



Overview of Geospatial Technology Trends – 2013

“MegaTrends”

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Geospatial Technology Trends - 2013



- **The Power of Location**
 - Predicting intent
 - Location data quality
- **Internet of Things**
 - Reached “Apple II” stage
 - Opportunistic sensing/SWE
- **Mobile Development**
 - 1 GB/user/day, Mobile first
 - LBS DWG, Geopackage
- **Indoor Frontier**
 - Human scale geo
 - Indoor maps, IndoorGML
- **Geographers of future**
 - Maps became personal
 - AR, Semantics
- **Geospatial Processing**
 - Analytics, Cloud, models,
 - WPS Profiles, Provenance
- **Smart Cities**
 - Urban Scale geo
 - Spatial intelligence of cities
- **Policy implementation**
 - Uncertainty inhibiting growth
 - Implement licenses:



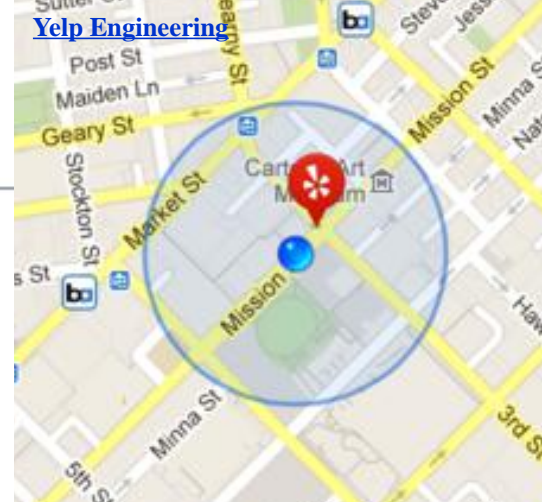
The Power of Location

Power of Location



- “Location targeting is **holy grail** for marketers”
 - Sir Martin Sorrell, WPP CEO, MWC 2011
- By measuring the entropy of each individual’s trajectory, we find a **93% potential predictability in user mobility**
 - Limits of Predictability in Human Mobility, Science 2010
- **1st law of geography:** “Everything is related to everything else, but near things are more related than distant things.”
 - Waldo Tobler

Location Data Quality



- Current status:
 - "Roughly half of all venue data on Facebook and Foursquare is not accurate"
 - "Inferred" ("made up") lat/long - Dirty Little Secret Of LBS Ads
 - "...important for decision makers to understand the accuracy of the available geocodes so that they have a sense of the level of confidence they can place in the data."
 - John O'Hara, Pitney Bowes, Jan 2013
- Develop Location Data Quality standard?
 - Data Quality DWG: surveyed ~1000 Geospatial professionals, researched ISO specs, reviewed data quality use cases
 - Metrics for "geocoded addressing for commercial purposes."

Points of Interest



- POI Standard development
 - Began in the World Wide Web consortium with OGC participation
 - OGC now forming a Standards Working Group to complete work
- OGC OpenPOIs is a registry of all the places in the world, and links to all of their web resources
 - APIs to get the information as maps, A location resource that's always current, accurate, and authoritative
 - Interactive Atlas
 - Easy interface to add Points



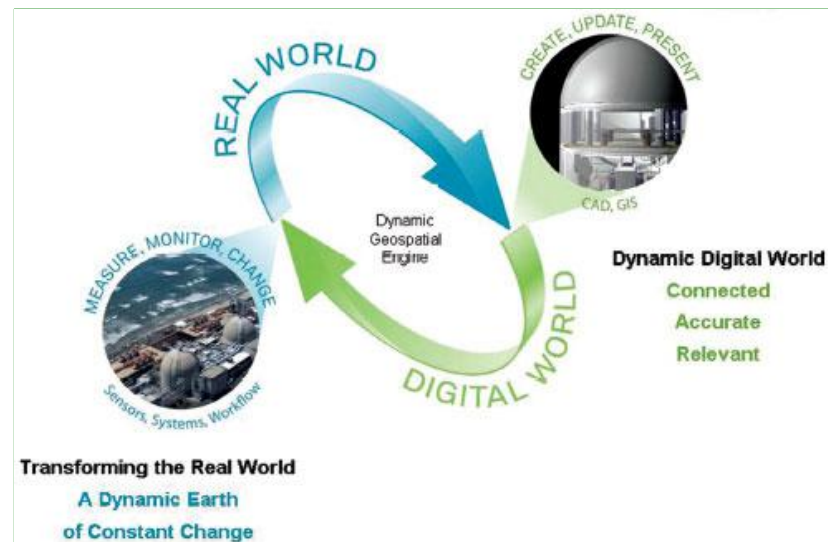


Internet of Things (IoT)

