



Prepared for the IQPC  
Advanced Navigation Conference Pottsdam  
November 2008

# Workshop

## Updating Map Data Used in Navigation Devices

### Crowd Concensus versus Expert Witnesses

Michael L. Sena  
Pottsdam  
November 2008



## Introduction

- 1969 Bachelor and 1972 Master Degrees from Princeton University in architecture and urban planning
- 1972 – 1977: London and Boston – Computer-aided design and planning
- 1978 – 1982: Boston and Stockholm - Digital cartographic production
- 1983 – 1992: Matrix Consultants - Consulting in digital map production for cartography and navigation applications to map publishers (Rand McNally, K+F, others) and automobile travel clubs (AAA, AA, Michelin)
- 1993 – 1996: Volvo Technological Development Corporation. Director of navigation and traffic map data; strategy for telematics introduction; expert on CEN and ISO digital map working groups
- 1997 – Present: Michael L. Sena Consulting AB – Consulting in navigation systems and applications; strategic consulting and project management in telematics. Project manager for implementation of Volvo On Call telematics system in 15 European countries.
- 2008 – Full-time assignment with Hughes Telematics as Vice President of European Development

## Workshop Overview

- Background: Map updates have been performed by experts. Some believe that crowds can do a better job.
- What needs to be updated and how is it being approached?
- What are the deficiencies in the current approaches?
- Can the wisdom of crowds move the locus of competition?
- What are the opportunities and threats for businesses?



## The Thesis

- *Crowdsourcing* can be applied to map updating under certain circumstances, but not as a general rule.
- User Generated Content (UGC) is fine for annotating (tagging) Points of Interest, but is probably not suitable for navigable map data.
- Map data content generation and updating can be greatly improved by a wider deployment of location-enabled mobile devices.



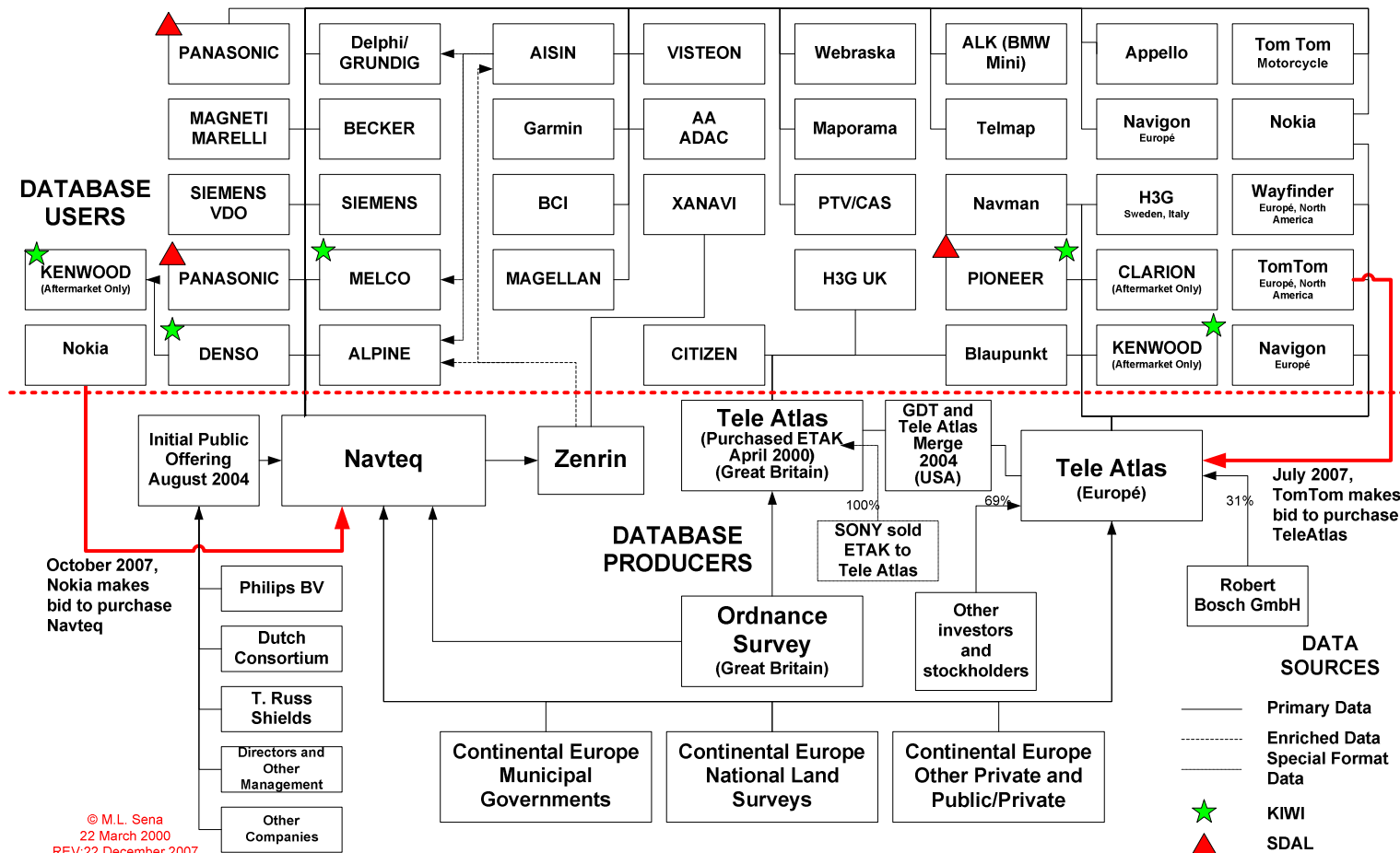
## Information Context #1

- Navteq, Tele Atlas, JDRMA and other navigable map database producers have created closed systems to produce proprietary intellectual property that the world depends upon for all of their location-based service applications.
- The methods used to create these resources beginning over twenty-five years ago were, and continue to be, critical to the way the data were collected and stored and the ultimate success of the companies:
  - Navteq created a single, mainframe-based database covering the world; license only when absolutely necessary, try to never pay royalties, and own it outright.
  - Tele Atlas based its future on automatic scanning and conflation of different data sources; license different sources, pay royalties when convenient, and cover as much ground as fast as possible
  - JDRMA built its database on the Japan Land Survey's base. It has affected everything from the way routes are planned to how traffic information is delivered.
- Building and maintaining their databases required the special training on the proprietary systems and methods that each of these organisations had invented.



# The Experts and Their Customers

## European Digital Map Sources, Producers and Users



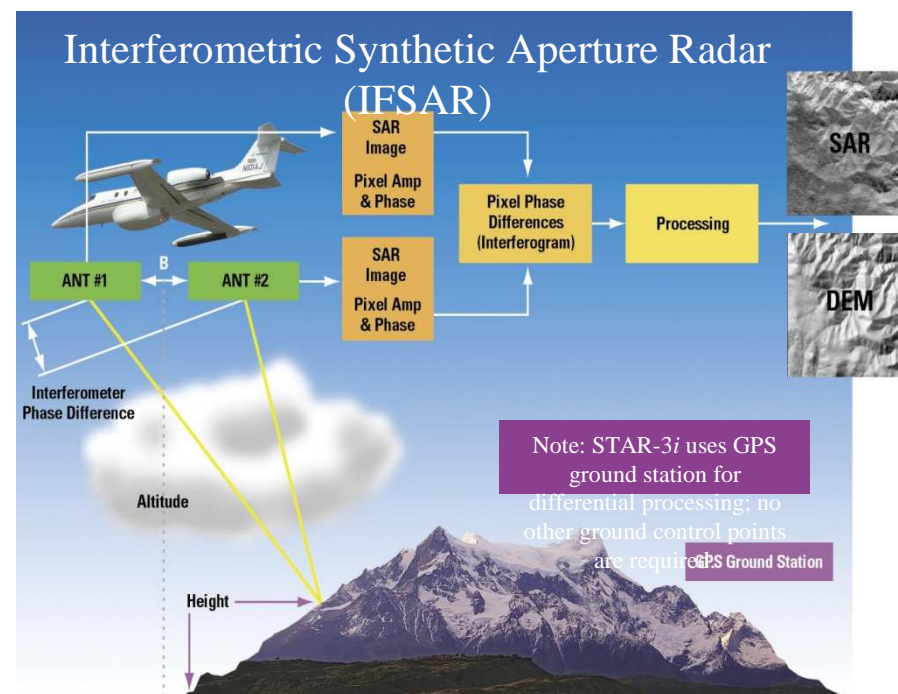
© M.L. Sena  
22 March 2000  
REV:22 December 2007

## Information Context #2

■ The methods that we have available today for **collecting and storing information** are different than what was available when navigable database management systems were designed and implemented twenty plus years ago.

■ Today

- ✓ Mobile phones
- ✓ GPS
- ✓ Differential GPS
- ✓ The Internet
- ✓ High precision aerial photography
- ✓ Navigation systems for route testing
- ✓ Collaborative tools



## Information Context #3

- The methods that we have available today for **interacting with information** are very different from how people worked with data even a decade ago.

In their 2007 book, *Connecting to the **Net.Generation**: What Higher Education Professionals Need to Know About Today's Students*, Reynol Junco and Jeanna Mastrodicasa found that in a survey of 7,705 college students in the US:

97% own a computer

97% have downloaded music and other media using peer-to-peer file sharing

94% own a mobile phone

76% use instant messaging and social networking sites

75% of college students have a Facebook account

60% own some type of portable music and/or video device such as an iPod

49% regularly download music and other media using peer-to-peer file sharing

34% use websites as their primary source of news

28% author a blog and 44% read blogs

15% of IM users are logged on 24 hours a day/7 days a week

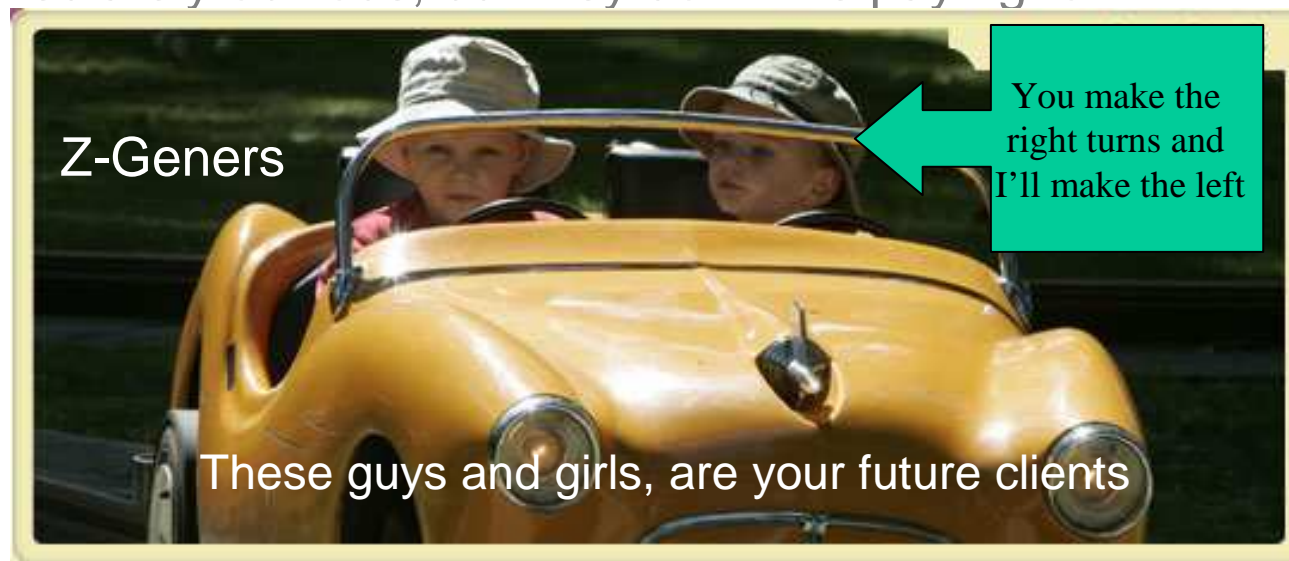


## The Ne(x)t Generation of Prosumers

- Net Generation boys and girls (baby-boomers' kids born between '78 and '94 known as **Net Geners\***) have grown up with free access to information being a birthright.
- They participate in multiple social networks in order to obtain the best information that is available, and they don't like paying for it.
- Proprietary platforms and formats are accepted only if the benefits are immediately obvious, but they don't like paying for them.

