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Research



Microsoft Research Asia **Faculty Summit 2012**



EVOLUTION TO 5G WIRELESS WITH MOBILE CLOUD APPLICATIONS

AN EFFICIENT MEET-UP MECHANISM BY MASHING-UP SOCIAL AND MOBILE CLOUDS

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Generation Aspect of Cellular Mobile Systems

2G

GSM



14.4Kbps

3G

WCDMA



2Mbps

3.5G

HSPA



14.4Mbps

4G

LTE/LTE-

A

*Unlimited
Possibility*

~1Gbps

HSPA: High Speed Packet Access

LTE: Long Term Evolution

Key Features of IMT-Advanced

- user equipment suitable for worldwide use;
- worldwide roaming capability;
- user-friendly applications, services and equipment;
- enhanced peak data rates to support advanced services and applications (100 Mbit/s for high and 1 Gbit/s for low mobility were established as targets for research).



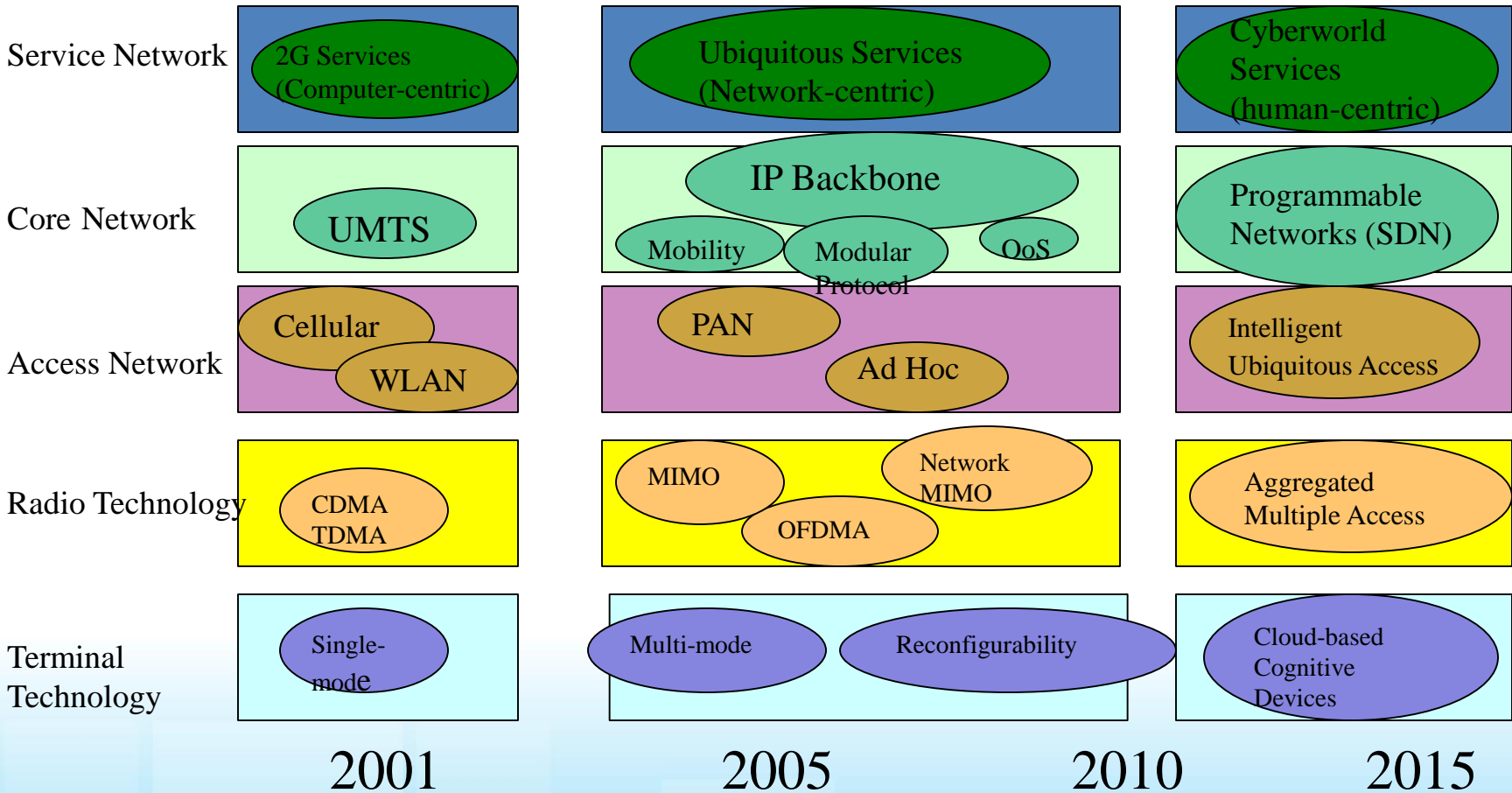
Key Features of IMT -Advanced

- a high degree of commonality of functionality worldwide while retaining the flexibility to support a wide range of services and applications in a cost efficient manner;
- **compatibility of services within IMT and with fixed networks;**
- **capability of interworking with other radio access systems;**
- high quality mobile services;

