Mobile Applications and Services
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Location-based Service and Geosocial Services

Navid Nikaein
Mobile Communication Department

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Content

- Basic concept
- (Geo-)Location-based services and architecture
- Location-based Service Ecosystem
- Geo-social service
- New trends
Mobility and Location

- Mobility is one of the characteristics of mobile devices as they change position
  - Abstract: where something is or moved or is moving
  - More concrete: coordinates, elevation, speed, heading
  - History: produce location trail

- Different scenarios require different spatial & temporal resolution

- However, users might want to control how their location is obtained and exposed?
  - Location privacy issues
Basic Concept

- **Position**: association of a single point with spatial coordinates
  - Commonly used coordinate system is the latitude-longitude-altitude system
  - Another example is the Universal Transverse Mercator (UTM)

- **Location**: association of an object with a place in the real world, a descriptive position (Locality, Postal or ZIP codes, etc...)

- **Geolocation**: identification of the real-world geographic location of an object
  - Establish a location information useful for recommendations, advertising, marketing, tagging, targeting and etc.

- **Location Service**: Self localization
  - Example: Where am I?

- **(Geo-)Location-based service (LBS)**: Value-added service
  - Report your location to other users
  - Associate/bind real-world locations (cinema) to your location
  - Example: How can I get to a certain place?
Buzzword of the year 2010

- (Geo-)location-based service was the technical buzzword of 2010
  - Change the way we socialize and discover new places

- The next wave of is about value-added services mainly in social networking and professional usage
  - Facebook, Twitter, and Google+ now wants to know “where are you?”
In 2011-2012: Increased demand for Improved Mobile Internet Experience

Deliver the next-gen wireless broadband experience

**Today**
Advanced users are discovering the power of *wireless broadband*

**Tomorrow**
Wireless users will consume enriched services and demand increased *quality of experience*

Consumers: video, image, location
Business: collaboration, video conference, data transfer

- Trusted Web Experience
- Presence and Location-Enriched Services
- New Connected Devices
- Pay For QoE and Productivity Gain. Accept Ads on Consumer Services

Source: ALU
Emergency calls localization is required by government within 125 meters (in 67% of all cases)

- Associates a physical address with the calling party’s telephone number
  - Even those without GPS, in any environment (indoor, in-vehicle, urban, suburban, rural, etc.), with very high reliability and accuracy
- This location information is then forwarded to the appropriate public safety answering point (PSAP) to coordinate the dispatch of emergency personnel

Examples:
- Enhanced E911 in USA, E112 in EU
- Operators may provide their own location services
  - Verizon's family locator
LBS type

- **Pull**
  - Sends a request for local weather forecast by SMS to the service number 1234.

- **Push**
  - Service provider send information to customer
    - Operators give the position of the customer to the service providers based on customer permission

- **Track**
  - Get the location of a terminal (person, vehicle, fleet)
  - Permissions is given to the operators to a third party or service to track the terminal
  - Could provide location profile/history
Location Information Provisioning

Location-Based Services consists of the following 5 steps
1. position determination
2. location pre-processing
3. service operation
4. result pre-processing
5. final result presentation

Which induces four main flaws
- The location description is specific to the service
- The location is restricted to the geographic position interpretation
- It is dependant on the positioning mechanism
- Only point-based positioning is supported
Position Acquisition Methods

- **Trilateration**
  - estimates the distance from **two or more known time-synchronized reference points** (i.e. BS)
  - received signal strength
  - derived from time-of-arrival (TOA) of received signal

- **Triangulation**
  - Estimate the angle of arrival between the mobile terminal and three reference points
  - Also known as direction of arrival (DOA) or Angle of Arrival (AOA)

- **Multilateration or hyperbolic positioning**
  - Estimate the time difference of arrival (TDOA) from the mobile terminal to three reference points **without the need for time synchronization**
Position Determination

- **Network based**
  - BS does the measurements
  - BS reports the measurements to a common location center
  - Location center determines the final terminal’s position

- **Terminal based**
  - All done by the terminal itself

- **Network assisted**
  - BS does the measurements
  - BS reports the measurements to a common location center in the network
  - Terminal determines the final terminal position

- **Terminal assisted**
  - Terminal does the measurements
  - Terminal reports the measurements to a common location center
  - Location center determines the final terminal’s position
Classification

Non GPS
- Proximity
  - IP/MAC/RFID/UUID/WiFi Fingerprinting database
  - GSM Fingerprinting database
  - Cell ID