Major industrials have been preparing for IoT



- “In 2008, the number of devices connected to the Internet exceeded the number of people on Earth. By 2020, there will be 50 billion devices connected” - CISCO
- Internet of things to give \$10-15 trillion boost to global economy:
General Electric



"Redefining the language of geospatial industry"
Ola Rollen, President and CEO, Hexagon AB.

IoT is finally arriving: it's bubbling up from the grassroots.

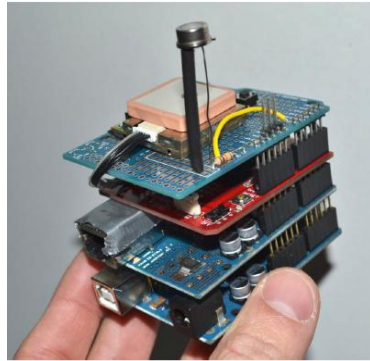


- IoT: long-prophesied phenomenon of everyday devices talking to one another — and us — online
 - Back in the '90s, big companies built systems to do tricks like this, but they were expensive, hard to use, and vendor-specific.
- Independent developers now using increasingly inexpensive sensors and open source hardware, adding intelligence to ordinary objects.
 - Sensor prices going down; sizes going down. Only limit is your imagination.
 - Cloud services – “If This Then That” - let devices interact in unexpected ways
- IoT has reached the “Apple II stage”
 - when a new technology finally becomes easy enough to use that thousands of people start using it.

Proliferation of IoT devices and Cloud Services



ARM® Cortex™-M0



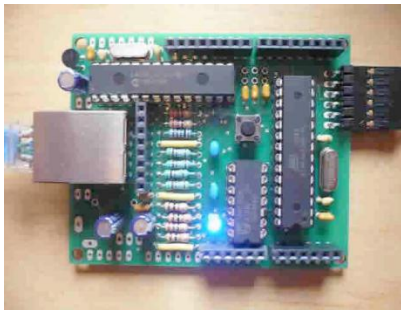
52North SenseBox



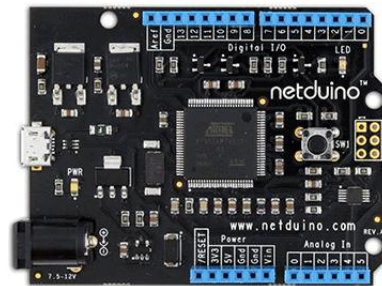
Koubachi



NEST



Nanode



Netduino



Twine



Mobile Development

One GB per mobile user per day by 2020

Applications are driving the network evolution



From: Yrjö Neuvo , Aalto University (Former CTO Nokia)
“Unfogging the Future” Opening speech at Microwave Week Amsterdam 2012

Mobile Development



- Mobile Growth
 - Mobile device market to reach 2.6 billion units by 2016
 - App downloads to hit 56 billion in 2013
- Forecast Growth of LBS
 - LBS revenues in Europe to grow from € 325 million in 2012 at a compound annual growth rate of 20.5 % to € 825 million in 2017.
 - 40 percent of all mobile subscribers in Europe use LBS
- Geospatial services need to consider “the other end of the spectrum has customers who do not use laptops and computers. They use cell phones and tablets
 - Ola Rollen, President and CEO, Hexagon AB



Indoor Frontier

Indoor Frontier



- The simple reason LBS has not quite yet lived up to the promise: people spend nearly 90% of time indoors
 - Joep van Beurden, CEO CSR Plc
- Indoor location brings a new dawn in mapmaking
 - Christof Hellmis, Vice President-Map Platform, Nokia
- Over 15,000 indoor venue maps throughout the world developed by one company: Micello
- Indoor infighting means technology companies are duplicating their efforts at great expense - The Economist