Xgen – '65-'81  
Ygen – '82-'94  
Zgen – '95-

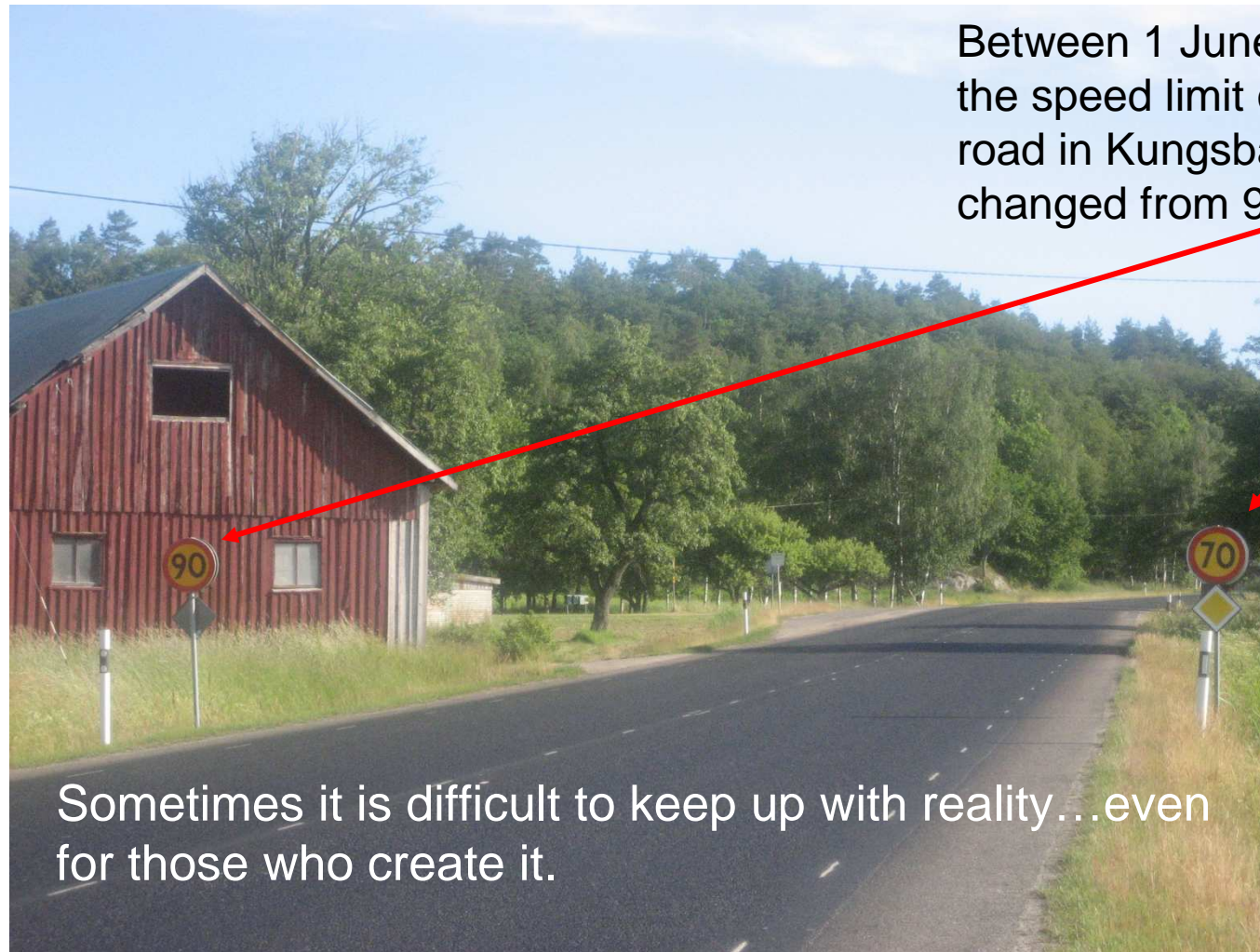
\***Net Generation** coined by  
Don Tapscott in *Growing up  
Digital* (1997)



## Getting to know us

Query: Of the total number of us_____	Response
How many of us have bought a book on Amazon?	
How many of us have bought or sold anything on eBay?	
How many of us have used Wikipedia?	
How many of us contribute to an open source effort?	
How many of us have our own blog?	
How many of us have our own space on My Space?	
How many of us regularly use Face Book?	
How many of us use Firefox and/or Linux	
How many of us have a child born between '82 and '94?	
How many of us have a child born after '94?	
How many of us are X-Geners – born between '65 – '81?	
How many of us are Y-Geners- born between '82 – 94?	

## So what's the problem with data?



Between 1 June and 1 September the speed limit on a 9 km stretch of road in Kungsbacka, Sweden is changed from 90 km/h to 70 km/h

Sometimes it is difficult to keep up with reality...even for those who create it.



## Map by Eniro and Swedish Land Survey



Walking and cycle path June 2007 not shown

New Road opened June 2007 not shown

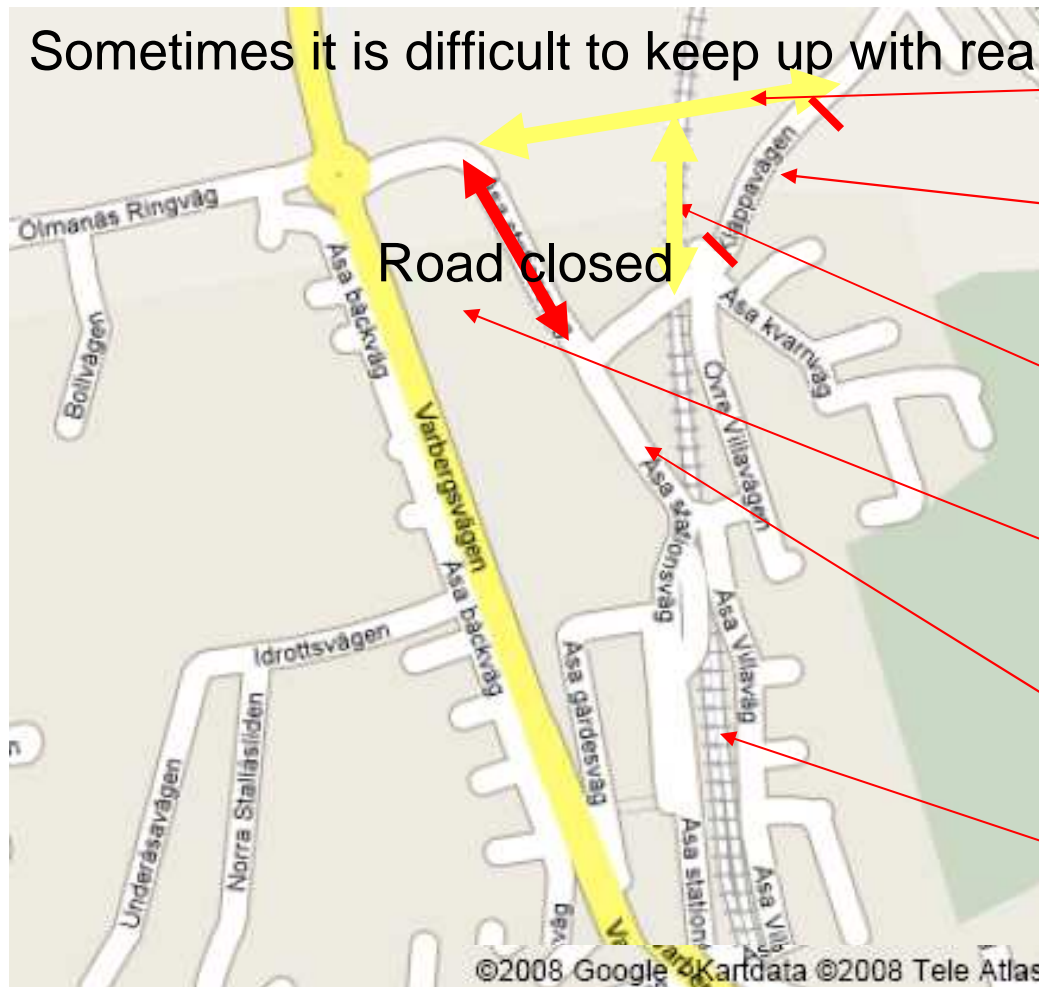
**Our house**

Railroad track bed moved 1 km to east November 2005

New Intermediate School not shown

Map by Google and Tele Atlas

Sometimes it is difficult to keep up with reality.



New Road opened  
2006 not shown

Walking and cycle path June 2007 not shown

New Road opened  
June 2007 not shown

New Intermediate  
School not shown

## Our house

Railroad track bed  
moved 1 km to east  
November 2005



## Map by Microsoft and Navteq

Sometimes it is difficult to keep up with reality.



New Road opened  
June 2007 not shown

Walking and cycle  
path June 2007 not  
shown

New roundabout  
correctly shown

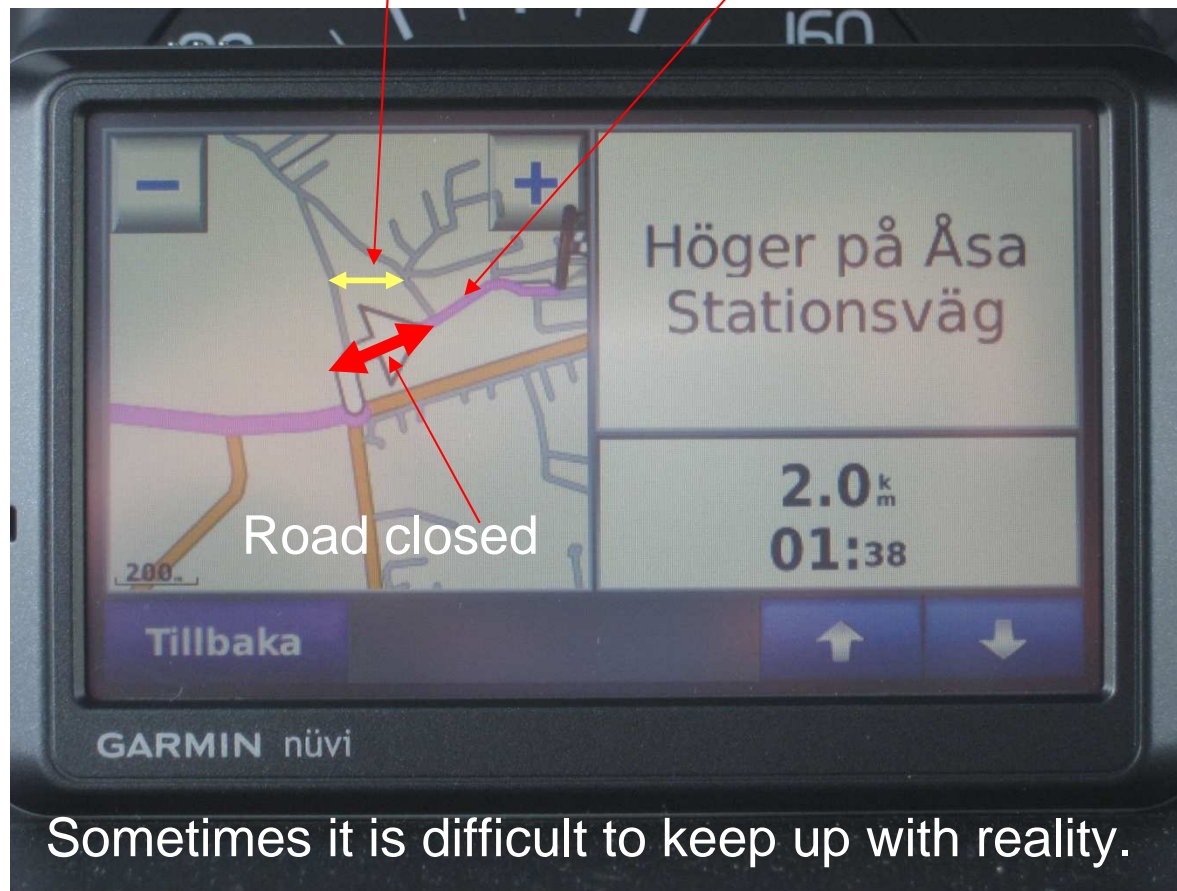
New Intermediate  
School not shown



## Map by Navteq; PND by Garmin

New Road opened  
June 2007 not shown

**Our house**



Sometimes it is difficult to keep up with reality.