Triangulation Multilateration
- AOA
- E-OTD
- TOA
- U-TDOA
- AFLT (CDMA)
- OTDOA

GPS
- Trilateration

A-GPS

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IP Positioning: Address Problems

- Identifying an IP address block's owner can be done through public registries, and used for
  - host or network interface identification
  - Location addressing

- Modern network technologies made IP addresses less reliable
  - Network Address Translation (NAT) hides device IP addresses to the outside world
  - Dynamic Host Configuration Protocol (DHCP) makes IP addresses less static
  - Virtual Private Network (VPN) technology assigns internal addresses for external devices

- IP addresses are still useful as a fallback and for stationary devices
  - big organizations often have a well-defined location and IP addresses
  - for location on the regional level this often is good enough

- IP addresses are almost useless for phone-based connectivity expect on the nation-level
Wi-Fi Positioning

- **Wi-Fi networks have unique identifiers**
  - Media Access Control (MAC) which uniquely identifies each manufactured device
  - Service Set Identifier (SSID) which is not unique but publicly visible and reasonably good

- **Wi-Fi networks have short range and thus provide good localization**
  - Maximum indoor range of 802.11n is 70m
  - Maximum outdoor range of 802.11n is 250m

- **Wi-Fi networks are widely deployed and identified**
  - Wardriving: trend of collecting Wi-Fi information
  - Big databases: contain tens of millions of WiFi networks

- **Links to Geolocation database:**
  - [http://geomena.org/](http://geomena.org/)
  - [http://www.skyhookwireless.com/](http://www.skyhookwireless.com/)
  - [http://www.wigle.net/](http://www.wigle.net/)
A snapshot of the Wi-Fi World Map
Connectivity Matters

- IP address from local Wi-Fi

```xml
<Response>
  <Ip>128.32.226.183</Ip>
  <Status>OK</Status>
  <CountryName>United States</CountryName>
  <RegionCode>06</RegionCode>
  <RegionName>California</RegionName>
  <City>Berkeley</City>
  <ZipPostalCode>94720</ZipPostalCode>
  <Latitude>37.8668</Latitude>
  <Longitude>-122.254</Longitude>
  <TimeZone>-8</TimeZone>
</Response>
```

- IP address through AT&T 3G

```xml
<Response>
  <Ip>166.205.136.159</Ip>
  <Status>OK</Status>
  <CountryName>United States</CountryName>
  <TimeZone>-6</TimeZone>
  <Latitude>38</Latitude>
  <Longitude>-97</Longitude>
</Response>
```
GPS Positioning

- Obtain coordination $(x,y,z)$: Latitude, Longitude, Altitude
- GPS was conceived in the mid-1970's by US’s DoD for people and objects positioning (e.g. Long-range ballistic missiles need global navigation)
  - first experimental satellite launched in 1978
  - initial operational capability was achieved in December 1993
  - Selective Availability (SA) was switched off in 2000
  - globally available (signal strength is low and receivers requires LoS)
- In 2002, the European Union decided to build a GPS-like system called Galileo which is scheduled to start operations in 2014
  - Same (military) frequency is used for GPS and Galileo
- Beidou navigation system in China is now online for region service, and will provide world-wide service by 2020
  - 北斗导航系统
- GLONASS Globalnaya Navigatsionnaya Sputnikovaya Sistema or Global Navigation Satellite System
- Augmented service
  - WAAS/EGNOS/MSAS,
  - Differential GPS (DGPS),
  - Nationwide Differential GPS (NDGPS),
  - Real-Time Kinematic (RTK)
GPS Techniques

- "Standalone" or "Autonomous" GPS operation uses radio signals from satellites alone
  - Coarse/Acquisition (CA) code: freely available to public, a form of CDMA
  - Precision (P) code: usually reserved for military
  - Military (M) code: further improve the jamming and secure access

- Terminal-based Trilateration

Navigation message includes:
1. GPS Date and time
2. Orbital information (ephemeris)
3. Status information (almanac)
A-GPS: Assisted GPS

- A-GPS additionally uses network resources to locate and utilize the satellites in poor signal conditions
  - Improve the initial position acquisition performance (delay, precision)
  - Useful in poor signal conditions, e.g. a city, indoor environment
- Supply ephemeris and almanac data to the terminal for faster lock on CA code
- Network-based/handset-assisted trilateration
A-GPS: Assisted GPS

The assistance server

- locate the phone roughly by the cell it is connected to on the cellular network.
- has a good satellite signal, and lots of computation power, so it can compare fragmentary signals relayed to it by cell phones with the satellite signal it receives directly, and then inform the cell phone or emergency services of the cell phone’s position.
- supply ephemeris and/or almanac data for the GPS satellites to the cell phone, enabling the cell phone to lock on to the satellites faster in some cases.

