Updating Map Data Used in Navigation Devices
Crowd Concensus versus Expert Witnesses

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Presentation Overview

- The navigable map data update paradigm is broken and needs to be fixed; how should we do it? (I will principally address the source updating process today, and partly on how data gets to the user).

- Map updates have been performed by experts. Some believe that crowds can do a better job.

- Can the wisdom of crowds move the locus of competition from content to services?

- Can map data content generation and updating be improved by a wider deployment of location-enabled mobile devices, rather than by trying to employ wise crowds?

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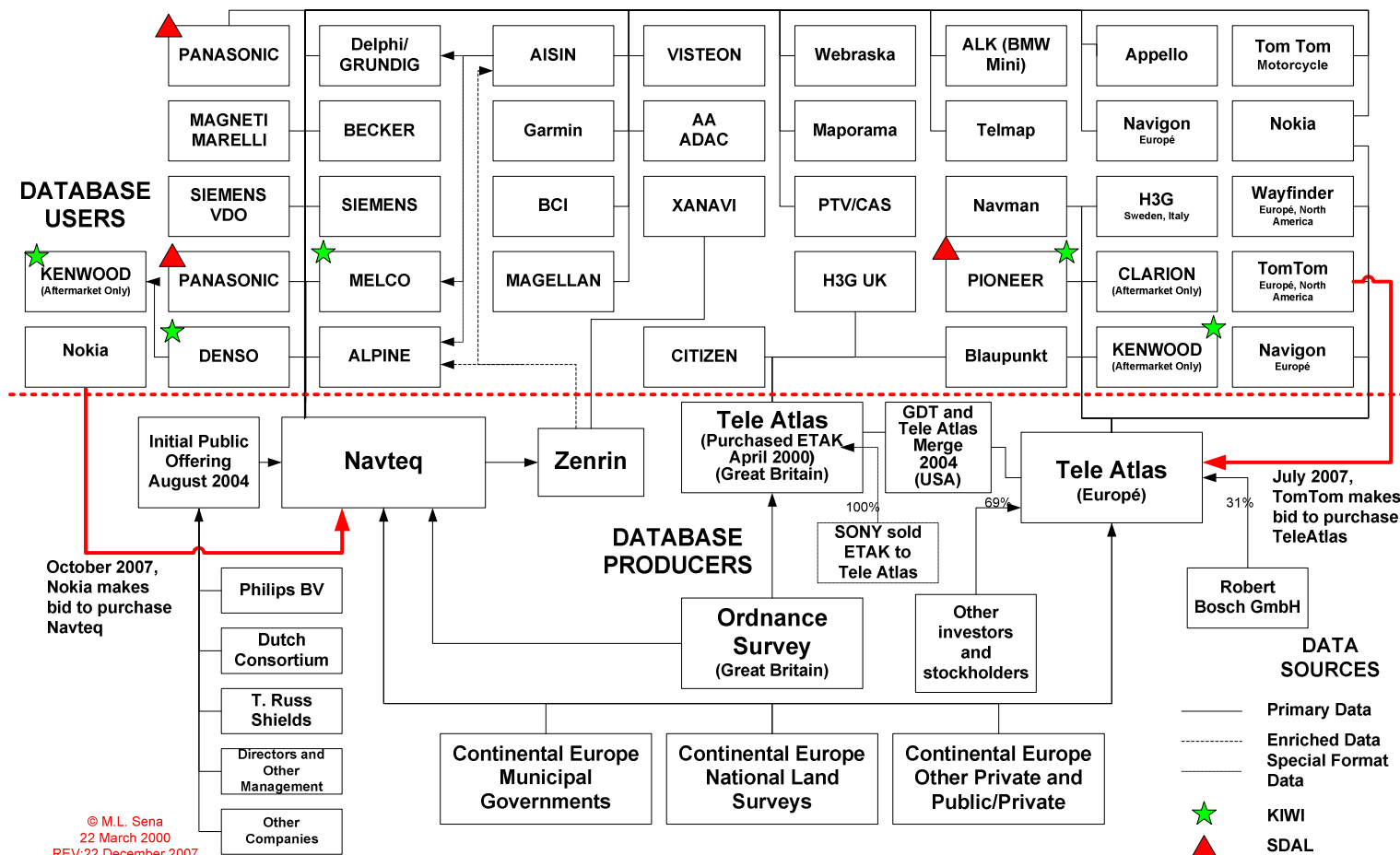
Information Context #1

- 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.