Note: IMT = International Mobile Telecommunications

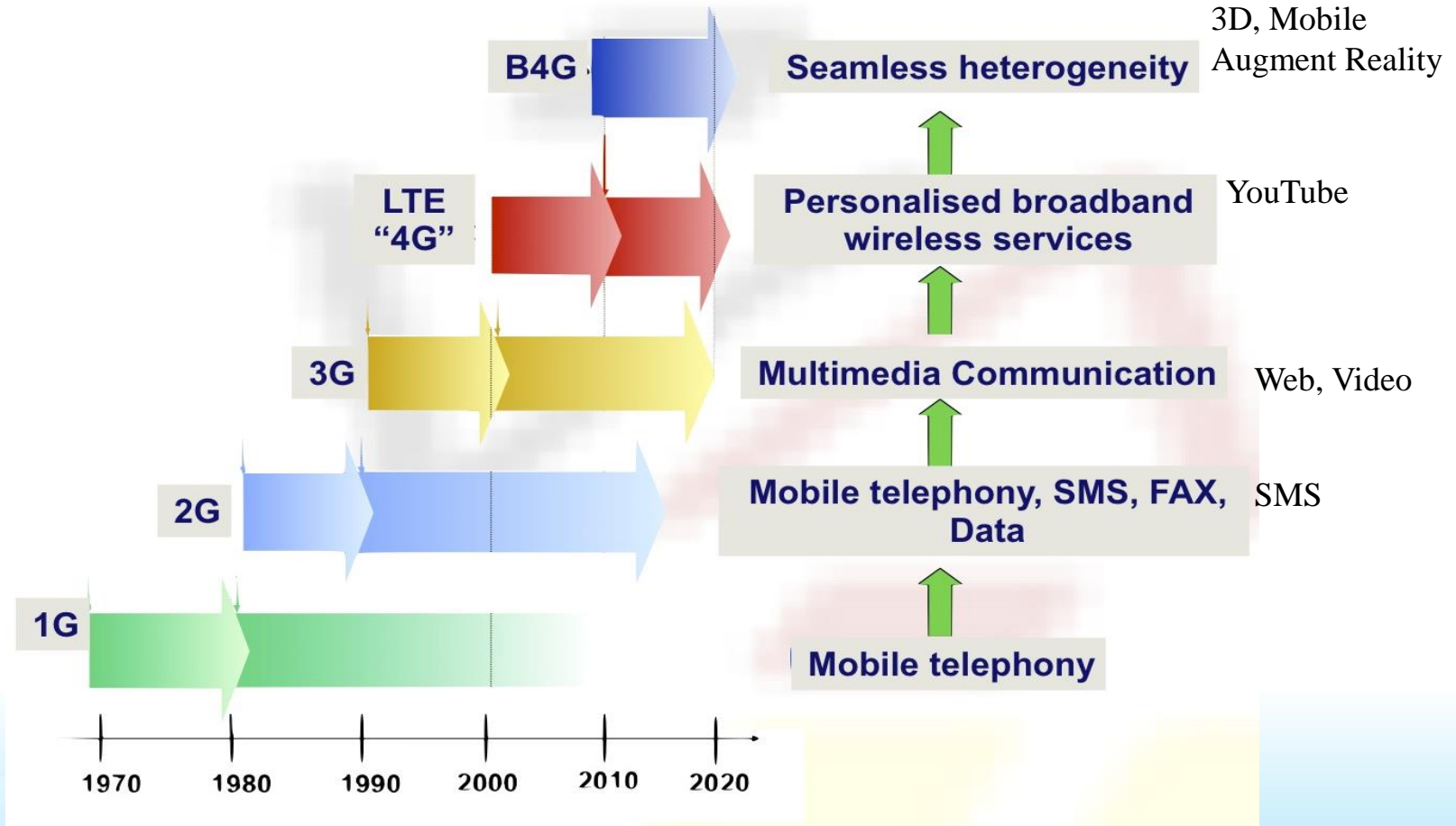


Drivers of 5G Wireless





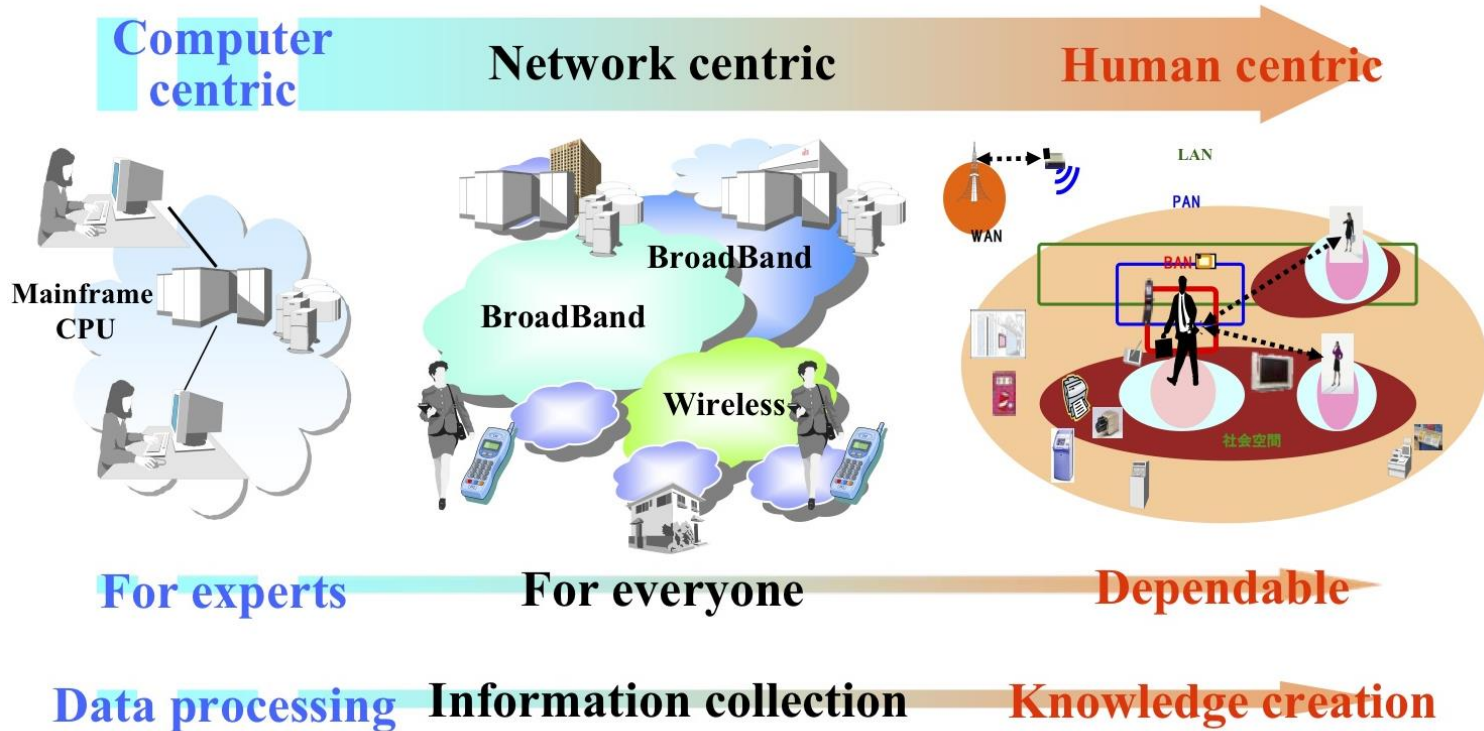
Applications for 5G





Service Aspect for 5G Wireless

■ Toward a human centric system



What is human centric service?