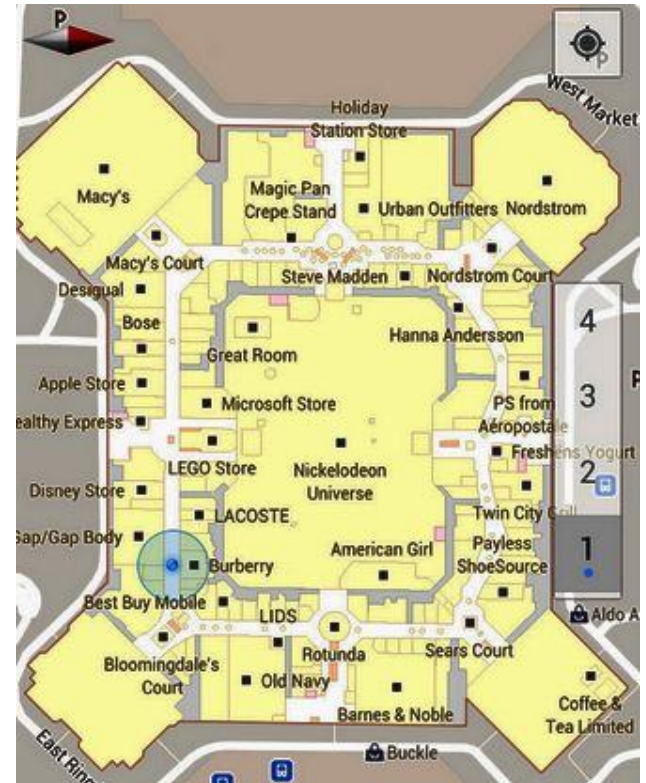
<http://informedinfrastructure.com/2668/interior-location-and-mapping-prompted-by-innovations-that-improve-position-and-navigation/>
<http://issuu.com/geospatialworld/docs/geospatial-world-annual-edition-january-2013>
<http://www.micello.com/>

Google Maps Indoors for Android



- “We use a special app that runs on an Android phone that creates the WiFi map in the same way we can locate you using cell towers,”
- “What we then do is combine that interior model with plans that the facility provides us.
- “Ultimately, that allows a 2-3 meter accuracy.”

Ed Parsons, Google



Google is increasingly providing indoor labels and navigation, with the ultimate goal of providing seamless navigation that act the same indoors as out.

IndoorGML: Multilayered Space Model



1st layer: **Topographic space model**

- **building' structure** (topography)
- geometric-topological model
- network for route planning

2nd layer: **Sensor space model**

- **sensor / transmitter structure**
- coverage of sensor areas
- transition between sensor areas



- Builds on existing International standards **CityGML** and **IFC**

- Already suitable for addressing, route descriptions and route tracking
- Add: sensor space model, mode of navigation, logical layers



Geographers Of The Future

Geographers Of The Future



- The major change in mapping in the past decade, as opposed to in the previous 6,000 to 10,000 years, is that **mapping has become personal**
 - Michael Jones, Google
- **Cybercartography:**
 - Organisation, presentation, analysis and communication of spatially referenced information on a wide range of topics of interest and use to society in an interactive, dynamic, multimedia, multi-sensory format with the use of multimedia and multimodal interfaces.”
 - DRF. Taylor 2003
- The future “living” 3D map must be extensible at every tier by every developer, not just GIS specialists
 - S. Lawler, Bing

Social Networking User Generated Information / Crowdsourcing

Source: <http://www.usahidi.com/>

Ushahidi: The 2010 Earthquake in Haiti. Transitioning to Noulia.ht. Ushahidi-Haiti @ Tufts UNIVERSITY. HOME REPORTS SUBMIT. Ushahidi. HOW TO HELP ABOUT. CATEGORY FILTER: ALL CATEGORIES, 1. URGENCES | EMERGENCY, 2. URGENCES LOGISTIQUES | VITAL LINES, 3. PUBLIC HEALTH, 4. MENACES | SECURITY THREATS, 5. INFRASTRUCTURE DAMAGE, 6. NATURAL HAZARDS.



Source: Erik (HASH) Hersman. Flickr

- Ushahidi
- InRelief
- OpenStreetMap
- Sahana
- CrisisCommons

InRelief.org. 79 days since Asia Floods. X 24 EXERCISE 24. InRelief.org Current Events. Houses are half submerged in heavy floodwater in Pakistan - Mon...

