Replicated Client-Server Execution to Overcome Unpredictability in Mobile Environment

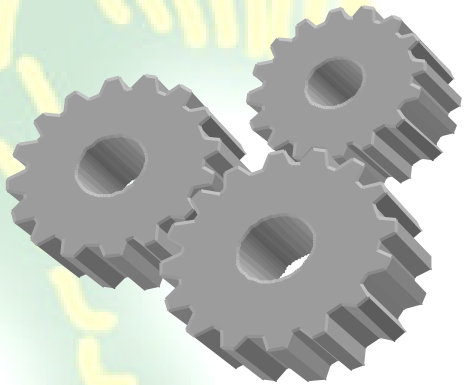
Bing You and Hao Chu
Intelligent Space Lab
National Taiwan University

Outline

- Problem
- Related Work
- Replicated Client-Server Model
- Experiments
- Implementation
- Conclusion

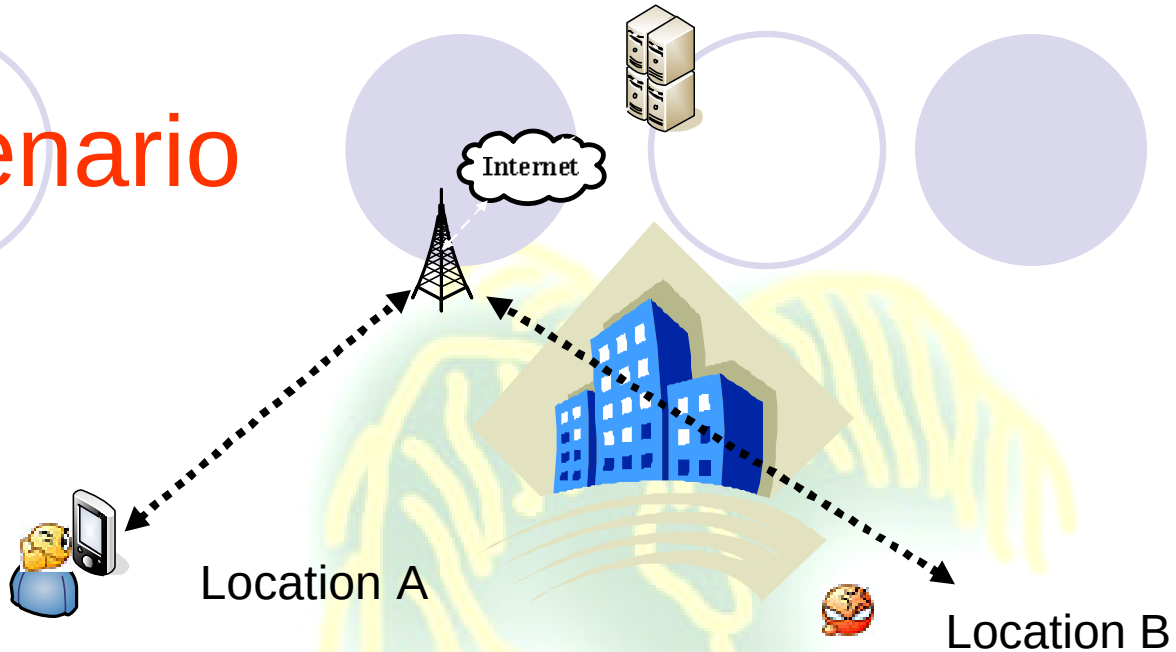
Problem

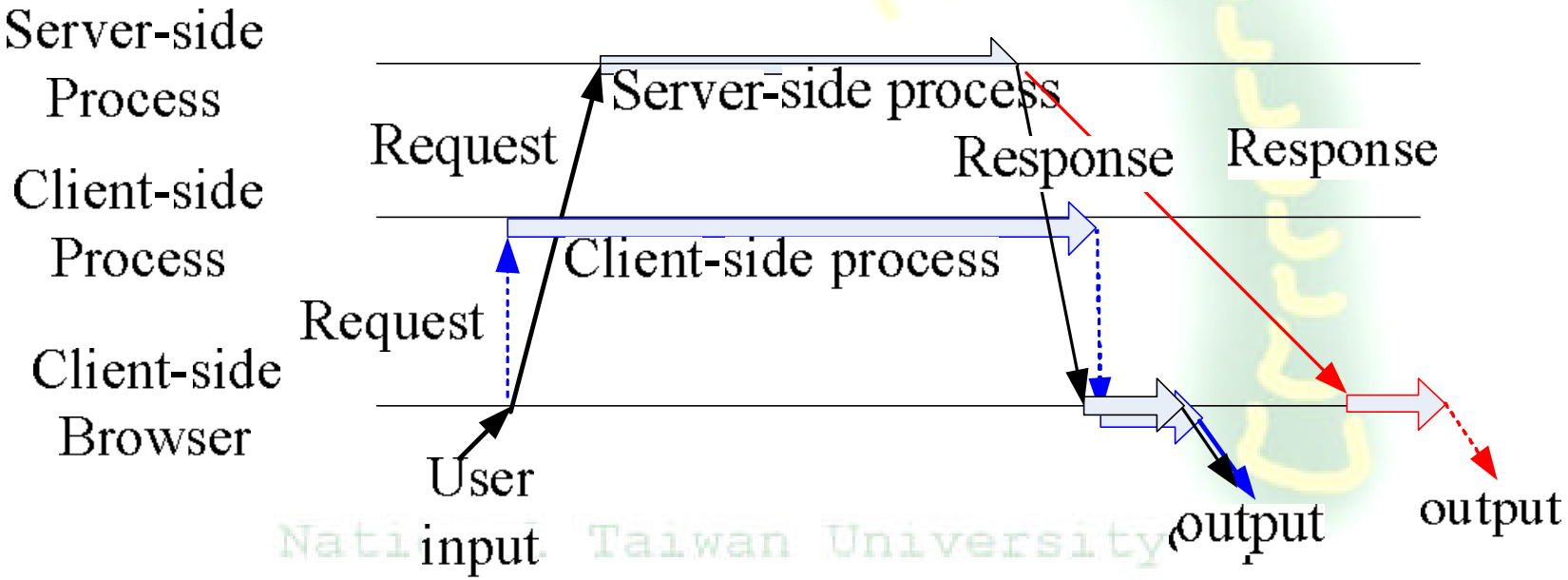
- Dynamic factors in mobile environment that affect response time
  - Wireless network bandwidth
  - Server loads
  - Usage patterns



- The optimal client thickness (application partition) depends on these dynamic factors.