Adapted to user's environment

- User is supported in an unconscious manner

Dependable system

- operates on a non-stop basis
- System provides high security

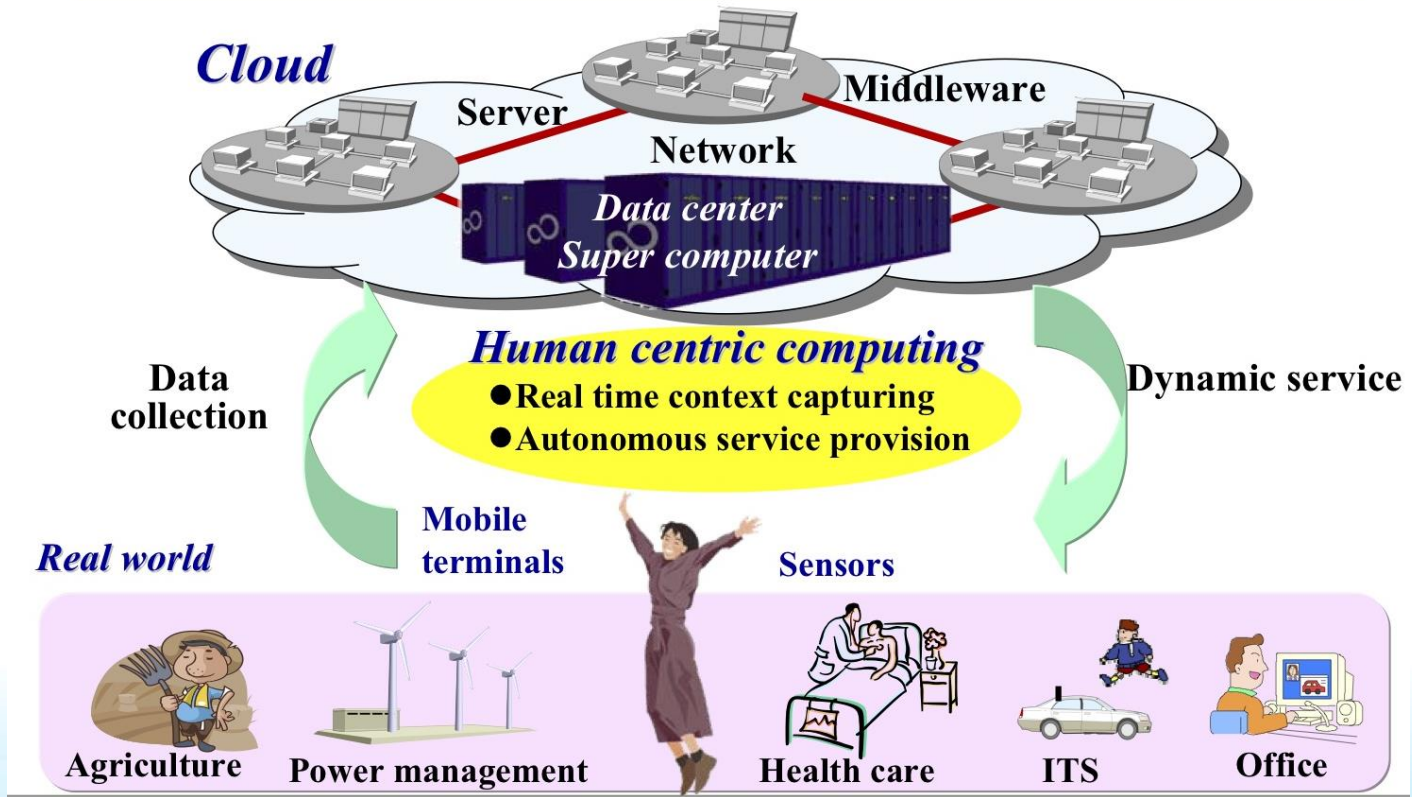
Knowledge creation

- Create useful knowledge from abundant information



Intelligent Human Centric Society

New value creation through a human centric system



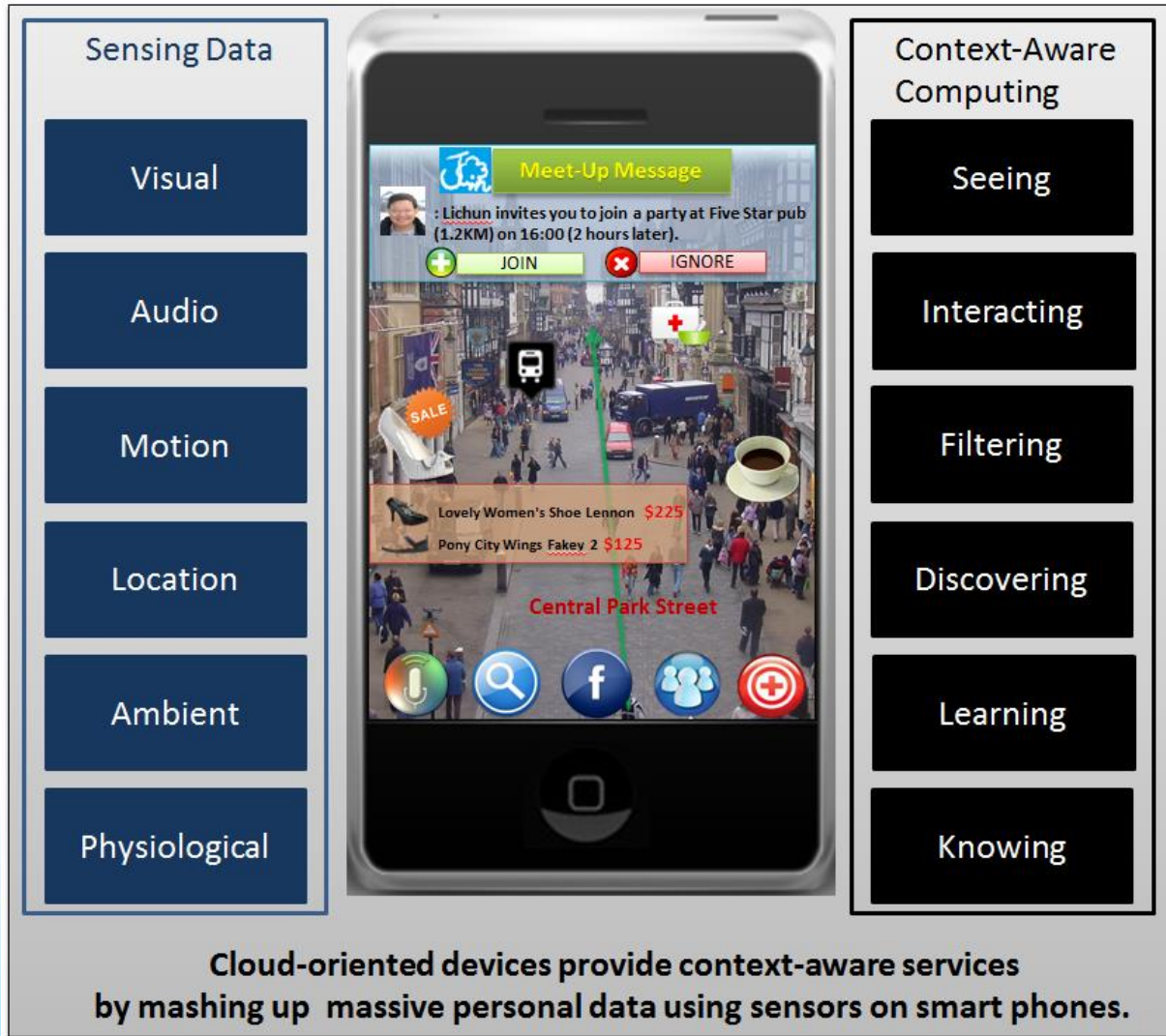


Terminal Aspect for 5G Wireless

- 2001
 - Single-mode
- 2005
 - Multi-mode
 - Open architecture
- 2010
 - Reconfigurability
 - Cognitive Radio or more?



Future Multiple-Sense Mobile Device



Massive scale computation (billion of simultaneous transactions) needed to mash up personal data, preference, real-world data, and device capability.

Current Applications of Sensors in Smart Phones

- **Motion** and **proximity** sensors
 - detects the movement of the phone to your ear
 - automatically goes into speech recognition mode.
- **Microphone**
- Search databases + speech recognition database
 - the most frequent search terms in its database.
- **Location** sensors
 - A search for "pizza" returns the result you most likely want: the name, location, and contact information for the three nearest pizza restaurants.





Mobile Augmented Reality

- [Wikitude](#): travel guide application for Android
 - Point the phone's **camera** at a point of interest
 - **GPS** to superimpose distances to points of interest
 - **Compass** to keep track of where you're looking
 - The application looks up what it sees in its online database



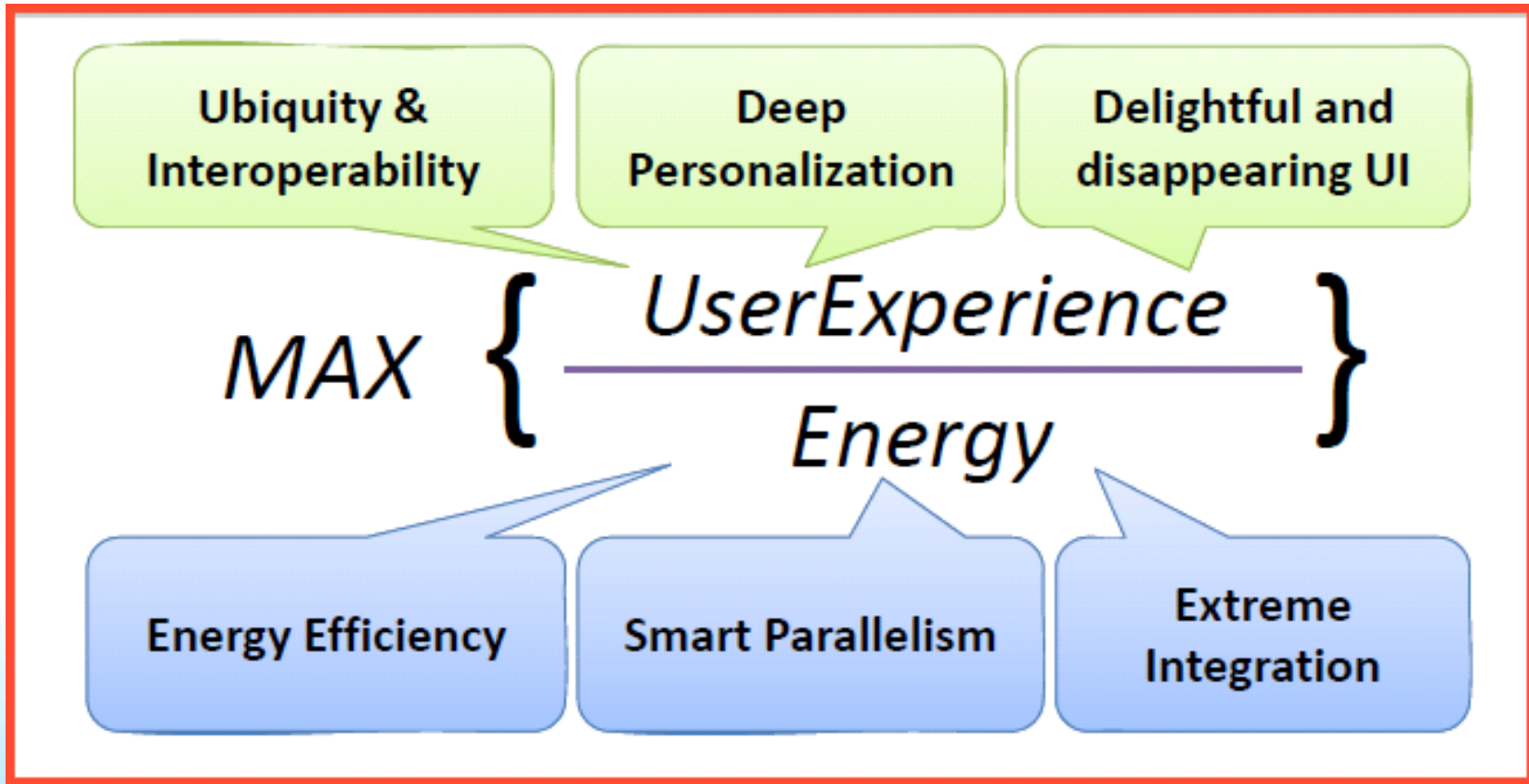


MAR for Hearing-Impaired





Challenges and Opportunities for Smart Phones





Potentials of sensor-enabled smart phones have **Not** exploited yet!

- Smart Connectivity

- Connecting to heterogeneous wireless networks, 4G/B4G, WiFi, WiMAX, Bluetooth, NFC

- Smart Computing: context aware and low power

- **Visual:** cameras
- **Audio:** microphone, microphone array
- **Multi-touch**
- **Location:** GPS, compass
- **Motion:** accelerometers, proximity sensors
- **Ambient:** light, thermometers, humidity, pressure
- **Physiological:** temperature, galvanic skin response (GSR), pulse, respiration
- **Chemical:** electronic nose, electronic tongue

- Output
 - **Visual:** HD display, pico-projectors
 - **Audio:** speakers
 - **Vibrator**
 - ...



What is the role of Smart Phones in cloud computing?

- Smartphones = gateway to the cloud, and the bridge of sensors



Are Current Smart Phones Smart Enough?