Source: www.inrelief.org

Sahana Technology and Features

- Environments
 - Linux, Windows, Portable App
 - VM, LiveCD, LiveUSB
- Translation & Localization
 - Poote, Character sets
 - Right-to-left scripting
- Messaging:
 - SMS, GPRS, e-mail
- GIS & Open Standards:
 - KML, WMS, GeoRSS, WFS
 - EDXL, CAP, JSON, XML
- Mobile Accessibility
 - Android, iPhone, iPad
 - Blackberry, NetBooks, Cellphones

27 May 2010 <http://www.SahanaFoundation.org>

Source: <http://www.sahanafoundation.org>

OpenStreetMap. Source: <http://www.openstreetmap.org>

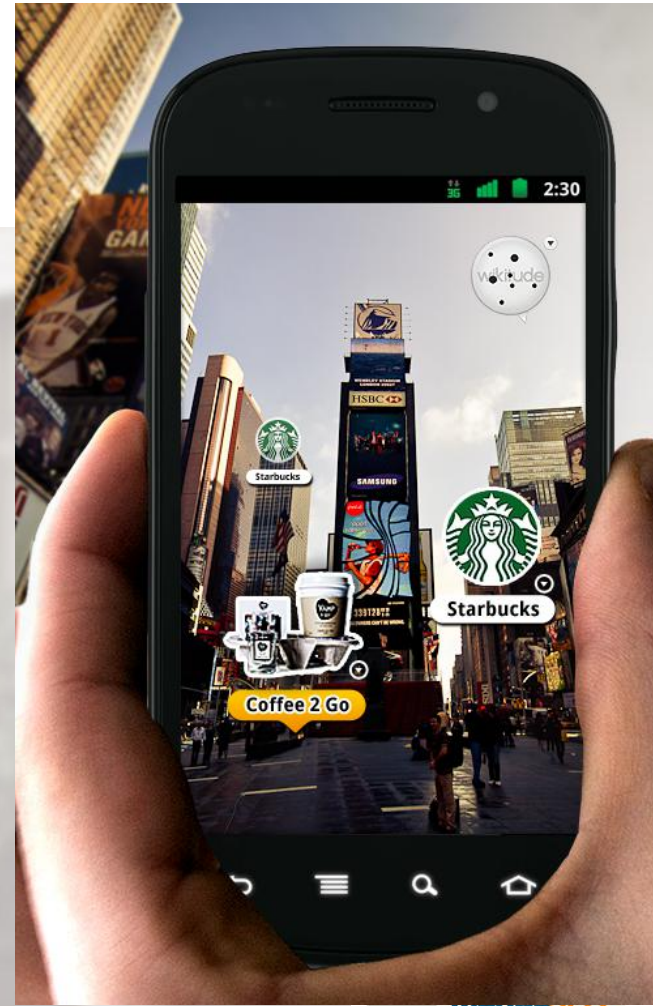
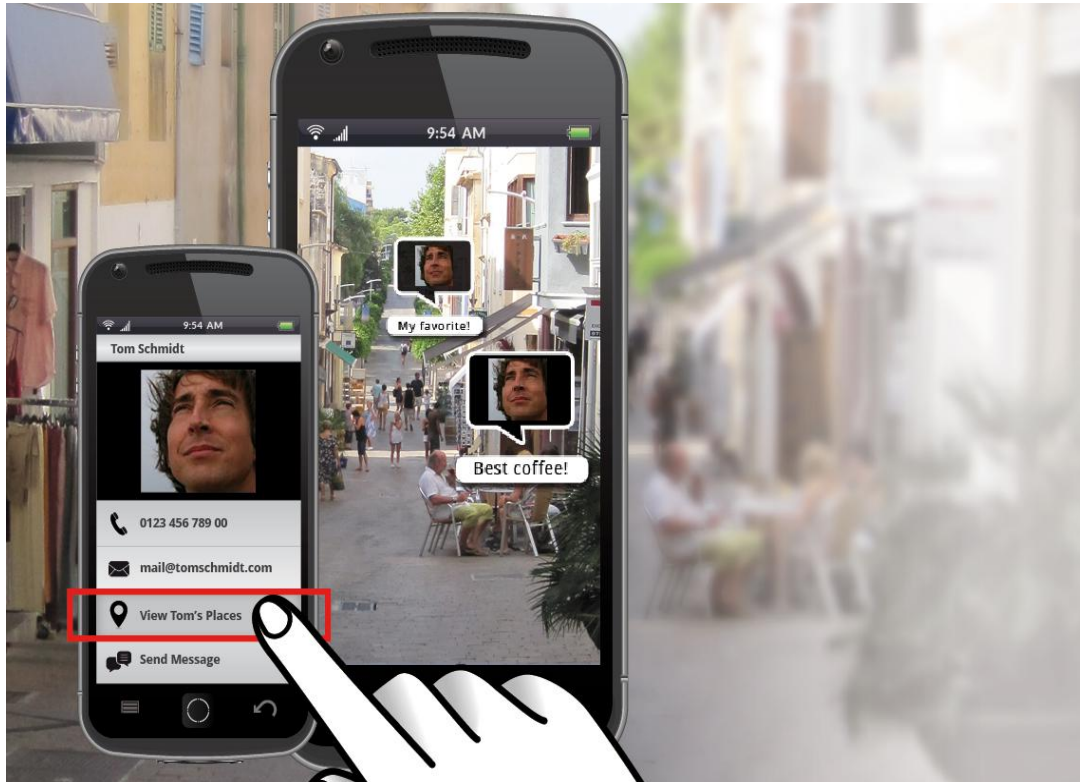
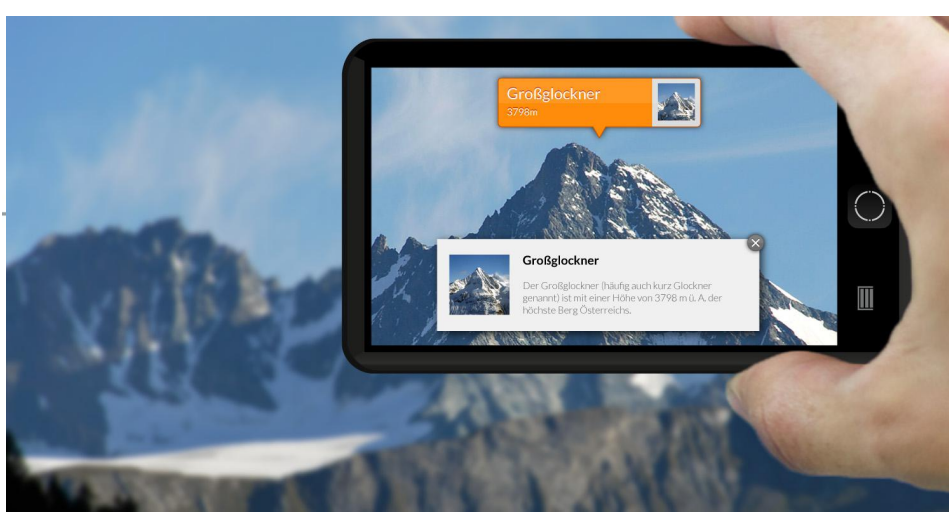
Semantics and the new geography