Problem Scenario





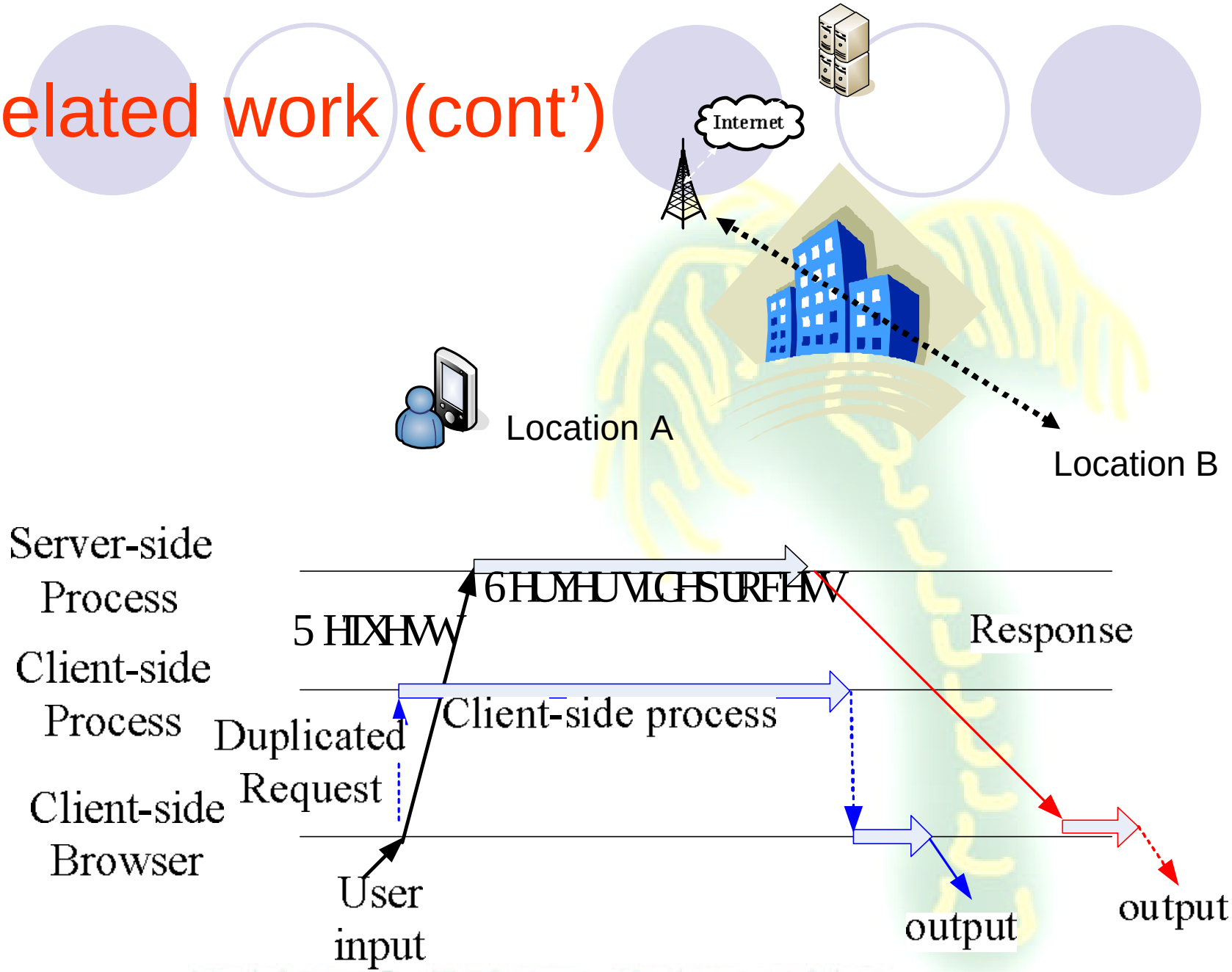
Related work

- Adaptation methods
  - Chroma from CMU

    Replets from NTT DoCoMo USA Lab

    Agilos from UIUC
  - Based on a closed control loop to runtime repartition the application between client and server.
    - Resource monitor
    - Resource prediction
    - Application reconfiguration