The Garmin system was purchased July 2008. The correct route is along the yellow arrow on the road that was opened in June 2007. The right turn show by the large arrow, and the voice instructions, lead into a school parking lot that does not have access to a through road.

## Reality

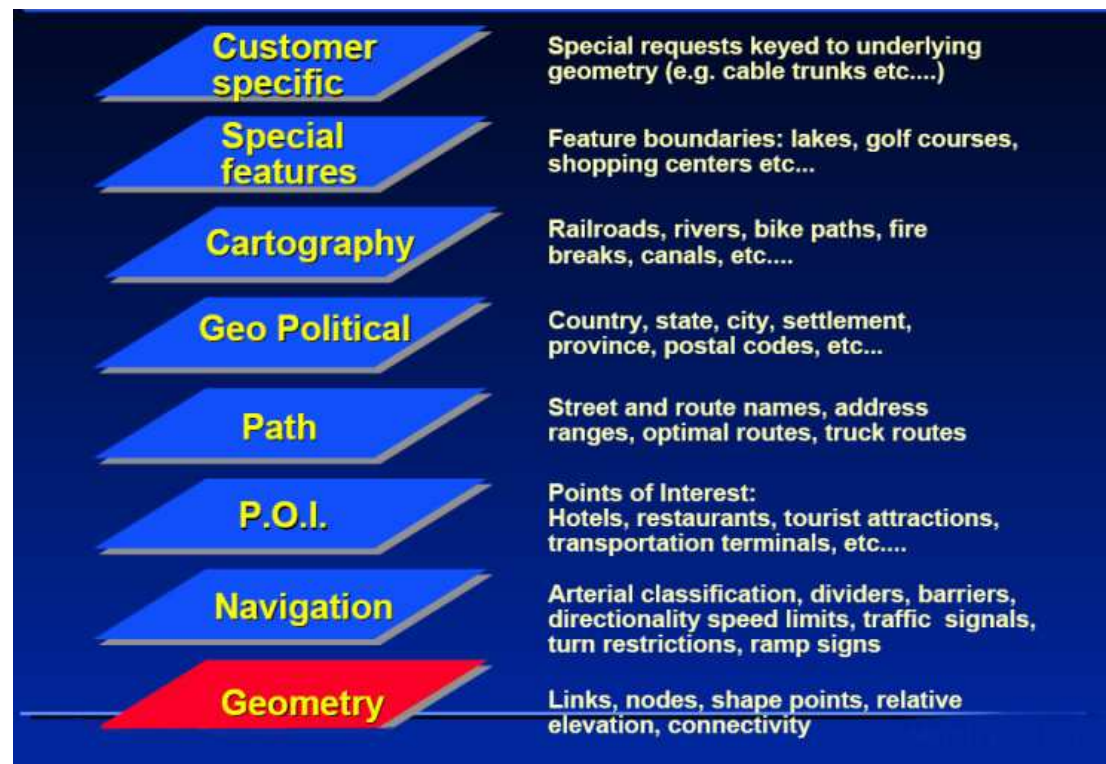


New Intermediate School not shown on any maps. Construction began summer of 2007.

The road leading through the new school grounds was closed in June 2007 when a new road to the east was opened

## What needs updating?

- What is fixed on the ground
- What can be changed by humans
- What can be changed by other forces (e.g. effects of natural disasters)
- What changes on its own (e.g. traffic)
- What is always changing (e.g. events)



## Different kinds of data needing updating

- Navigable data
- Detailed geometry and slope
- Geo-coded locations
- Aerial photography
- Digital terrain models
- 3D building geometry
- Traffic information and other types of travel-related data



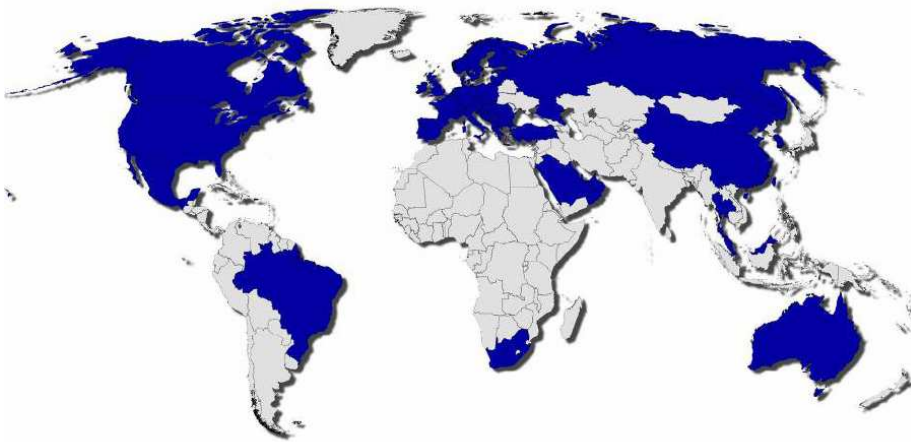
**Zenrin navigation map image of London**



## Gathering the Data: The main problem is that the experts have their hands full with adding new countries

### The Industry's Largest Navigable Footprint

Fifty nine countries – one global specification



- Both Navteq and Tele Atlas have specific plans to map the entire world, and they are making progress.
- For example, Navteq increased their coverage of Mexico from 20% detailed coverage in 2006 to 40% in 2007, launched initial coverage in Turkey, Belarus, Moldova, India, New Zealand, Indonesia, and they will be adding all cities over one million in population in Russia during 2008.
- They are working to provide coverage in the Middle East and on the African and South American continents.
- Can they keep up with updating as well?

# What is the best way to update map data

Experts Collecting  
Data from Experts

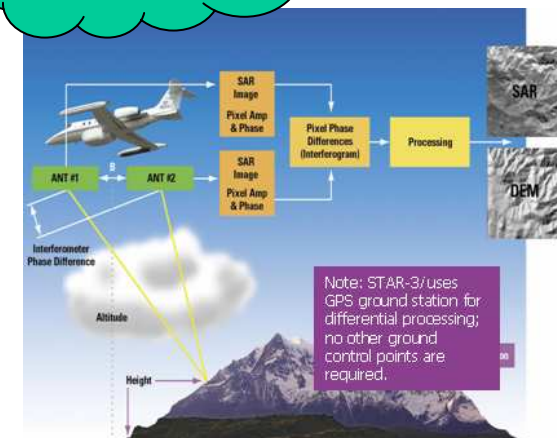


What we are  
thinking about  
doing tomorrow

Any man or woman  
on the Street  
**Crowdsourcing**

Automated  
Sources

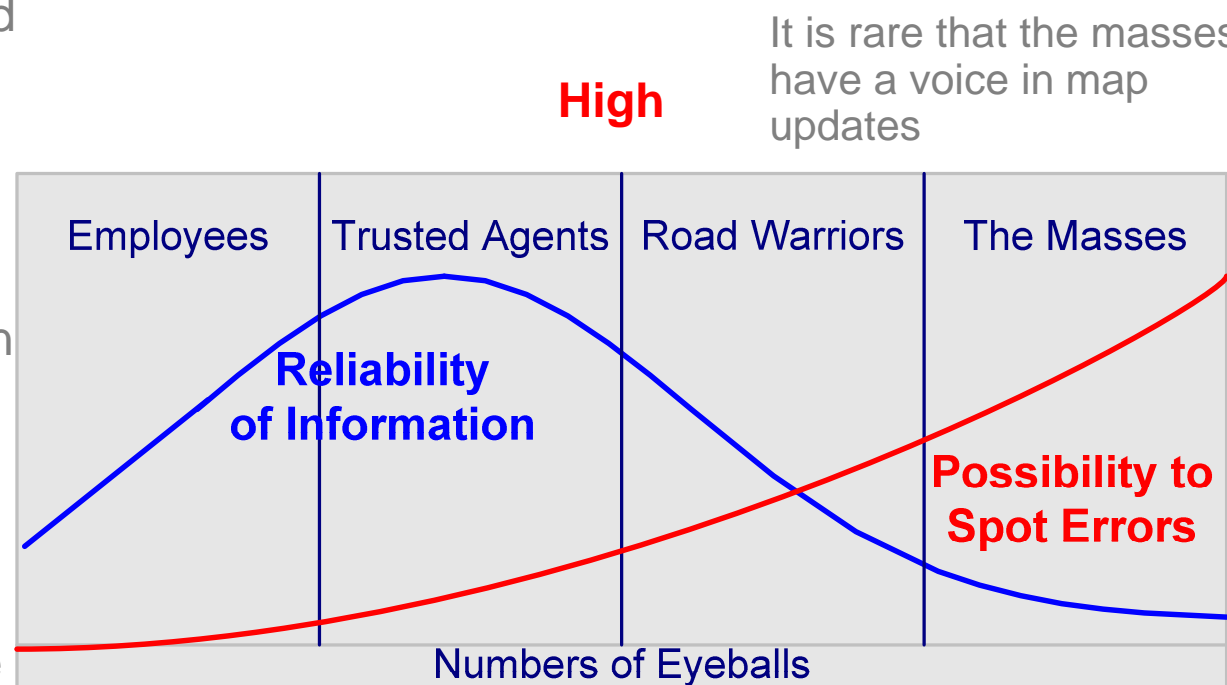
What we are  
mostly doing today





## Traditional View of Map Updating

- Maps have been produced and updated by experts, usually employees of the organisation responsible for the maps.
- Some groups rely on trusted agents to report new information.
- Authorised non-professionals (road warriors) are a source of last resort.
- Rarely are customer corrections taken seriously.

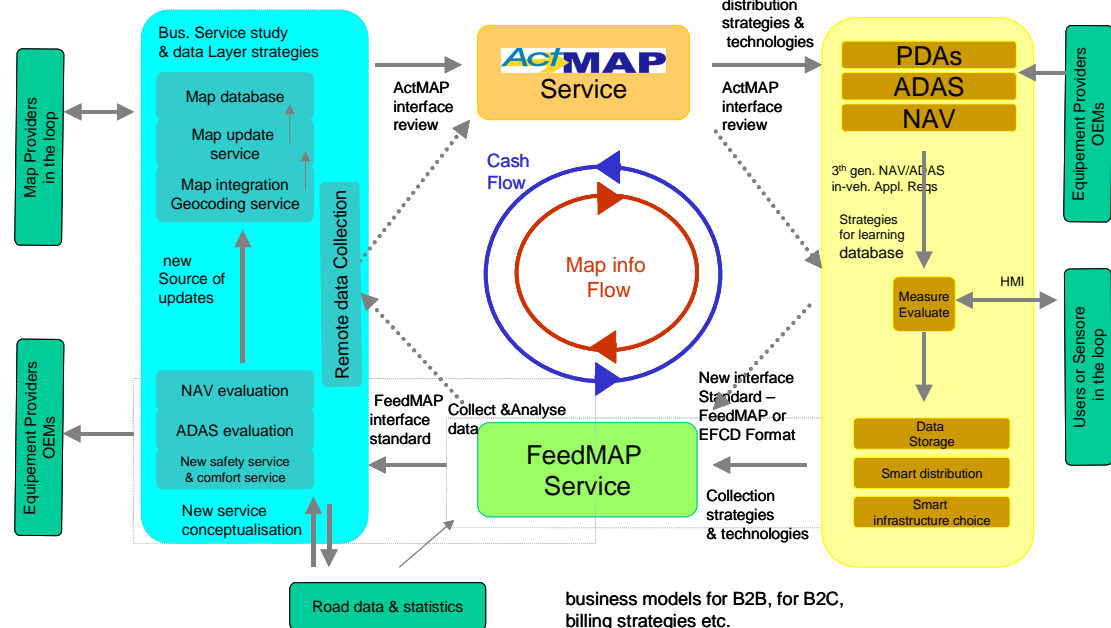


The traditional view is that reliability of error reports decreases the further away a person gets from being a company employee

## Building Updating into the Processes

- The **FeedMAP** project is developing a framework that will detect map errors and then will quickly update the maps of all other vehicles using a standardised mechanism for delivering incremental map updates as developed in the **ActMAP** project.
- There are two major sections of the project:
  - Deviation detection
  - Deviation analysis

BMW Group; Daimler; Centro Ficerche Fiat; Volvo Technology Corporation; Navteq; Tele Atlas; PTV; Navigon; Magneti Marelli; Swedish Road Administration; (German road authority); ICCS; ERTICO; and the Bayern Road Authority (Oberste Baubehörde). Siemens VDO was originally part of the project, but backed out when they were purchased by Continental.



