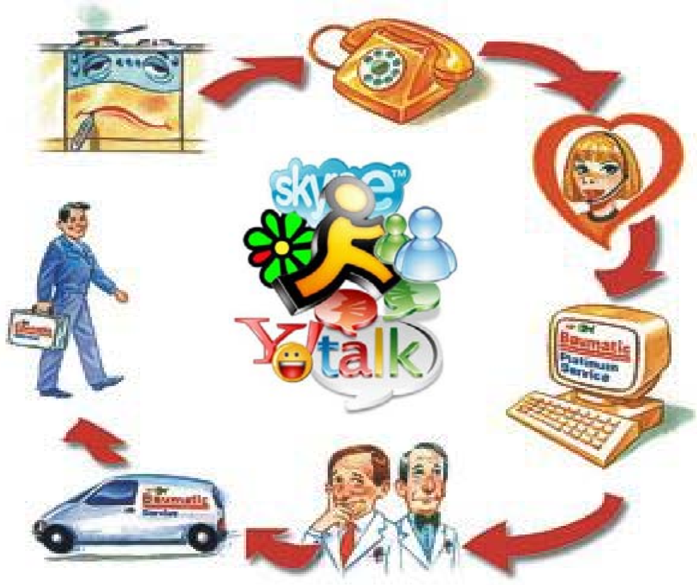
Context-Aware Mobile Instant Messenger

（支持情境感知的行動式即時訊息系統）



王卓立

March 13, 2008

香港大學計算機科學系

@Taiwan

Agenda

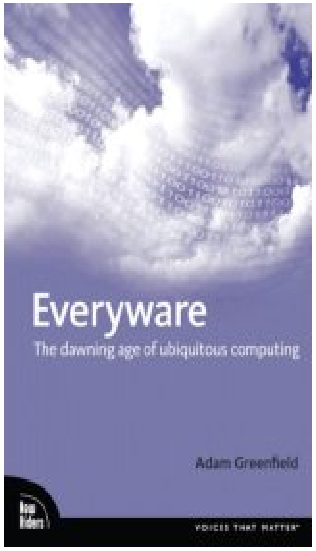
- Part I: Pervasive Computing
- Part II: HKU Sparkle System
- Part III: *Context-Aware Mobile Instant Messenger*
  - Motivations
  - Three features of our Mobile IM (MIM):
    - Significant location extraction
    - Cooperative place annotation
    - Context-aware presence management
  - Implementation & Evaluation
  - Conclusion and Outlook

Part I: Pervasive Computing

普及運算 or 普適计算

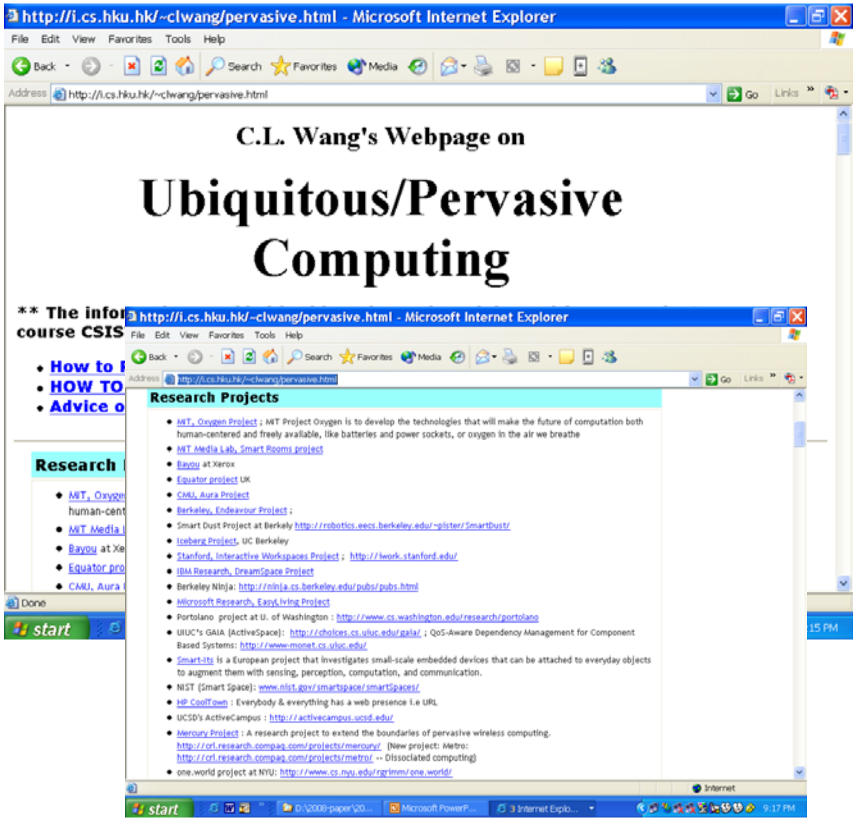
Pervasive/Ubiquitous Computing (無所不在的運算, 隨處運算)

- Xerox PARC科學家Mark Weiser 1991年提出.
  - *計算與環境融爲一體，信息与計算“唾手”可得*
  - ***aims to reduce the "excitement" of information overload --*** ***Calm Technology (Mark Weiser)***
- Other terms:
  - ***Invisible Computing***
  - ***Unremarkable Computing**:不值得注意的*
  - ***Context-aware Computing:** 情境感知的*
  - ***Ambient (周遭的) Intelligence : (Philips,1998)***
  - ***Everyware (2004: Adam Greenfield)***



Research Work on PvC

- US
  - MIT: Oxygen
  - CMU: Aura
  - Illinois : Gaia (Active Space)
  - OGI和GIT: InfoSphere
  - UC Berkeley : Endeavor
  - U. of Washington: Portolano
  - HP Cooltwon
- Europe
  - Ubiquitous Computing in Europe
  - 英国 : Equator


http://i.cs.hku.hk/~clwang/pervasive.html - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Back Search Favorites Media
Address http://i.cs.hku.hk/~clwang/pervasive.html
Go Links
Done
start

C.L. Wang's Webpage on

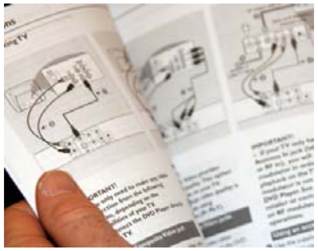
Ubiquitous/Pervasive Computing

Research Projects

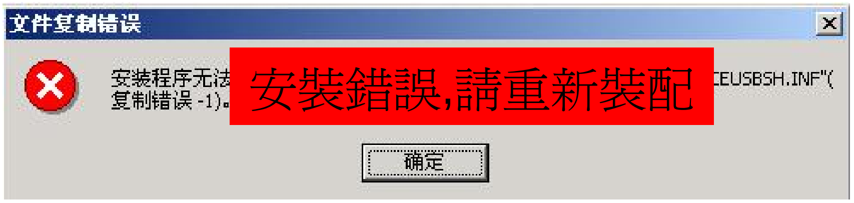
- MIT, Oxygen Project ; MIT Project Oxygen is to develop the technologies that will make the future of computation both human-centered and freely available, like batteries and power sockets, or oxygen in the air we breathe
- MIT Media Lab, Smart Rooms project
- Bayou at Xerox
- Equator project UK
- CMU, Aura Project
- Berkeley, Endeavour Project ;
- Smart Dust Project at Berkely http://robotics.eecs.berkeley.edu/~pister/SmartDust/
- Iceberg Project, UC Berkeley
- Stanford, Interactive Workspaces Project ; http://iwork.stanford.edu/
- IBM Research, DreamSpace Project
- Berkeley Ninja: http://ninja.cs.berkeley.edu/pubs/pubs.html
- Microsoft Research, EasyLiving Project
- Portolano project at U. of Washington : http://www.cs.washington.edu/research/portolano
- UIUC's GAIA (ActiveSpace): http://choices.cs.uiuc.edu/gaia/ ; QoS-Aware Dependency Management for Component Based Systems: http://www-monet.cs.uiuc.edu/
- Smart-its is a European project that investigates small-scale embedded devices that can be attached to everyday objects to augment them with sensing, perception, computation, and communication.
- NIST (Smart Space): www.nist.gov/smartspace/smartSpaces/
- HP CoolTown : Everybody & everything has a web presence i.e URL
- UCSD's ActiveCampus : http://activecampus.ucsd.edu/
- Mercury Project : A research project to extend the boundaries of pervasive wireless computing. http://crl.research.compaq.com/projects/mercury/ (New project: Metro: http://crl.research.compaq.com/projects/metro/ -- Dissociated computing)
- one.world project at NYU: http://www.cs.nyu.edu/rgrimm/one.world/

Read C.L. Wang's Webpage on Ubiquitous/Pervasive Computing: http://www.cs.hku.hk/~clwang/pervasive.html

PvC is "User Centric"
(以「人爲中心」的計算)



- 目前的桌面計算模式：
  - Difficult to use. required us to interact with them on their terms, speaking their languages
- 計算機佔據主導地位，人是計算機的"僕人"
  - 人必須處理各種計算任務的細節才能获得计算和信息服务；
  - **User Interface**適合機器而不是人;
  - 人必須處理各種計算任務的細節才能獲得所需結果，比如硬件軟件安裝、需記住數據的存放地點等



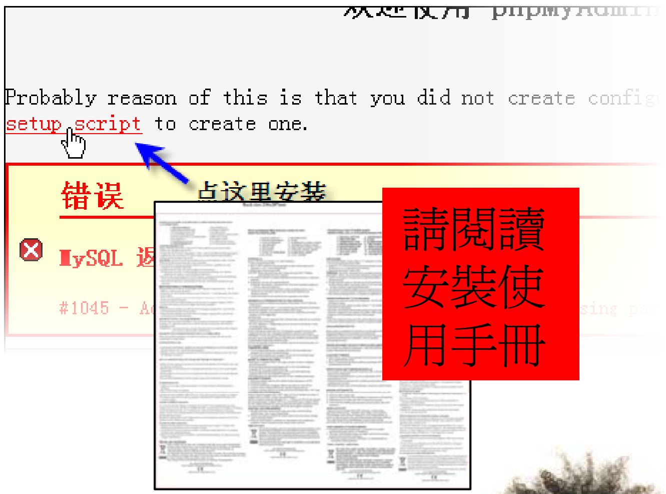
文件复制错误

安装程序无法
复制错误 -1)。

EUSBSH.INF"(

确定

安裝錯誤,請重新裝配



欢迎使用 phpMyAdmin

Probably reason of this is that you did not create config
setup script to create one.

点这里安装

错误

MySQL 返

#1045 - Ac

請閱讀安裝使用手冊

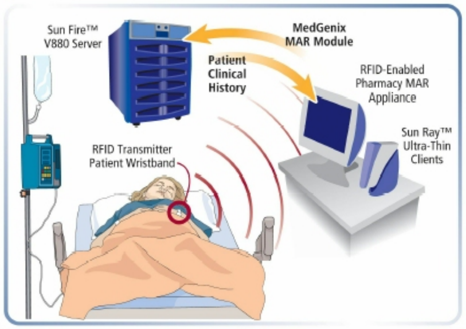
Where is my file ?

人的注意力被計算設備所佔據, 而不是要完成的任務

Pervasive Computing (PvC)

- **Extends both the time and space scales of computation**
  - ***"Might happen*** *anytime anywhere*, ***last*** *any duration*, ***span*** *any number* *and* *type of devices*, ***and which could offer exciting services you never have conceived before".***
- 計算不是固定的，而是隨時可移動的
- 計算資源是共享的，而不是私有的

無縫移動 + **365**天**/24**小時 永不間斷服務


Sun Fire™ V880 Server
MedGenix MAR Module
Patient Clinical History
RFID-Enabled Pharmacy MAR Appliance
Sun Ray™ Ultra-Thin Clients
RFID Transmitter Patient Wristband

智能醫院

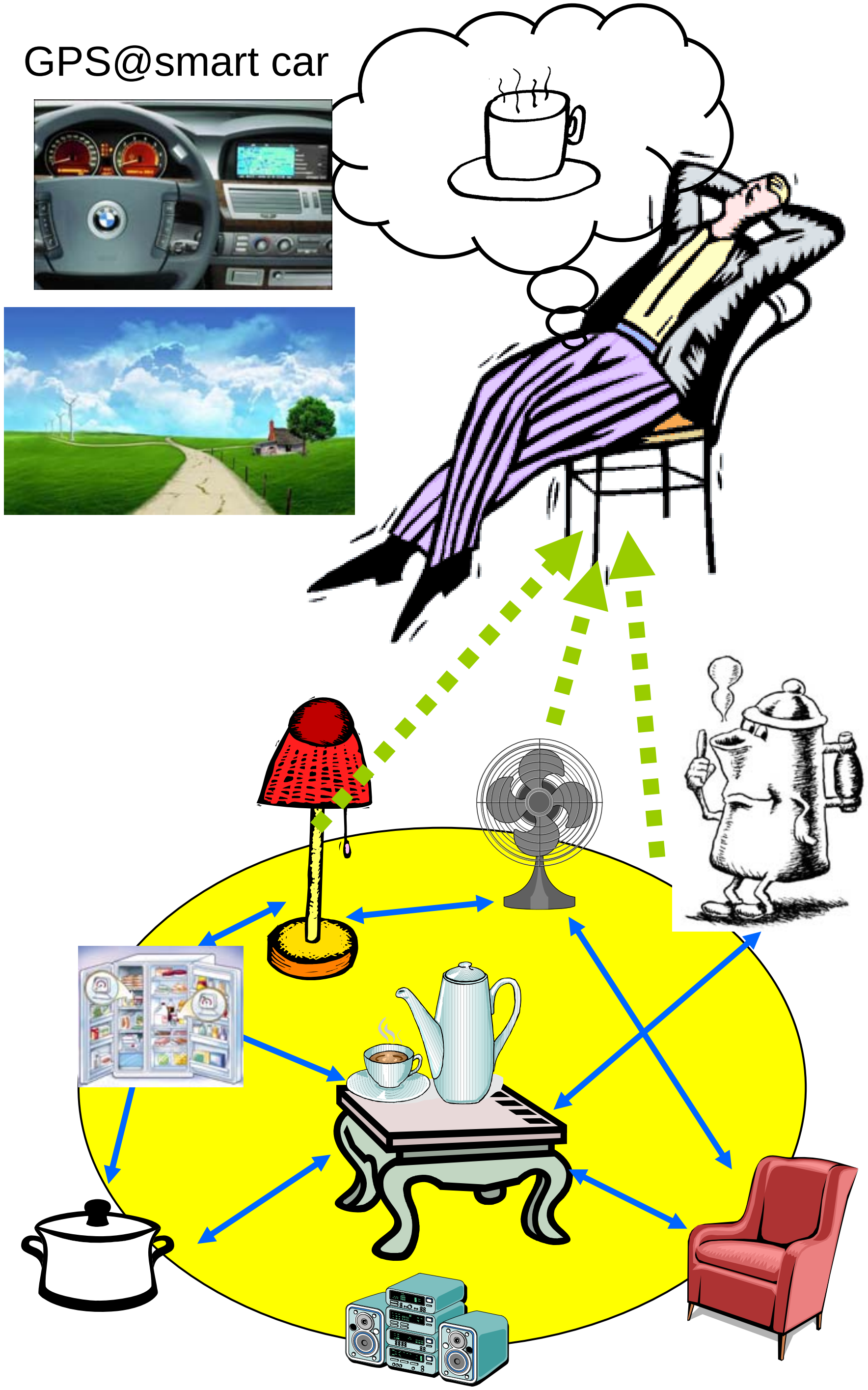
Interactive Workspaces

Smart Car

智能家居

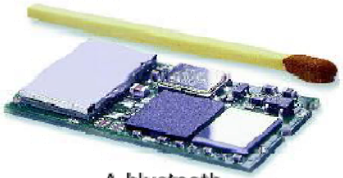
A Day in a PvC Age

- Everything becomes computerized
- Everything becomes smart (情境感知力)
  - Your coffee pot “thinks” you are tired and prepares coffee
- They can communicate with each other
  - The refrigerator, coffee pot, sofa, and fan, talk and cooperate with each other to make your life better.