Related work (cont')



Related work (cont')

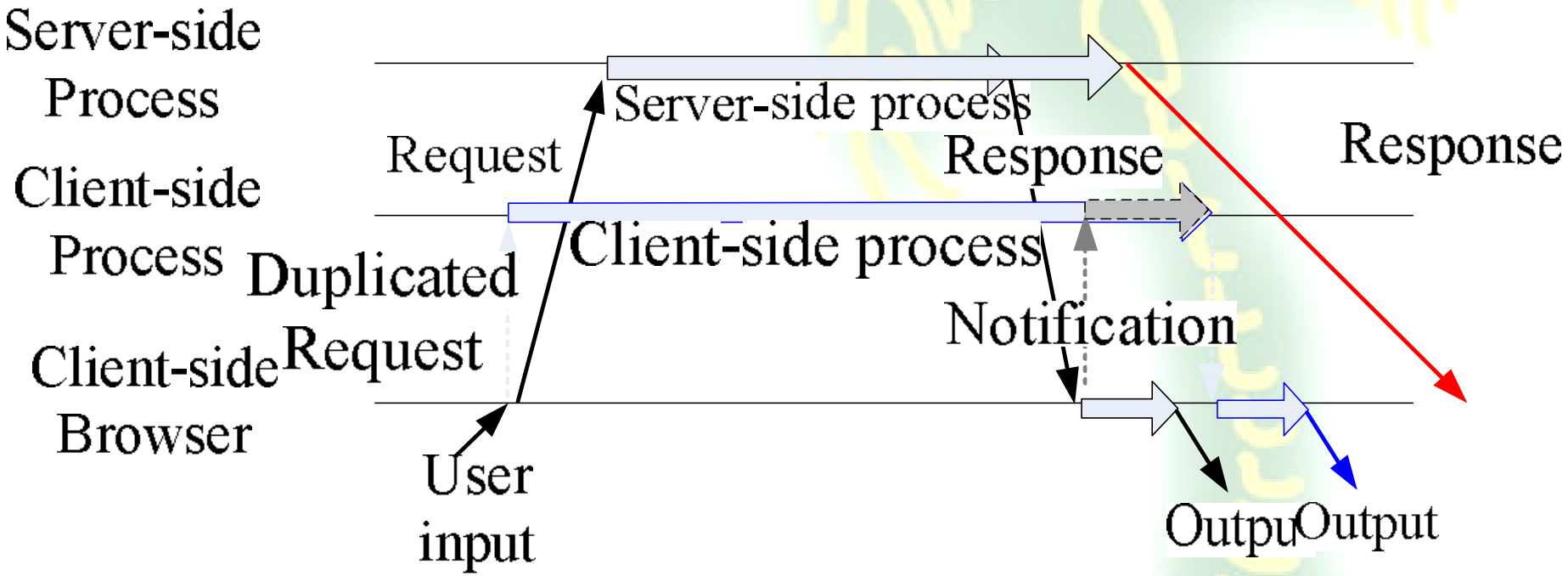
- Major limitation of adaptation methods
  - **Require predictable resources**
- What happen if resources are unpredictable?
  - Frequent application reconfigurations
  - Each reconfiguration incurs computing overheads.
  - Incorrect reconfiguration
    - **Poor response time**