- Building and maintaining their databases required the special training on the proprietary systems and methods that each of these organisations had invented.
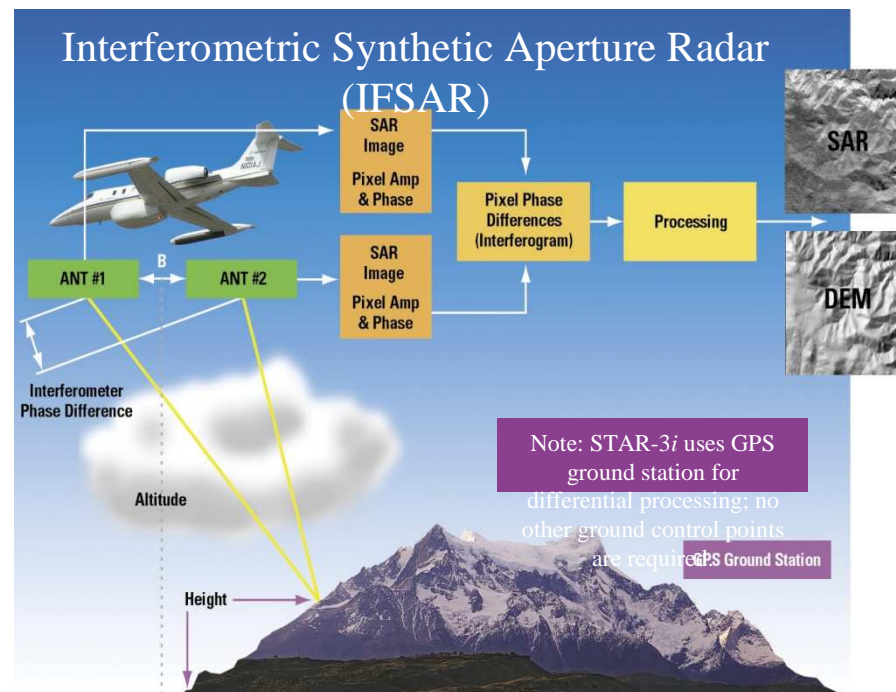
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The Experts and Their Customers

European Digital Map Sources, Producers and Users

DATABASE USERS

PANASONIC	Delphi/ GRUNDIG	AISIN	VISTEON	Webraska	ALK (BMW Mini)	Appello	Tom Tom Motorcycle
MAGNETI MARELLI	BECKER	Garmin	AA ADAC	Maporama	Telmap	Navigon Europé	Nokia
SIEMENS VDO	SIEMENS	BCI	XANAVI	PTV/CAS	Navman	H3G Sweden, Italy	Wayfinder Europé, North America
KENWOOD (Aftermarket Only)	PANASONIC	MELCO	MAGELLAN	H3G UK	PIONEER	CLARION (Aftermarket Only)	TomTom Europé, North America
Nokia	DENSO	ALPINE		CITIZEN	Blaupunkt	KENWOOD (Aftermarket Only)	Navigon Europé

DATABASE PRODUCERS

Initial Public Offering August 2004

Navteq

Zenrin

Tele Atlas (Purchased ETAK April 2000) (Great Britain)

GDT and Tele Atlas Merge 2004 (USA)

Tele Atlas (Europé)

100%

69%

31%

July 2007, TomTom makes bid to purchase TeleAtlas

October 2007, Nokia makes bid to purchase Navteq

SONY sold ETAK to Tele Atlas

Philips BV

Dutch Consortium

T. Russ Shields

Directors and Other Management

Other Companies

Ordnance Survey (Great Britain)

Other investors and stockholders

Robert Bosch GmbH

Continental Europe Municipal Governments

Continental Europe National Land Surveys

Continental Europe Other Private and Public/Private

DATA SOURCES

——— Primary Data

--------- Enriched Data Special Format Data

——— Data

★ KIWI

▲ SDAL

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22 March 2000
REV:22 December 2007

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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 <u>twenty-five years </u>ago.

