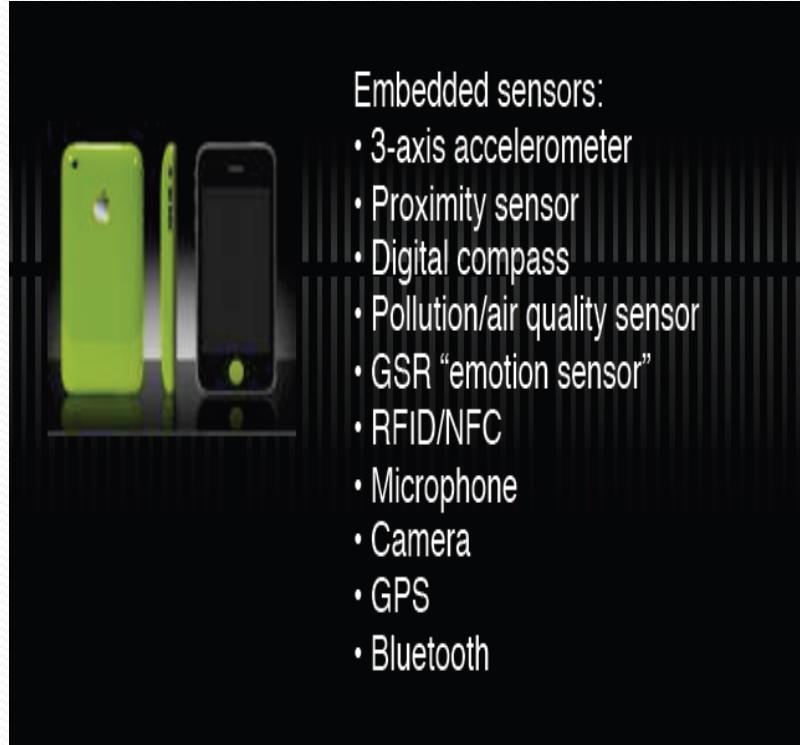


# From Digital Footprints to Social and Community Intelligence (SCI)

Daqing ZHANG

*Institut Mines-Telecom, TELECOM SudParis, France*

# As each of us carries a mobile ...



Embedded sensors:

- 3-axis accelerometer
- Proximity sensor
- Digital compass
- Pollution/air quality sensor
- GSR “emotion sensor”
- RFID/NFC
- Microphone
- Camera
- GPS
- Bluetooth

**“We have 4 billion “human-centric”, mobile sensors !**

We can ...

## Build innovative mobile systems/services for:

- 1. Target advertising, friends recommender**  
**(daily routine to user preference, by GPS)**
  - 2. Wellbeing management**  
**(walking/running/sitting/driving/biking by acc.)**
  - 3. Tour guide (snap2tell, camera)**
  - 4. Environment monitoring ( air) ...**
- .....

# If we tag each object with RFID...



We can ...

**Recognize a lot of Daily Activities like:**

**Taking medication,**

**Cooking (Safety),**

**Locking the door (Safety), .....**

# If we monitor the twitter messages ...

We can ...

**detect important events like  
“earthquake” or “bird flu”**



# Imagine further ...

- Every car, bus, train, truck, ship, plane, ..., object is tracked in real-time
- Each person is sensed in real-time (location, activity, ..., food-intake, eye-gaze, facebook, on-line chat)
- Environments are continuously monitored – locally and globally



# Research Vision - SCI

**Then ...**

By collecting all those “digital footprints” about the world, and by making sense of those data we can understand the **“Context”** about **individual, group, community, building, city, environment ...**

Social and Community Intelligence (SCI): **revealing the individual/group behaviors, their relationships as well as community dynamics** by mining the digital traces.

# Pervasive Environments

Static infrastructure

Physical World



The digital traces left by people while interacting with cyber-physical spaces are called “Digital Footprints”.

facebook



Web 2.0 services



Internet apps

Digital World

# Some New Research Areas

Social Computing  
(IEEE IS, 2005)

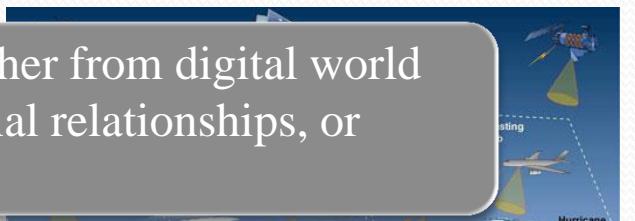
Reality  
Mining (MIT, 2008)

Urban  
Computing

Web data

Mobile devices

Sensor Networks



Existing research area focus on a single data source (either from digital world or real world) for studying either human behaviors, social relationships, or environment dynamics



What can we get if we merge the information from different digital footprint sources??