Replicated Client-Server Model

- How to get good response time under unpredictable resources without app reconfiguration?
  - Replicated client-server model

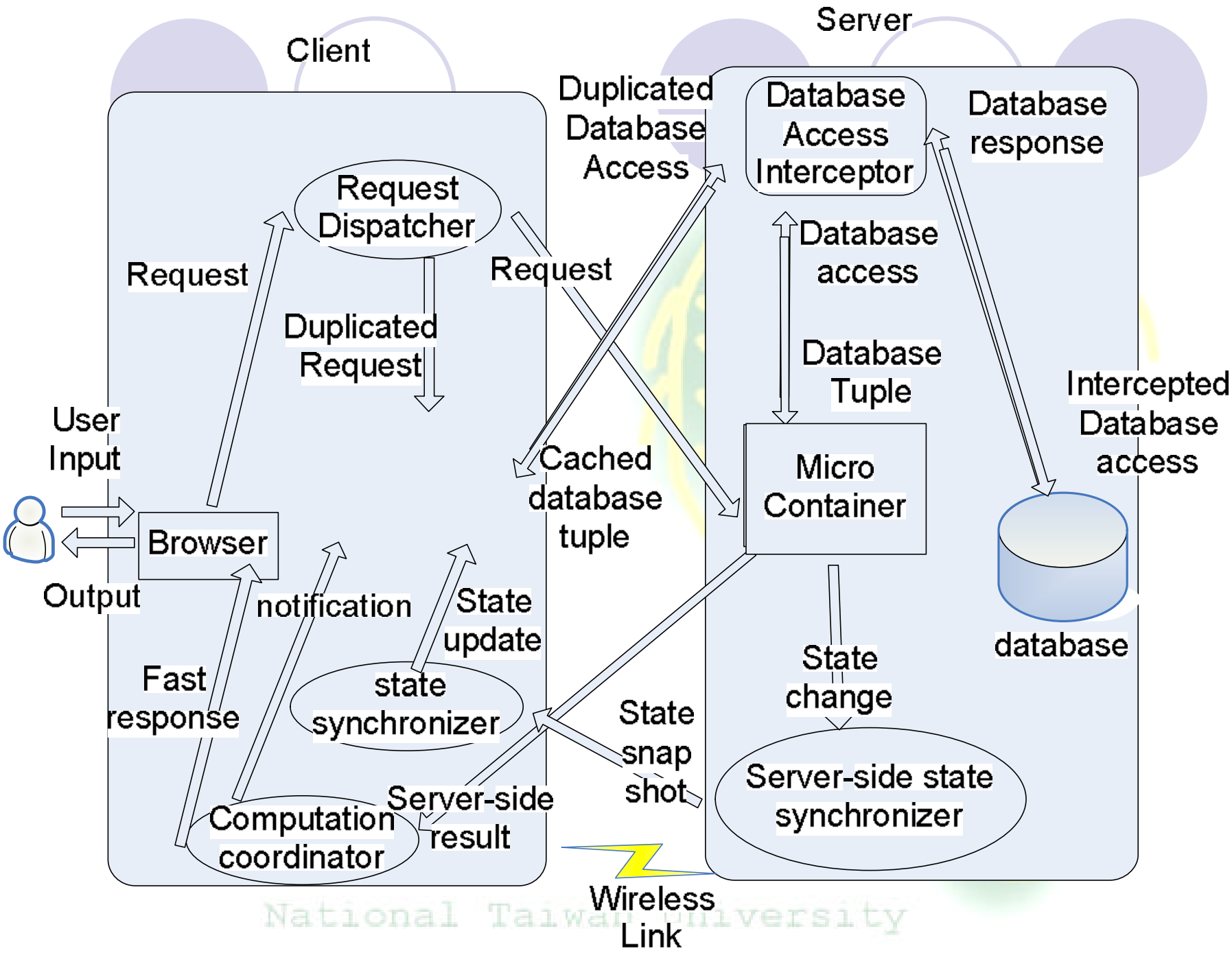
The best of thin and thick client models