The BS captures a brief snapshot of the GPS signal, with approximate time, for the server to later process into a position

- By having accurate, surveyed coordinates for the cell site towers, it has better knowledge of ionospheres' conditions and other errors affecting the GPS signal than the cell phone alone, enabling more precise calculation of position.
Geolocation API

- W3C provides efforts to standardize an interface to retrieve the geographical location information for a client side device

- GPS-based coordinates have become the norm
  - globally usable and readily available from GPS receivers
  - printed maps start supporting WGS84 coordinates as well

- http://dev.w3.org/geo/api/spec-source.html

```javascript
interface Position {
    readonly attribute Coordinate coords;
    readonly attribute DOMTimeStamp timestamp;
};
```

```javascript
interface Coordinates {
    readonly attribute double latitude;
    readonly attribute double longitude;
    readonly attribute double altitude;
    readonly attribute double accuracy;
    readonly attribute double altitudeAccuracy;
    readonly attribute double heading;
    readonly attribute double speed;
};
```
Geocoding and Reverse Geocoding

- The current API only supports coordinates
  - civic locations will be supported in the next version

- Geocoding turns locations into coordinates
  - Eurecom, Sophia → (43.623731,7.041106)

- Reverse Geocoding turns coordinates into locations
  - (43.623731,7.041106) → Eurecom, Sophia

- Geocoding is not a simple 1:1 mapping operation
  - most locations are not points; they are areas
  - most points can be associated with more than one location

- Geonames.org provides data and Web services for (reverse) geocoding
  - findNearBy(43.623731,7.041106)
  - extendedfindNearby(43.623731,7.041106)
  - findNearbyPostalCodes(43.623731,7.041106)
The API at work

```html
<!DOCTYPE html>
<html>
  <head>
    <title>Minimal Geolocation Demo</title>
    <script type="text/javascript">
      navigator.geolocation.getCurrentPosition(successFunction);
      function successFunction(position){
        var lat = position.coords.latitude;
        var long = position.coords.longitude;
        var coord = "at (" + lat + "," + long + ")";
        document.getElementById('location').textContent = coord; }
    </script></head>
  <body>
    <h1> <a href="http://www.w3.org/TR/geolocation-API/**"> Geolocation </a> Demo </h1>
    <p>You are <span id="location">somewhere</span>.</p>
  </body>
</html>
```
## Performances

<table>
<thead>
<tr>
<th>LBS Type</th>
<th>Location Accuracy(67%)</th>
<th>Implementation Cost</th>
<th>Time To Fix</th>
<th>Coverage</th>
<th>Technology Standard</th>
<th>Handset Requirements</th>
<th>Network Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Cell ID</strong></td>
<td>Network Based</td>
<td>Low</td>
<td>Fast</td>
<td>Moderate</td>
<td>GSM</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td><strong>Cell ID - Signal strength</strong></td>
<td>Network Based</td>
<td>250m-12km</td>
<td>Fast</td>
<td>High</td>
<td>GSM</td>
<td>None</td>
<td>Hardware Modifications</td>
</tr>
<tr>
<td><strong>Cell ID - TA/RTT</strong></td>
<td>Network based + handset assisted</td>
<td>200m-11km</td>
<td>Fast</td>
<td>High</td>
<td>GSM</td>
<td>None</td>
<td>Software modifications</td>
</tr>
<tr>
<td><strong>AOA</strong></td>
<td>Network Based</td>
<td>100-200m</td>
<td>Moderate</td>
<td>Good (Multipath prop issues)</td>
<td>GSM</td>
<td>None</td>
<td>Hardware &amp; Software Modifications</td>
</tr>
<tr>
<td><strong>TOA</strong></td>
<td>Network Based + Handset assisted</td>
<td>50-200m</td>
<td>Moderate</td>
<td>Good (Multipath prop issues)</td>
<td>GSM</td>
<td>None</td>
<td>Hardware &amp; Software Modifications</td>
</tr>
<tr>
<td><strong>E-OTD</strong></td>
<td>Handset Based + Network Assisted</td>
<td>50-125m</td>
<td>Moderate</td>
<td>Good (Multipath prop issues)</td>
<td>GSM</td>
<td>Software Modifications</td>
<td>Addl. Hardware and Software(LMU)</td>
</tr>
<tr>
<td><strong>O-TDOA</strong></td>
<td>Handset Based + Network Assisted</td>
<td>20-200m</td>
<td>High</td>
<td>Good (Multipath prop issues)</td>
<td>UMTS</td>
<td>Software Modifications</td>
<td>Addl Hardware and Software(LMU)</td>
</tr>
<tr>
<td><strong>EFLT/AFLT</strong></td>
<td>Network Based</td>
<td>30-350 m</td>
<td>Moderate</td>
<td>Good (Multipath prop issues)</td>
<td>CDMA</td>
<td>Software Modifications</td>
<td>Hardware &amp; Software Modifications</td>
</tr>
<tr>
<td><strong>GPS</strong></td>
<td>Handset Based</td>
<td>30-80m</td>
<td>Slow</td>
<td>Moderate in urban High in rural &amp; suburban</td>
<td>All</td>
<td>Addl HW and Software</td>
<td>Minor Modifications</td>
</tr>
<tr>
<td><strong>AGPS</strong></td>
<td>Network Based + Handset assisted</td>
<td>5-50m</td>
<td>Moderate</td>
<td>Variable</td>
<td>CDMA/EVDO</td>
<td>Addl HW and Software</td>
<td>Addl HW and Software</td>
</tr>
<tr>
<td><strong>WLAN/RF Fingerprinting</strong></td>
<td>Network Based (Indoor/Outdoor)</td>
<td>Moderate</td>
<td>Moderate</td>
<td>Good</td>
<td>---</td>
<td>---</td>
<td>Software and Hardware</td>
</tr>
</tbody>
</table>
Location-based Service Architecture