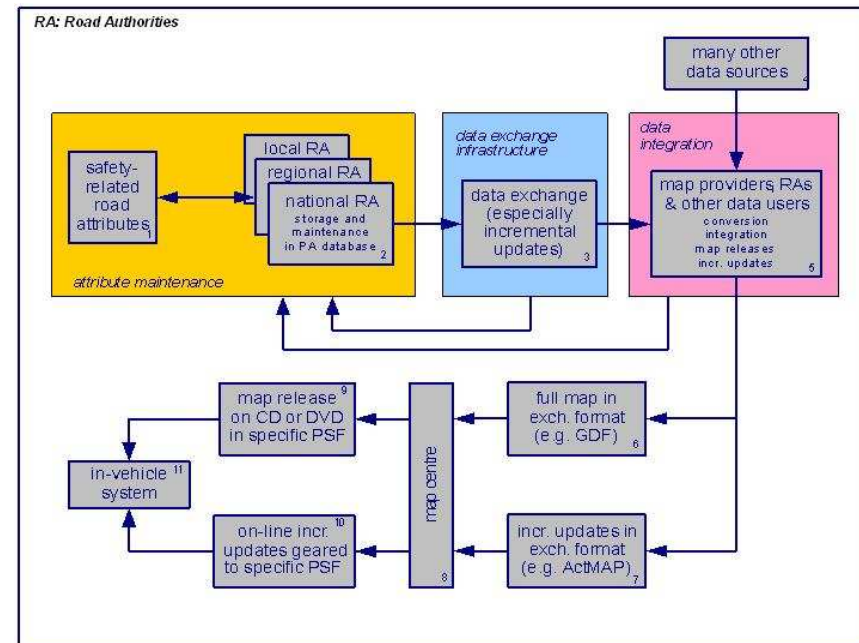
## Getting More Experts Involved: Trusted Agents

The principal objectives of ROSATTE are:

- Use public authorities and road operator data as sources for maps used in all types of safety-related applications.
- Develop standardised interfaces between the public map sources and the digital map data producers.

**The project has just started and no concrete results are available. Follow this project closely.**

### **ROSATTE** (ROad SAFety ATtributes exchange infrastructure in Europe) **EU-FP7-financed project – start 080101**



## High accuracy laser/inertial profiling

- The Swedish Road Administration use modern Profilographs to measure road geometry and surface condition, while driving at normal traffic speed.
- Typical results include Curvature, Cross slope, Rutting (depth, width, shape), International Roughness Index, Megatexture, Macrotexture and calculated reference ride vibration and ride quality.
- They use satellite technology to position the results into a GIS. Relevant national and international standards, such as ISO 2631, are used to guarantee traceability and quality in the work.

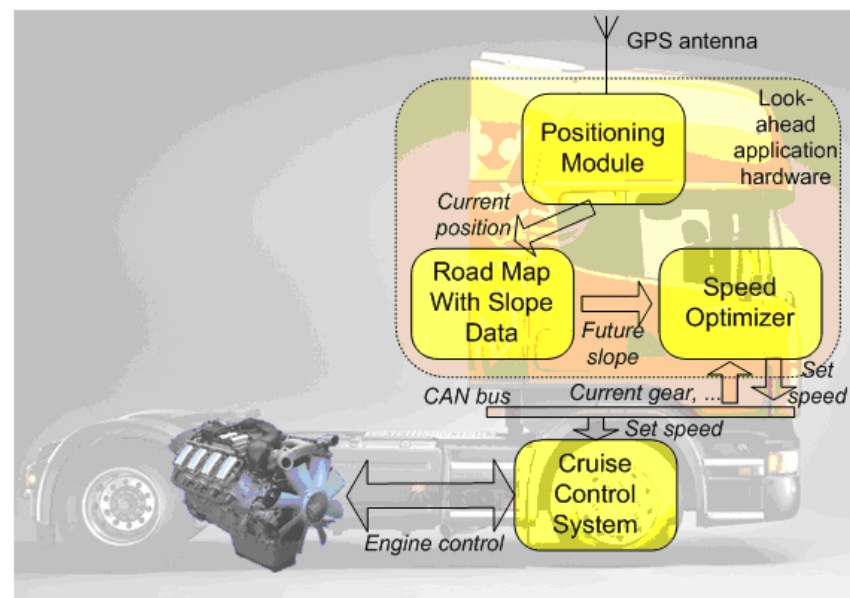


The laser measurement vehicles are equipped with a total of nineteen lasers, seventeen of which are placed in a beam on the front of the vehicle, and the remaining two are mounted on the back.

## Truck applications need high quality data

- **Static Data:** Slope with a high absolute accuracy and actual speed limits are two attributes that are important for route planning for trucks, but which are both difficult and expensive for the private map suppliers to collect using current data collection methods.
- **Dynamic Data:** Variable speed limits, temporary speed limits, roadwork-related detours, temporary road restrictions are a sample of what the national and local road authorities can provide.

### The Scania Trucks Application Platform



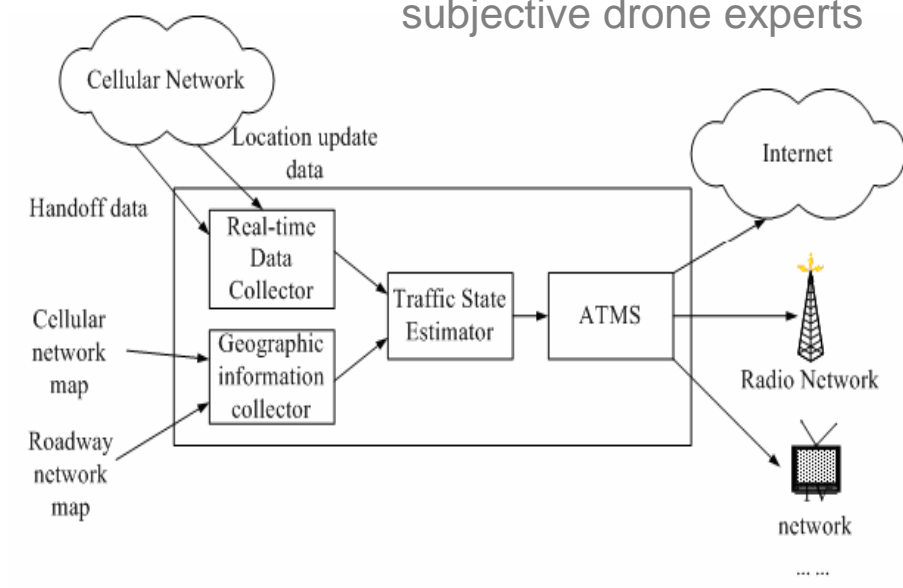
Detailed road slope and curvature information are two of the most important attributes for both safety and performance applications.

## Integrating Invisible Data: Trusted Non-human Agents

The diagram illustrates the system architecture of a **cellular floating vehicle data** system. It includes the three basic functions that need to be present:

- Real-time data collector to retrieve the data from the wireless carrier;
- Map data collector to generate and store both the cellular network related map data and the roadway network map data; and,
- A traffic data estimator that converts the real-time cell phone data into the required traffic flow information.

Literally, Machine Vision  
Not eyeballs, but non-  
subjective drone experts





Take a breather

# Historic Comparison

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## The Mapping Industry Circa 1982

	Swedish Land Survey	Kümmerly+Frey	Esselte Kartor	Rand McNally
<b>Distribution</b>	Own Shops Own Distribution and Contract	Own Distribution and Contract	Own Shops Own Distribution and Contract	Own Shops Own Distribution
<b>Manufacturing</b>	In-house and Contract	In-house	Contract	In-house
<b>Production</b>	Manual	Manual and Automated (Scitex)	Manual and Automated (Scitex)	Manual
<b>Design</b>	Manual	Manual	Manual and Automated (Scitex)	Manual
<b>Content Aggregation</b>	Manual and Automated	Manual	Manual and Automated (Intergraph)	Manual
<b>Content Sourcing</b>	Aerial Photography & Land Survey	Own Collection and License Gov't Maps	Own Collection and License Gov't Maps	Own Collection and License Gov't Maps

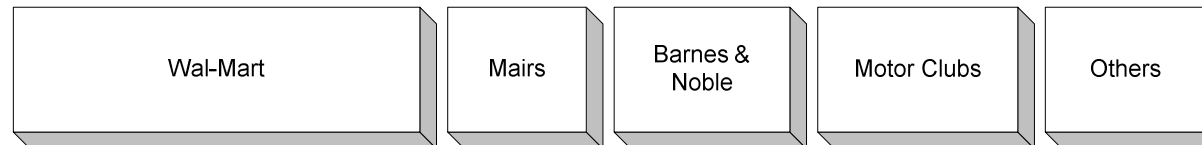
# Twenty Years Later

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## The Paper Mapping Industry Circa 2002