Enabling Technologies:

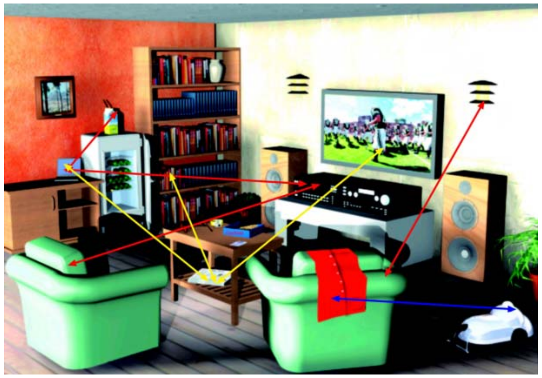
嵌入式硬件, 嵌入式操作系统和軟體開發的支持
(計算与環境融為一體 !)

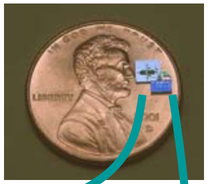


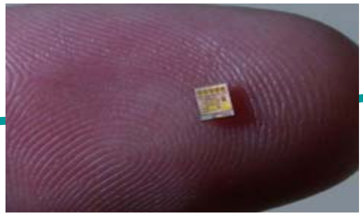
A bluetooth module

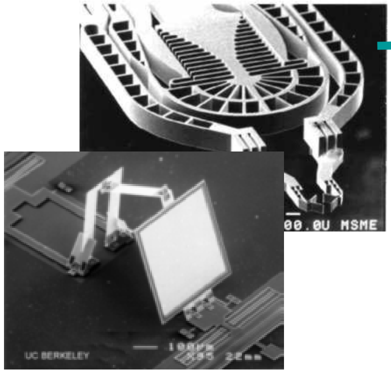
Wrist watches will monitor our blood pressure and heart beat

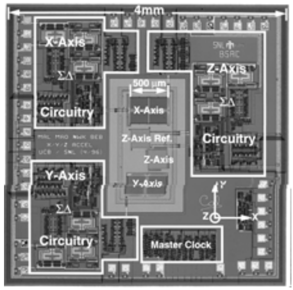
Latest top-level BMWs contain over 100 micro-processors

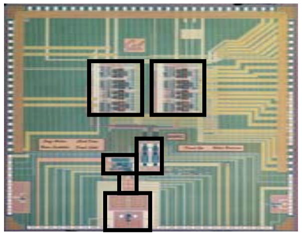


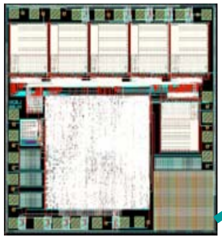








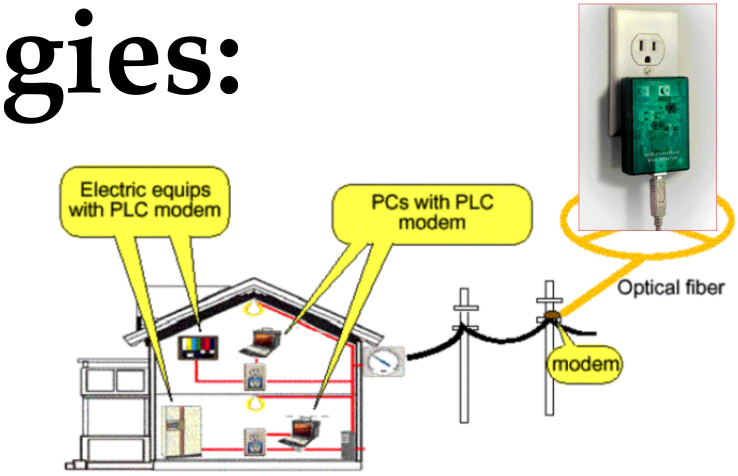




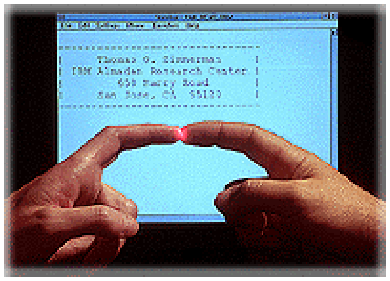
Enabling Technologies: Communication

- High-speed Internet
  - 10-100 Mbps edge connection
  - Bandwidth of single fibers ~10 Gb/s
  - E.g., 10 Gb/s HKU Campus Network
- Wireless
  - mobile phone: 3G(2.4Mbps), 4G(100 Mbps)
  - wireless LAN (> 10 Mb/s), BlueTooth
- New network technologies:
  - Power line networking (PLC)
    - HomePlug : 14Mbps data transfer rates
    - coffee maker "automatically" connected to the Internet
  - Personal area networks
  - Wireless radio frequency (RF) technology

- *Everything can be connected !!*



Power Line Communication (PLC, 電力線通信)



Personal area networks

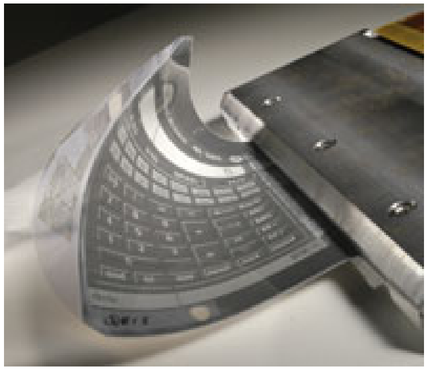
PCCW Wi-Fi
無線寬頻熱點
Available here

Y5 ZONE

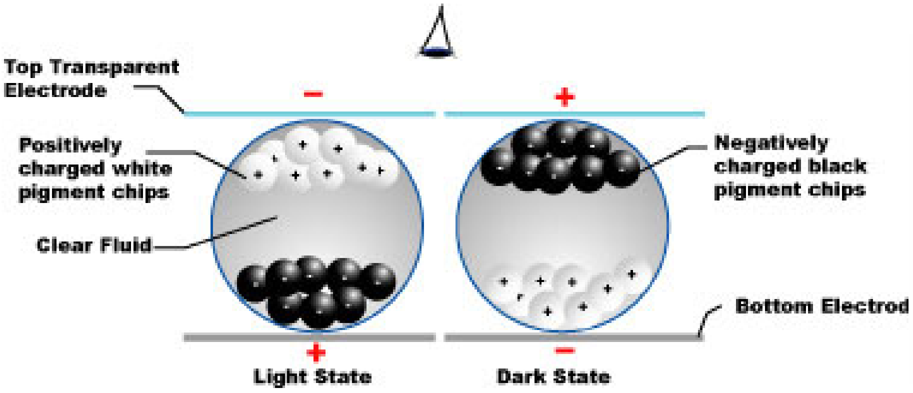
HK "Wi-Fi city“: > 3000 Hotspots

Enabling Technologies: 新視覺顯示技術

- E-paper: *(Write and Display Everywhere)*
  - reusable display material
  - high contrast, low energy, flexible
  - Rewritable with magnetic pen
- Smart Glasses : *(View Everywhere !)*
  - Visual information will be written directly onto our retinas (視網膜) by devices in our eyeglasses and contact lenses”



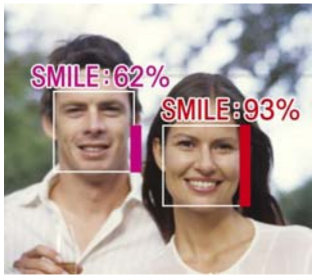
Foldable and Rollable Display


Top Transparent Electrode
Positively charged white pigment chips
Clear Fluid
Negatively charged black pigment chips
Bottom Electrod
Light State
Dark State

E-paper from Xerox and 3M

Enabling Technologies:
Sensors/Actuators (傳感器 /促動器)

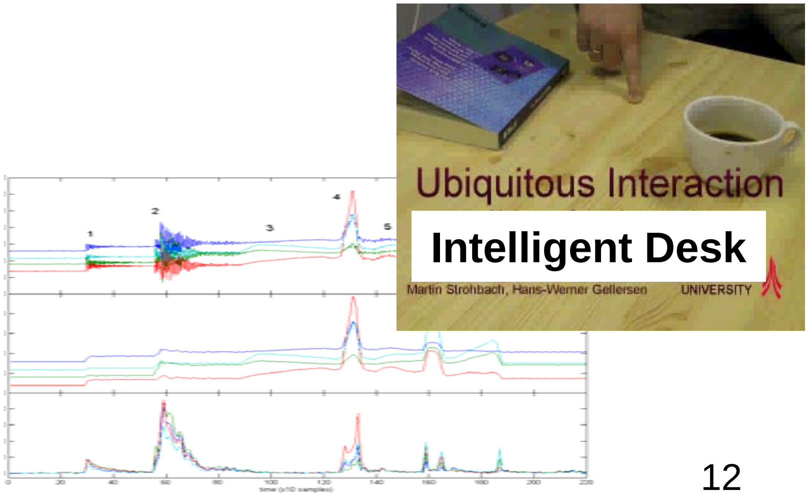
- Basic sensors: 壓力、溫濕度、流量、液位、超聲波、浸水、照度、加速感應器 (accelerometer)
- Fingerprint sensor
- RFID
- Infrared
- Location sensors

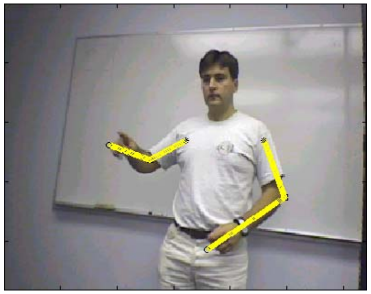


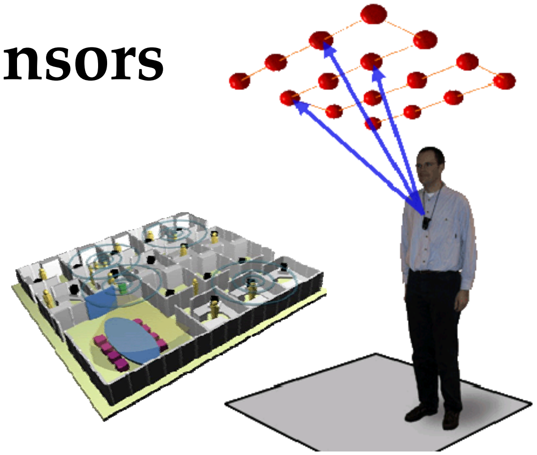
微笑快門

MediaCup

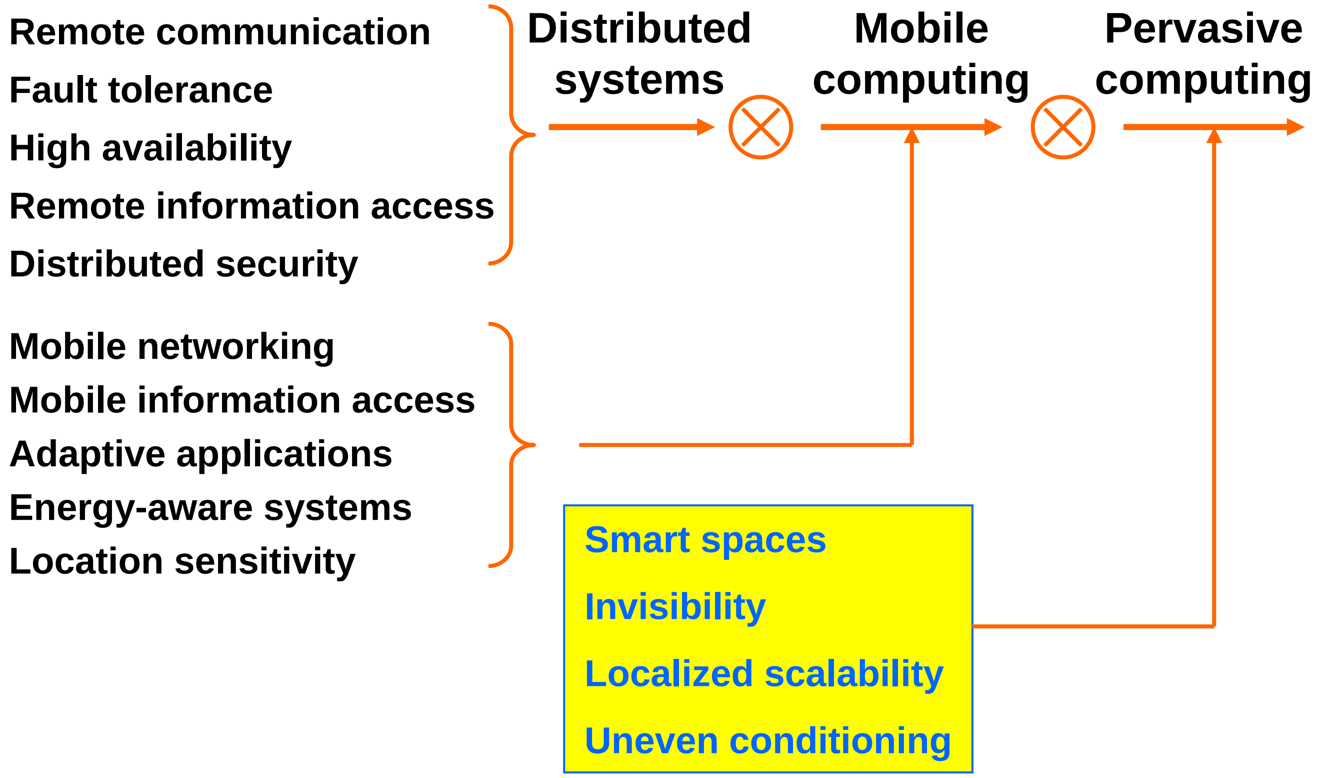
智能衣服







PvC : Core Research Issues
普適計算的挑戰



Remote communication
Fault tolerance
High availability
Remote information access
Distributed security

Mobile networking
Mobile information access
Adaptive applications
Energy-aware systems
Location sensitivity

Distributed systems

Mobile computing

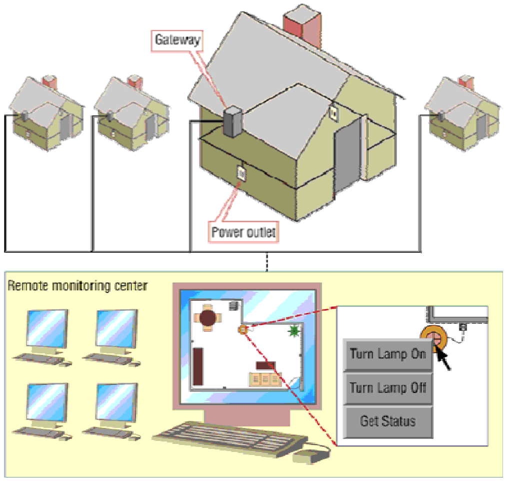
Pervasive computing

Smart spaces
Invisibility
Localized scalability
Uneven conditioning

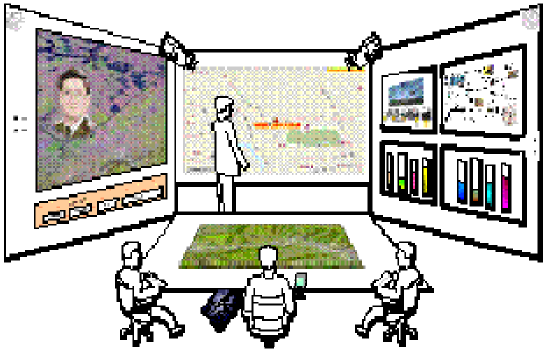
"Pervasive Computing: Vision and Challenges"
M. Satyanarayanan [CMU, Aura Project, 2001]

1. Effective Use of Smart Spaces

- *A smart space is an enclosed area* equipped with embedded computers, information appliances, and multi-modal sensors allowing people to perform tasks efficiently by offering access to information and assistance from computers.