# SCI: A New Emerging Research Area

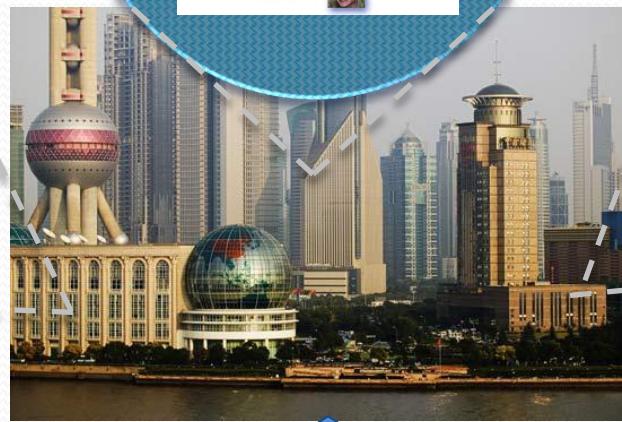
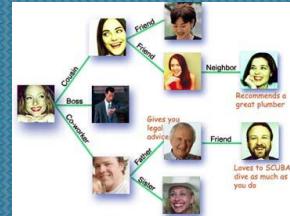
- Social and Community Intelligence (SCI) Definition:  
revealing the individual/group behaviors, their relationships  
as well as community dynamics by mining the digital traces  
left by people while interacting with cyber-physical spaces.
- SCI goes from mining the pattern of single type of  
information to fusion of three types of information sources:  
Internet and Web applications, static infrastructure, mobile  
devices and wearable sensors.