▪Today

✓ Mobile phones

✓ GPS

✓ Differential GPS

✓ The Internet

✓ High precision aerial photography

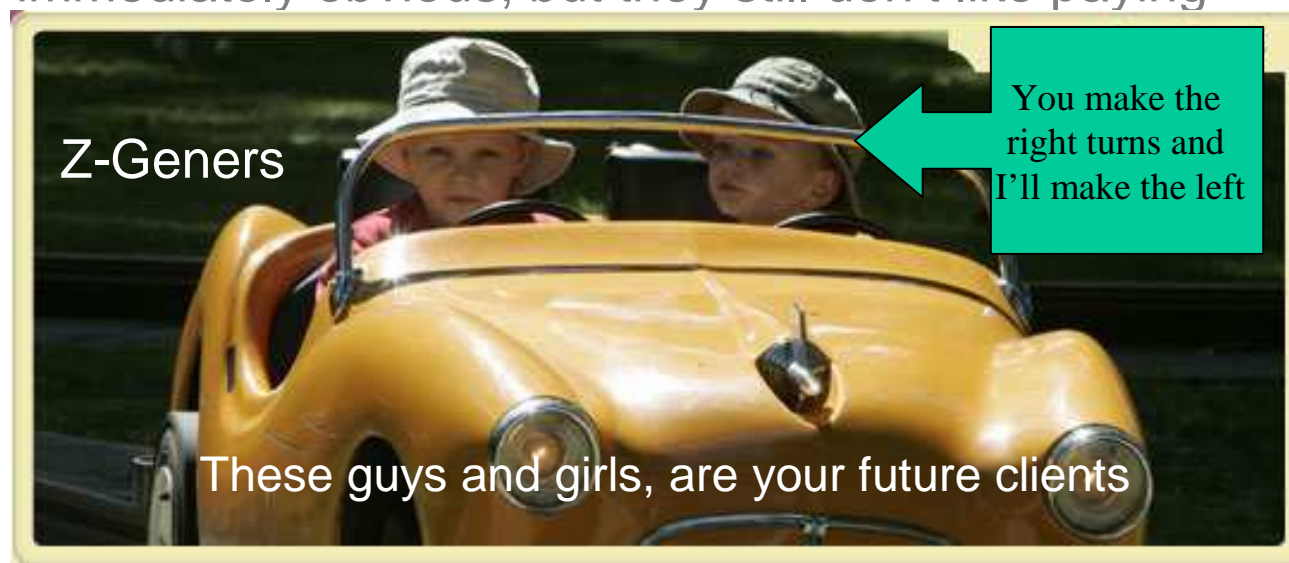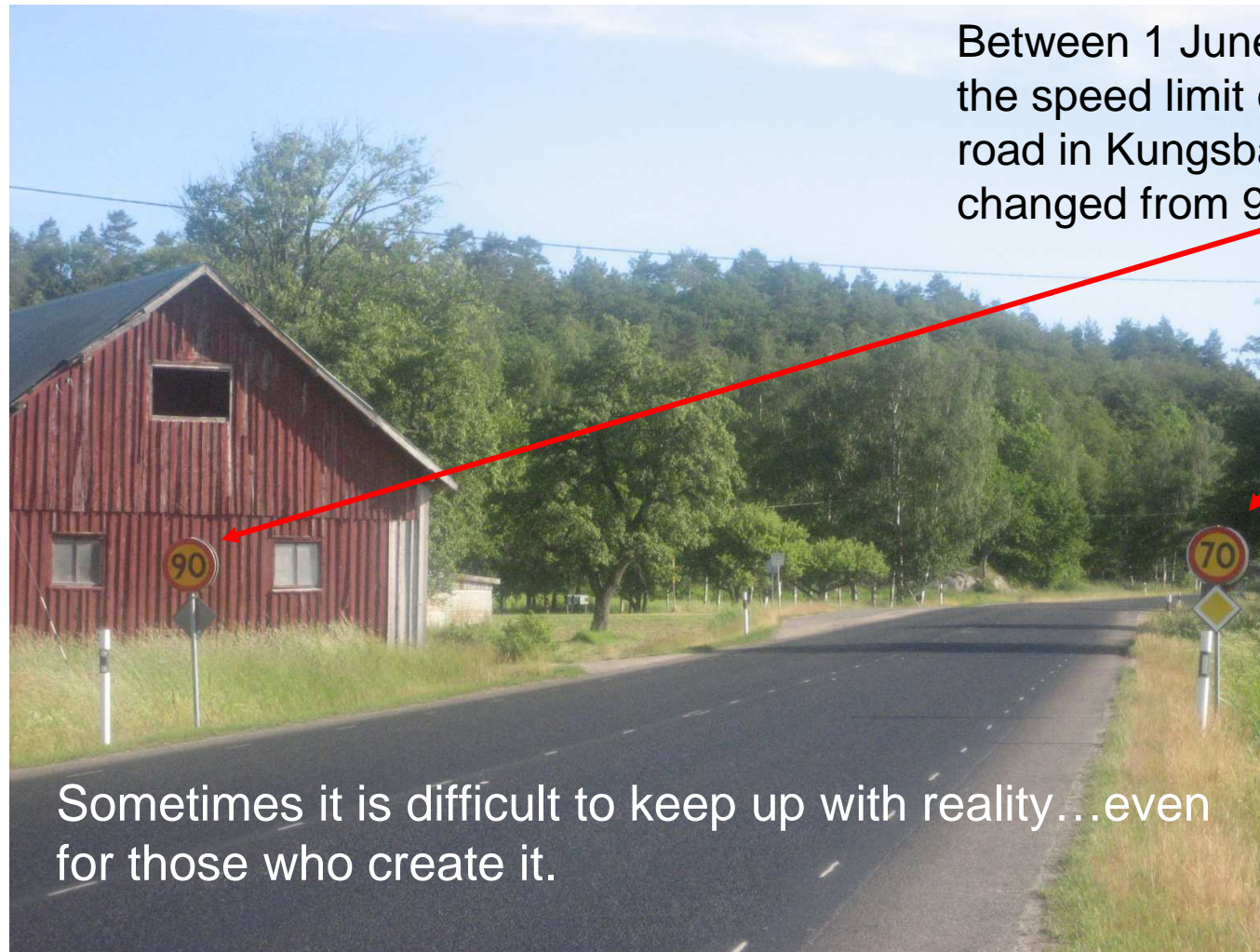✓ Navigation systems for route testing