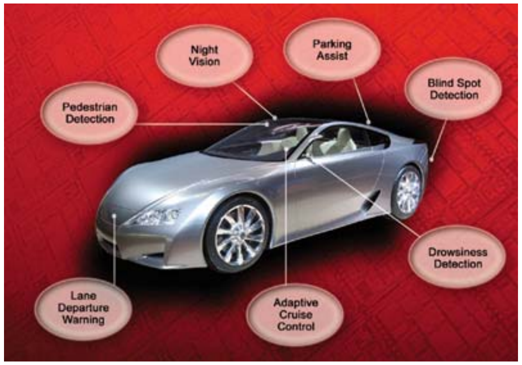


Smart Home



Smart Classroom

Interactive Workspaces



Smart car

2. Invisibility: 計算機褪入,隱藏在背後 ➔ 變成看不見的, 無形的

Making computers ubiquitous (everywhere) is not enough; we should also strive to make them invisible.

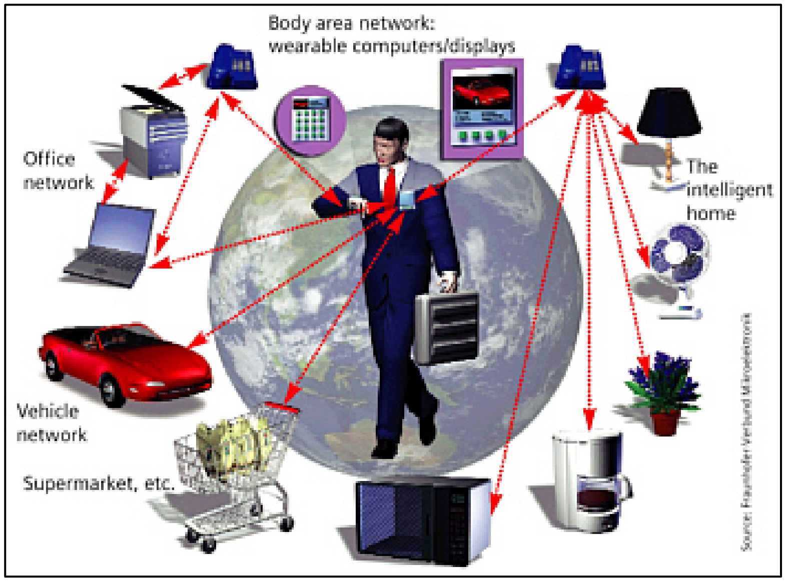
Computers are ubiquitous (everywhere)

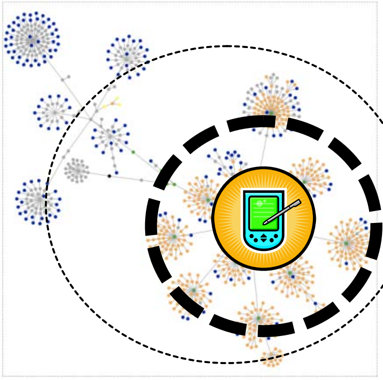
The computer and its software fade into the background, and become "invisible".

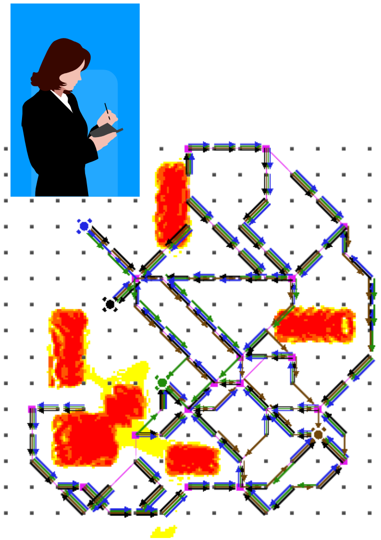
(1) Make it small: fully embedded and physically disappear
(2) Make it smart: The environment continuously meets user expectations and rarely presents him with surprises

3. Localized scalability:

- The Problem:
  - As smart spaces grow in sophistication, the intensity of interactions between a user’s personal computing space and its surroundings increases.
- Consider scalability with physical distance, despite their potential huge number of devices.







4. Masking Uneven Conditioning

- Not all spaces are equally smart.
- Large dynamic range of "smartness" causing user distraction (分心).
  - E.g.: A teacher moves from a well-equipped classroom to a classroom with only a blackboard.
- Masking Uneven Conditioning: make user able to act normally, even if the service/application is not available or is not fully functional.

Select a Source
LECTURE ENVIROMENT
SOURCE SELECT
Projectors
PROJECTION SCREENS
SYSTEM OFF
?
1:29
July 20th, 2001
END CLASS
PODIUM COMPUTER
STUDENT COMPUTERS
ELMO
Video Input
S-video Input
NO SOURCE
?

A well-equipped classroom

An old classroom

Multi-Fidelity Computation -

Re-think our model of computing

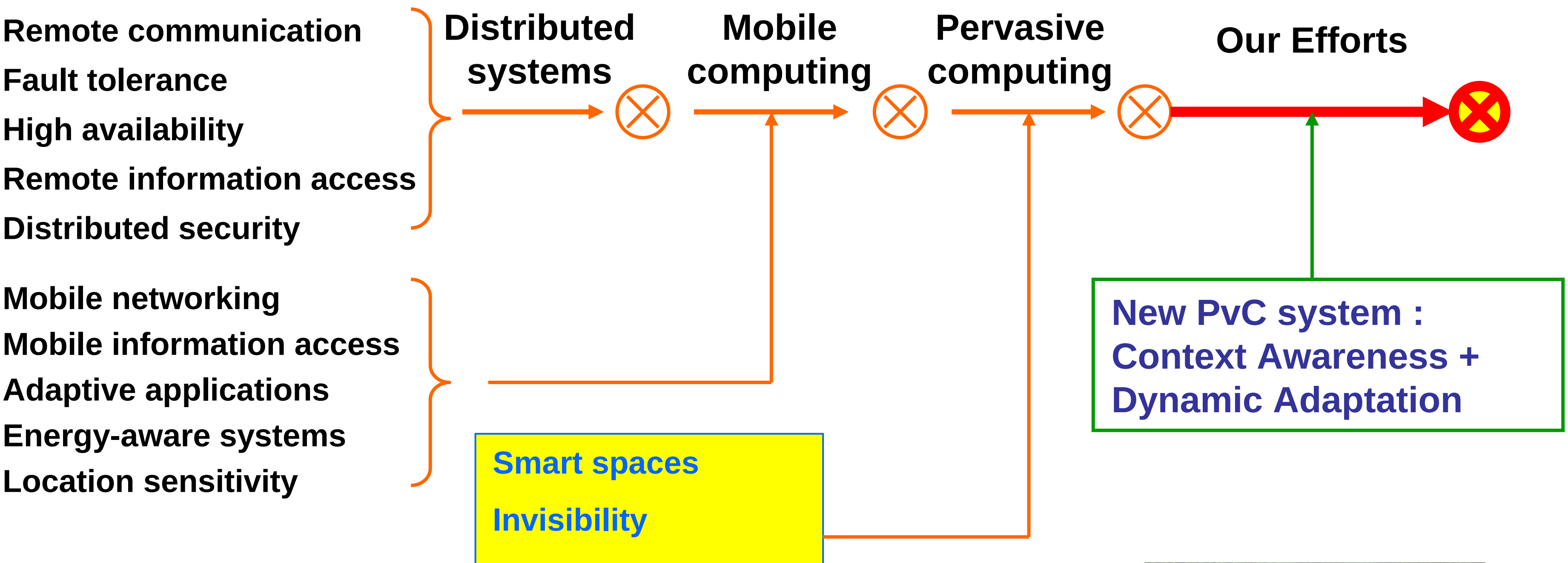
- Traditional algorithm
  - fixed correctness criteria (fixed output spec)
  - variable amount of resources consumed to meet this

- Multi-fidelity多保真度 algorithm
  - Multiple notions of “correct”; each is a level of fidelity
  - Many allowable outputs/answers:
    - different fidelities → different outputs, resource usage
  - *“Do the best you can using no more than X units of resource”*

Short Summary *Pervasive/Ubiquitous Computing*

- Mass deployment of computing in everyday life
  - computing anytime, anywhere;
- An environment saturated with computing and communication capability, yet so gracefully integrated with users that it becomes a "technology that disappears" --*Invisible Computing;*
- "Each person is continually interacting with hundreds of nearby interconnected computers without explicitly attending to them" -- Machines sense users' presence and act accordingly

The Pervasive Expedition
普適計算時代的機遇和新挑戰



Remote communication
Fault tolerance
High availability
Remote information access
Distributed security

Mobile networking
Mobile information access
Adaptive applications
Energy-aware systems
Location sensitivity

New PvC system :
Context Awareness +
Dynamic Adaptation

Smart spaces

Invisibility

Localized scalability

Uneven conditioning

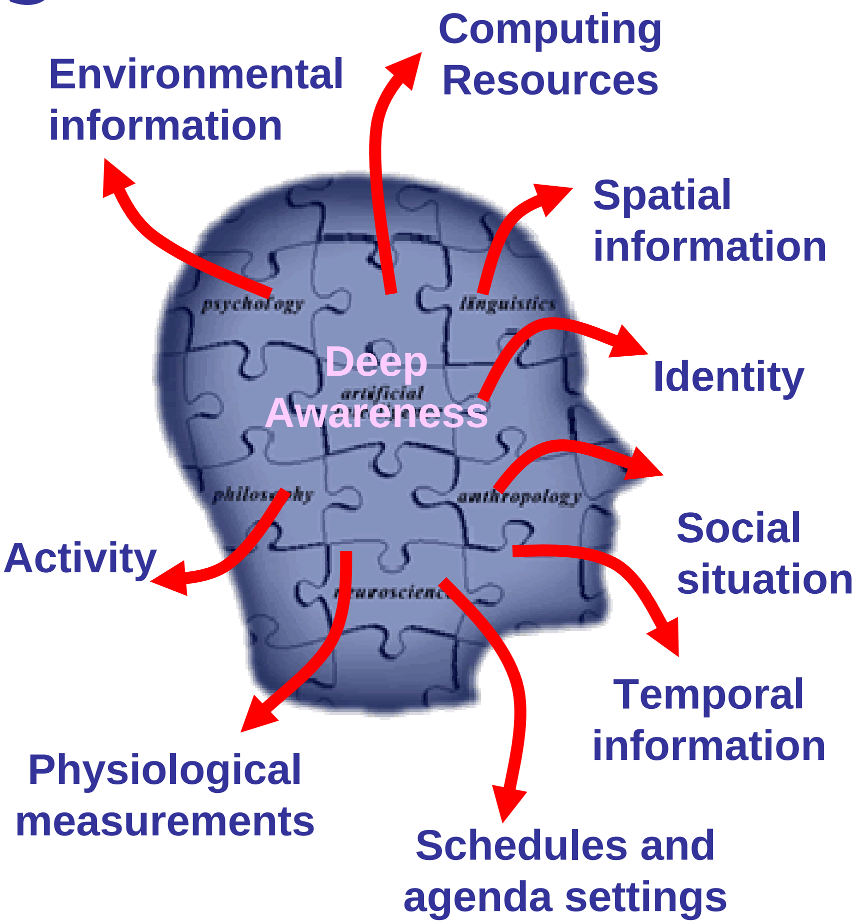
"Pervasive Computing: Vision and Challenges"
M. Satyanarayanan [CMU, Aura Project, 2001]

Our Focus

- *Context awareness support:*
  - The software is able to monitor the context of its environment (smart space), itself (program), and its users (user status/intent)
  - Deep Awareness
- *Dynamic adaptation support:*
  - Resource-aware adaptation:
    - (Bandwidth) Context-aware network sockets
    - (Battery power) Energy-aware power management
  - Environment adaptation: (dynamic smart space construction)
    - spontaneously integration or removal of devices and application components.
  - Content/data adaptation:
    - Change the data formats (lower resolution, smaller image,..
  - Functionality adaptation:
    - Same functionality but different code/implementation: e.g., trading time for space (different algorithms for *tree search, sorting, …u*se different software for communications : e-mail, SMS, video chat, text chat..)

Deep Awareness

- The majority of context-aware computing to date has been restricted to *location-aware computing* for mobile applications (location-based services).
- ***Deep Awareness*:**
  - Make full use of context information
  - Make use of "commodity sensors" (e.g., WebCam, RFID, Temp/Light,..)
  - Make use of "soft sensors" (weather forecast, work schedule, on-line maps,..)



Deep Awareness

Environmental information

Computing Resources

Spatial information

Identity

Social situation

Temporal information

Schedules and agenda settings

Physiological measurements

Activity

Part II: Sparkle PvC Systems

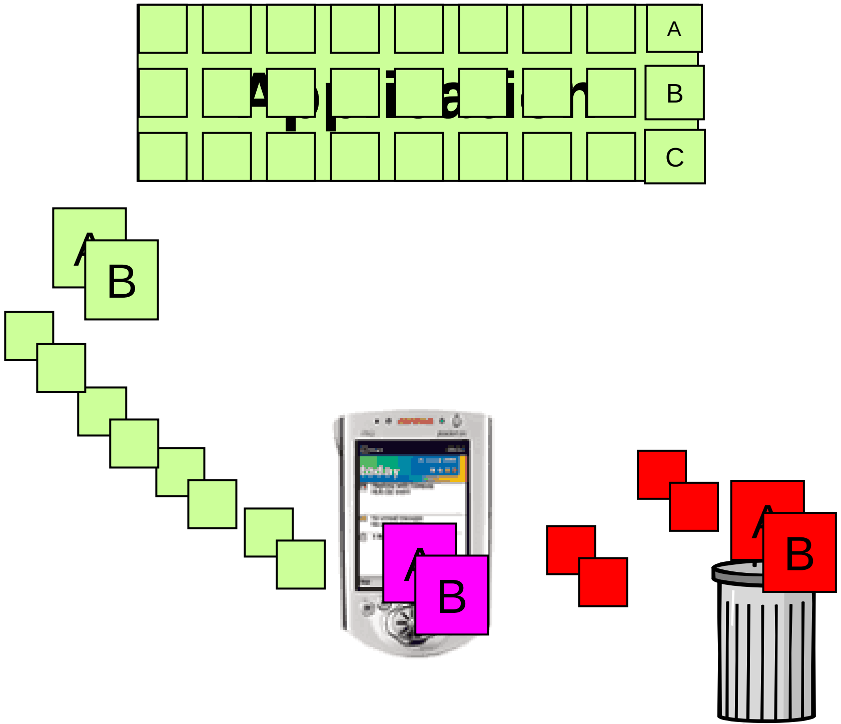
Sparkle PvC Systems

- A component-based software architecture with ***functionality adaptation*** for Pervasive Computing
- Goal: achieve 4 “A”s -- Computing **A**nytime, **A**nywhere, at **A**ny device, and support Any **A**pplication.