- **Control plane**
  - a standard-based implementation in which the positioning messages are transported over the control signaling channels of the mobile network
    - User traffic (voice or data) can be transported in parallel with positioning data

- **Data plane**
  - Based on IP transmission of positioning messages
    - All the positioning messaging appears as user traffic to the mobile network.

- **U-Plane can be used either as an alternative or as a complementary to the C-Plane approaches**
## LCS Architecture: C-Plane and U-Plane

<table>
<thead>
<tr>
<th>Control Plane</th>
<th>User Plane</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interface between system entities is signaling-based</td>
<td>Interface between system entities is IP-based</td>
</tr>
<tr>
<td>Requires upgrades of network elements to handle the standard protocols:</td>
<td>Quick time to market, lower deployment costs, various applications,</td>
</tr>
<tr>
<td>positioning server, gateway server</td>
<td>adaptative implementation to carrier’s specific needs</td>
</tr>
<tr>
<td>Supports legacy terminals</td>
<td>Application focused, handsets intelligent</td>
</tr>
<tr>
<td>Voice centric, network based</td>
<td>More options in terms of roaming: the mobile always interacts with the</td>
</tr>
<tr>
<td></td>
<td>home service</td>
</tr>
<tr>
<td>Centralized control</td>
<td>Client-server architecture</td>
</tr>
<tr>
<td>Does not allow easy third party applications development and hosting</td>
<td>Allows third parties to develop and host services with minimal network</td>
</tr>
<tr>
<td></td>
<td>impact</td>
</tr>
<tr>
<td>Allows operators to deploy services with or without data connectivity</td>
<td>Most of the applications require data connectivity</td>
</tr>
<tr>
<td>Emergency, 911 applications, LBS routing for voice services</td>
<td>Commercial applications</td>
</tr>
</tbody>
</table>

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GEOSOCIAL NETWORKING
Geolocation

- Location has always been important and is not just a new trend in smartphone
  - Where can I find something to eat?
  - Where is the post office?

- But in 21 century, people are mobile around the globe
  - Physical position/location becomes more important than ever

- Geolocation is an association of an object with a geographical position/coordinate
Difference between Geolocation and Places?

- **Geolocation**
  - 43.626854, 7.047082

- **Place**
  - Research institute
  - My graduate school
  - Eurecom

- Only places have a social meaning

- Social Networking + Places = GeoSocial Network
Why Geosocial Networking?

- Allow users to interact relative to their current locations
  - Web mapping: match users with places, event, local group to socialize in
- People are studying/working from different places
  - Social ties are easily broken many times

Transformation in human social behavior?
Why Geosocial Networking?

