size 800 KB $\Rightarrow$
     6.4s pre-fetched data

- Proxy-Server rebinding process lasts 2s $\Rightarrow$
     UBD at least 250 KB

Conclusions & Ongoing work

1. Supporting provisioning of personalized services without interruptions when WiCs handover

2. Proactive migration of middleware components

3. Data pre-fetching only when needed

- Our proposed mobility prediction/data pre-fetching solution implies
  - limited fixed host memory wasting
  - limited requirements on wireless device

- Coupling proxy-based service management with a client-side adaptive buffering

Software and documents about proposed predictors
are available on the Web:
http://lia.deis.unibo.it/Research/SOMA/SmartBuffer/
http://lia.deis.unibo.it/Research/SOMA/MobilityPrediction/