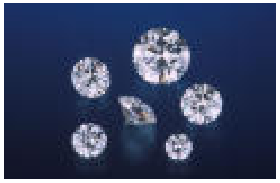
Adobe Photoshop cs

Won’t Fit

Applications distributed as monolithic blocks



Functionality Adaptation in Sparkle

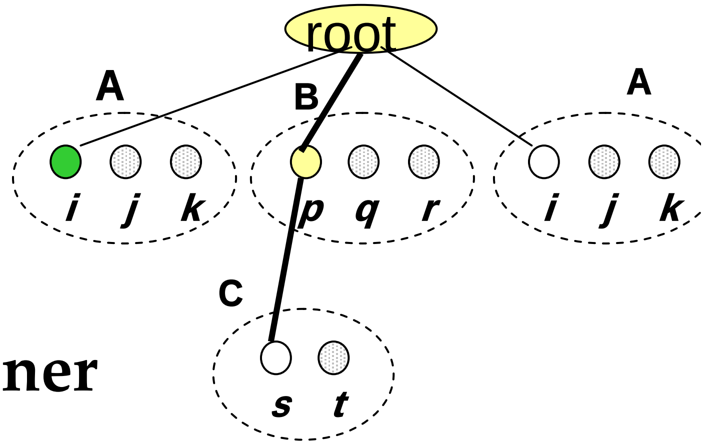


Facets – flat planes which make up a diamond

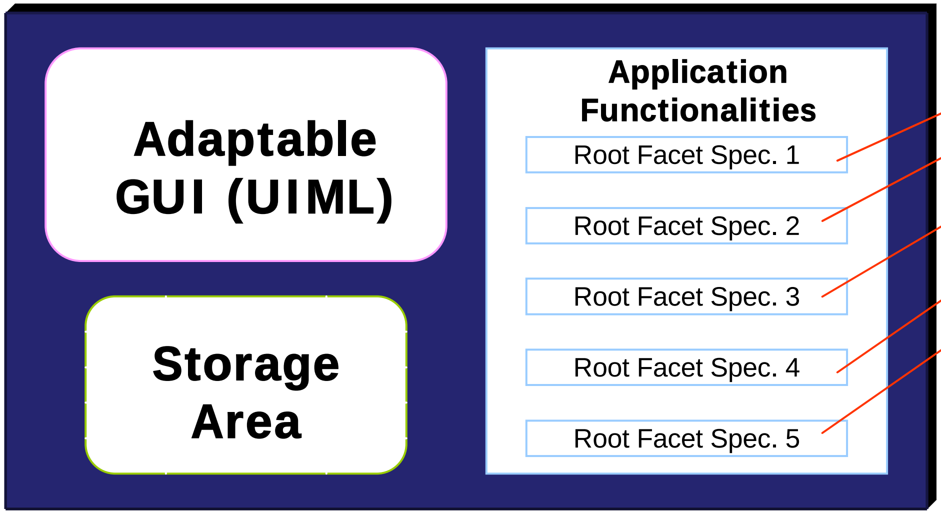
- *Facet Programming Model:*
  - *Facet = code + facet description*
  - *Separation of code and data*, **preparing for**
    - *Adaptation*: **code and data can be adapted individually**
    - *Migration*: **state is kept in container (root facet + UI)**
  - *Facet is stateless:*
    - **makes it throwable & replaceable at run-time**
  - *Functionality Adaptation*
    - **Components of the same functionality have varied granularity and/or feature**
    - *Multi-fidelity computing*: **Pick the one that meets user's needed "functions"and resource availability.**

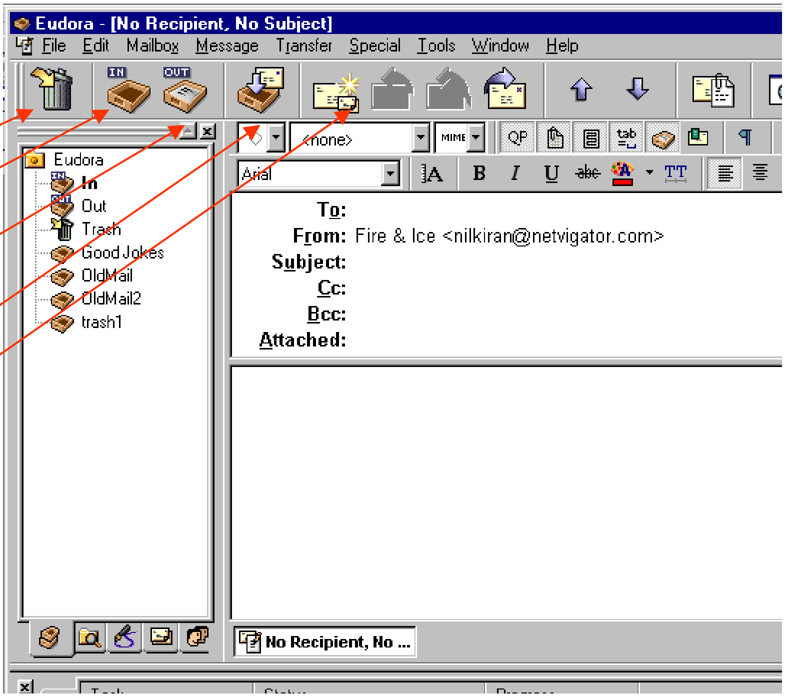
Container Concept : “Migration-Ready”

- *Application-like abstraction*
  - Interacts with the user through the UI
  - Provides a place to store run-time state
  - Provides specifications of the root facets



- Root facet specification : the functionalities this particular container can offer.




Eudora - [No Recipient, No Subject]
File Edit Mailbox Message Transfer Special Tools Window Help
IN
OUT
<none>
MIME
QP
Arial
Eudora
In
Out
Trash
Good Jokes
OldMail
OldMail2
trash1
No Recipient, No ...

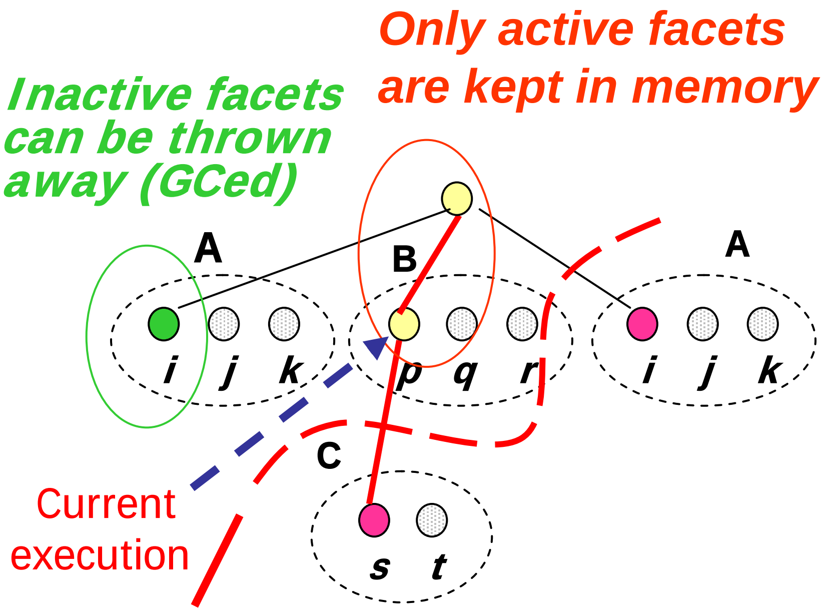
To:
From: Fire & Ice <nilkiran@netvigator.com>
Subject:
Cc:
Bcc:
Attached:

User Interface Markup Language (UIML)

Functionality Adaptation

Facet Dependency Graph

- Facets may call upon other facets to achieve their functionality
- May have more than one facet fulfilling the functionality (e.g., i,j, k for A)
- Dependency types:
  - **“compulsory”**
  - **"optional" : "if-then-else“**



Only active facets are kept in memory

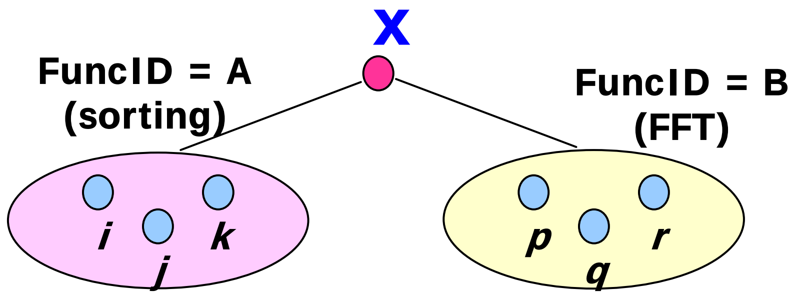
Inactive facets can be thrown away (GCed)

Current execution

🟢 Inactive Facet -already executed completely

🔴 Facet which has not yet been brought in/loaded

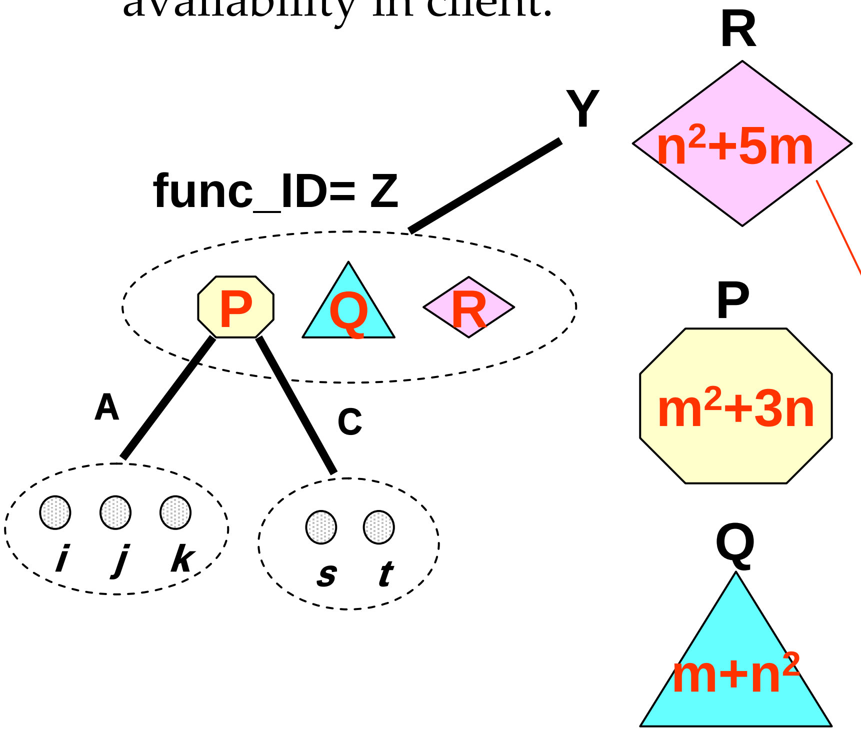
🟡 Active Facet - currently running

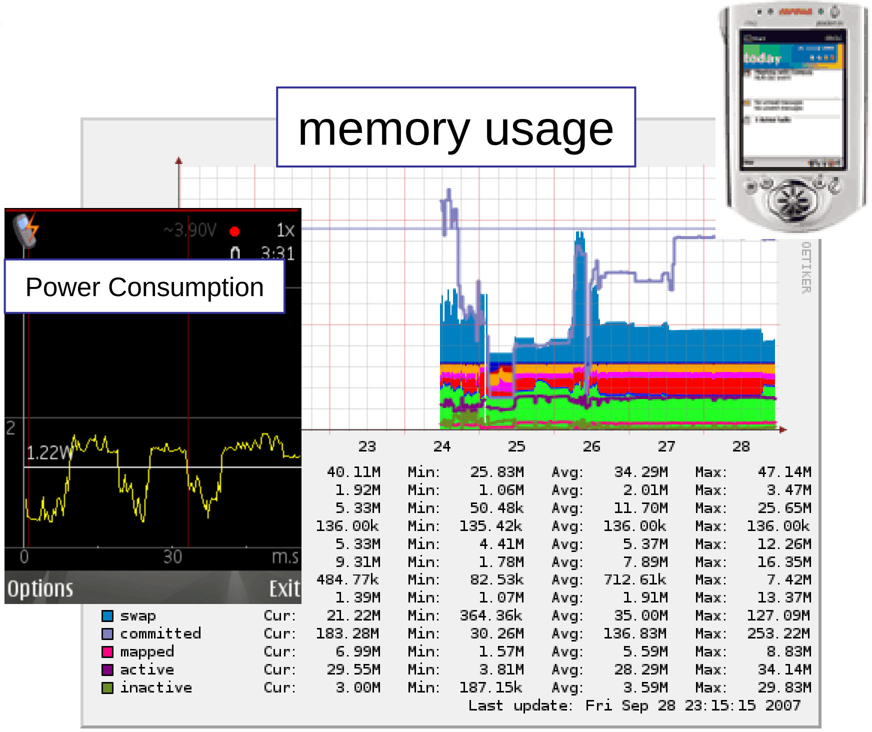


i: quick sort; i: bubble sort; k: merge sort

Functionality Adaptation : How?

- The proxy compares the *resource requirement* of facets with the resource availability in the client.
- Proxy will send a facet whose resource requirement + the resource requirements of all its dependencies together is less than the resource availability in client.