- Collaborate and help when something happens
  - Disaster: natural catastrophe, epidemic, terrorist attack
  - Event: protect, manifestation, news
  - Shopping: exchange/barter, buy/sell, ads

- Usage
  - Collaborative map: develop a collective situational awareness through an assembly of individual perspective around collaboratively filtered geotag information
  - Collaborative event: organize, track, and communicate events
  - Social shopping: collect information on different items as you pass by
    - ThisNext, Shopkick, and Do Together
Why second life did not succeed

- Locations are virtual
- People were anonymous
  - difficult to find friends
  - difficult to create presence
- Tele-transporting and flying as a way to navigate and search
- Not easy to pop/push an information
- 3D experience not matured
  - Difficult to convey the information
Until now, but

- **Being online remains virtual**
  - the missing piece is the physical link between person and society

- **Identification service**
  - Mapping a person’s online identity to their real life identity
Geosocial Networking

- Type of social networking in which geolocation/location-based services and capabilities such as geocodeing and geotagging are used to generate additional social dynamics [wikipedia]
  - Where are your friends right now?
  - What did your friends do this WE?
  - Who were your friends hanging out with?
  - What is this place? What is the hot spot around me right now?

Geosocial Networking Trends:
- Support for other social networks
- Native and web based application
- Gaming aspects
- Augmented reality
- Man-machine social networking
Why Facebook is successful

- **Mapping to people’s real life**
  - Originate from the real world
  - People are real with the real name and photo

- **Community medium**
  - Value increases with every new member

- **Feedback system**
  - Action and response

- **Cheap and easy to maintain your social network**

- **Self communication and promotion**
  - Let friends sort the information

- **Re-establish the broken social ties**
  - Personal identify
  - Associations (movie, music, fashion, etc.)
  - Share stuff and exchange information
Network effect or Word of Mouth

- When people are influenced by the behaviors of their neighbors in the network, the adoption of a new product or innovation (Leskovec et al. 2007)
Why Geosocial?

- Growth of Geosocial network
  - Smartphones increase usage
  - New emerging device like iPad and Galaxy Tab
  - Gaming and augmented reality aspect
  - Functional application
    - Waze: realtime live map and traffic information based on wisdom of the crowd

- Observation:
  - Fast growing but fragmented market
  - Increasing number of users
  - Emerging opportunities yet small market
What Can You Do With Geosocial Services?

Check ins
- Friend finder
- Leave extra information

Earn points and unlock rewards
- Owner of Places
- Get real or imaginary discounts

Discover the world around you
- See the nearby places and business
- Get direction and contact info
- Connect to friends
- Location alert

Create challenge
- Add your own trips/ places / business
- Add tips about your visits
- Add story

Analyze and manage locations
- Privacy
- Monitor your establishment
Main Geosocial platforms

- Basic Platforms
  - Foursquare
  - Gowalla
  - Facebook Places
  - Google latitude
  - Loopt / Loopt Star

- Gaming Platform
  - SCVNGR
  - Whrrl

- Augmented Reality
  - Yelp
  - Layar
Foursquare

- Location-based service for social networking: move – check-in – tell friends
  - Friend finder and social city guide
  - Gaming aspect
    - Become mayor, get badges and special offers
    - Badges are little rewards you earn for doing or checking-in to interesting places
  - Earn points
  - Track the history
  - Create private/public to do list and tips for a venue

- Other features
  - Biggest Geosocial community: 4 million users
  - Developers API
  - Establishment may reward their customers
  - Support for Facebook, Twitter and Gmail contact
  - Support for iPhone, Android, webOS, WP7, BB
  - Three level of super users status with varying levels of control to edit locations
  - Partners: NY times
  - Web and mobile application

- Maybe bought by Yahoo
Gowalla

- **Location based social networking** to keep up with friends, discover new places and hot spots for fun and memorable, find inspiration to explore
  - Check in, gain pins, gain stamps, carry items, do trips, and add photo and comment
  - Stamp your passport
  - Connect with friends
  - Enjoy the existing trips/tour/spot and create your own by grouping locations together
  - Take photo, comment on places, and share highlights from your life, collect pins for check ins, completing trips, find spot
  - Find virtual items as you explore, some are rewards in realworld

- **Other features**
  - Support for Facebook and Twitter
  - Map and satellite view
  - Support for iPhone, Android, webOS, WP7, BB
  - Partner with CNN, national geographic, etc.
  - Elevated user level called “street team elite ” can modify location data and add additional content about a venue
Google Latitude