- “Real-world trellis and underlying data ontology”
 - The future is ‘Where’” - S. Lawler, Bing
- Semantic technologies progress
 - Google Knowledge Graph: contains more than 500 million objects, as well as 3.5 billion facts and relationships between the objects
 - But - the Semantic Web Services Challenge showed over a 5-year period, almost no one could simply reuse a previously successful ontology without close collaboration with its authors
- Geodata ontology development
 - OGC standards: GeoSPARQL and future
 - Could geo-ontologies be maintained by crowds?

<http://issuu.com/geospatialworld/docs/geospatial-world-annual-edition-january-2013>
<http://googleblog.blogspot.com/2012/05/introducing-knowledge-graph-things-not.html>
<http://ieeexplore.ieee.org/xpl/articleDetails.jsp?tp=&arnumber=6319309>
<http://ieeexplore.ieee.org/xpl/articleDetails.jsp?tp=&arnumber=6200249>

Augmented Reality



Evolution of Personal Geography



- **LBS**
 - Where am I in space – location determination
 - Where am I going – routing and guidance
 - What is interesting along the way – Pols
- **Social – Mobile – Local**
 - Where am I in the world and what is around? – Context
 - Apps that use context
- **Ubiquitous and IoT**
 - Sensing the world around me
 - World that responds to my presence



Geospatial Processing

Geospatial Processing



- Geospatial data is a big part of the Big Data problem
 - georeferenced data - an exabyte per day globally.
- Big Data Initiatives:
 - NSF
 - Big Data Public Private Forum (European Commission)
- Cloud Initiatives
 - Too many to count
- But what does the community need to do?
 - Geographic analytics
 - Geospatial models
 - Provenance
 - “Move beyond the interface”