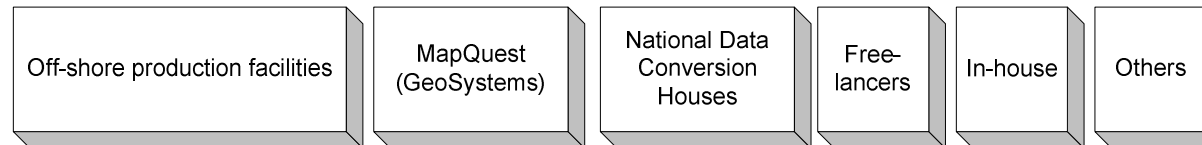
### Distribution



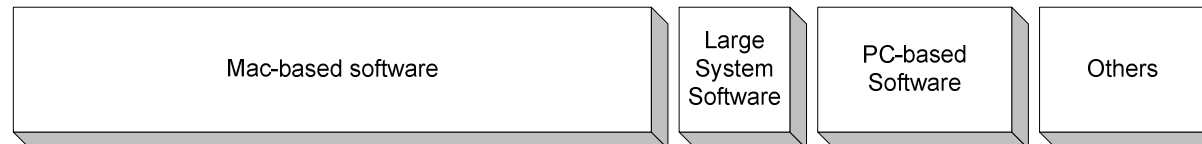
### Manufacturing



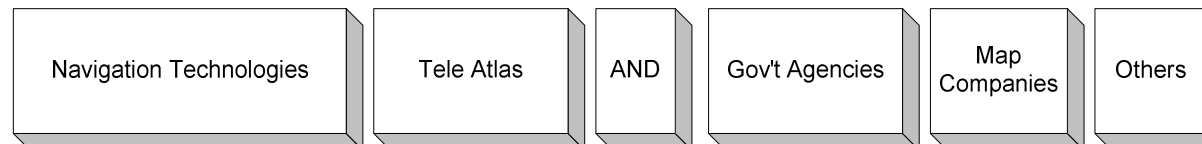
### Production



### Design



### Content Aggregation



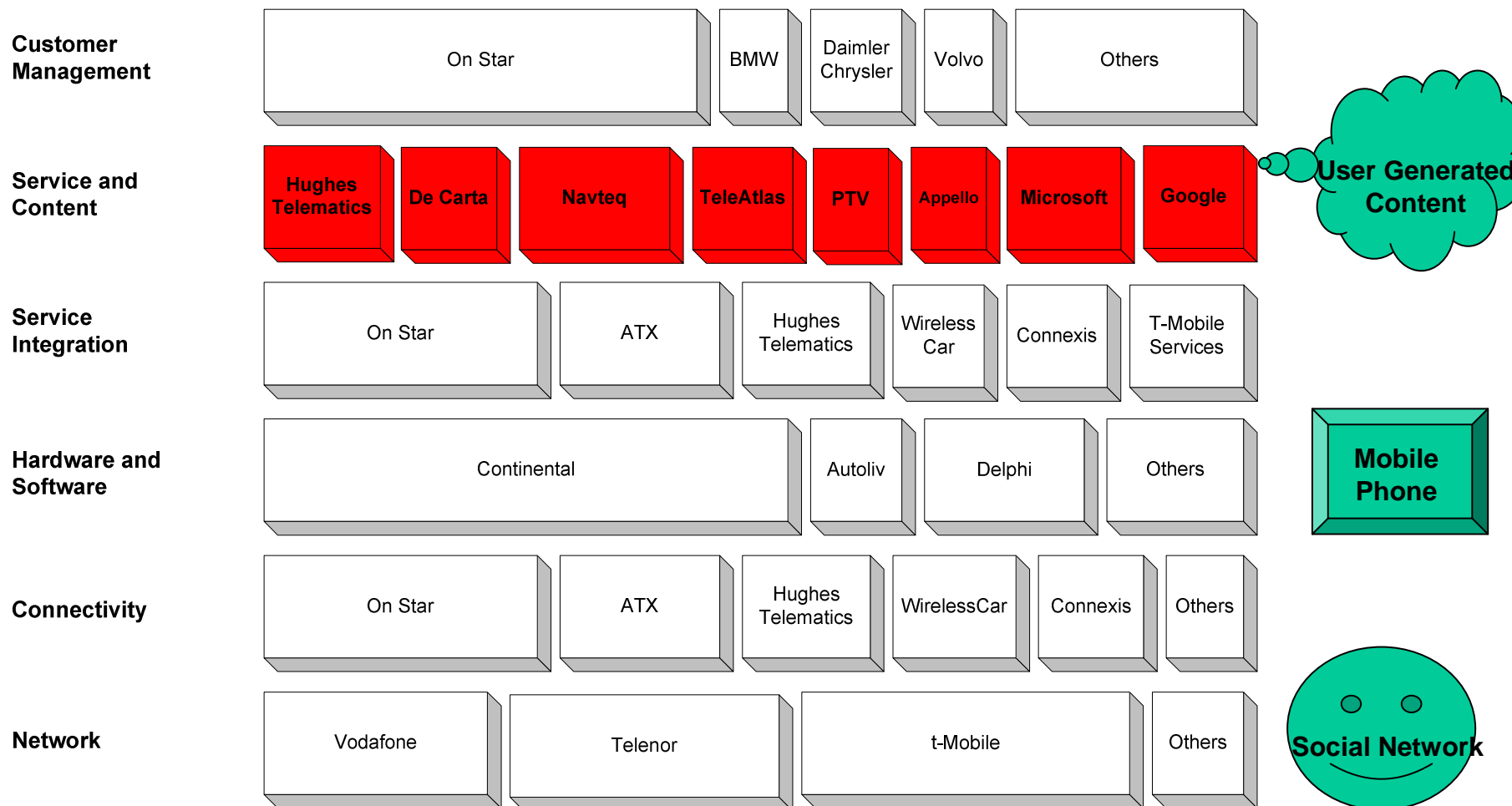
### Content Sourcing



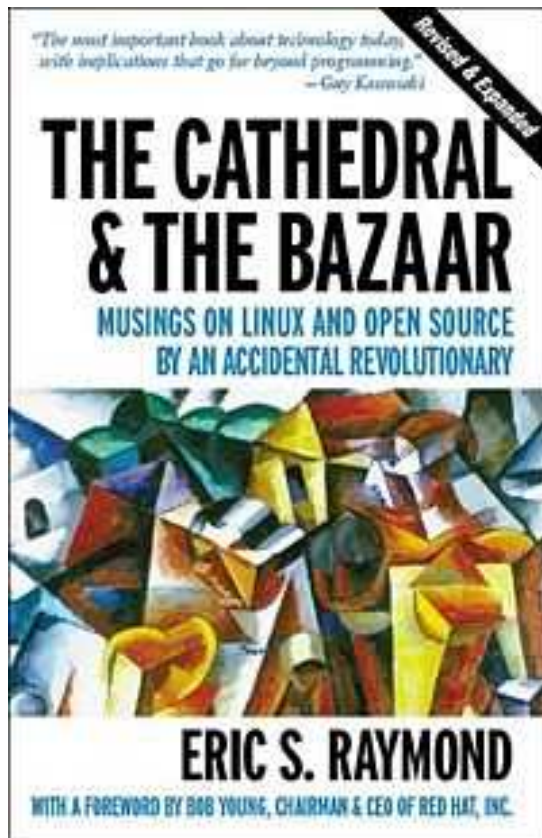
# Total Change: Today

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## In-vehicle Location-based Services - The Horizontal Industry Structure



## From consumers to **pro**(ducers/con)**sumers**: Cocreating goods and services



- The *Cathedral* model, in which source code is available with each software release, but code developed between releases is restricted to an exclusive group of software developers.
- The *Bazaar* model, in which the code is developed over the Internet in view of the public. Raymond credits Linus Torvalds, leader of the Linux kernel project, as the inventor of this process. Raymond also provides anecdotal accounts of his own implementation of this model for the fetchmail project.

## Linux + Unix = Linux



Linus Torvalds

The Linux community seems to resemble a great babbling bazaar of differing agendas and approaches out of which a coherent and stable system could seemingly emerge only by a succession of miracles

### Linus's Law

Given enough eyeballs,  
all bugs are shallow.  
(i.e., become trivial)

Eric S. Raymond



## Open Source versus Proprietary Information

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### Open Source

- Nobody owns it
- Everybody can use it
- Anybody can improve it

### Open Street Map

Communities of producers use general public licenses to guarantee users the right to share and modify created works provided that the modifications are shared.

### Proprietary

- Somebody owns it
- You can use it for a price
- Only the owner can make it better

### Navteq; Tele Atlas

Traditional intellectual property rights confer the right to exclude others from using or distributing creative works.

## A Dialectic: Objectivism versus Post Modernism

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### Objectivism

- Truth exists independently of the minds and opinions of individuals. Truth is objectively knowable.
- Ayn Rand in *Fountainhead* and *Atlas Shrugged*

### Post Modernism

- There are many truths, depending on the perspective of the observer.
- *The Postmodern Condition* by Jean-François Lyotard

### Wikipedianism

- Reality exists, it is knowable, and it can be discovered through consensus of many observers.
- Jimmy Wales, founder of Wikipedia

## The models for Open Source/Wikipedianism

- Mass Collaboration – Widely distributed production using specially designed tools (e.g. Wikipedia, Linux, OpenStreetMap)
- Crowdsourcing – Going beyond outsourcing, giving the assignment to any taker anywhere (e.g. Longitude, X Prize, DARPA Challenge)
- Peer Production – Voluntary labour (e.g. MySpace, YouTube, )
- Prosumers – Making your customers your co-producers (e.g. MapShare)

## Is there Knowledge in Numbers?

- Zagat Guide Books – been there, rated that and maybe even got a free meal.
- Wikis – Anyone can be an expert, but peers will eventually correct the mistakes.
- TomTom's Map Share – give me your knowledge
- Open Source – power to the people
- Open Street Map – Together we can
- YouTube/FaceBook – Show me yours and I'll show you mine
- Mash-ups – Something for nothing, and the drinks are free

### Wikipedia

- "The online encyclopedia that anybody can edit and that has arguably become the single best example of user-generated content, audience participation, the hive mind, collective intelligence and other Web 2.0 buzzwords."

Brain Scan; The Economist Technology Quarterly; June 7th 2008

## Wikinomics

- Dan Tapscott and Anthony D. Williams wrote the book Wikinomics: How Mass Collaboration Changes Everything (2006).

*Wikinomics is based on new competitive principles: openness; peering; sharing and acting globally.*

- Wiki is Hawaiian for “quick”. It is a metaphor for a new era of participation, say the authors.

Wiki: A collaborative Web site comprises the perpetual collective work of many authors. Similar to a blog in structure and logic, a wiki allows anyone to edit, delete or modify content that has been placed on the Web site using a browser interface, including the work of previous authors.

Webopedia Computer  
Dictionary.



## Preconditions for Peer Production

Peer production is a way of producing goods and services that relies entirely on self-organising, egalitarian communities of individuals who come together voluntarily to produce a shared outcome.

### Obstacles

- Peer review is needed
- Leaders are needed to guide and manage
- Design rules for cooperation are required
- People must be continually motivated
- Coordination is required over long periods

## Crowdsourcing

- Jeff Howe coined the term Crowdsourcing in a 2006 article in *Wired* magazine

*The act of taking a job traditionally performed by a designated agent (usually an employee) and outsourcing it to an undefined, generally large group of people in the form of an open call.*

- He wrote the book *Crowdsourcing: Why the Power of the Crowd is Driving the Future of Business* (2008)

In 1714, the British government established a prize for the discovery of a proven method for measuring longitude.

The prize was won by John Harrison, but claiming the prize was his death.

Harrison's Marine Timekeeper  
No. 1-H1



## The Wisdom of Crowds

- James Surowiecki wrote the book *The Wisdom of Crowds: Why the Many Are Smarter Than the Few and How Collective Wisdom Shapes Business, Economies, Societies and Nations* (2004)

*The aggregation of information in groups results in decisions that are often better than those that could have been made by any single member of the group.*

- Crowds make good guesses; they are better at prediction.

Wise Crowds are

- Diverse
- Independent
- Decentralised
- ...and have an aggregation mechanism that turns private judgments into a collective decision

## Preconditions for Wise Crowds

- **Diversity of Opinion** - Each person should have private information even if it's just an eccentric interpretation of the known facts.
- **Independence** - People's opinions aren't determined by the opinions of those around them.
- **Decentralisation** - People are able to specialize and draw on local knowledge.
- **Aggregation** - Some mechanism exists for turning private judgments into a collective decision.

## A Test of Wiseness

Question	Response
What is the height of Mont Blanc?	1.
	2.
	3.
	4.
	5.
	6.
	7.
	8.
	Crowd:
	Correct: 4810 metres

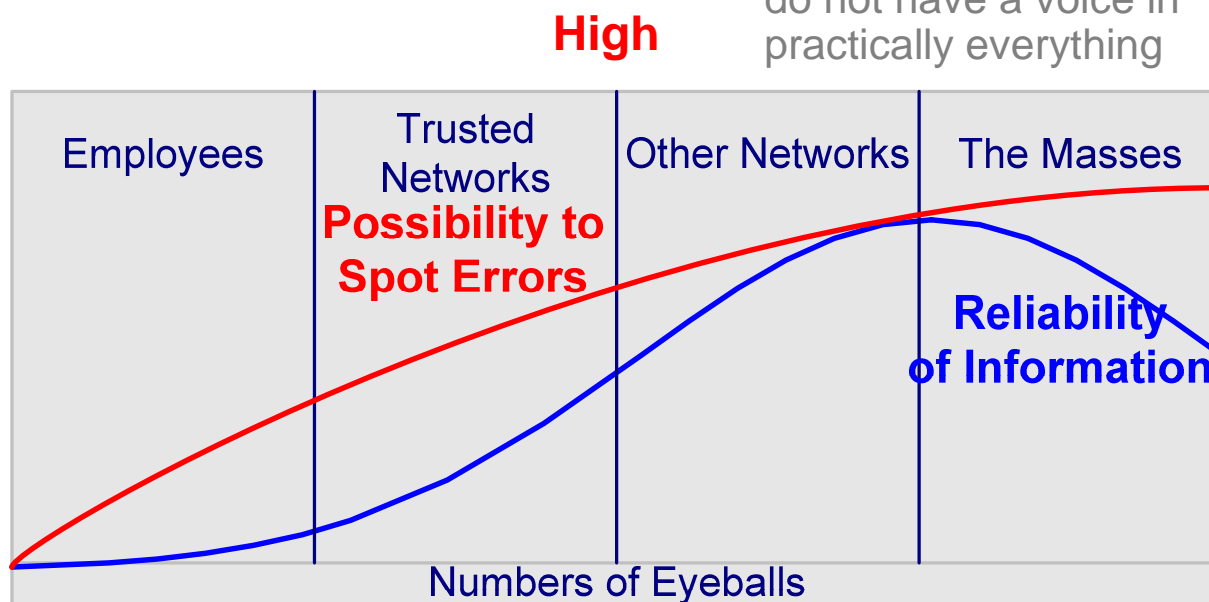


## The View of Wise Crowds

Is there Knowledge in Numbers?

- Can trusted networks and other networks provide support to official employees so that the reliability of information actually increases?
- Can methods be employed for *crowdsourcing* that give the masses a voice?

In the world of networks, it is rare that the masses do not have a voice in practically everything



**Few**

An alternative view is that reliability of error reports can increase along with the possibility to spot errors—if the correct conditions are met.

**Many**

## Key benefits of peer production/wise crowds for map updating

- Harness external talent by finding hidden geographers – Allow the millions of “map freaks” to come forth.
- Keep up with users – Let them share their inventions around your bottlenecks.
- Boost demand for complementary offerings – Users will find new things to do with your products if they can change them.
- Reduce costs – Maybe.
- Shift locus of competition from content to services – This might just make it possible to break down the barriers to entry...again, maybe.
- Develop social capital – Make your consumers your stakeholders.