# Social and Community Intelligence (SCI)

User/Group Behaviors



Human Relationships



Community Dynamics



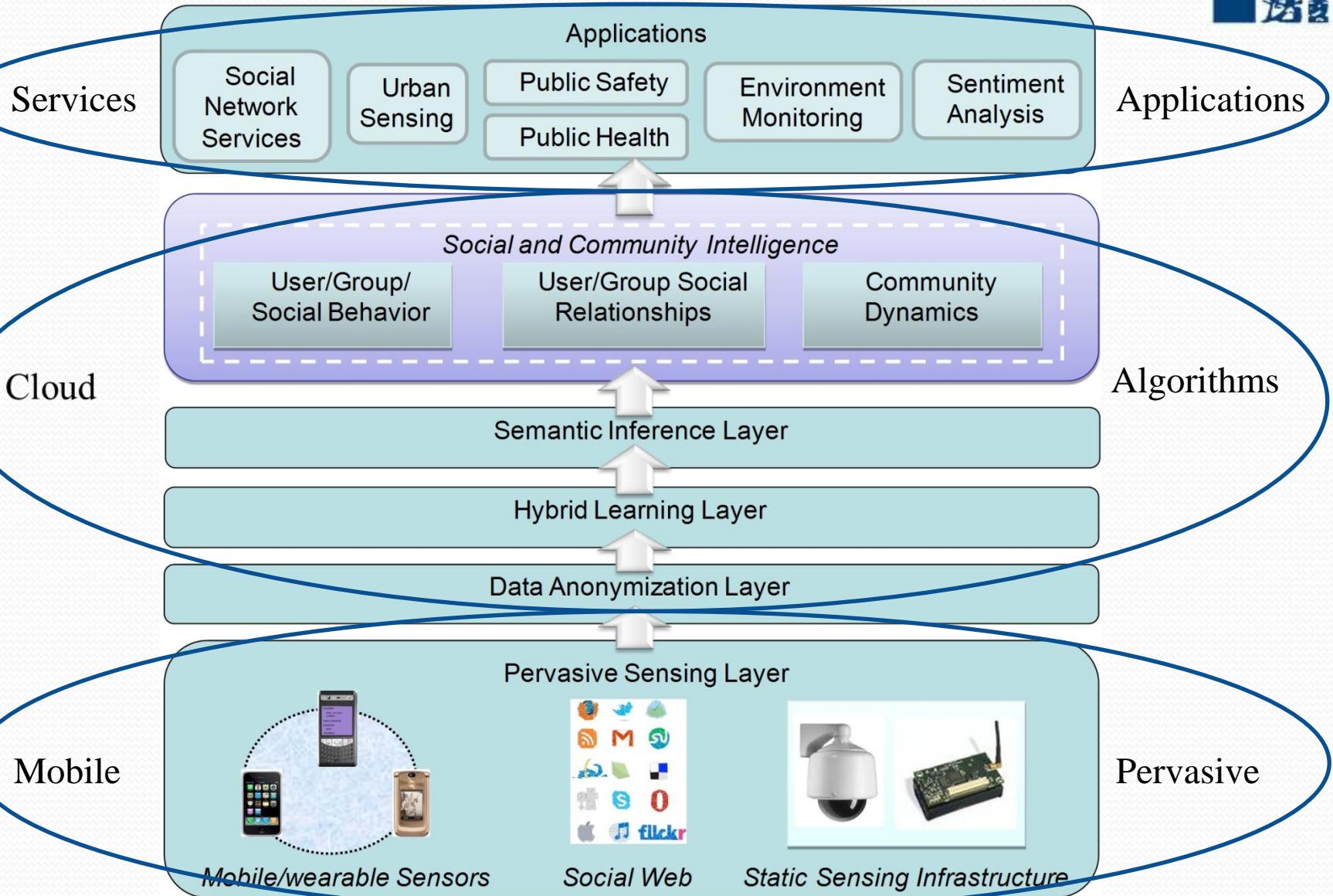
Internet and Web applications

Static Infrastructure

Mobile and Wearable devices

*Digital Footprints*

# A General SCI Framework



# SCI Enabled Applications

# APP 1: Urban Computing (Smart City)

- 7600 taxis' data for one year
- Including GPS trace, time stamp, occupied/empty, speed,...



Community Dynamics:

- (1) Social dynamics (land-use function, mobility pattern, hotspot extraction, etc.)
- (2) Traffic dynamics (travel time, taxi fare and traffic density estimation)
- (3) Operational dynamics (passenger finding, route planning, route/destination prediction, anomaly detection)