Geospatial Analytics



- Analytic exploitation of the space-time features will usher in advances in high-quality prediction systems.
 - Space time features: the highest order bits - Jonas, Tucker
- Using algorithmic extraction and big data graphs to create and relate entities on the Web, organising them through a semantic taxonomy and enabling natural access
 - The future is ‘Where’ - S. Lawler, Bing
- Entity oriented analytics to transform raw data into actionable intelligence without external data models or human effort
 - Digital Reasoning

<http://issuu.com/geospatialworld/docs/geospatial-world-annual-edition-january-2013>
<http://www.digitalreasoning.com/>



Smart Cities

The Battle for Control of Smart Cities



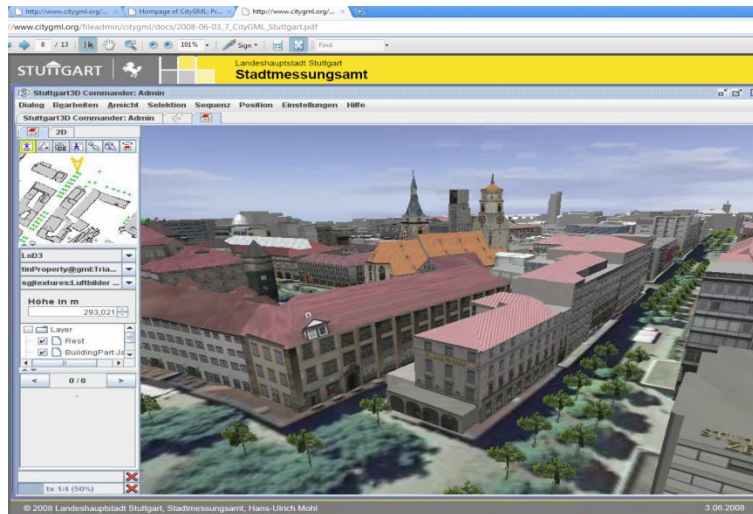
- Who will own the brains of smart cities: citizens or corporations?
 - At stake is an impending massive trove of data, not to mention issues of privacy, services, and inclusion.
- Battle in the streets between hacktivists pushing for self-serve governance and monopolies e.g., IBM or Cisco
 - Delicate balance between big companies and DIY spirit of “gov 2.0” champions
 - The urban poor could be the biggest losers.
- Achieving balance falls to smarter cities’ mayors, who must keep the tech heavyweights in check and “frame an agenda of openness, transparency and inclusiveness.”

Technology Needs



- Smart Cities advance through cooperation among standards organizations
 - *Futuristic scenarios will become reality as integrated standards platforms enable cities' and citizens' information systems to integrate information from GIS, BIM and civil engineering documents and services.*
- OGC brings
 - CityGML
 - LandXML
 - 3D Portrayal
 - ARML
 - SWE
 - Mobile for Sites

CityGML - 3D Urban Models



www.3d-stadtmodell-berlin.de



Source; Thomas Kolbe, Berlin TU

- **Urban Planning / Operations**
- **Emergency Mgt / Response**
- **Transportation / Routing / Logistics**
- **Indoor navigation**
- **Retail Site analysis**
- **Sustainable / Green Communities**
- **City Services Management**
- **Noise abatement**
- **Telecommunications placement**
- **Many other uses...**

OGC work in Smart Cities



- Develop a framework for the Spatial intelligence of cities
 - City Models: CityGML, IndoorGML, OpenLS Mobile for Sites (MfS)
 - OGC Indoor strategy: location, maps, routing
 - Opportunistic Sensing: SWE for IoT
 - Geospatial processing: Moving Features
 - Visualization: 3D Portrayal, ARML

Smart Cities domain is ripe for open standards



Policy Implementation

"Regulations to support a 'location-enabled' society" - Kevin Pomfret



- policy and legal developments are beginning to threaten broader adoption of geospatial technologies and consequently the creation of location-enabled societies.
 - including concerns over privacy, increased government regulation, uncertainty over ownership rights in location information, issues involving national and homeland security as well government funding challenges.
- combining spatially-enabled information from governments, commercial enterprises (and increasingly, individuals) from around the world will be subject to differing and uncertain intellectual property regimes.
- must take into account that a person's location information is different from other types of personal information.

Questions ?



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- Predicting intent
- Location data quality

- **Internet of Things**

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