## Applying Peer Production to Map Updating

Preconditions for Peer Production	Meets Yes/No
Object of production is information which keeps the cost of participation low for contributors	Yes
Tasks can be "chunked out" into bite-size pieces that individuals can contribute in small increments and independently of other producers.	Yes
The costs for integrating those pieces into a finished end product, including leadership and quality control mechanism, must be low.	Maybe

## Anyone need a BlackBerry break?

When we come back we will investigate a crowd-sourced, peer-produced map product.



## Open Street Map

OpenStreetMap of Cambridge, UK

URL

<http://www.openstreetmap.org>

Slogan

The Free Wiki World Map

Commercial?

No

Type of site

Collaborative mapping

Registration

required for contributors

Owner

OpenStreetMap Foundation

Created by

Steve Coast

Launched

July 1, 2004







## Open Street Map

- OpenStreetMap is a free, editable map of the whole world. It is made by people like you and me.
- OpenStreetMap allows you to view, edit and use geographical data in a collaborative way from anywhere on Earth.
- OpenStreetMap (OSM) was founded in July 2004 by Steve Coast (sic). In April 2006, a foundation was established with the aim of encouraging the growth, development and distribution of free geospatial data and providing geospatial data for anybody to use and share.
- In December 2006 Yahoo confirmed that OpenStreetMap could use their aerial photography as a backdrop for map production.



## Open Street Map

- In April 2007 Automotive Navigation Data (aka AND, a determined competitor to Navteq and Tele Atlas) donated a complete road dataset for the Netherlands and trunk road data for India and China to the project, and by July 2007, when the first OSM international *The State of the Map* conference was held, there were 9,000 registered users. Sponsors of the event included Google, Yahoo and Multimap.
- In February 2008 a series of workshops were held in India.
- In March, two founders of OpenStreetMap announced that they have received **VENTURE CAPITAL** funding of €2.4m for Cloud Made, a commercial company that will use OpenStreetMap data.
- By August 2008, shortly after the second *The State of the Map* conference was held, there were over 50,000 registered users with over 5,000 active contributors.



## Open Street Map

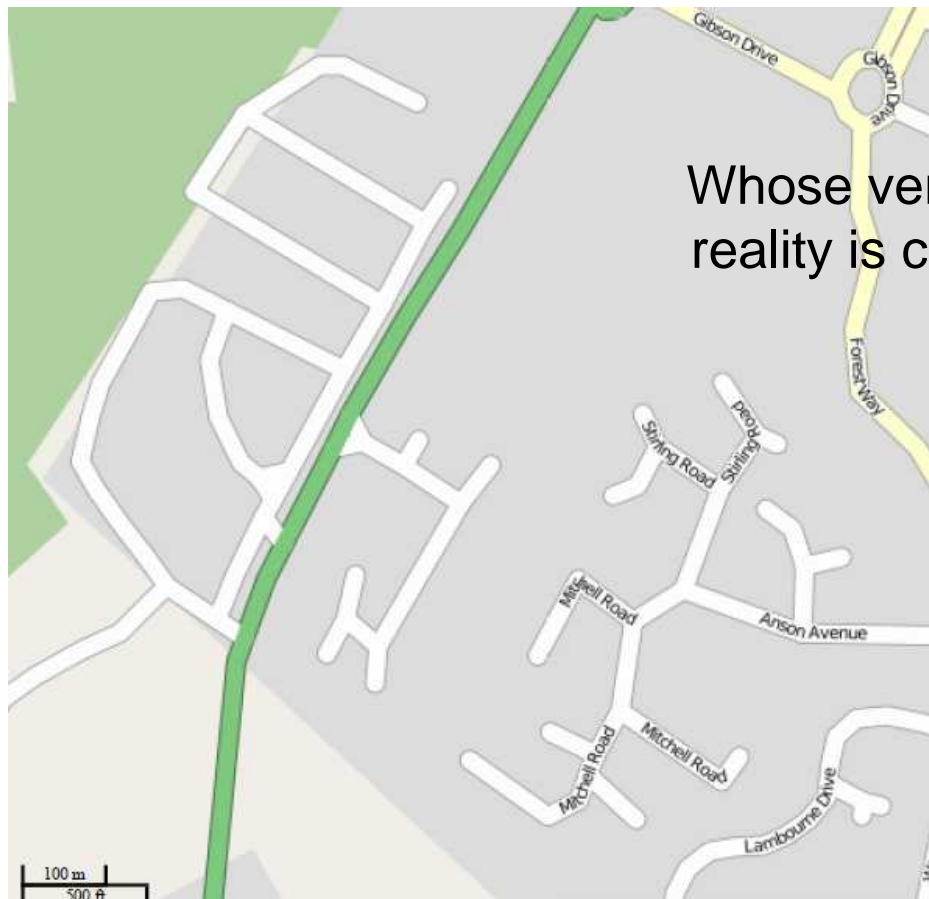
- The initial map data was all built from scratch by volunteers performing systematic ground surveys using a handheld GPS unit and a notebook or a voice recorder. Data was then entered into the OpenStreetMap database from a computer.
- Recently, the availability of aerial photography and other data sources from commercial and government sources have greatly increased the speed of this work and has allowed land-use data to be collected more accurately.
- When large datasets are available, a **technical team** will manage the conversion and import of the data.



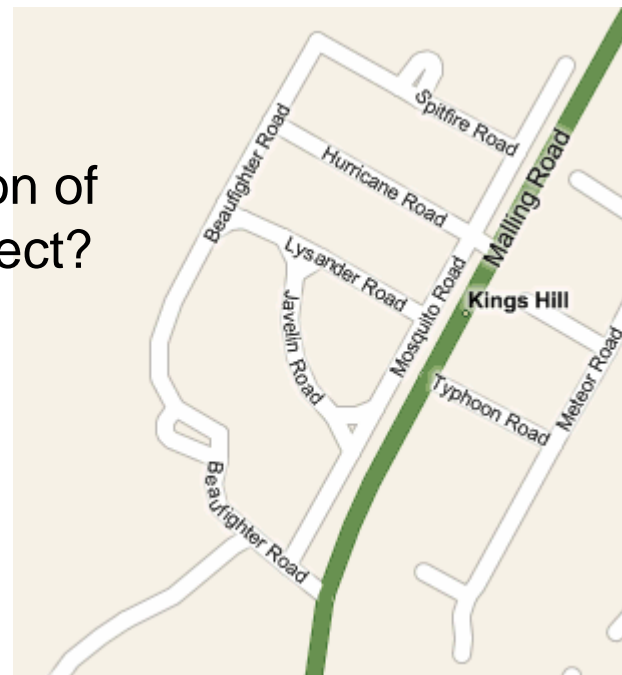
Ground surveys are performed by a volunteer, on foot, bicycle or in a car, although a bicycle is apparently the mode of choice for many volunteers mapping urban areas.



## Open Street Map on the ground



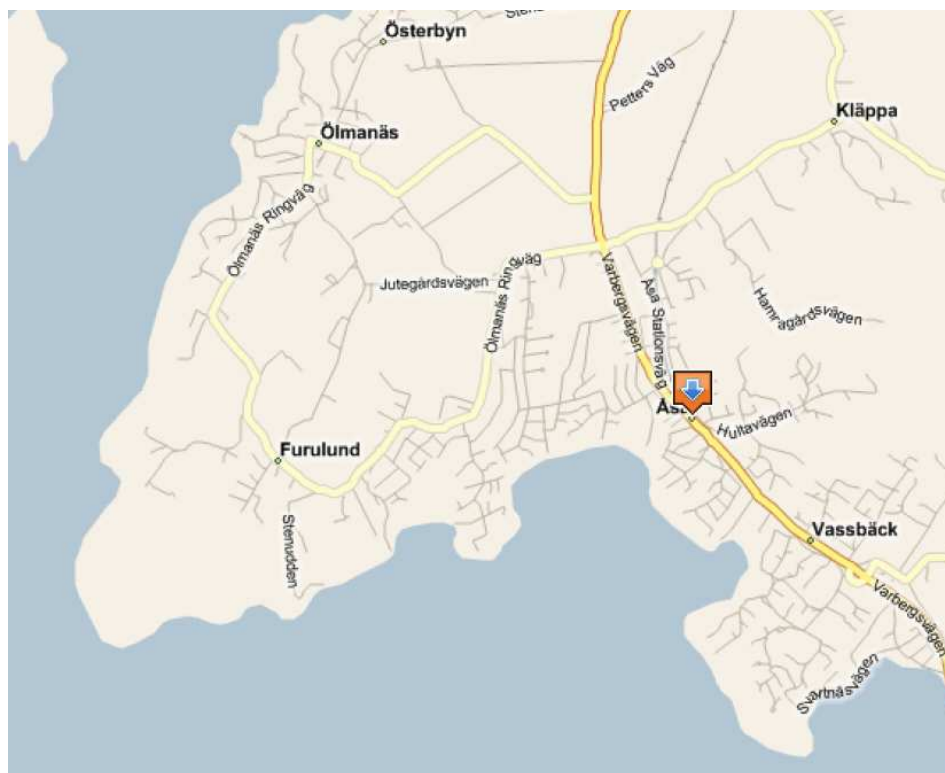
OpenStreetMap



Navteq in Microsoft Mappoint



## Open Street Map



Navteq in Microsoft Mappoint



OpenStreetMap  
I guess I had better sign up for Åsa duty.





## How good is OpenStreetMap?

A comparative study of OpenStreetMap and Ordnance Survey datasets for London and the rest of England

Dr Mordechai (Muki) Haklay, August 2008

- The analysis shows that OpenStreetMap information can be fairly accurate: on average within about 6 metres of the position recorded by the OS, and with approximately 80% overlap of motorway objects between the two datasets.
- In the space of four years, OpenStreetMap has captured about 29% of the area of England, of which approximately 4% are digitised lines without a complete set of attributes.
- Importantly, most of the data capture (80%) was carried out by 90 participants and a very large group of users disengaged from the project after minimal contribution.

## What can we take away from OpenStreetMap?

Question	Answer
Is it a threat to the majors?	Not today
Is the approach valid for long-term sustainability?	Not today
Does it meet the criteria for peer production?	
• Peer review built into process	Not today
• Design rules explicit	Not today
• Constant motivation provided	No
• Long-term coordination	Not today

## TomTom: The company that **disrupted** the navigation system game



...and now it wants to change the map data game as well.

<http://www.youtube.com/watch?v=GU2iQX4vJ10>



## TomTom's Map Share

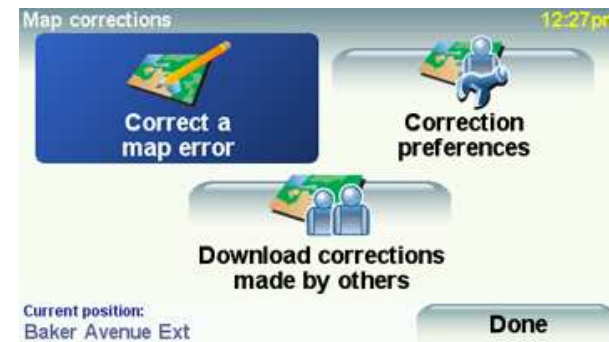
- TomTom introduced its [MapShare](#) service in the second half of 2007 in connection with the release of the TomTom GO 720.
- TomTom claims in its own description of [MapShare](#) that it is part of a growing trend in connected computing called **Social Networking**. In the words of TomTom:

“This involves individuals sharing information, particularly their location, with others who belong to the same social network. Members can join or leave the network as they choose, based on how well they feel the group and the information it provides fits with their own needs and desires.”
- [MapShare](#) data updates will only be available on TomTom, so it would not be possible for one friend who has a TomTom to provide his or her information to a friend who has a Nokia Maps or Garmin PND.

## TomTom's MapShare

- This makes it important for TomTom to have some control over both the data and the way the data is formatted for viewing on their device.
- Whether this idea will catch on remains to be seen. It seems too easy to abuse the system.
  - For example, a [MapShare](#) user could change the name of a street to his own name; or,
  - Block a street where she lives to reduce traffic on the street.
- Nevertheless, Tele Atlas' Rob van Essen, VP Strategic Research and Development, reports that "the first figures of MapShare use are very promising, and already twenty times as large as the number of reports at the Tele Atlas user feedback system".

## TomTom's Map Share



What you can do with  
**MapShare**



TomTom is counting on its users to do the job its map supplier (Tele Atlas) hasn't been able to do itself.

