Drawing the Big Picture:
Geographically Integrating Information
Google Mission

“To geographically organize the world’s information and make it universally accessible and useful.”
'The Power of Where'
Integration Platform
Physical vs Virtual Worlds
Spatial Data Infrastructures
Infrastructure

A reliable environment supporting
• multiple and diverse applications
• for different (and future) users,
• provided and maintained by different stakeholders
• under defined business models.
• like: transportation, telecommunication, electricity, ...
<table>
<thead>
<tr>
<th>Data</th>
<th>Measurements</th>
<th>Observations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Databases</td>
<td>(Object-)Relational</td>
<td>NoSQL</td>
</tr>
<tr>
<td>Services</td>
<td>WFS(T)</td>
<td>WMS</td>
</tr>
<tr>
<td>Spatial Data Infrastructure</td>
<td>Query</td>
<td>Analysis (WPS)</td>
</tr>
</tbody>
</table>
Public Transport App
Cloud Computing
Techware vs. Brainware
Sensors, Sensors Everywhere
Lukole / Tanzania

Distribution of dwellings 2002
- Low
- Medium
- High
- Very high

Lukole, Tanzania

<table>
<thead>
<tr>
<th>Date</th>
<th>Number of extracted dwellings</th>
</tr>
</thead>
<tbody>
<tr>
<td>24 Sep 2000</td>
<td>23377</td>
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<td>16 Dec 2005</td>
<td>7944</td>
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<tr>
<td>26 Jun 2013</td>
<td>40</td>
</tr>
</tbody>
</table>
People as Sensors
Collective Sensing
Christchurch Earthquake Ushahidi Trends

Filter Reports
- All Categories
- Property Damage
- Roads Affected
- Hazards
- Trusted Reports
- Evacuations
- Power Outages
- Help/Services

Source: http://eq.org.nz


Map Data Copyright © 2011, Mapbox
World Trade Center

Aggregated call intensity
Central Station

Aggregated call intensity
Mobility patterns
Urban Mobility
(handovers in mobile networks)

Characteristic temporal mobility patterns per day of week

Exceptional events
Relationships on facebook
THE INTERNET of THINGS

CONNECT THE WORLD
(The “Internet of Everything”)

Source: Cisco Whitepaper 2013

Connecting the Unconnected
Graphs are the basic representation.
...and it links with static data.
Progression of Geospatial Information

- **Device-Centric Geospatial Information**
- **Human-Centric Geospatial Information**
- **Feature-Centric Geospatial Information**
- **Region-Centric Geospatial Information**

number of users vs. size of space:
- **IoT Space**
- **Indoor Space**
- **Pedestrian Navigation**
- **Car Navigation/Web Map**
- **Urban Planning/Civil Engineering**

Source: S. Liang

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About the forest and the trees ...
Multi- / Inter- / Trans-Disciplinary

- Mathematics: Theory of Graphs, Networks, Statistics, Game Theory...
- Psychology: Social attitudes, Cognitive properties, Human Information Processing, Experimental Methods...
- Biology: Evolutionary dynamics, Systems biology, Plasticity...
- Sociology: Social attitudes, Theory of groups, Social networks, Plume Tracing...
- Ecology: Structure of ecosystems, Ecosystem Productivity, Population Dynamics, Digital Biosphere...
- Computer Science: Computability, De-centralised Information Systems, Semantic Web, Process Calculus...
- Artificial Intelligence: Knowledge Representation, Languages, Inference, Bayesian Methods, Agent Based Computing...
- Economics: Theory of Markets, Macro and Micro economics, Auction models, Types of capital...
- Law: Intellectual Property, EU/regulatory drivers, Public engage vs indifferent, Corporate social responsibility...
- Media: Fragmented public media and discourse, Single issue moral panics, Smart mobs, Mobile opinion formers...