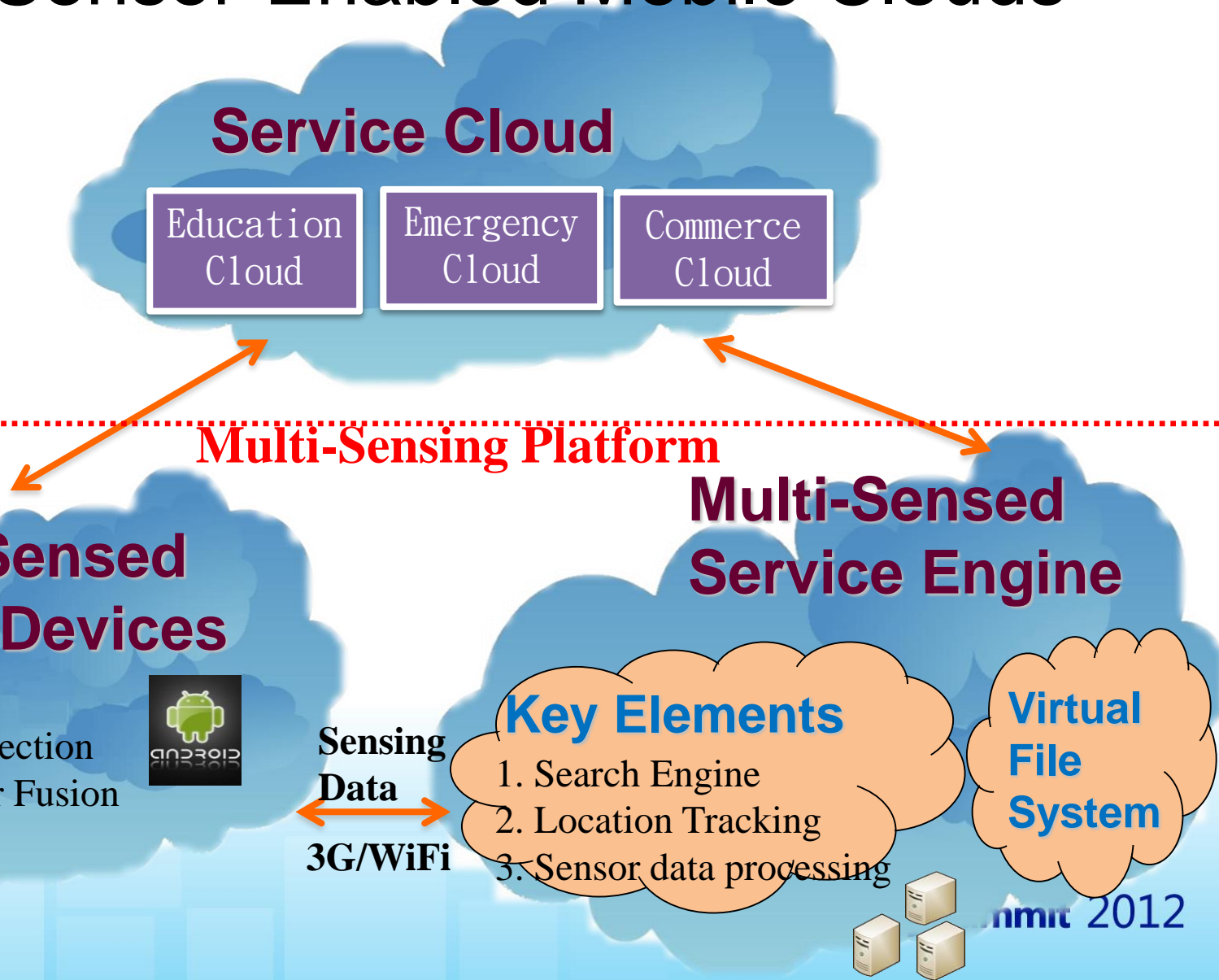
- **No!**
- **Challenges:**
 - APIs of sensors of current mobile phones are different and not standardized.
 - There is a gap between PaaS and SaaS . Programmers cannot easily use PaaS to develop new mobile applications
- A set of standardized APIs for multi-sensing platform is needed to create new cloud applications for smart phones.
- Domain-specific Platform as a Service (aPaaS) is needed.



Se-So-Mo-Lo (思索摸路) Project in NCTU

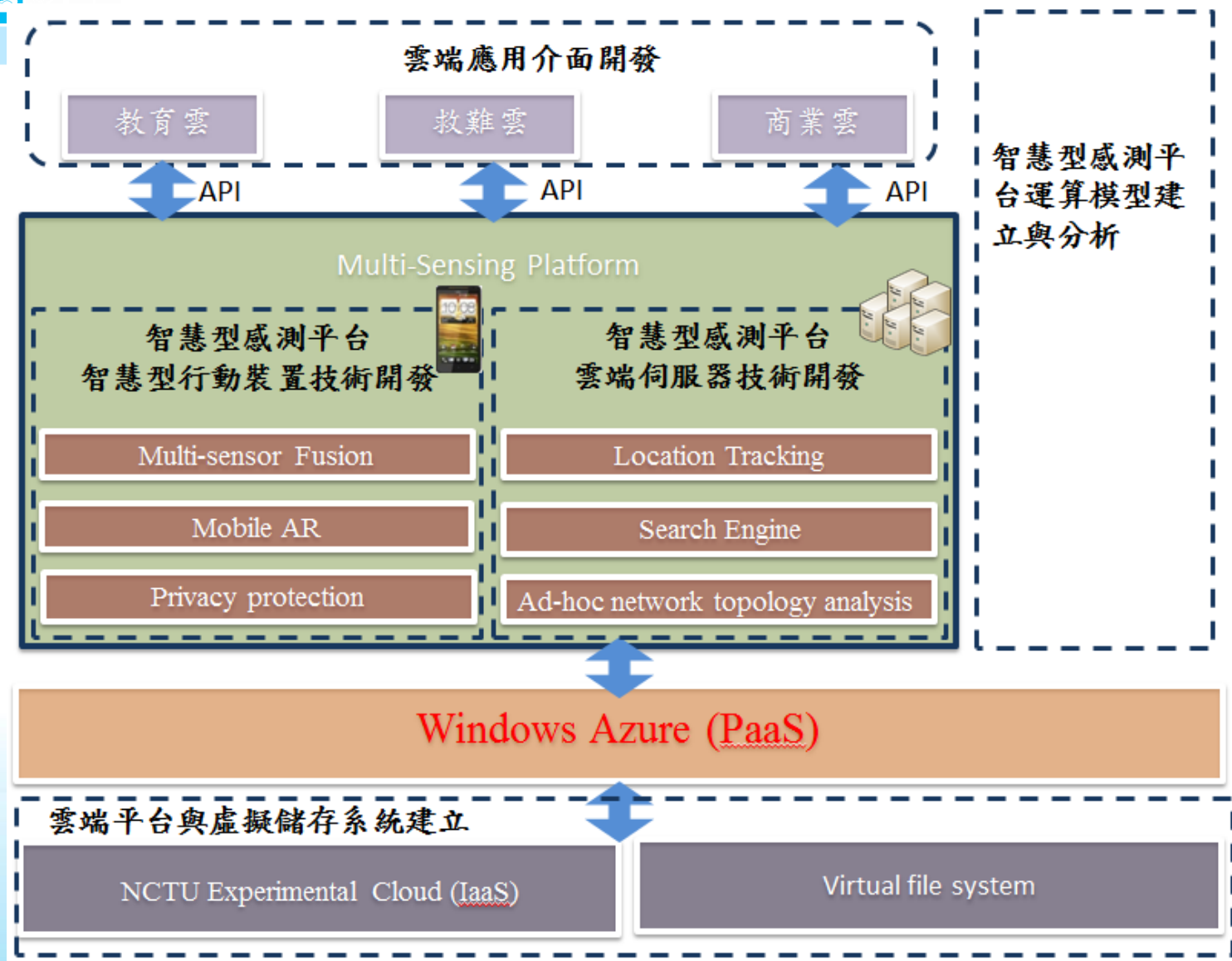
- Integrate Sensor + Social + Mobile + Local
- To provide human centric services from on-line to off-line

Sensor-Enabled Mobile Clouds





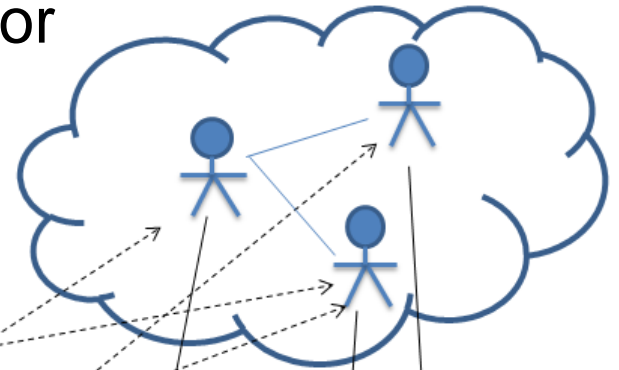
dPaaS in Sensor-Enabled Mobile Clouds



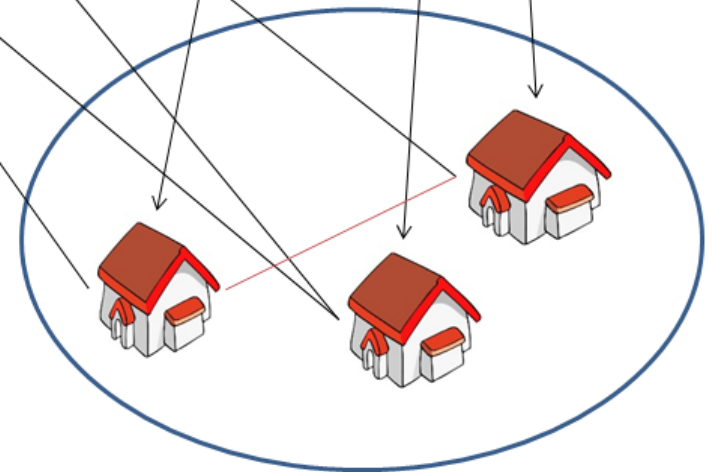
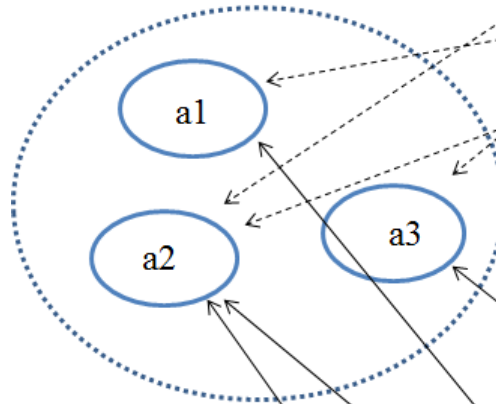
Multi-Layer Data Mining for Retailer Commerce