- TomTom's **MapShare** is their way of trying to ensure that users have the most up-to-date data on their systems.
- One of the reasons for launching **MapShare** was that it was receiving up to 16,000 corrections each month, but it had no effective way to get the corrections into the maps data.
- Did TomTom buy TeleAtlas in order to be able to control the map data updates that it was feeding to it from TomTom users? Probably.
- Will MapShare change the map updating paradigm? Partly, but TomTom has another trick up its



Once the change is made, it can be shared with other TomTom Go users by connecting to the Internet at TomTom HOME.

## TomTom Data Strategy

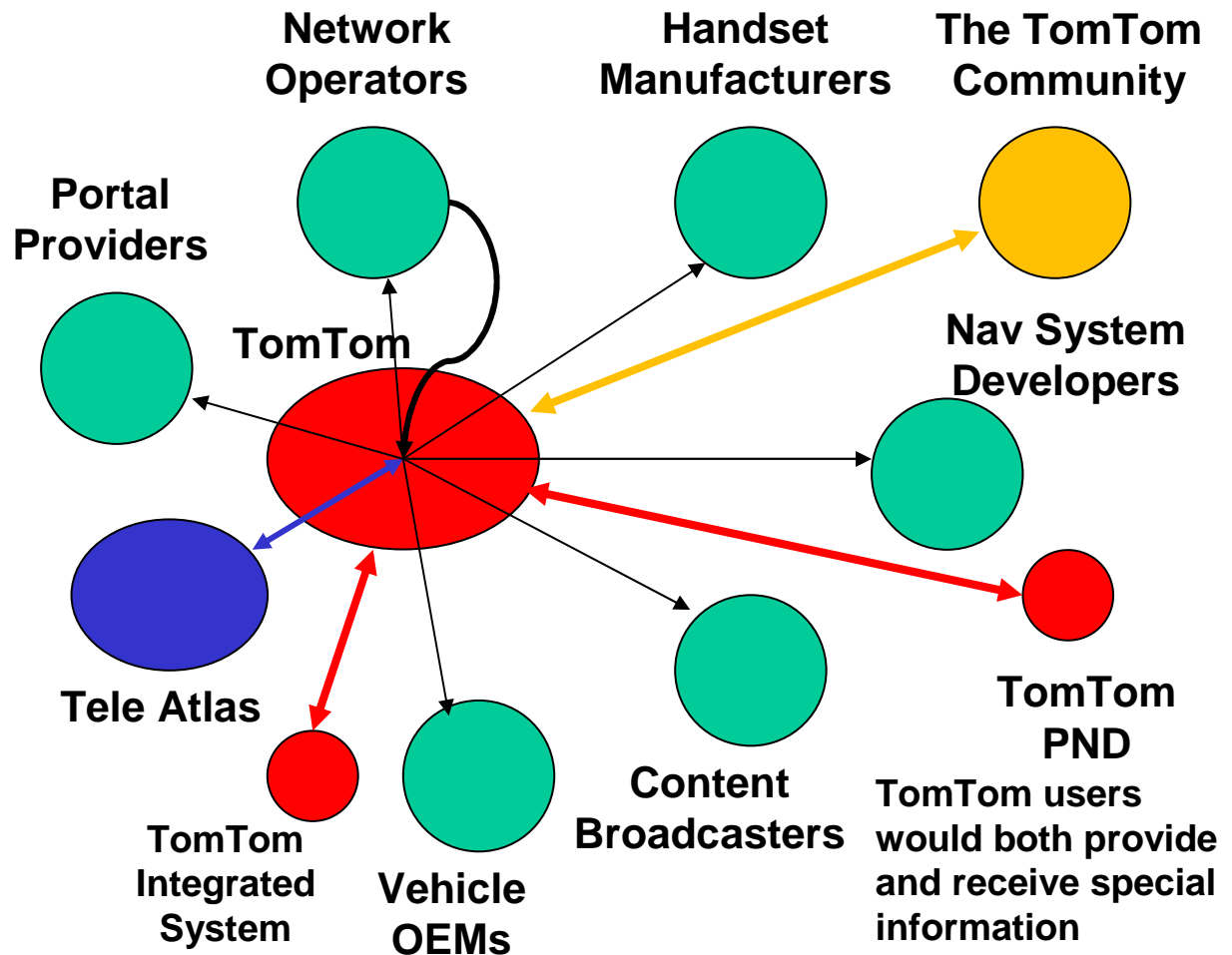
- Purchase of **Applied Generics** in January 2006. They provide method of delivering traffic information using cellular floating vehicle data.
- Agreement with **Vodafone** Netherlands to use their mobile phone data for producing real-time traffic service.
- Delivery in November 2007 of the TomTom One XL HD with integrated GSM modem and SIM-card and the Vodafone service.
- Purchase of **Tele Atlas** and all data sources are used to produce what TomTom hopes is the freshest map on the market.



**TomTom's One XL HD**  
*The SIM-card delivered with the unit is provided by Vodafone. It is embedded, which means the customer does not have access to it. The customer pays €10 per month for the service*

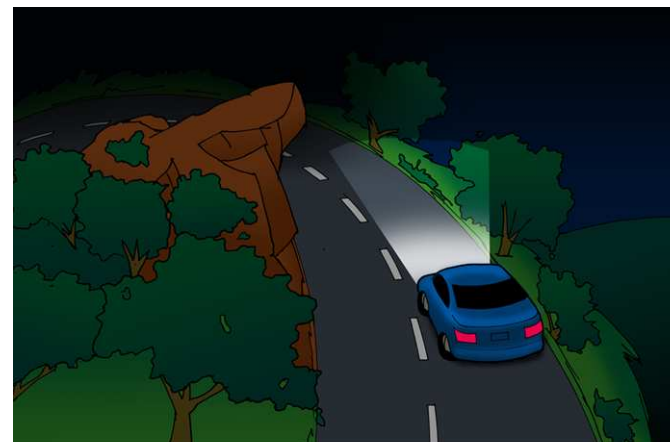
## MapShare fits TomTom's future Strategy

- Tele Atlas receives information from users of TomTom and delivers data to TomTom for distribution to all customers.
- TomTom users are both peer producers and prosumers, since they are improving the product they are using.

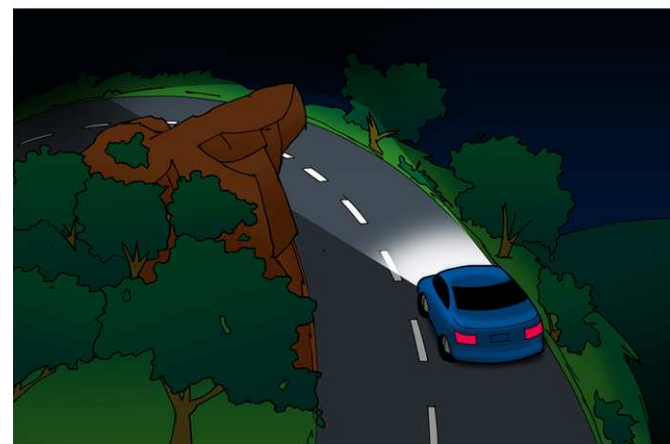


## Can MapShare move the locus of competition

- Nokia/Navteq will continue to focus on content quality, coverage, suitability to demanding in-vehicle applications.
- Navteq's announcement that they are unbundling their map data from navigation to supply electronic horizon data for advanced driver assistance systems means they are serious about improving their data quality.
- There is not much scope for user-generated content to create sub-metre slope accuracy, unless the users employ expensive pieces of equipment—like 18 tonne trucks.



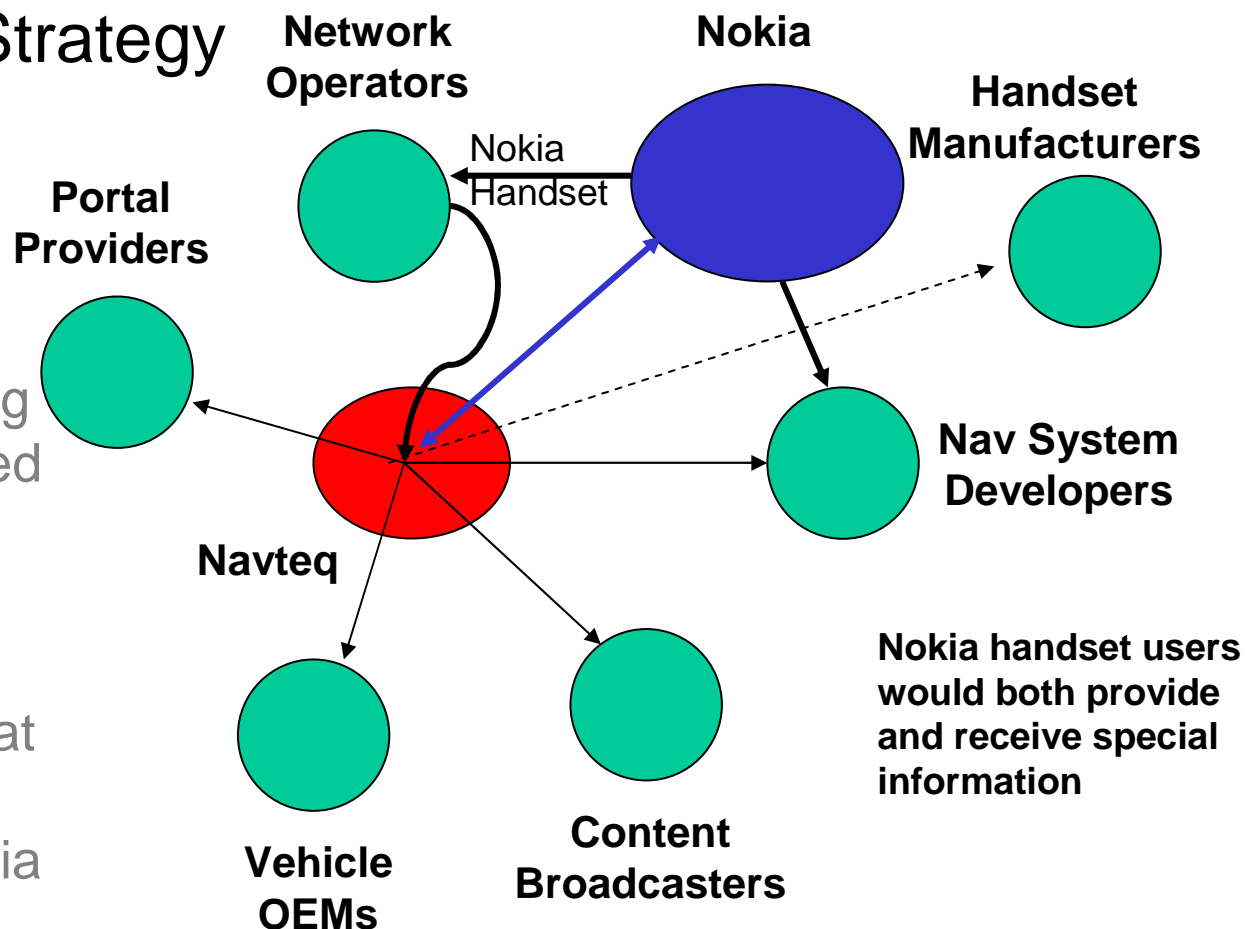
Visibility scenario *without* predictive headlights



Visibility scenario *with* predictive headlights

# Nokia/Navteq Strategy

- Nokia would manage the relationships with the network operators, delivering maps already loaded or subscriptions for downloads.
- Navteq would function as it does at present, but offer special data to Nokia users.



## What can we take away from TomTom's MapShare?

Question	Answer
Is it producing more up-to-date data?	Uncertain
Will TomTom/TeleAtlas increase profitability as a result?	Uncertain
Will the buyers of TomTom systems share in the profits if they materialize?	Not unless they buy stock
Will the focus of competition move from data to services in TomTom's favour?	It already is

Net Geners are starting to buy navigation products!