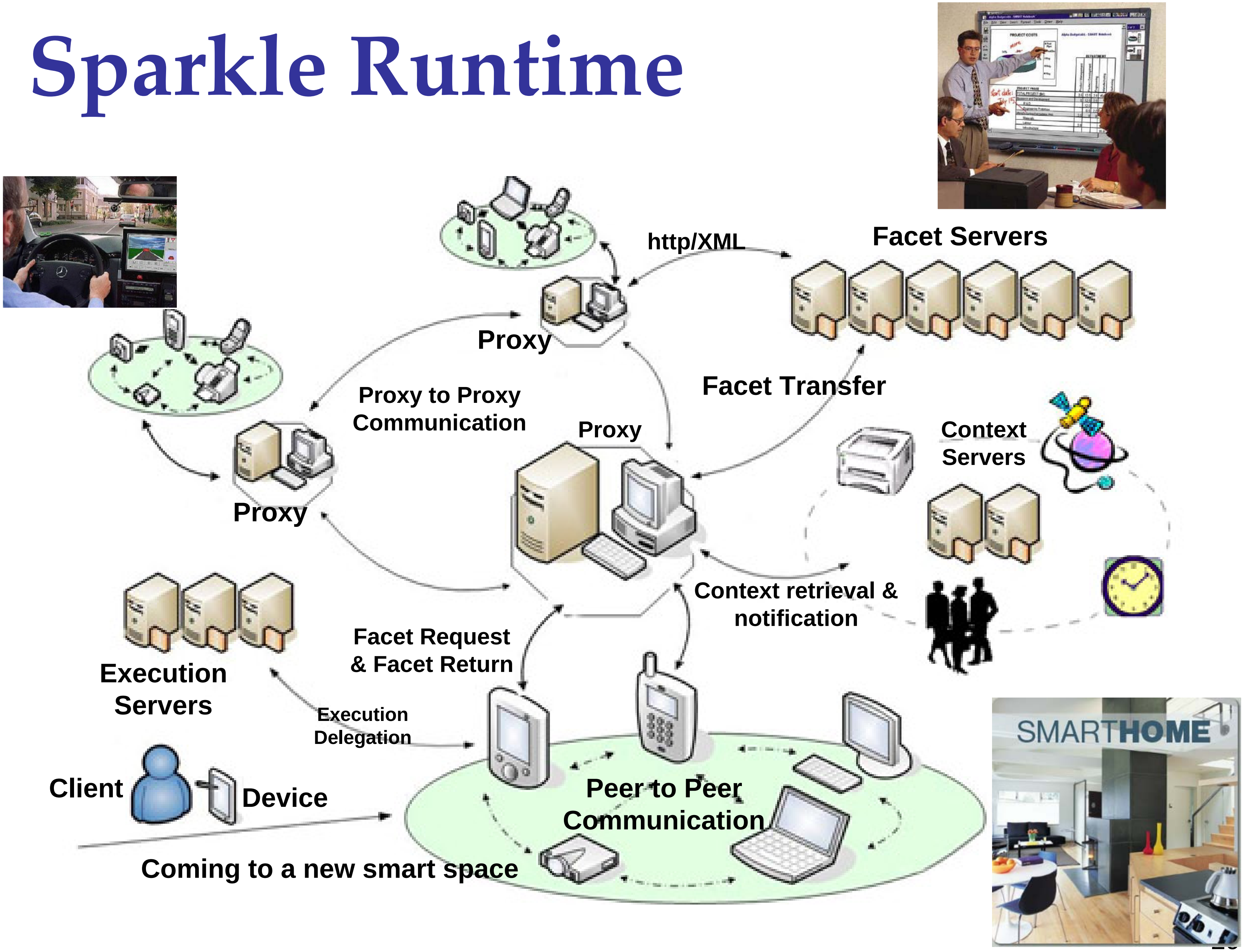


```
 40.11M   Min:  25.83M   Avg:  34.29M   Max:  47.14M
  1.92M   Min:   1.06M   Avg:   2.01M   Max:   3.47M
  5.33M   Min:  50.48k   Avg:  11.70M   Max:  25.65M
136.00k   Min: 135.42k   Avg: 136.00k   Max: 136.00k
  5.33M   Min:   4.41M   Avg:   5.37M   Max:  12.26M
  9.31M   Min:   1.78M   Avg:   7.89M   Max:  16.35M
484.77k   Min:  82.53k   Avg: 712.61k   Max:   7.42M
  1.39M   Min:   1.07M   Avg:   1.91M   Max:  13.37M
■ swap        Cur:  21.22M   Min: 364.36k   Avg:  35.00M   Max: 127.09M
■ committed   Cur: 183.28M   Min:  30.26M   Avg: 136.83M   Max: 253.22M
■ mapped      Cur:   6.99M   Min:   1.57M   Avg:   5.59M   Max:   8.83M
■ active      Cur:  29.55M   Min:   3.81M   Avg:  28.29M   Max:  34.14M
■ inactive    Cur:   3.00M   Min: 187.15k   Avg:   3.59M   Max:  29.83M
                              Last update: Fri Sep 28 23:15:15 2007
```

```
….// Facet R's Resource Requirement
<dynamic>
    <input_variables>
            <parameter name="m"> 1 </parameter>
            <parameter name="n"> 2 </parameter>
    </input_variables>
    <formula> n^2+5m </formula>
 </dynamic>
```

Resource Consumption of Facets

Sparkle Runtime


http/XML
Facet Servers
Proxy
Proxy to Proxy Communication
Facet Transfer
Proxy
Context Servers
Proxy
Context retrieval & notification
Facet Request & Facet Return
Execution Servers
Execution Delegation
Client
Device
Peer to Peer Communication
Coming to a new smart space
SMARTHOME

Part III:
Context-aware Mobile Instant Messenger

The pervading IM

- “42% of internet users report using instant messaging“
- “*53 million* adults in U.S. exchange instant messages and 24% of them swap IMs more frequently than email”

  --- “Pew Internet and American Life” Survey 04
- ICQ, MSN Messenger, Yahoo!, gtalk, AIM, QQ (78% in China)…
- Increased Internet connection time booming population.

IM User in Feb. 2006

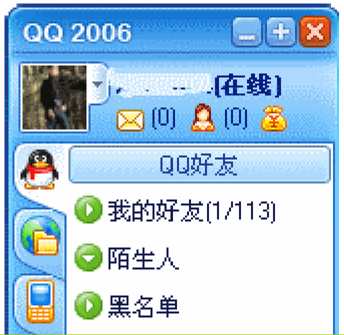
April 10, 2006 – reported by comScore Networks

- Europe : 82 million people, (49 % of the online population), used IM applications to communicate online.
- North America : 69 million people (37 % of the online population), used IM.
- Latin America : 64% of its online population chatting to each other via IM.

Why people like IM ?

- People can locate and be located by others in cyberspace while maintaining various degrees of control over their privacy and the timing in which they are willing to communicate.
- Presence-awareness (在場;存在)
  - Indicates a user's *responsive status*
- Sense of "Buddy" (親密夥伴,拍檔,)
  - Keep a friend-to-friend network
  - Stay social and connected
- One-click distance
- Free talk in any dialect
  - "gd nite & cu tmr"
  - 表情符號 (日語:「顏文字」)
  - "麻吉language"

Emoticon 表情符號



QQ 2006

[在线]

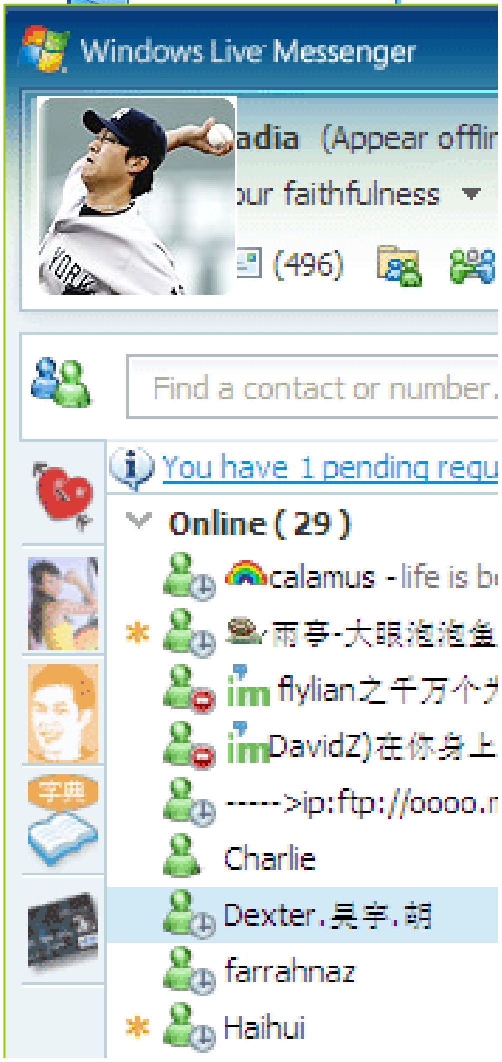
(0) (0)

QQ好友

我的好友[1/113]

陌生人

黑名单



Windows Live Messenger

adia (Appear offlir

our faithfulness

(496)

Find a contact or number.

You have 1 pending requ

Online (29)

calamus - life is b

雨亭-大眼泡泡鱼

im flylian之千万个

im DavidZ)在你身上

----->ip:ftp://oooo.r

Charlie

Dexter.吴宇.胡

farrahnaz

Haihui

表情符號 (Emoticon = Emotion icons)

符號	意思	符號	意思
ｏ-_-)０)。０)	給你一拳~~	m(_ _)m	萬事拜託(跪地，嗑頭)
(/_\)	看不到~眼睛被手擄住了	|(- _-)|	沒聽到~耳朵遮住了
(⊙０⊙)	目瞪口呆	⊙.⊙	睜大眼
\(^ 0^)/	舉手歡呼	－　－||||	無奈
?~?	疑問、疑問	(T_T)	
ＱＱ	流淚	Ｑ０Ｑ	
〒△〒	哭	T△T	
U／／／U	臉紅紅～	≧◇≦	
╮(－_－)╭	兩手一攤~	＝　＝#	
= 3 =	嘟嘴(	(－_－)y--~~	
(/｀Ⅲ´)/	抓你來咬!!!	(Q o Q) b	
\(^_^)/	拿彩球、爲你加油~	(#｀´)	
(>_<)	小生氣	_/#	
(*^ · ^*)	親一個!!!	\(@^０^@)/★	晚安~~
(>﹏<)	不!!!!!!!!!!!11	(*+﹏+*)~@	受不了~受不了
｀(*∩_∩*)´	獻上最可愛的笑容	(x_x)	昏倒
........\(><)/	哇!!出現了!!	= =b	冒冷汗
^ ^"	笑笑的無奈	(－_－) z Z	睡著了啦～
－▽－ y	耶！	∪__∪	恩恩～
((。(^_^)。))	期待、期待	<(｀▽´)>	哈哈哈~~(我是壞人~)
"(/><)/	阿達~~	(>c<)	唉唉叫~

:-) 微笑。
:-(不悅。
;-) 使眼色。
:-D 開心。
:-P 吐舌頭。
:-C 很悲傷。
:-O 驚訝, 張大口。
:-/ 懷疑。
（︶︿︶） 不滿

Context-aware Instant Messenger

- ***Exploit the usage of IM on mobile devices in future pervasive communication:***
- ***Pervasiveness: 4 "A"s:***
  - ***Anytime, Anywhere,* on *Any devices, for Any Applications***
- ***Deep (context) awareness:***
  - Know ***when***, ***where***, and ***how*** to communicate.
- ***Buddy-like conversation***
  - among **"Anything".**
  - with familiar interface

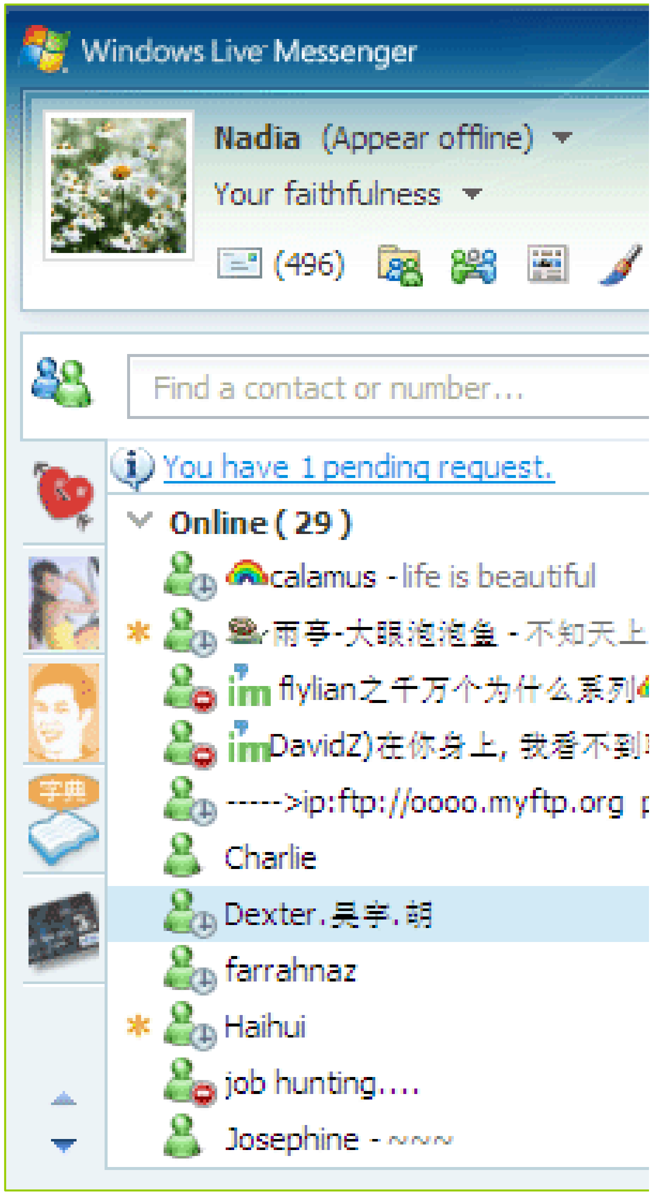
	P	D	S	O
P	✓	✓	✓	✓
D	✓	✓	✓	✓
S	✓	✓	✓	✓
O	✓	✓	✓	✓

P – Person
D – Device
S – Software
O – Other entities

Pushing IM into Pervasive Computing Environments

Current Desktop IM

- “Presence cues” could be
  - 在線, 離線 (Log in or not),忙碌 Busy,馬上回來Away, keyboard activity,開心?..
  - 狀態更新: Usually manual input status & custom text
- What’s the problem ?
  - Limited : not rich presence
  - Static: don’t change very often
  - Fixed: once set, same display on all buddies’ IM.



Windows Live Messenger

Nadia (Appear offline)

Your faithfulness

(496)

Find a contact or number…

You have 1 pending request.

Online (29)

calamus - life is beautiful

雨亭-大眼泡泡鱼 - 不知天上

flylian之千万个为什么系列

DavidZ)在你身上, 我看不到

------>ip:ftp://oooo.myftp.org

Charlie

Dexter.吴宇.胡

farrahnaz

Haihui

job hunting....