Social layer



Virtual attribute layer



Shop layer

- **Social Layer**
 - Purchase behavior analysis for a group of people
- **Attribute Layer**
 - Every transaction of a customer reflect his/her purchase behavior
- **Shop Layer**
 - Recommend related stores to potential customers



JOIN: A mobile social network application



- Objective: Provide immediate and personalized LBS information for a group of users.
- Real-time meet-up activities for a group of mobile users
 - Integrating GPS, cloud computing, smart phone and wireless communications.
 - A on-line LBS service beyond the combination foursquares.com and





Mashup Clouds for Mobile Social Networks

Mobile Networks

Social Networks

Cloud Platforms: Facebook, MSN
 System Components: Community Engine
 Functions: 1. Group Event Announcement
 2. Group Membership

facebook



Internet



GPS
3G/LTE

Mobile Devices

NCTU Cloud Platforms

Cloud Platform: Hyper-v
 System Components: JOIN Engine
 Functions: 1. Mobile User Location Database
 2. Area Interesting Events
 Advertisement
 3. Location-based Group Scheduling
 4. Speech Recognition



WiFi



JOIN Client Architecture



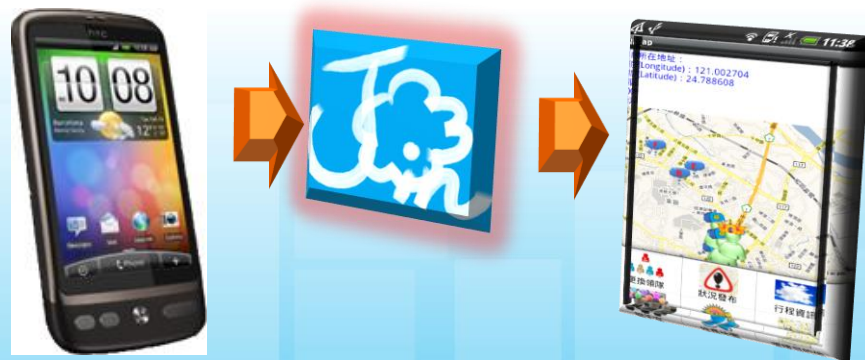
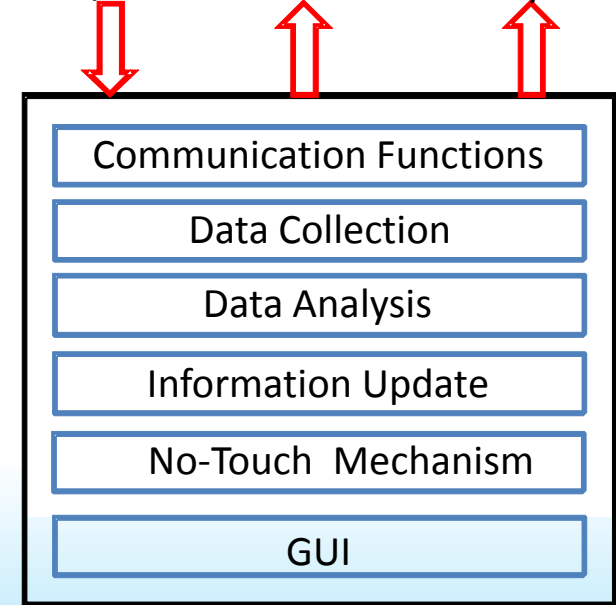
Software Design and Using:

- Android Developer
- WP7



Hardware Using:

- Smart Phone
- Location
 - GPS (satellite fix)
 - AGPS (base station fix)
 - Sensors
- Communication devices:
 - WiFi
 - 3G / LTE





JOIN Cloud Architecture

NCTU Cloud Platforms

JOIN engine:

- Location database
 - Current and historical locations of each user
 - Dynamic calculation of distance among friends
 - Static locations of stores related to interested groups
- Group membership and polling
- Event Scheduling with data mining