- Location-aware mobile app mapped to google map
  - Find your friends on a map and see nearby friends and meet up
  - Share where you are with the friends you choose
  - Control your location and privacy settings
  - Other services
    - Location history: manage and analyze user locations with google map (e.g. view trips). Not shared.
    - Location alert: notification when you are near your friends, or doing something different than routines
    - Location badge: publish your location or city spots on your blog/website
    - Google talk status: share information with all of your google contacts

- Standalone and web app support for iPhone
  - Feature of google maps for android, blackberry, symbian, WP

- Google Places (business oriented)
  - Add google tags to be found on google search and maps
Google Latitude Screenshots
Facebook Places

- Before just who, what, when, and now includes where
  - Share where you are
    - Check in and your page “Place/Wall/News Feed” will be updated automatically
    - Tag the friends to activate group update
    - Appear in “Here Now” to nearby friends
  - Connect with friends nearby
    - Check out “Here Now” of nearby friends and get in touch with them
  - Find local deals
    - Get special offers through “deal” logo
    - Check in and get discounts
    - Check out good deals and let friends know about it
Other platforms: game

- **SCVNGR**: a game about doing challenges at places
  - Go places
  - Create challenges
  - Do Challenges through check in
  - Earn points and unlock awards
  - Integration with facebook and twitter
  - Consumer and enterprise components

- **WHRRRL**: a game to unlock societies and leave your footprint
  - Check in
  - Create societies based on users’ real world passions
  - Create recommendation
  - Earn points and rewards
  - Create story with posting photos and notes
Other platforms: Augmented Reality

- Layar: retrieve data based on your geolocation, and overlay real time digital information on top of the real world as seen through the camera of your mobile phone.
Google +

- Company 4\textsuperscript{th} attempt for social networking platform
  - Google profiles, buzz, friend connect, orkut

- Refresh the visual design across Google products to achieve a consistent experience across the Google spectrum

- Features
  - Circles: organize contacts into groups for sharing
  - Hangout: group video, instant webcast, share docs
  - Sparks: front-end for google search for identifying topics
  - messenger: instant messaging with sms support
  - Ripple: rehashing activities happens in a public post
  - Creative kit: online photo editor
  - Games, Instant upload, Messenger, +1, search, pages, badge, mobile
Privacy Issues

- Opt. in vs. opt. out
  - user should join or sign up to network, and then the host is given permission to access the user's information and to contact him or her
  - network is defaulted to have the user included in a group, and users must remove themselves from the network if they wish to not be included
Geosocial Business leverage

- Discounts for check ins / Mayor-ships
- Custom icons for branding
- Search, follow and track the customers
- Promotional campaigns for product launches
- Custom event stamps for special events
- Loyalty /reward campaigns

Example:
- Starbucks coffee: as a mayor of the store, get $1 off
Geosocial Networking & Journalism

- Finding target contacts
- Breaking news
- Source information from tips/comments
- Learn about people around and their behavior
- Discover and monitor trends
- Publish and distribute contents
- Crowd sourcing news and rewarding readers with badges
NEW TRENDS IN GEOSOCIAL NETWORKING
Quick Response (QR) Code

- 2 dimensional barcode readable by QR scanner allowing fast readability and large storage capacity (ISO standard, free of license)
  - Legacy data: numeric, alphanumerical, bytes/binary, kanji
  - Any other type of data through extensions

- Created by Toyota in 1994 for tracking parts in vehicle manufacturing

- Also readable by smartphones through camera
  - Realtime analytical
  - Social networking
  - Live content to be received instantly
  - Run javascript
  - Invoke application on your phone

- Risks
  - Malicious website
  - Enabling the microphone/camera/GPS and streaming those feeds to a remote server

- Example: Qrpedia, SPARQ Code
Manual Input

http://www.eurecom.fr/~nikaein/mobserv

Characters Left: 161

QR Code: 

http://www.sparqcode.com/static/maestro
Social Media in Box

- Easy check ins by scanning QR codes at the entry of Places!
  - A service for local businesses to connect their customers with their online presences
Near Field Communication

- NFC is a contact-less short range (max 10cm) wireless connectivity technology standard
  - Based on RFID technology at 13.56 MHz
  - Support both: Initiator/target and active/passive
  - 3 modes
    - Card emulation, Reader/writer, Peer to peer

- Gradually turning to the social side
  - Support for google+ already provided
    - Check out a place and share it with Circles, and perhaps even add us into somebody's Circle or Hangout
  - When paying through google wallet?
    - Google, Apple, Paypal changing the game on how payment is done, banks are just following!