# APP 1: Anomalous Taxi Trajectory detection

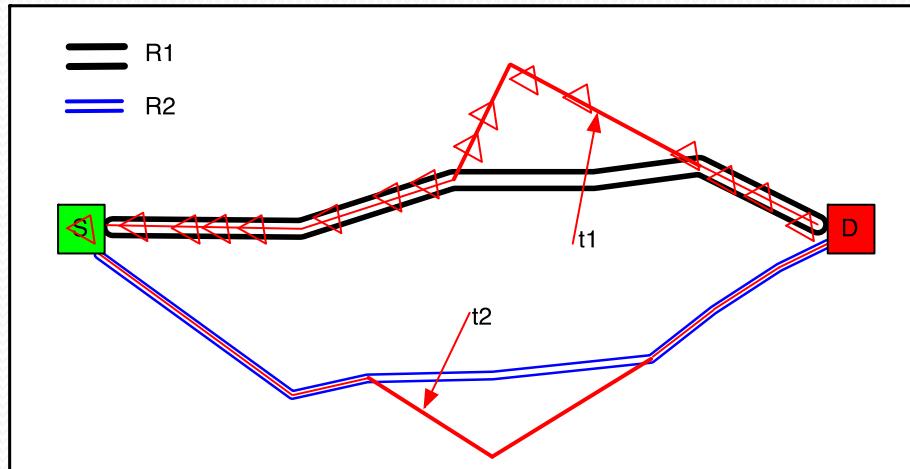
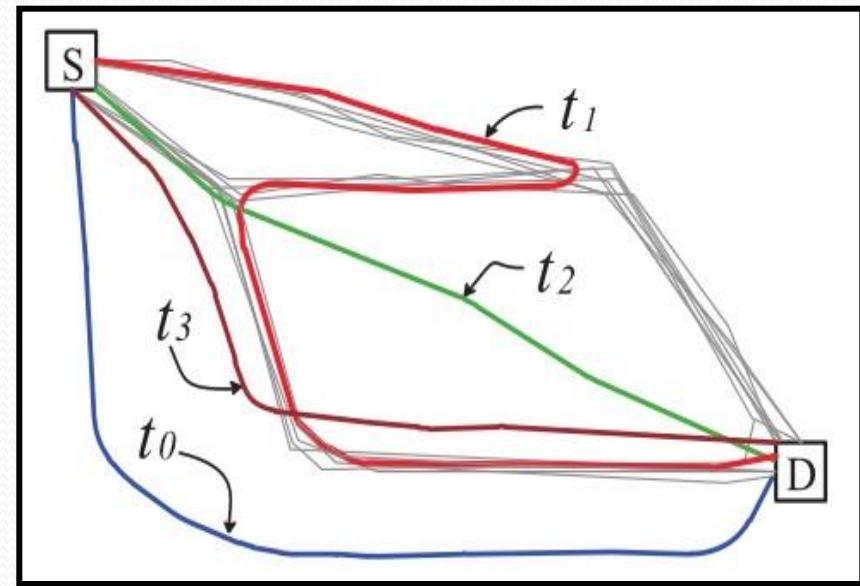
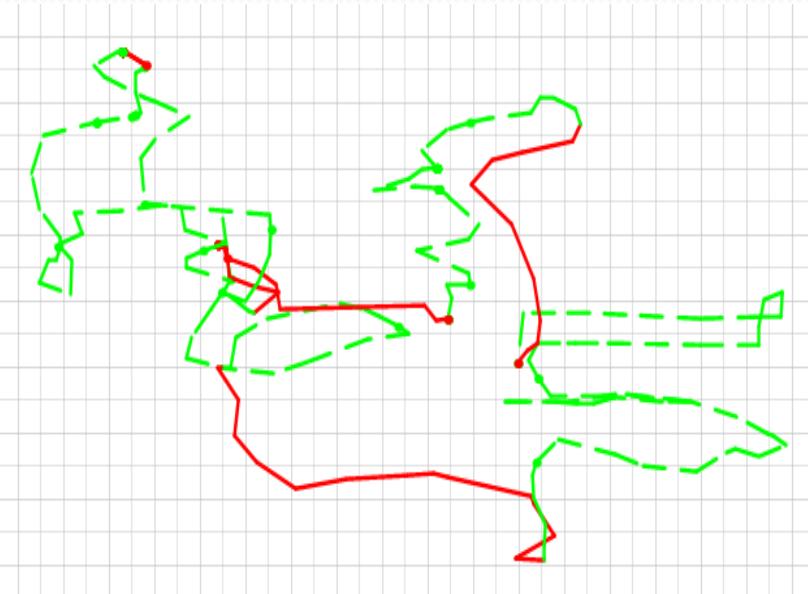
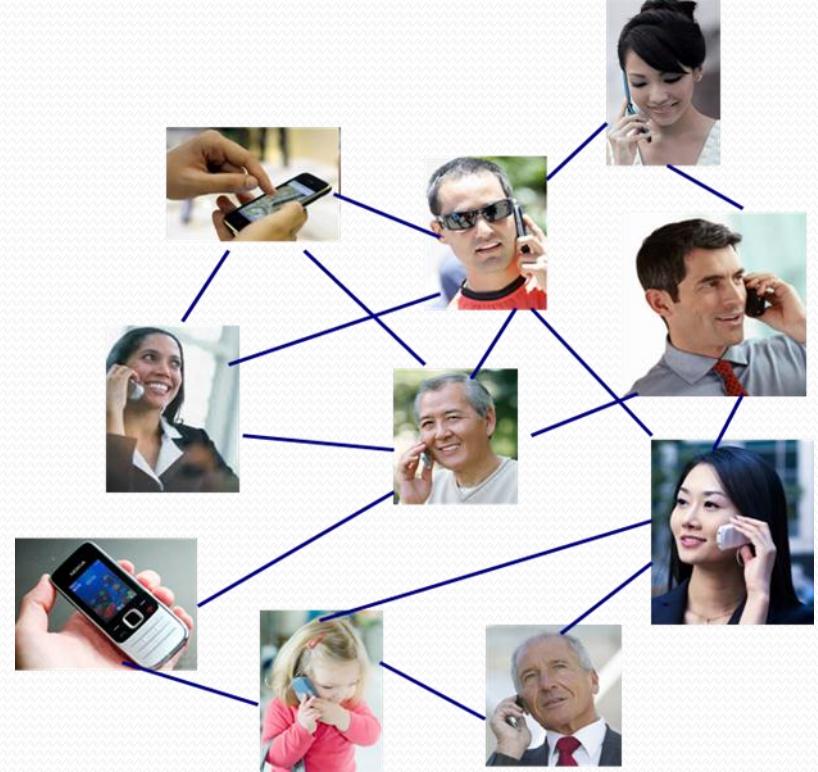


Table 3. The AUC value of iBAT and density-based method.