Josephine - ~~~~

Mobile Instant Messenger

- When it comes to mobile situation :
  - User's status changes more frequently
    - location, activity, environment, etc
  - Since user's moving, they only want to pay minimum effort to update mobile presence.
- Existing MIM
  - merely a "slim" version (with similar functions) of their Desktop one
    - e.g., MSN mobile, Agile Messenger, QuickIM, IM+ All-in-One Mobile Messenger

Context-Aware MIM for PvC

- **Everything as your buddy and can be communicated using real-time message exchange**
- **Three main features**
  - **Context-aware (情境感知的) presence management**
    - **Context (情境,上下文) as presence**
    - **Different buddies see different status**
  - **Dynamic grouping (Buddies management at IM client)**
    - **Location-based Grouping ("buddy discovery")**
    - **Activity-based Grouping ("task centric")**
  - **Resource buddy services**
    - **extend the concept of "buddies" to all software and hardware components in your working space**
    - **IM as the unified communication interface**
    - **Buddy understands your dialect**

Issues on Mobile Presence

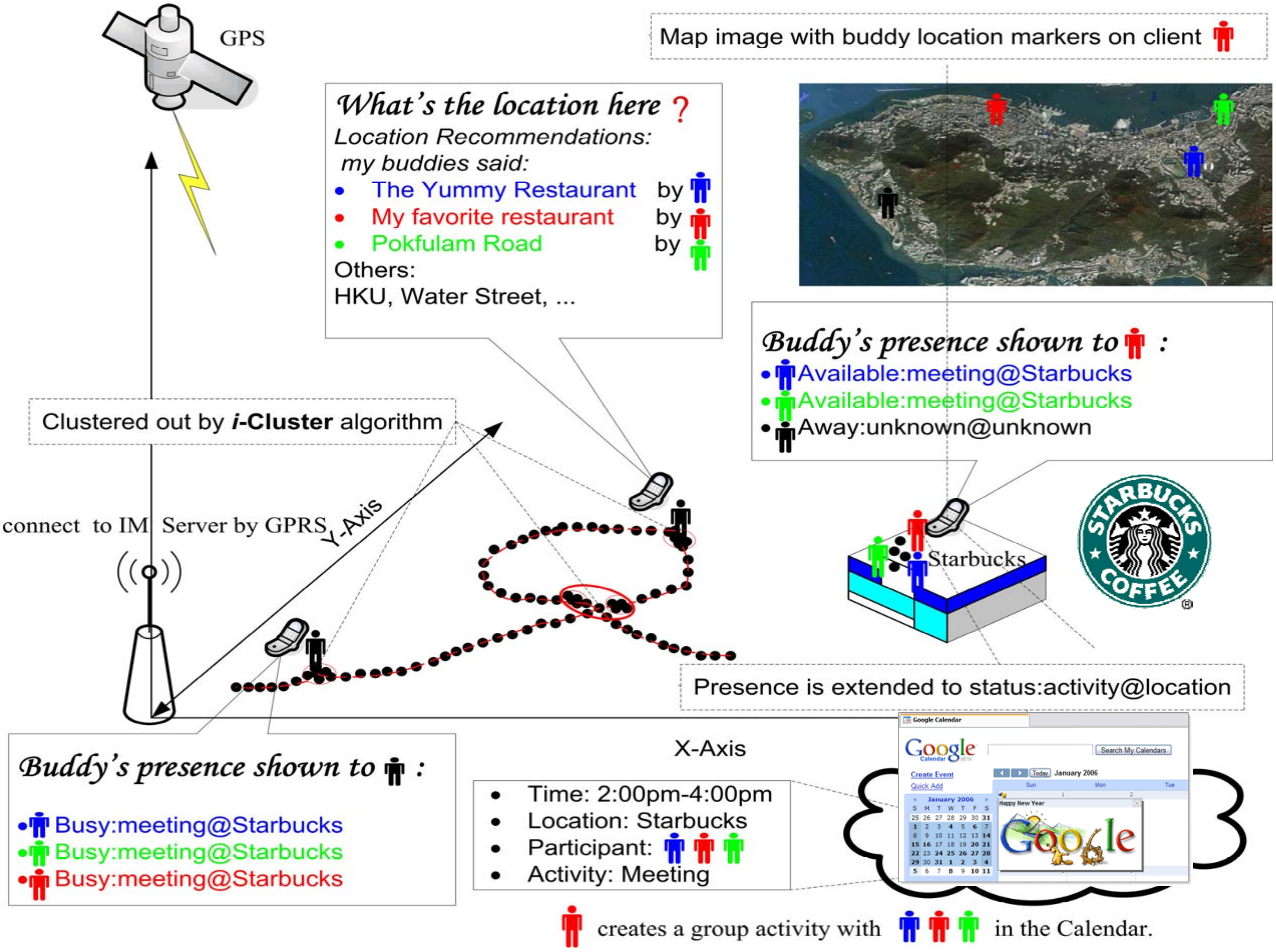
- How to interpret the raw location data (stream of GPS coordinates 座標) to symbolic, human-readable annotations -- “significant location”?
  - Mobile phone has limited computing power and small memory
  - Call for lightweight location extraction algorithm
- With location info, how to enhance the richness of presence status?

Mobile Presence in our MIM

- Presence is extended to

Status: activity @location

  - Location:
    - i-Cluster: GPS-based, extraction of "significant locations"
    - "Cooperative Geo Tagging" (place annotation)
    - Support Google Maps (no pre-installed map needed)
  - Status:
    - Availability and willingness for communication based on the current activity and buddy relationship.
  - Activity :
    - Based on registered calendar information
    - Google Calendar



What's the location here ?
Location Recommendations:
my buddies said:

- The Yummy Restaurant by 🧍
- My favorite restaurant by 🧍
- Pokfulam Road by 🧍

Others:
HKU, Water Street, ...

Clustered out by ***i*-Cluster** algorithm

Buddy's presence shown to 🧍 :

- 🧍Available:meeting@Starbucks
- 🧍Available:meeting@Starbucks
- 🧍Away:unknown@unknown

Presence is extended to status:activity@location

Buddy's presence shown to 🧍 :

- 🧍Busy:meeting@Starbucks
- 🧍Busy:meeting@Starbucks
- 🧍Busy:meeting@Starbucks

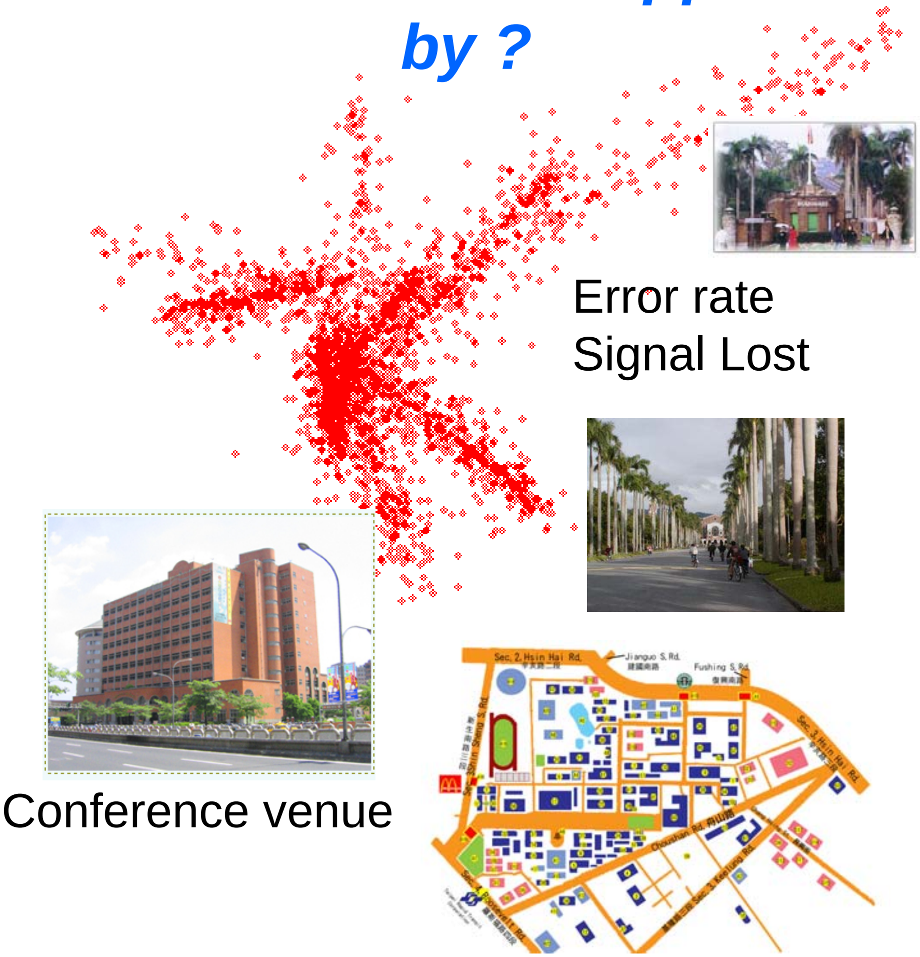
- Time: 2:00pm-4:00pm
- Location: Starbucks
- Participant: 🧍 🧍 🧍
- Activity: Meeting

🧍 creates a group activity with 🧍 🧍 🧍 in the Calendar.

(1) GPS-based Location Extraction

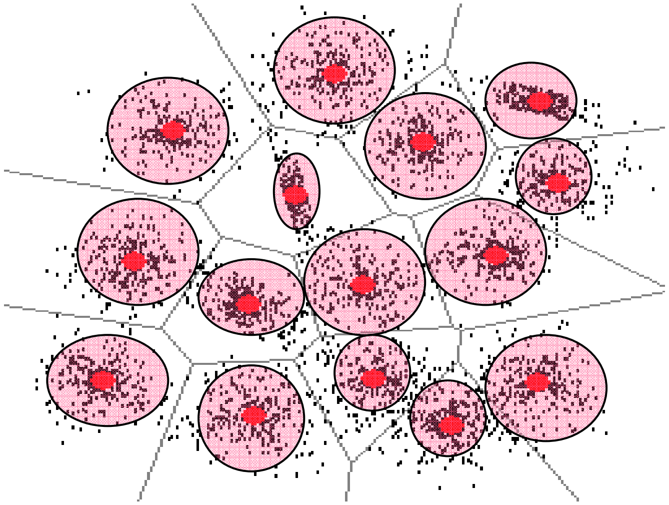
Raw GPD Data Points:

Where have I stopped by ?



Error rate
Signal Lost

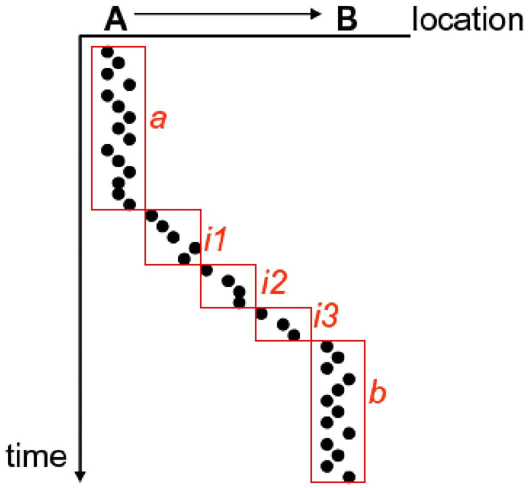
Conference venue



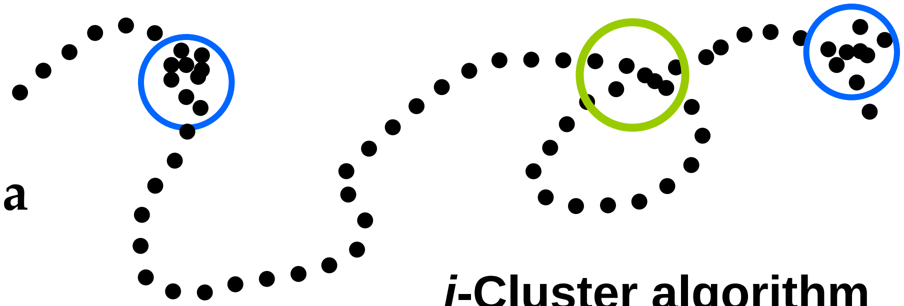
Traditional approach ➔ View location extraction problem as that for ***identifying densely clustered regions*** – high time and space complexity

i-Cluster algorithm

- Time-based Clustering [Kang:2004]
  - clusters the locations along the time axis (only recent coordinates within some time)
  - Sought only location visit that has a *recognizable duration*
- *i*-Cluster algorithm
  - We consider places *revisited shortly*
    - Entrance of a parking lot
    - Junctions of street
    - Shortly come back due to a disrupted task



Time-based Clustering



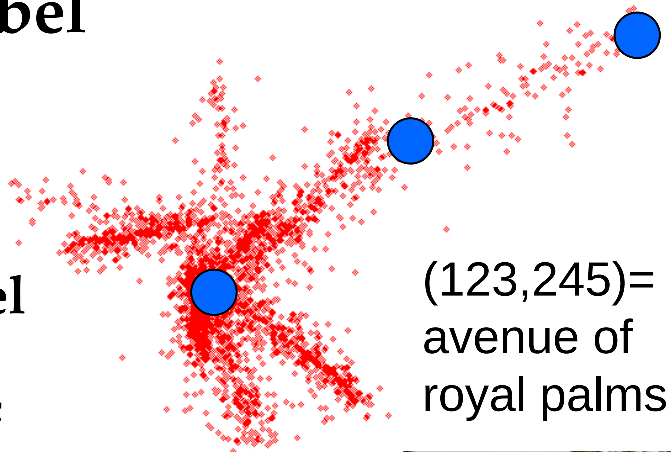
i-Cluster algorithm

(2) Cooperative Location Annotation: Geo Tagging

- From the raw location data to symbolic, human-readable annotations by selecting a place label recommendation created by their buddies based on
  - Location proximity : distance
  - Hit number : how many time this label used by others
  - Subjective : depend on user's focus of interest (e.g., current activity) on the spot

1. Gis Convention Center (23)
2. GCC/NTU (14)
3. EUC venue (8)
4. No.85, Roosevelt Road, Sec. 4 (5)
5. MRT KungGua Station (3)

(103,285)= "NTU Main Gate"