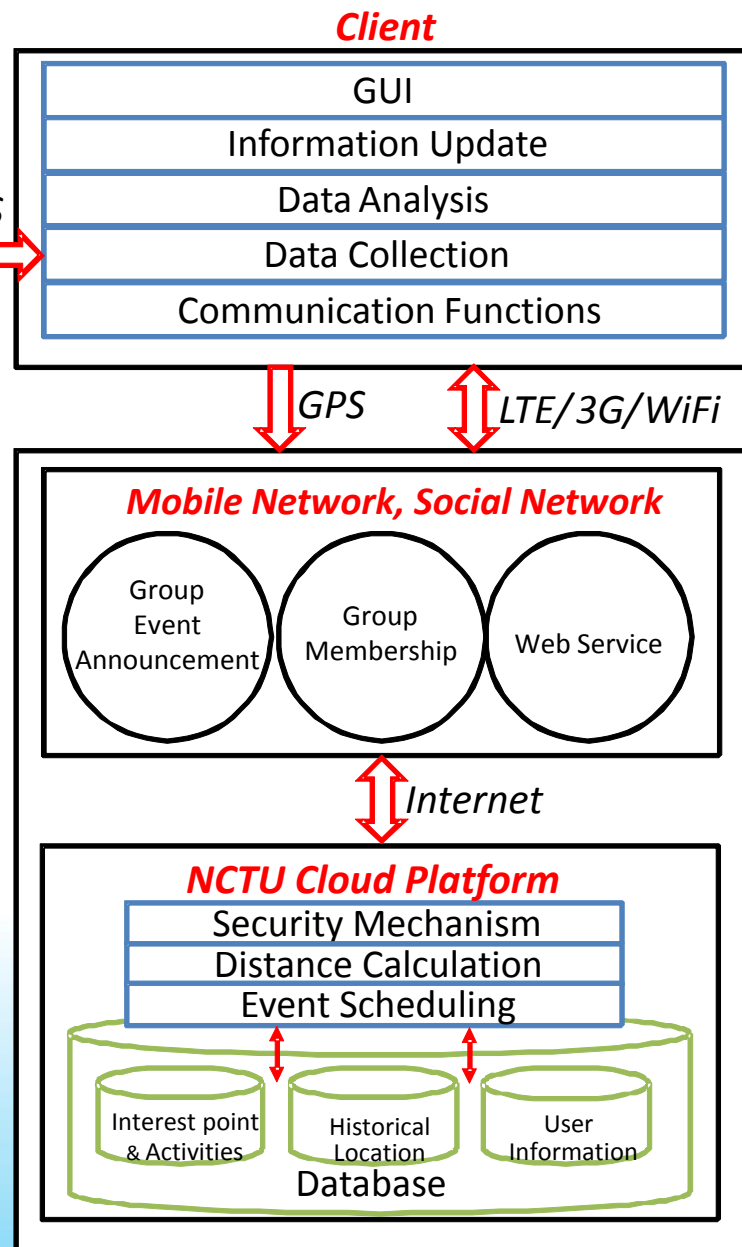
Social Networks

Community engine

- Group Event Announcement
- Group Scheduling



GPS





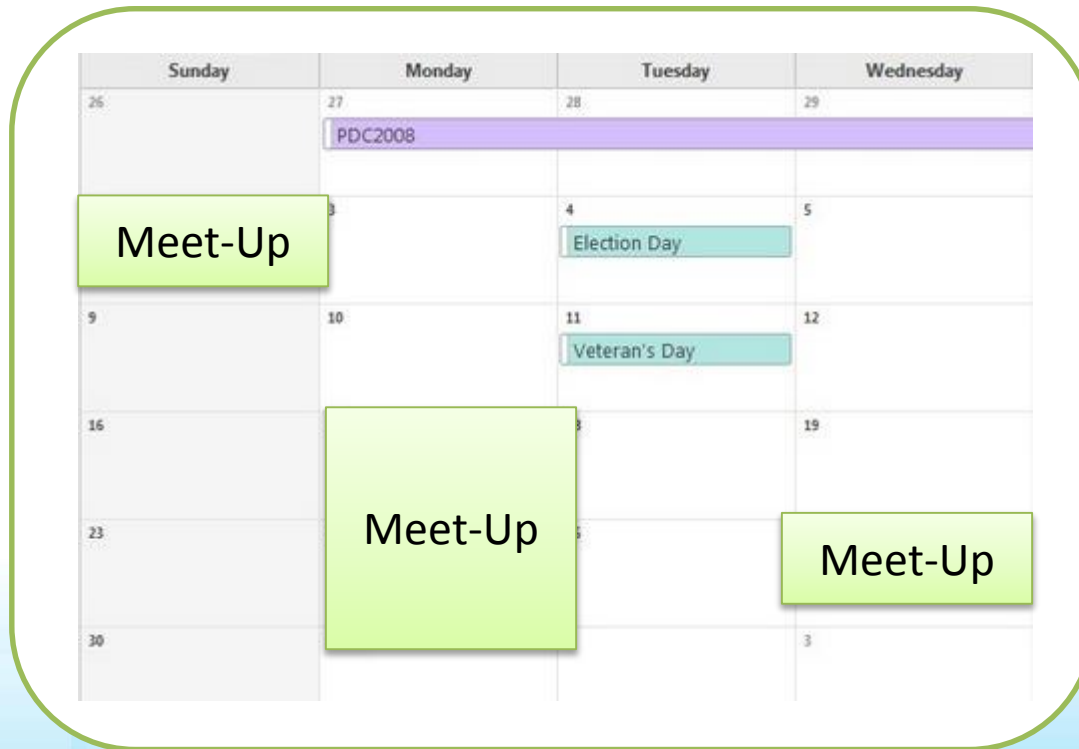
Developed mechanisms for mobile meet-up

- Calendar Merge-Up Mechanism
- Meet-Up Voting
- Location Pushing-Up Mechanism
- Proximity-Based No-Touch Mechanism for voting



Calendar Merge-Up Mechanism

- JOIN can search the common available time for each user in their calendar.





Allan

Sunday	Monday	Tuesday	Wednesday
26	27	28	29
	PDC2008		
Meet-Up	3	4	5
		Election Day	
9	10	11	12
		Veteran's Day	
16	Meet-Up		19
23	Meet-Up		Meet-Up
30		2	3

Babara

Sunday	Monday	Tuesday	Wednesday
31	Sep 1	2	3
	Labor Day		
Meet-Up	8	9	10
		Veteran's Day	
14	15	16	Meet-Up
21	22	Meet-Up	
			24

Allan

Sunday	Monday	Tuesday	Wednesday
26	27	28	29
	PDC2008		
3		4	5
		Election Day	
9	10	11	12
		Veteran's Day	
16	17	18	19
23			
30			

Meet-Up

Meet-Up

Babara

Sunday	Monday	Tuesday	Wednesday
26	27	28	29
	27	28	29
	PDC2008		
3		4	5
		Election Day	
9	10	11	12
		Veteran's Day	
16	17	18	19
23			
30			

Meet-Up

Meet-Up

Charles

Sunday	Monday
26	27
	PDC2008
2	3
9	10
16	17
23	24
30	31

Meet-Up

Sunday	Monday	Tuesday	Wednesday
26	27	28	29
	PDC2008		
2	3	4	5
		Election Day	
9	10	11	12
		Veteran's Day	
16	17	18	19
23			26
30	Dec 1	2	3

Meet-Up Option A

Meet-Up Option B

Diana

Tuesday	Wednesday
26	27
	PDC2008
2	3
9	10
16	17
23	24
30	31

Meet-Up

Edward

Sunday	Monday	Tuesday	Wednesday
26	27	28	29
	PDC2008		
2	3	4	5
		Election Day	
9	10	11	12
		Veteran's Day	
16	17	18	19
23			26
30	Dec 1	2	3

Meet-Up

Meet-Up

Meet-Up

Felicia

Sunday	Monday	Tuesday	Wednesday
26	27	28	29
	27	28	29
	PDC2008		
3		4	5
		Election Day	
9	10	11	12
		Veteran's Day	
16	17	18	19
23			26
30	Dec 1	2	3

Meet-Up

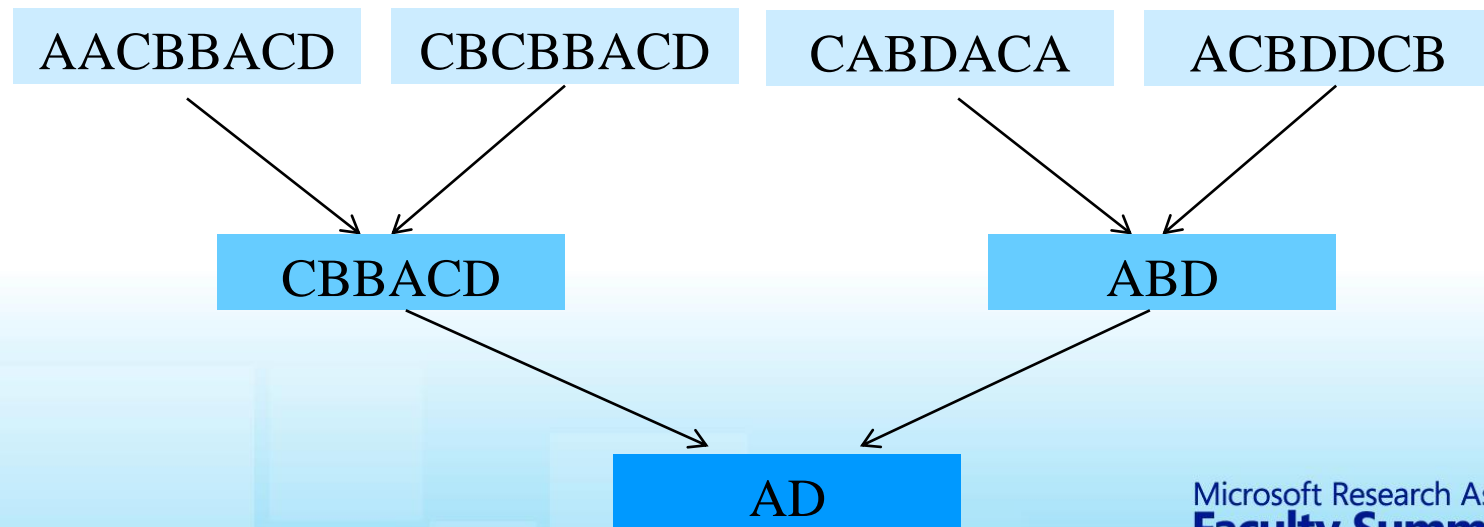
Meet-Up

Meet-Up



Calendar Merge-Up Mechanism (Cont.)

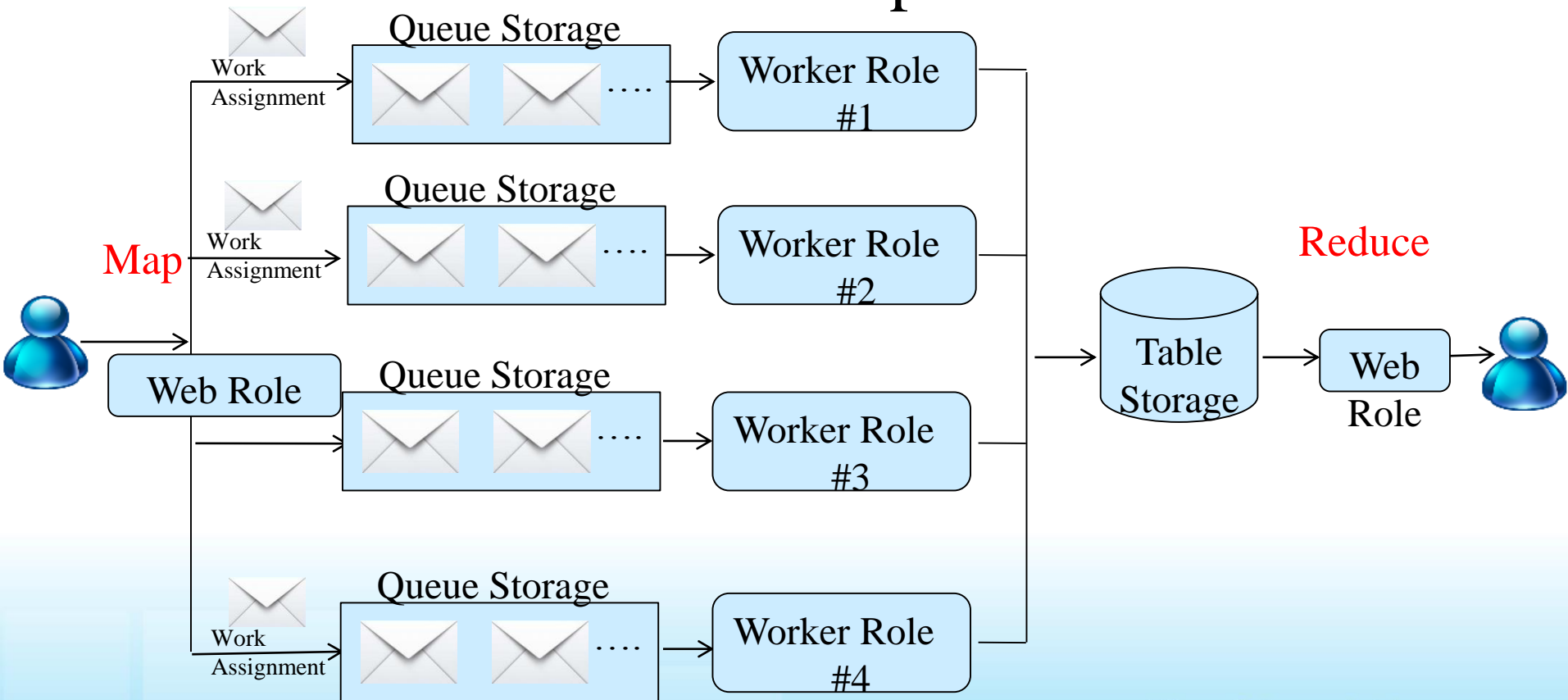
- Finding longest common subsequence(LCS) on MapReduce
- Mapper: Find LCS between two users
- Reducer: Combine the result