## Net Geners will force a new business model

### The Eight Norms of Net Geners\*

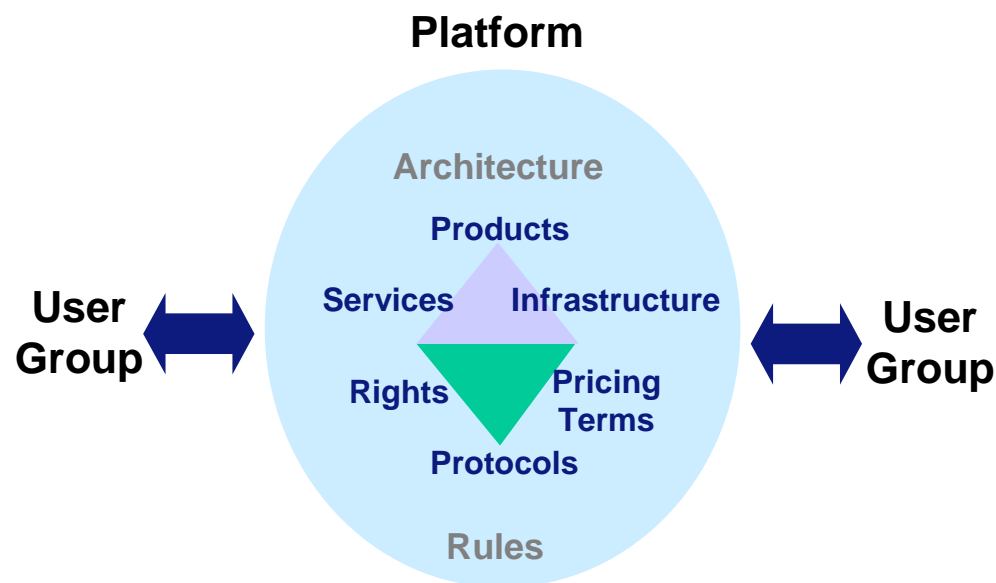
1. Net Geners value freedom and choice in everything they do.
2. They love to customise and personalise.
3. They scrutinise everything.
4. They demand integrity and openness, including when deciding what to buy and where to work.
5. They want entertainment and play in their work and education, as well as in their social lives.
6. They love to collaborate.
7. They expect everything to happen fast.
8. They expect constant innovation.

**\*Eight Norms of Net Geners** found in *Grown Up Digital: How the Net Generation is Changing Your World* by Dan Tapscott (2008)

## A New Business Model – Two-sided Network

- In the two-sided network, two user groups interact through a platform.
- The platform is provided by a third party who sets the rules for the user parties, including the prices.
- Some networks benefit from same-side effects: more computer program users results in more program developers writing more programs.
- Cross-side effects: more buyers in auctions benefits sellers, but disadvantages buyers.

A Two-sided Network

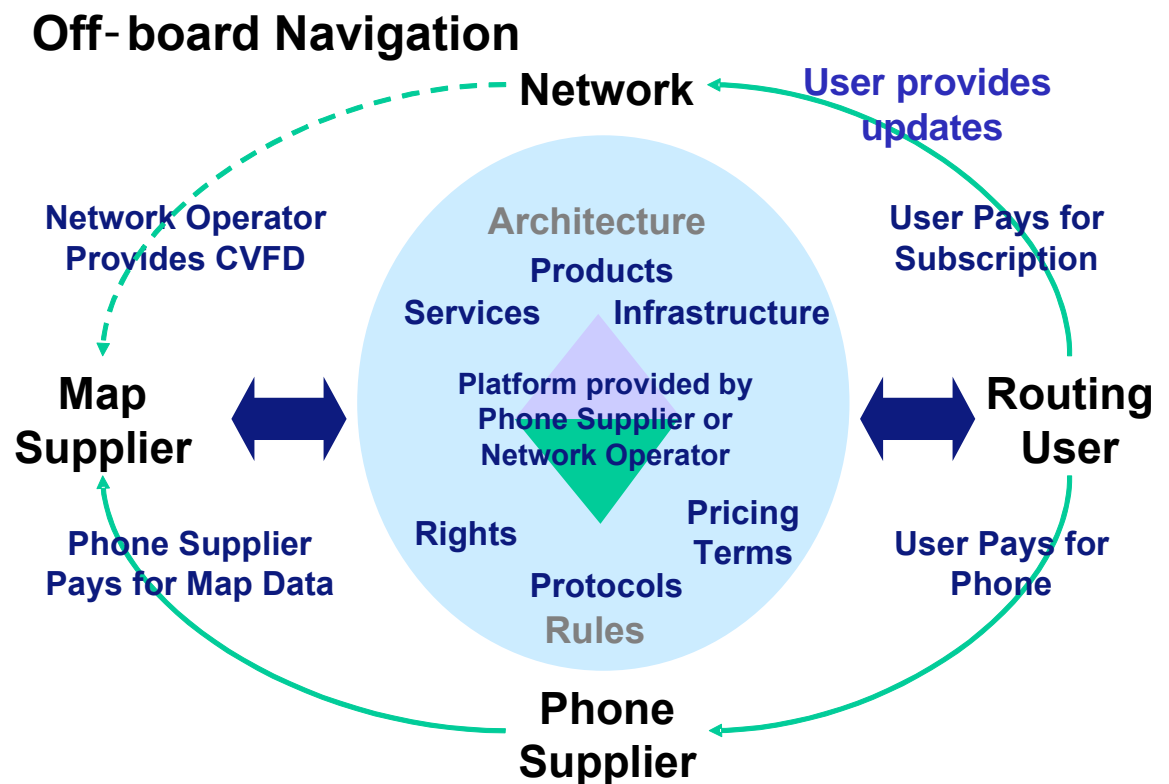


## A New Business Model – Two-sided Network

- Both Nokia and TomTom are attempting to revolutionise the delivery of maps and routes by creating a platform that is a virtuous circle.
- Customers buy their phones from Nokia because “maps and routes come with it”.
- Customers buy their PNDs from TomTom because they become part of a sharing community.

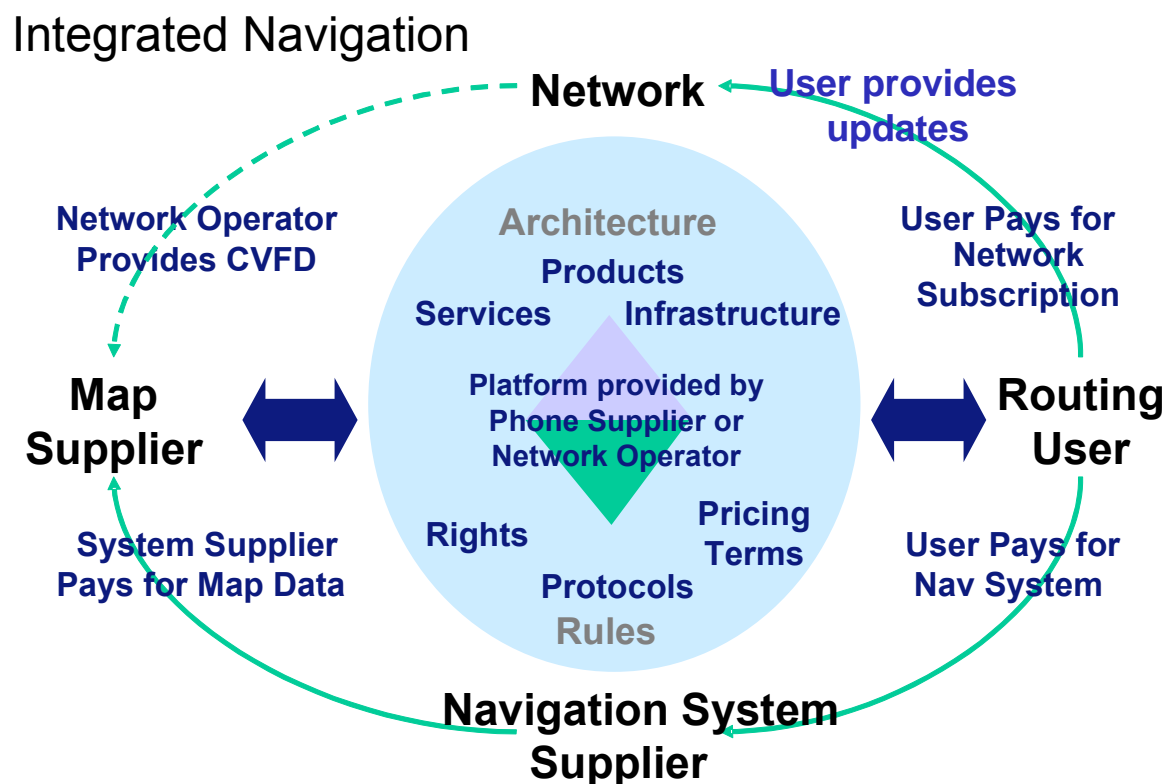
## A New Business Model – Two-sided Network

- Network operators earn money on the data transactions conducted over their networks using their SIM-cards/chips, and...
- They deliver location data to Navteq that is incorporated in the routing.
- They deliver cellular vehicle phone data to TomTom that is used to produce traffic flow data.



## A New Business Model – Two-sided Network

- How would the automotive OEMs participate in this two-sided network?
- The OEM or navigation system supplier would deliver the navigation system with built-in communications to enable the network to deliver value-added data.
- The OEM would either build their own platforms or “rent” them.



## Workshop Recap

Conclusion	Qualifier
<i>Crowdsourcing</i> can be applied to map updating under certain circumstances, but not as a general rule.	Crowdsourcing will be one of the ways that users will participate in the product community.
User Generated Content (UGC) is fine for annotating (tagging) Points of Interest, but is probably not suitable for navigable map data.	Allowing users to generate content may be a price of doing business. The key will be to find a way to gain value for all participants
Map data content generation and updating can be greatly improved by a wider deployment of location-enabled mobile devices.	It will not be a matter of selecting certain sources and rejecting others. All sources will need to be used...including sharing between competitors. Next workshop.



## Questions

Thank you.

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Is “on-the-fly” updating a possibility?



NASA Dryden Flight Research Center Photo Collection  
<http://www.dfrc.nasa.gov/gallery/photo/index.html>  
NASA Photo: EC95-43203-1 Date: July 1995

SR-71 Mid-air Refueling with KC-135 Tanker

Prepared for the IQPC  
Advanced Navigation Conference Pottsdam  
November 2008

Community participation in TomToms proprietary map improvement technology grows 1000% in less than a year

Auckland 16 December, 2008 - TomTom, the worlds leading navigation solutions provider, today announces that members of the TomTom Map Share community have made a total of five million map updates worldwide. This milestone results from a surging adoption of TomToms proprietary technology by the TomTom Map Share community, which has grown from half a million users at the beginning of this year to over five million users today. Porirua building inspector and volunteer fire-fighter Andrew Mills is New Zealands biggest Map Share user with 96 changes on his TomTom GO 720 since May 2008.

Dubbed a TomTom Road Warrior, Mills says, One thing is certain: roads are always changing. TomTom Map Share helps me block roads that can no longer be entered or give correct names to unnamed roads. Before Map Share I could maybe complain about map errors, but even if the map company fixed them it wouldnt affect my map. Now I can fix many problems immediately on my device. Mills adds, More importantly, Map Share makes my life easier and can help out others, so why not make the changes!

Mr. Mills receives a new TomTom GO 720 as congratulations for being New Zealands TomTom Road Warrior and he says he knows exactly where it is going: into the fire truck. TomTom is able to deliver the most up-to-date maps in a changing world by enlisting the help of its users worldwide. Map Share allows TomTom customers to make improvements to their map instantly on their TomTom navigation devices. Once checked by TomTom moderators, these updates are made available to the entire Map Share community, ensuring TomTom customers always have access to the most up-to-date maps. TomTom Map Share is certified by the prestigious German TÜV SÜD for its efficiency, intuitiveness and reliability.

‘From the beginning we envisioned Map Share as a tool to help drivers contend with the frustration of unexpected road changes and to be used in between map updates,’ said Corinne Vigneux, managing director TomTom. ‘To put this five million milestone in perspective: a one-hour trip made anywhere in Europe or North America will be influenced by twenty to thirty Map Share corrections.’

The success of Map Share is also due to the fact that the improvements made are those that customers really care about. This is clear due to the fact that the community has gone to the effort to report and share these corrections.

The significance of the milestone also becomes clear when one compares it to the 15,000 reports that Tele Atlas receives on average per month from end users via its online map reporting system, Map Insight.

Some interesting facts about Map Share changes include:

- the number of map changes worldwide is greater than the population of New Zealand
- hundreds of thousands of street names have been added
- close to a million roads that were incorrectly blocked (or open) are now included or excluded from TomTom routes

TomTom's complete map package – high-quality maps pre-installed on all products, TomTom's latest map guarantee™, the TomTom Map Update Service™ and Map Share - allows TomTom to provide customers with the most up-to-date and reliable maps in the industry.

Map Share corrections are available to TomTom customers via the TomTom HOME software, which comes standard with all TomTom devices •