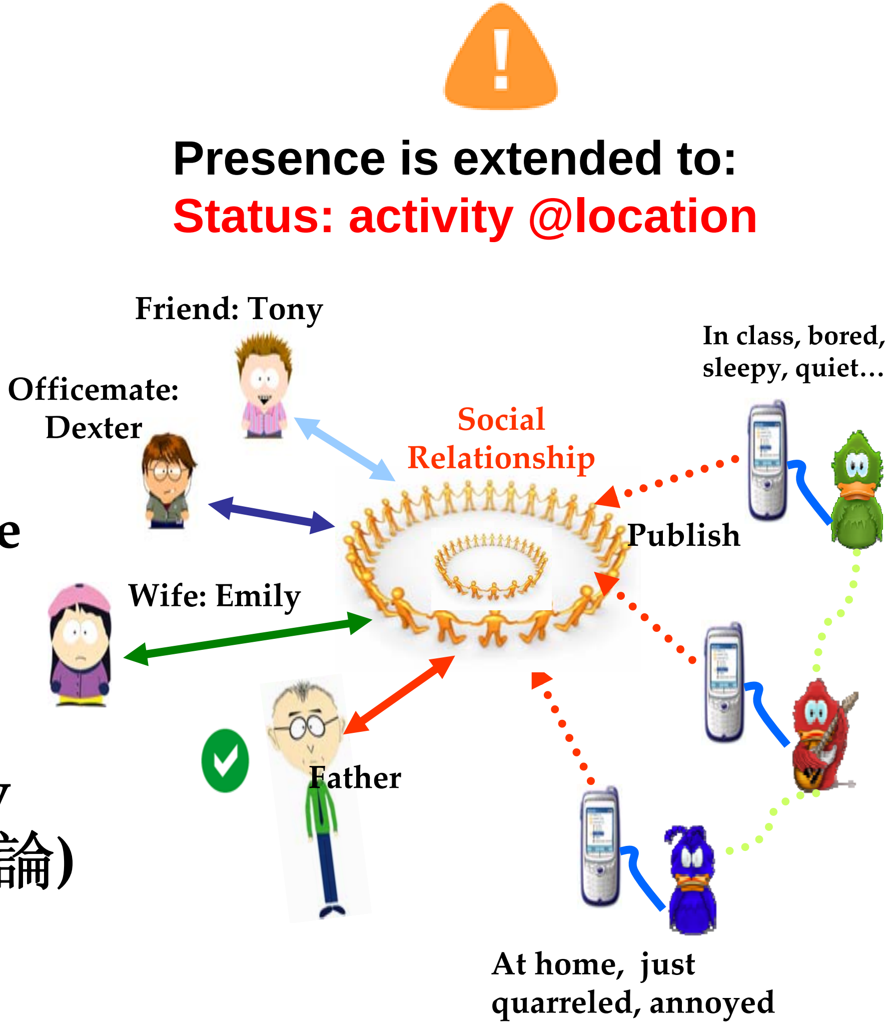
(123,245)= avenue of royal palms

(143,115)= Gis Convention Center

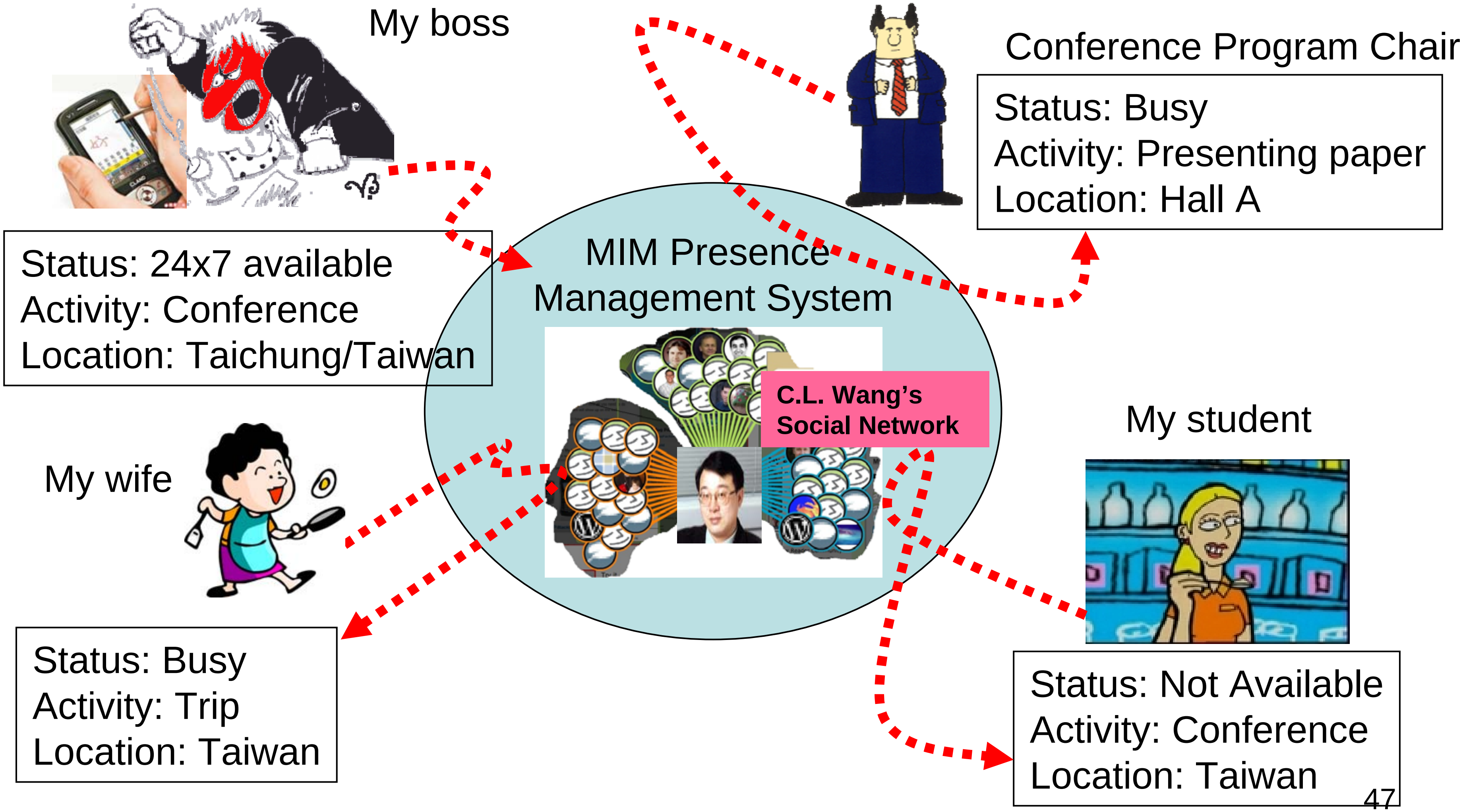
(3) Context-aware presence management

- How your current status is displayed in your buddies' IM ?
  - Different presence status is shown depending on your current location, activity & the social relationship between YOU and your buddy
- Produce customized presence to different buddy based on an Ontology(本體論) -based reasoning engine

Presence is extended to:
Status: activity @location



Example: C.L. Wang's Current Presence Display at his Buddy's IM client



My boss

Status: 24x7 available
Activity: Conference
Location: Taichung/Taiwan

Conference Program Chair

Status: Busy
Activity: Presenting paper
Location: Hall A

MIM Presence Management System

C.L. Wang's Social Network

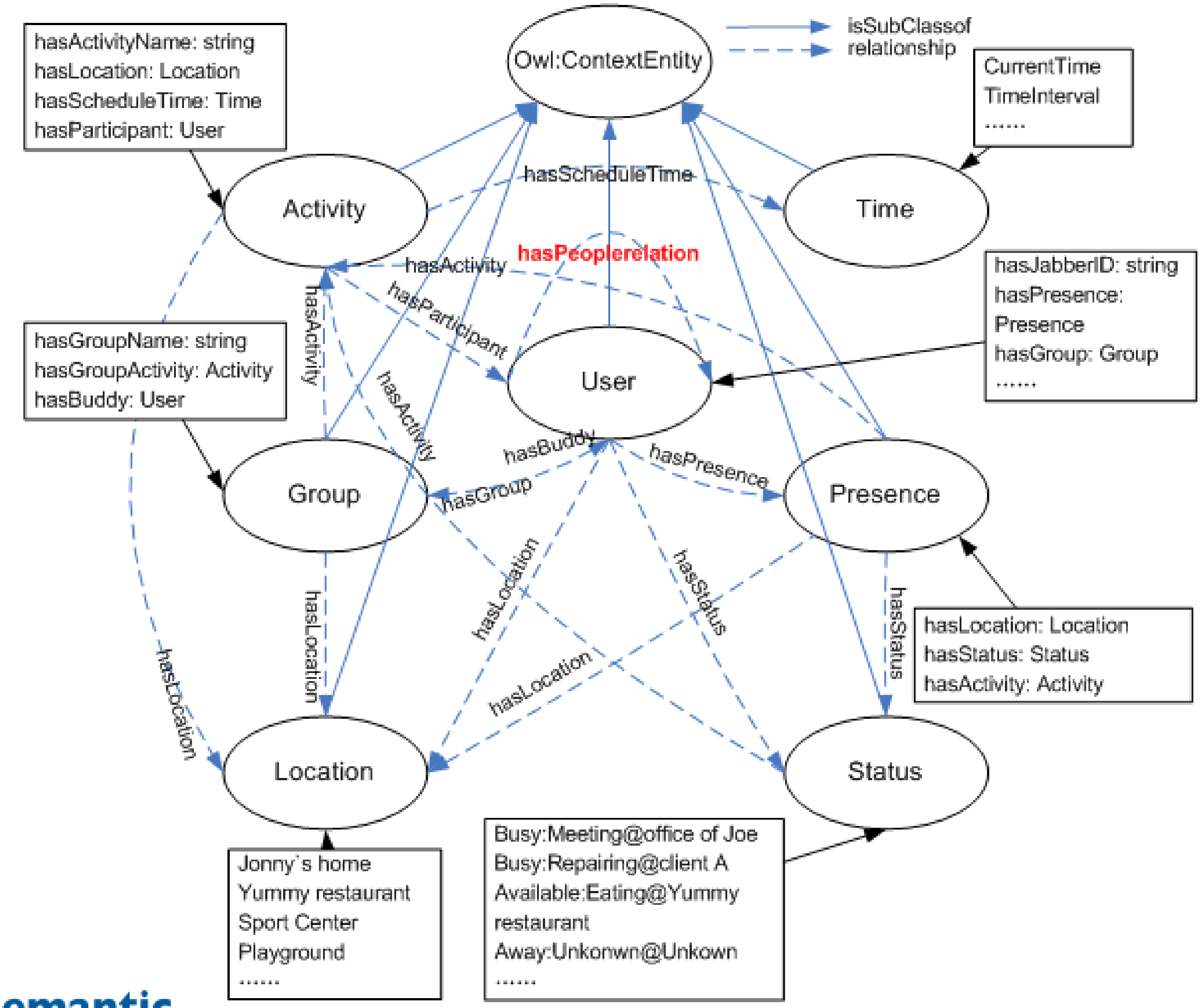
My wife

Status: Busy
Activity: Trip
Location: Taiwan

My student

Status: Not Available
Activity: Conference
Location: Taiwan

Presence Ontology



hasActivityName: string
hasLocation: Location
hasScheduleTime: Time
hasParticipant: User

CurrentTime
TimeInterval
......

hasJabberID: string
hasPresence:
Presence
hasGroup: Group
......

hasGroupName: string
hasGroupActivity: Activity
hasBuddy: User

hasLocation: Location
hasStatus: Status
hasActivity: Activity

Jonny`s home
Yummy restaurant
Sport Center
Playground
......

Busy:Meeting@office of Joe
Busy:Repairing@client A
Available:Eating@Yummy
restaurant
Away:Unkonwn@Unkown
......

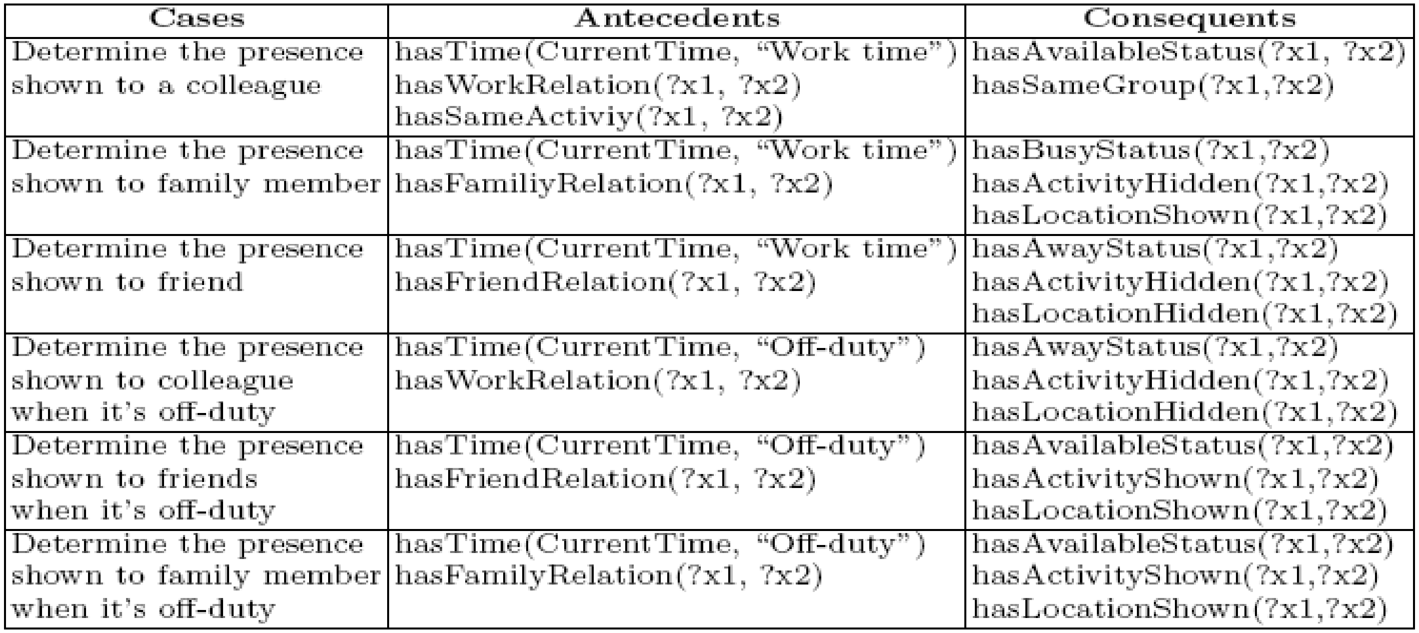
W3C Semantic Web

語義網(Semantic Web)

Language used: Web Ontology Language (OWL)

Reasoning rules for customized presence

- Using Jena Semantic Web Framework
- Reasoning Rules (examples)



Cases	Antecedents	Consequents

Determine the presence shown to a colleague	hasTime(CurrentTime, "Work time")
	hasWorkRelation(?x1, ?x2)
	hasSameActiviy(?x1, ?x2)
		hasAvailableStatus(?x1, ?x2)
		hasSameGroup(?x1,?x2)

Determine the presence shown to family member	hasTime(CurrentTime, "Work time")
	hasFamiliyRelation(?x1, ?x2)
		hasBusyStatus(?x1,?x2)
		hasActivityHidden(?x1,?x2)
		hasLocationShown(?x1,?x2)

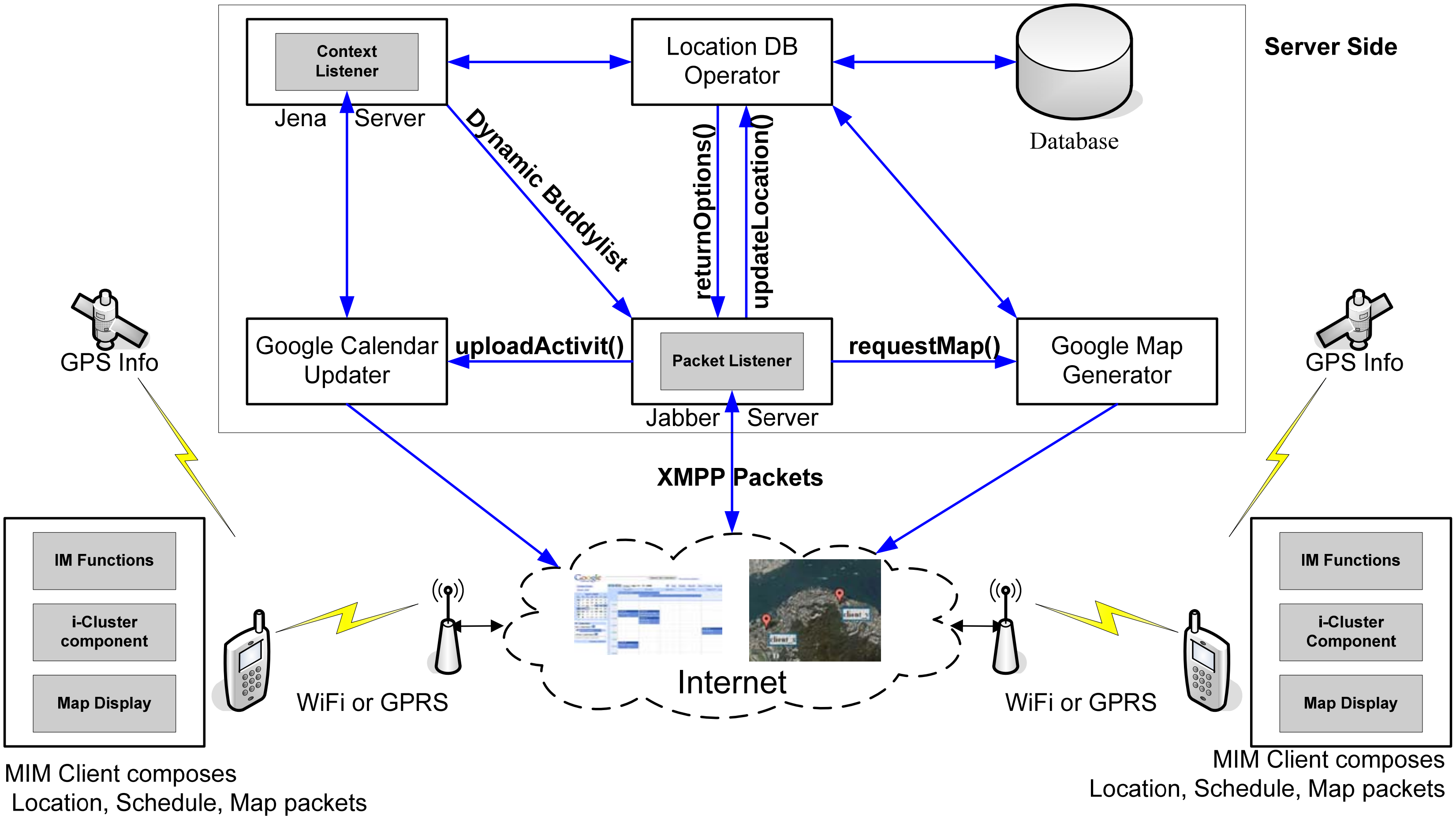
Determine the presence shown to friend	hasTime(CurrentTime, "Work time")
	hasFriendRelation(?x1, ?x2)
		hasAwayStatus(?x1,?x2)
		hasActivityHidden(?x1,?x2)
		hasLocationHidden(?x1,?x2)