	T-1	T-2	T-3	T-4	T-5
iBAT	0.9972	0.9936	0.9923	0.9970	0.9958
Density	0.9448	0.9491	0.9435	0.9712	0.9386

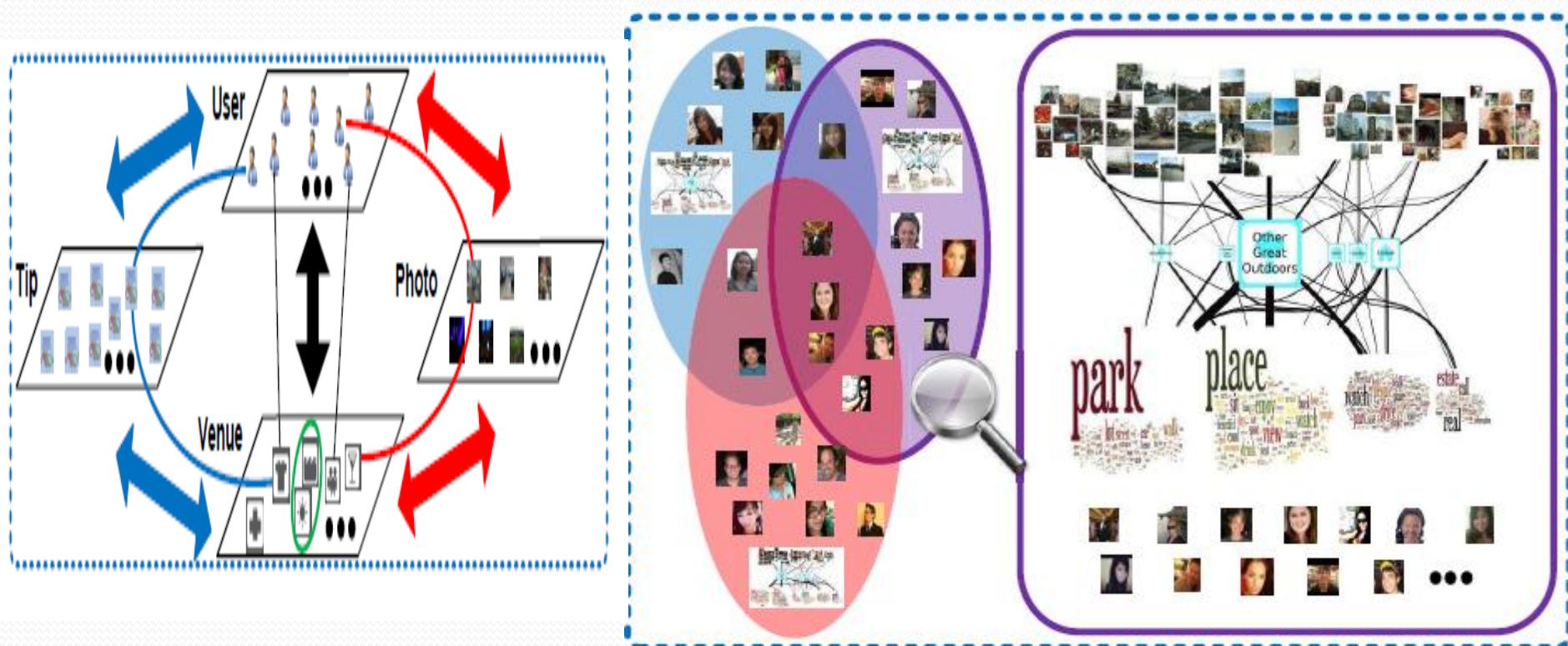
# APP 2: Mobile Computing (MSN)