Map Reduce Technique

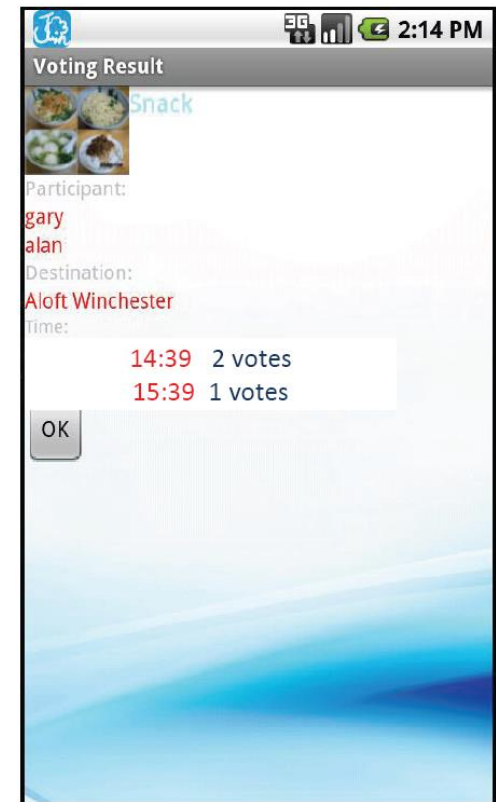
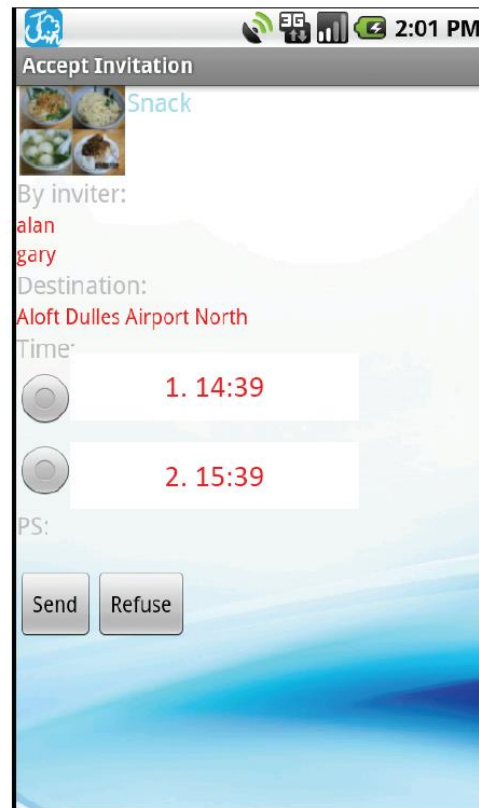
- Windows Azure with MapReduce





Meet-Up Voting

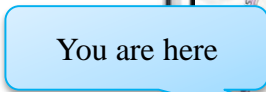
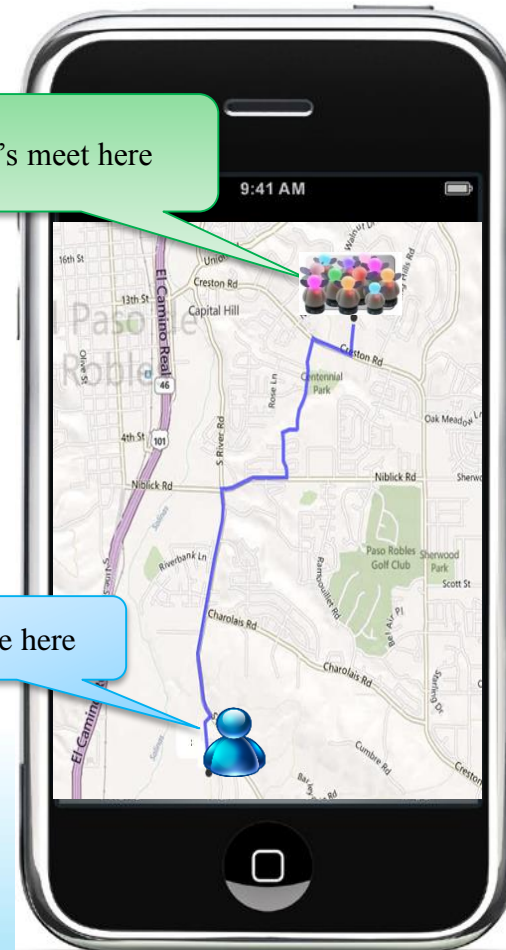
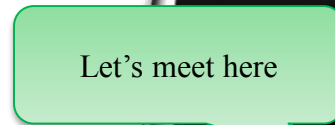
- Users can hold a activity.
 - vote for destination and time.
- Server can also proactively schedule the Meet-Up activity.





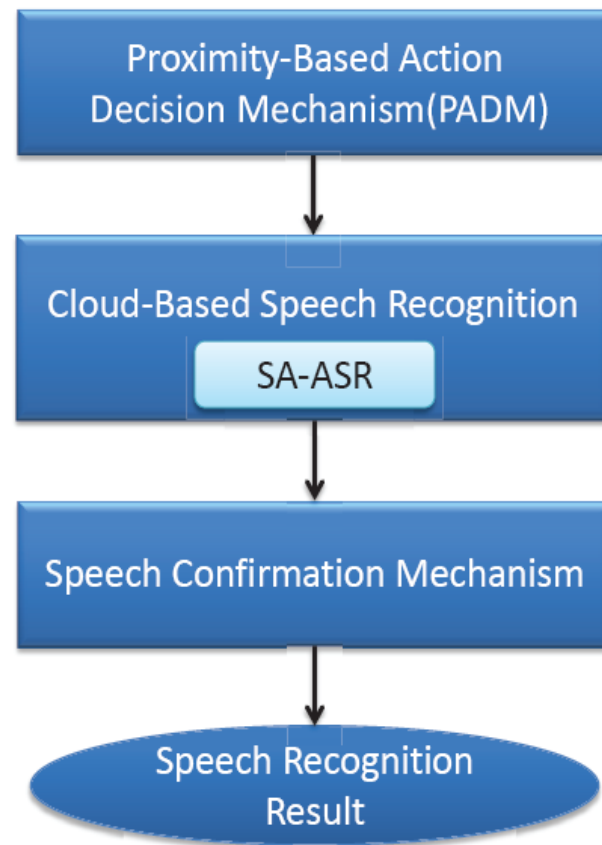
Location Pushing-Up Mechanism

- Location Pushing
 - Destination is pushed to each user with route planning.
- Reservation
 - Tickets
 - Rooms
- Booking in personal Calendar
 - Reminder



Proximity-Based No-Touch Mechanism for Voting

- Using touch screens are not safe for mobile phone users.
- Applying proximity sensors to initiate mobile applications without the need of touching the screen
- Integrate with cloud speech recognition.



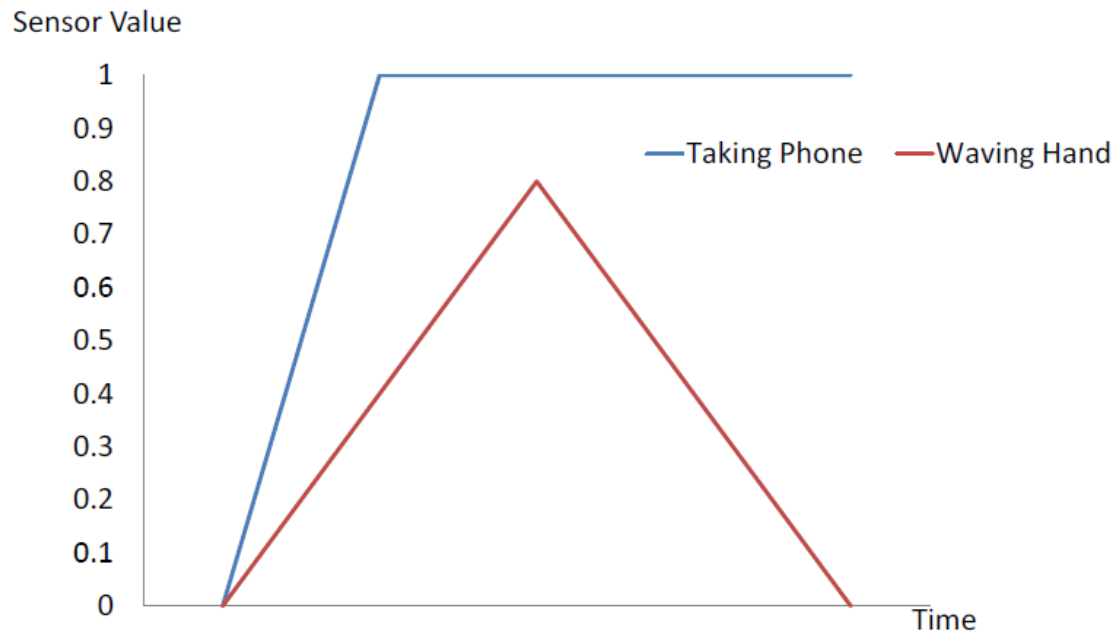
Proximity Sensor





Proximity-Based No-Touch Mechanism for Voting(cont.)