Determine the presence shown to colleague when it's off-duty	hasTime(CurrentTime, "Off-duty")
	hasWorkRelation(?x1, ?x2)
		hasAwayStatus(?x1,?x2)
		hasActivityHidden(?x1,?x2)
		hasLocationHidden(?x1,?x2)

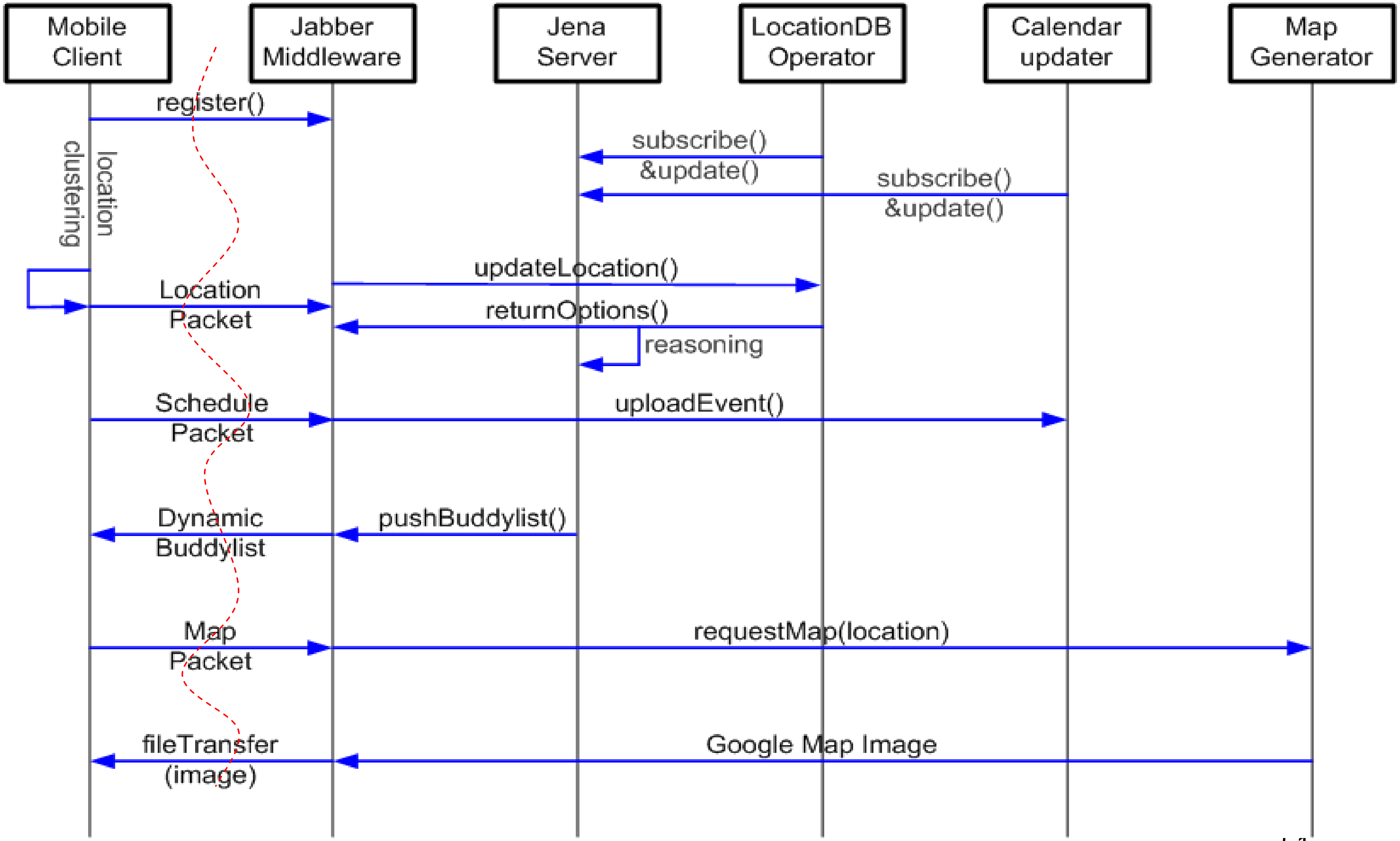
Determine the presence shown to friends when it's off-duty	hasTime(CurrentTime, "Off-duty")
	hasFriendRelation(?x1, ?x2)
		hasAvailableStatus(?x1,?x2)
		hasActivityShown(?x1,?x2)
		hasLocationShown(?x1,?x2)

Determine the presence shown to family member when it's off-duty	hasTime(CurrentTime, "Off-duty")
	hasFamilyRelation(?x1, ?x2)
		hasAvailableStatus(?x1,?x2)
		hasActivityShown(?x1,?x2)
		hasLocationShown(?x1,?x2)

MIM System Implementation



Communication Sequence Diagram

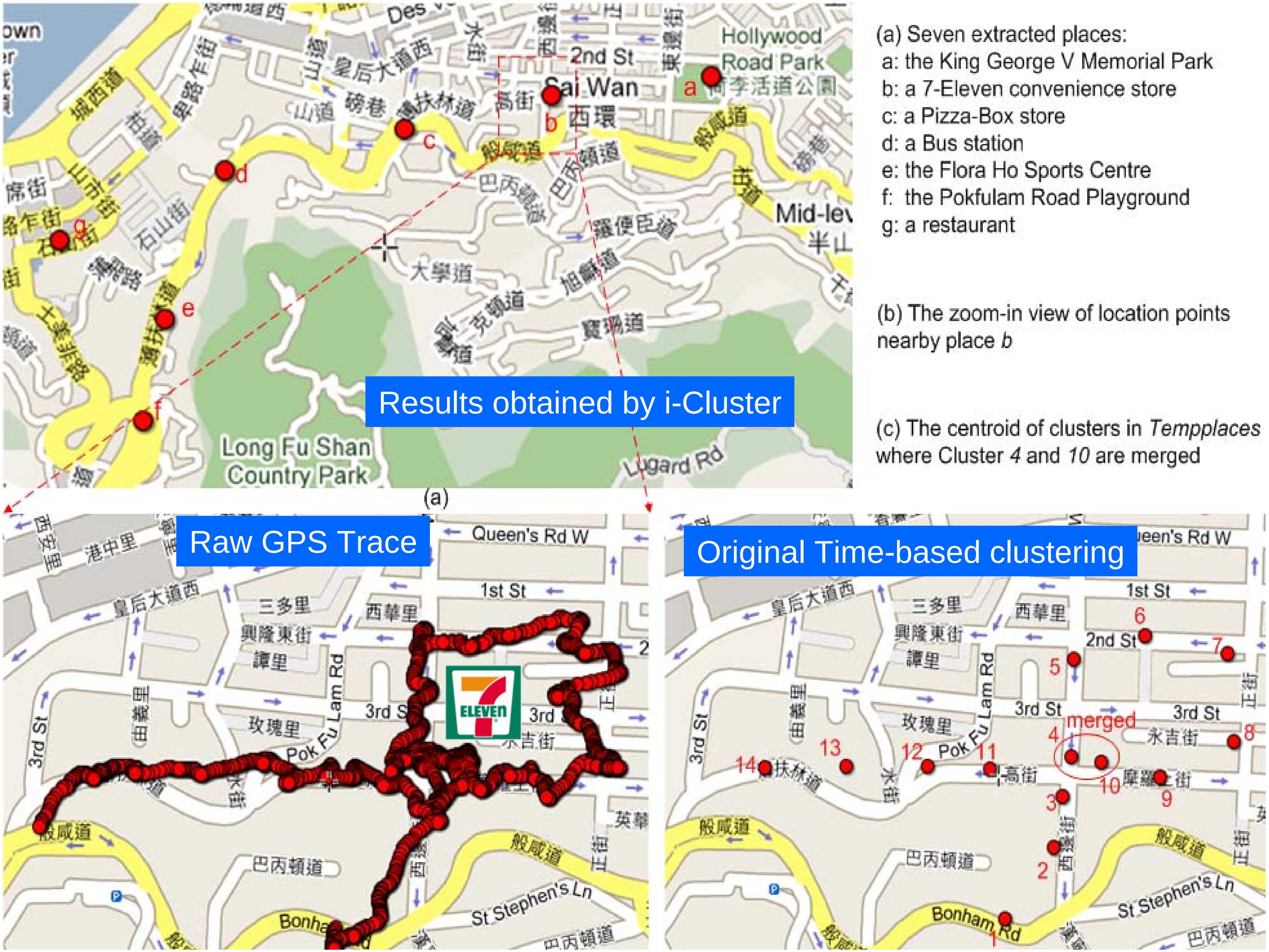


Implementation Details

- MIM client
    - **Hardware:**
        - **C720W Smartphone, (New: Nokia N73)**
        - **GPS receiver : Holux GPSlim236 with Bluetooth connection**
    - **Software:**
        - J2ME, Windows Mobile 5.0 Operating System, based on *moJab*
    - **Code size:**
        - ~1.1 MB without GPS data (source code 196KB).

Evaluation

- Parameter setting
  - d = 40 meters
  - t = 300 seconds
  - t_{intv} = 1200 seconds
  - l = 60. (1 min history samples)
- The values of d and t are determined according to the knee point in [3].
- 9373 GPS data points in 2.6 hours



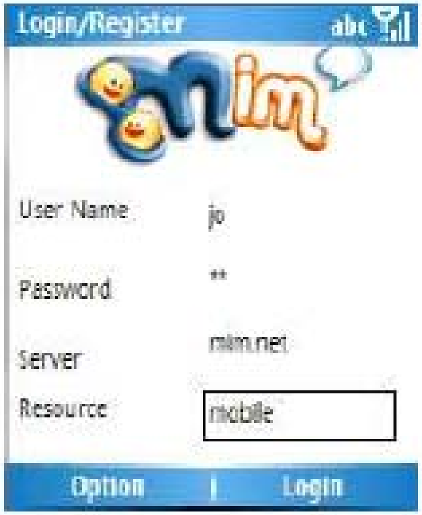
(a) Seven extracted places:
a: the King George V Memorial Park
b: a 7-Eleven convenience store
c: a Pizza-Box store
d: a Bus station
e: the Flora Ho Sports Centre
f: the Pokfulam Road Playground
g: a restaurant

(b) The zoom-in view of location points nearby place *b*

(c) The centroid of clusters in *Tempplaces* where Cluster *4* and *10* are merged

Snapshots

Snapshots generated by emulator



Login/Register

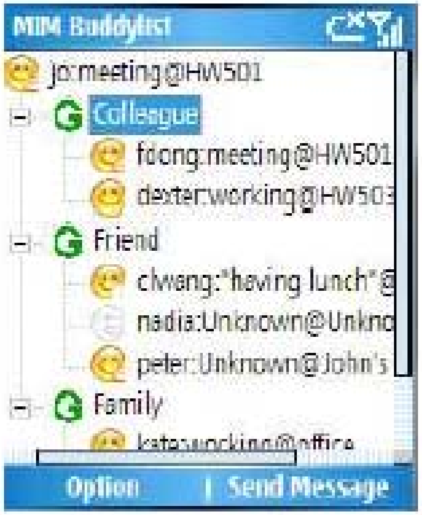
User Name: jo

Password: **

Server: mim.net

Resource: mobile

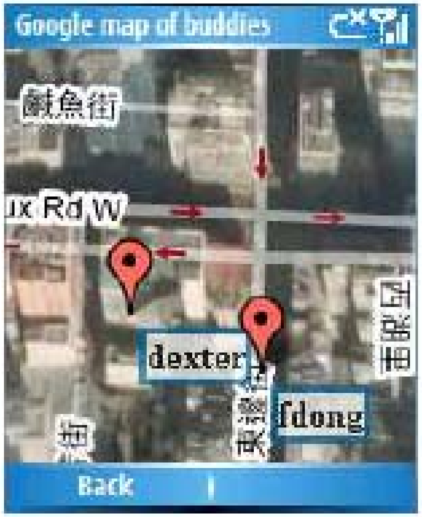
(a) MIM Login GUI



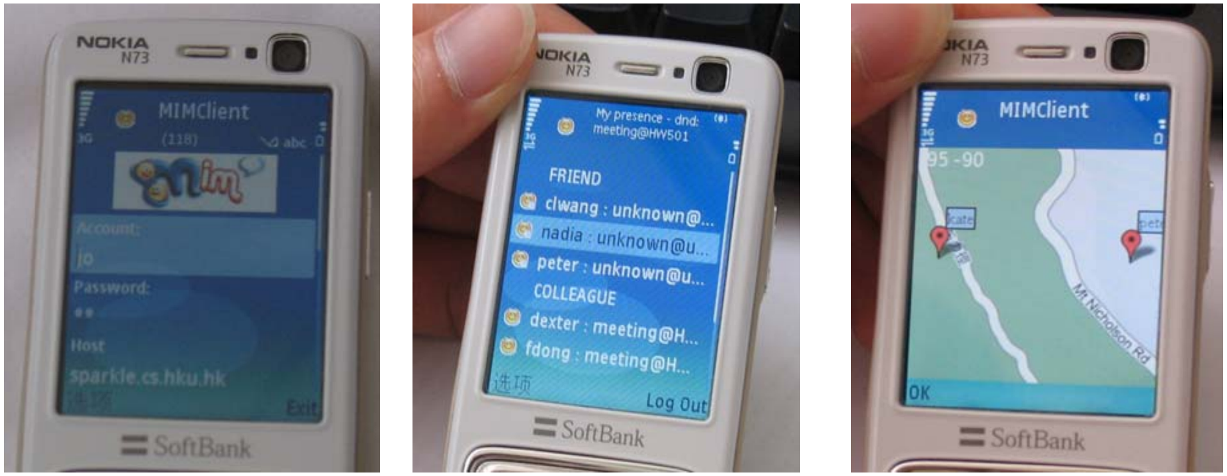
MIM Buddylist

- jo:meeting@HW501
  - Colleague
    - fdong:meeting@HW501
    - dexter:working@HW503
  - Friend
    - clwang:"having lunch"@
    - nadia:Unknown@Unkno
    - peter:Unknown@John's
  - Family
    - kate:working@office

(b) Buddylist of Jo



(c)Map with buddy locations



MIMClient

Account: jo

Password: **

Host: sparkle.cs.hku.hk

My presence - dnd: meeting@HW501

FRIEND

- clwang : unknown@...
- nadia : unknown@u...
- peter : unknown@u...

COLLEAGUE

- dexter : meeting@H...
- fdong : meeting@H...

MIM on Nokia N73

Demo

- MIM Demo
- http://sparkle.cs.hku.hk/wiki/index.php/Project

Conclusion and Outlook

- MIM
  - GPS-based location extraction
  - Cooperative place annotation
  - Context-awareness presence management
- Future work
  - More efficient and accurate clustering algorithm
  - Integration with indoor location service
  - Incorporate more presence cues (IM contents)
  - Use more public Web services

Thank You!

Q&A

More in

http://www.cs.hku.hk/~clwang/projects/SIM.htm