Replicated client-server model (cont')



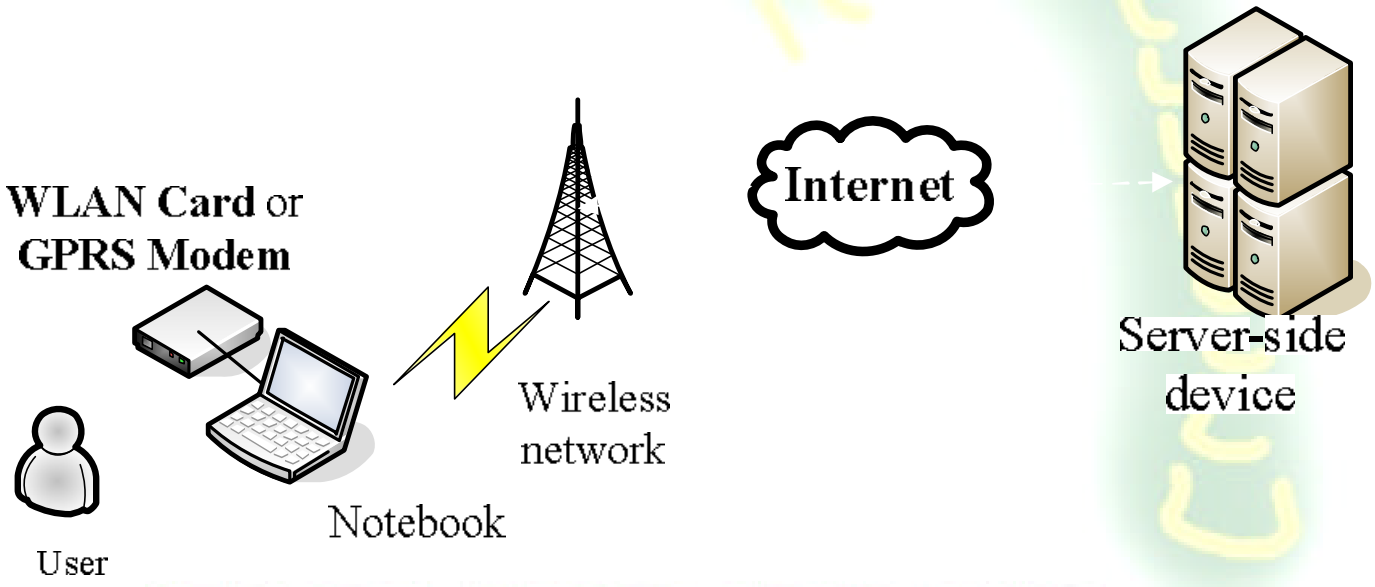
Replicated Client-Server Model vs. Adaptation Methods

- Use replication to solve unpredictability.
- No need to reconfigure under changing resource conditions
- Give good response time under unpredictable resources



Experiment Setup

- Using a component-based sample J2EE application to show the impact of changing resource conditions and usage patterns on application response time



Impact of usage patterns on response time

- two possible usage patterns when a user views his/her shopping cart
  - No sign-on: views his/her shopping cart prior to sign-on.
  - After sign-on: views his/her shopping cart after sign-on.
- Different usage patterns can change the optimal application partition.

Response time

Usage Patterns	Thick Client Partition	Thin Client Partition
No sign-on	2.489 s	9.016 s
After sign-on	45.065 s	11.241 s

Impact of network bandwidth on response time

- Handoff between WLAN and GPRS network
- Varying the network bandwidth can change the optimal application partition.

Response time

Network Bandwidth	Thick Client Partition	Thin Client Partition
GPRS	**2.489 s**	**9.016 s**
WLAN	2.987 s	**0.614 s**

Implementation and evaluation

- A preliminary implementation on HP ipaq
  - request dispatcher, computation coordinator, database access interceptor and application-level session state synchronization

- show the system overhead in replicated execution.

Response time

Usage Patterns	Thick Client Partition	Thin Client Partition	Replicated Execution (Overhead)
No sign-on	3.1 s	13.1 s	5.5 s (2.4 s)
After sign-on	17.3 s	15.0 s	18.6 s (3.6 s)

Conclusion

- Unpredictability in mobile environment
  - The adaptive system may frequently reconfigure.
- Replicated client-server model.
  - Give good response time (at a cost of replicated execution overhead)
  - Work well under resource unpredictability
- Future work
  - Refine our implementation
  - Code download mechanism

Q & A