*Mobility prediction, Co-location, MSN ...*



# APP 3: Social Media and LBSNs

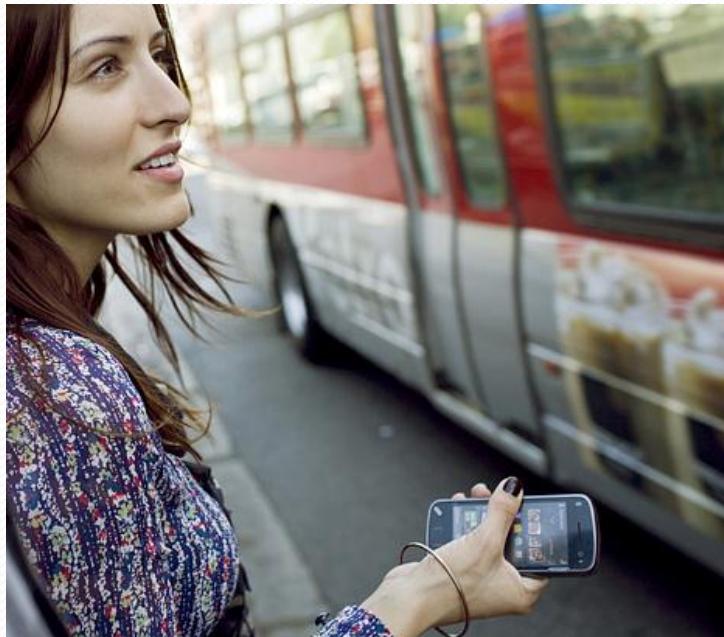
- In LBSN like Foursquare, people interact with each other through check-in at locations, making comments and sharing photos
- The entities such as users, venues, tips and photos can be represented as a multi-mode, multi-dimensional network, how to detect and profile communities ?



# SCI Research Challenges

# CH-1: Opportunistic or Participatory Sensing

- What roles should user play in community sensing, for security and privacy reasons?



**Opportunistic** : automatically starts whenever the state (e.g., location, user activity) matches the app needs



**Participatory**: incorporates people into significant decision making process

# CH-2: Data Privacy, Quality, and Trust



**Privacy:** Identity (who is asking for the data?), granularity (how much does the data reveal about people?), and time (how long will the data be retained?)

**Quality :** inaccurate, low-quality data?  
**Trust:** Anonymous contributors: is the source valid? Possible of fake data?

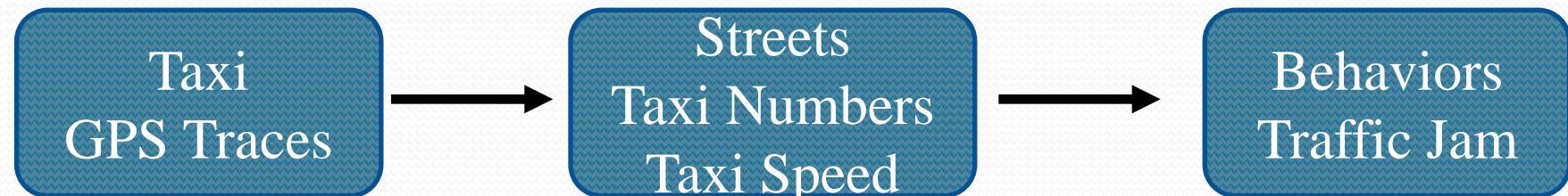
# CH-3: Processing Heterogeneous Data

Multi-Modal Data  
(different types of  
sensors)

Difficult to label all  
data (it is time-  
consuming for  
users to label data)

Inconsistency  
(Same event,  
different inference  
results)

# CH-4: From Low-level Data to High-level Context with Semantic Meaning



# Conclusion

- Social and Community Intelligence (SCI) represents a **new interdisciplinary research and application field**. It is expected to push the context-aware computing to a new territory.
- Going from mining the pattern of single type of information to fusion of multiple types of data, we expect to see the explosion of the research of SCI with the **aggregated power of three information sources** and a wide range of **innovative applications enabled by SCI**.

***Thank You for Your Attention !***

**Prof. Daqing ZHANG**

**Network and Services Department**

**Telecom SudParis, France**

**Tel: +33 1 6076 4123**

**E-mail: Daqing.Zhang@it-sudparis.eu**

**[http://www-public.it-sudparis.eu/~zhang\\_da/](http://www-public.it-sudparis.eu/~zhang_da/)**