- Body language Translator
- Waving hands testing mechanism (WTM)
 - A mechanism to differentiate taking phone from waving hand.





Performance Evaluation of Proximity-Based No-Touch Mechanism for Voting(cont.)

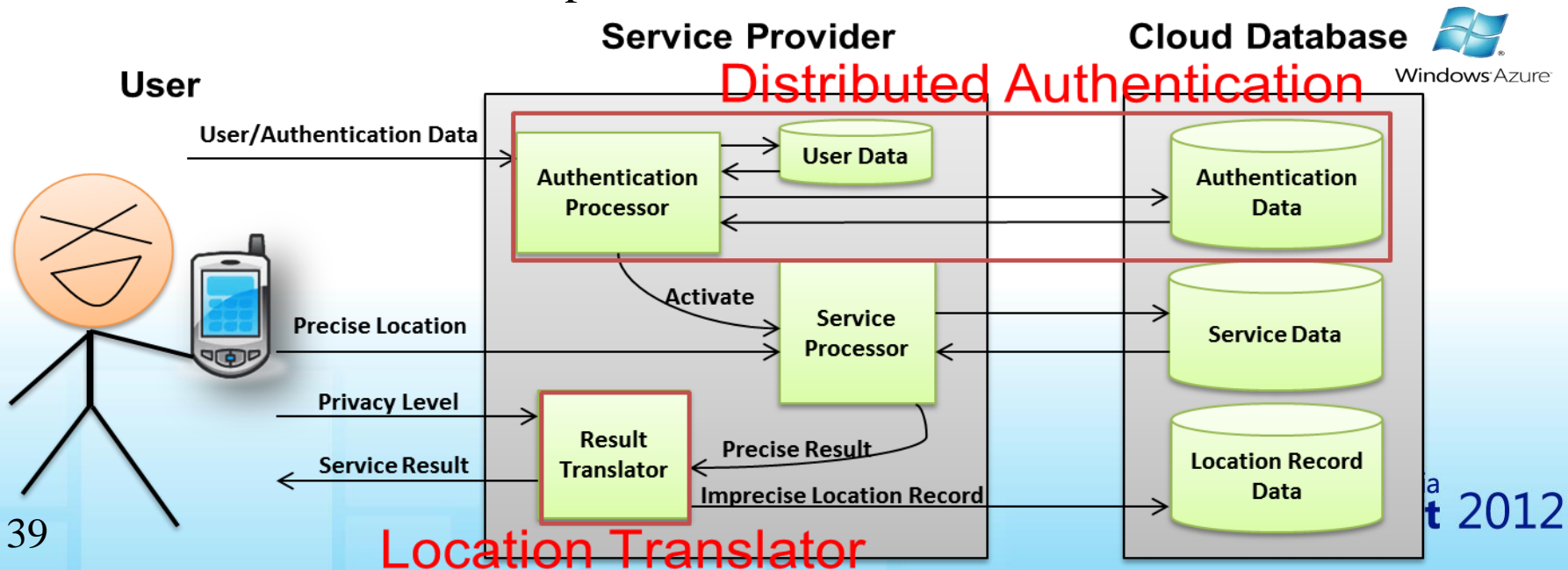
Sensor	Power consumption
Orientation sensor	9.7 mA
Magnetic field sensor	6.7 mA
Accelerometer	3.0 mA
Light sensor	0.5mA
Proximity sensor	0.5 mA

Mechanism	Testing Times	Error Times	Error Rate
Without using WTM	200 times	108 times	54%
Using WTM	200 times	2 times	1%

Enhanced Location Privacy



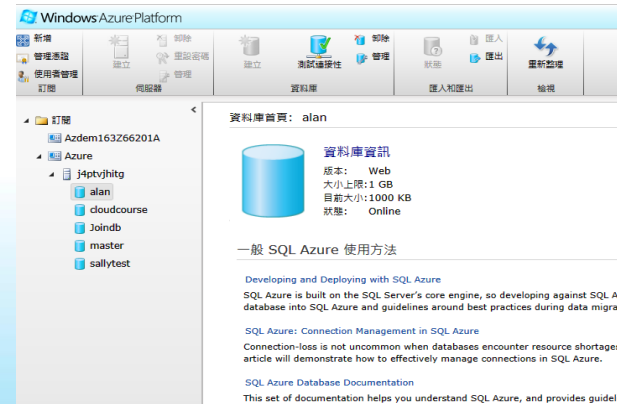
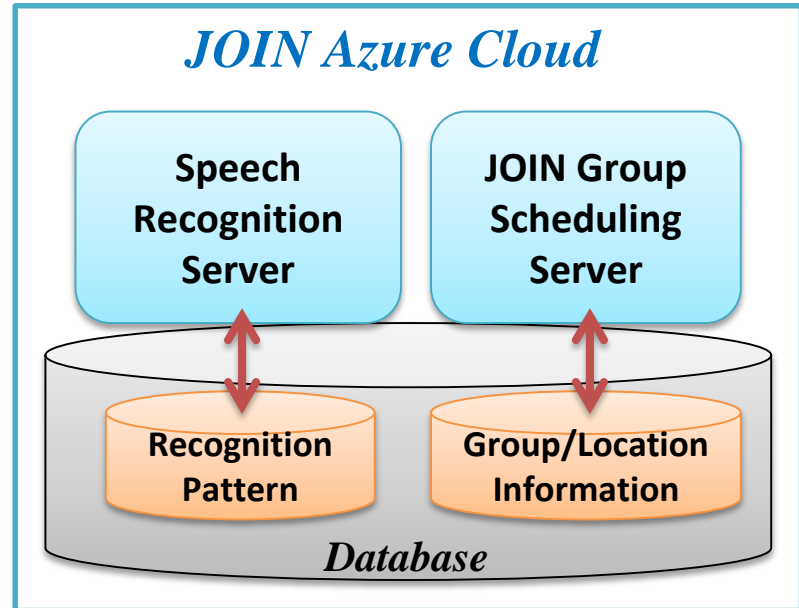
- Providing location security in LBS system with ODB service model
- IMSI-based pseudonym to secure the location data in JOIN services
 - Provable security
 - Less Power Consumption





Used Techniques in Database

- Windows Azure Platform
 - Speech recognition server
 - Group scheduling server
- Network Coding for Location Privacy
 - IMSI-based JOIN secure mechanism
- VMs Load Balancing
 - Queuing theoretical resource prediction





揪團：國立故宮博物院

搜尋好友

Ouch Liu

昱嘉陳

MuChiao Tung

林家瑜



聚會長度(小時)

3

聚會日期

10/14/2012

聚會時間

JOINxTAIPEI

您的揪團資訊已經傳送給2位好友！

Close

Eric Shangkuan

海派星星

Chih Ching Chang

Peter Hsu



臺北市 士林區至善路二段221號





Conclusion

- Present enabling mechanisms of meet-up applications for mobile phones, consisting of
 - calendar merge-up and polling mechanism
 - route information pushing-up mechanism
 - proximity-based no-touch mechanism
- Provide **immediate and personalized social LBS** information to mobile phone customers.
- Smartphones = gateway to the cloud, and the bridge of sensors



Reference

- [1] Y. T. Lee, L. C. Wang, and R. Gau, "Implementation Issues of Proactive Location-Based Group Scheduling for Cloud Applications", in IEEE VTS Asia Pacific Wireless Communications Symposium, 2010.
- [2] C. Y. Lin, Y. J. Chen, L. C. Wang and Y. C. Tseng, "Proximity-Based Speech Recognition in Mobile Cloud Computing, " 2nd International Workshop on Mobile Sensing (IPSN Workshop 2012)
- [3] C. Y. Lin, Y. J. Chen, L. C. Wang and Y. C. Tseng, "A No-Touch Mechanism to Initiate Mobile Applications on Smart Phones, " IEEE Vehicular Technology Conference (VTC2012-Fall), September 2012.
- [4] Y. J. Chen and L. C. Wang, "A Security Framework of Group Location-Based Mobile Applications in Cloud Computing, "Third International Workshop on Security in Cloud Computing (CloudSec 2011)
- [5] <http://msdn.microsoft.com/zh-tw/windowsazure/ff721941>

Thank you!