✓ Collaborative tools

Interferometric Synthetic Aperture Radar (IFSAR)

SAR Image
Pixel Amp & Phase

ANT #1   ANT #2

SAR Image
Pixel Amp & Phase

Pixel Phase Differences (Interferogram)

Processing

SAR

DEM

Interferometer Phase Difference

Altitude

Height

Note: STAR-3*i* uses GPS ground station for differential processing; no other ground control points are required.

GPS Ground Station

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Information Context #3

- Net Generation boys and girls (baby-boomers' kids born between '78 and '94 known as **Net Geners***) have grown up with <u>free access</u> 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 (e.g. iPod) and formats are accepted only if the benefits are immediately obvious, but they still 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)

Z-Geners

You make the right turns and I'll make the left

These guys and girls, are your future clients

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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.

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Map by Navteq; PND by Garmin

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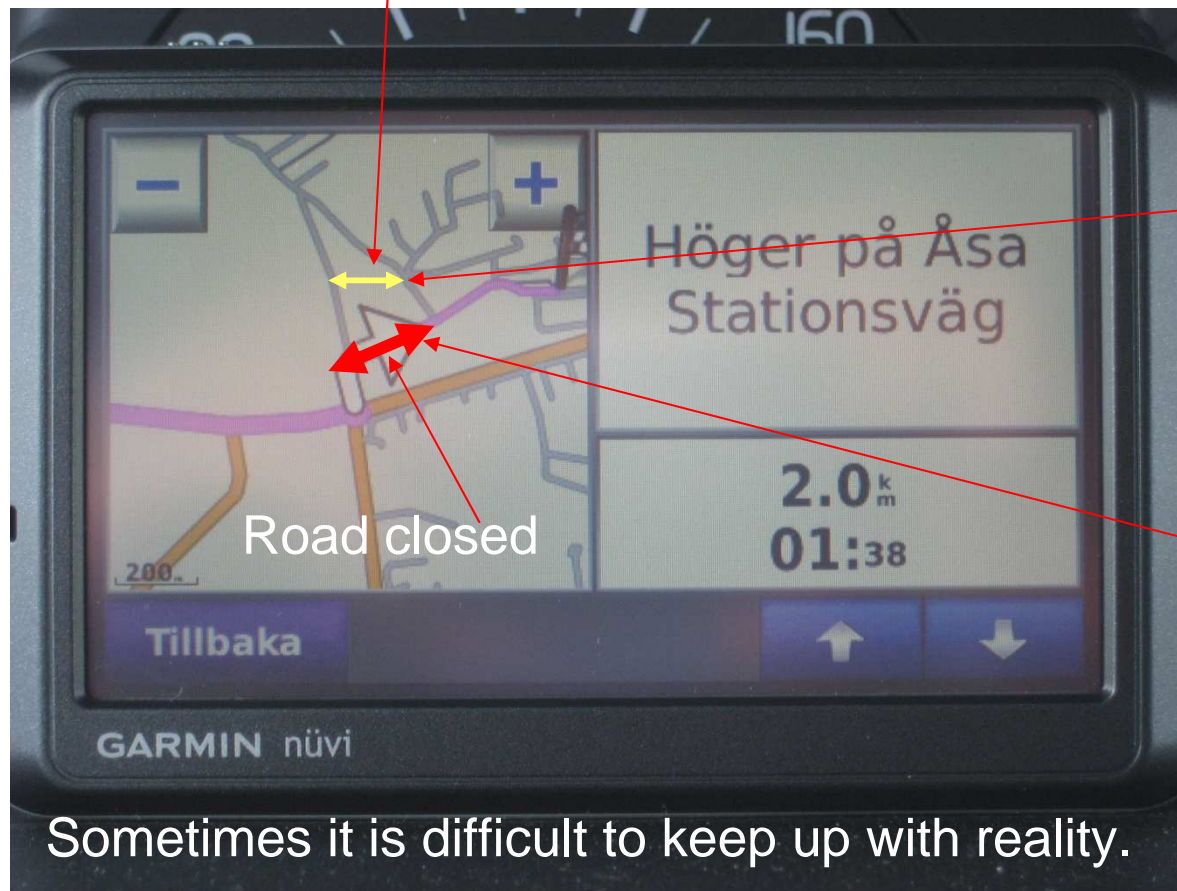
The Garmin system was purchased July 2008. The correct route is along the yellow arrow on the road that was opened in June 2007. The right turn show by the large arrow, and the voice instructions, lead into a school parking lot that does not have access to a through road.

Road closed

Sometimes it is difficult to keep up with reality.

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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

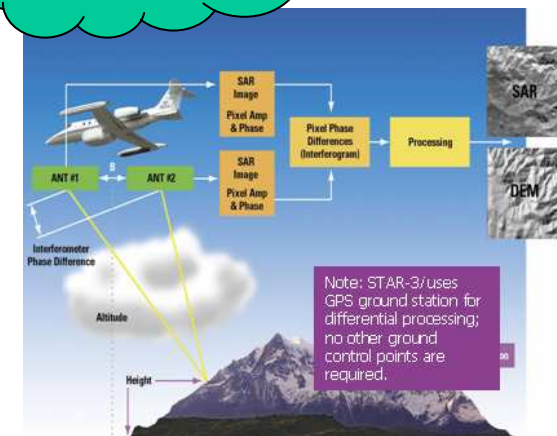The main problem is that the experts have their hands full with adding new countries

Zenrin navigation map image of London

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What is the best way to update map data

Experts Collecting
Data from Experts
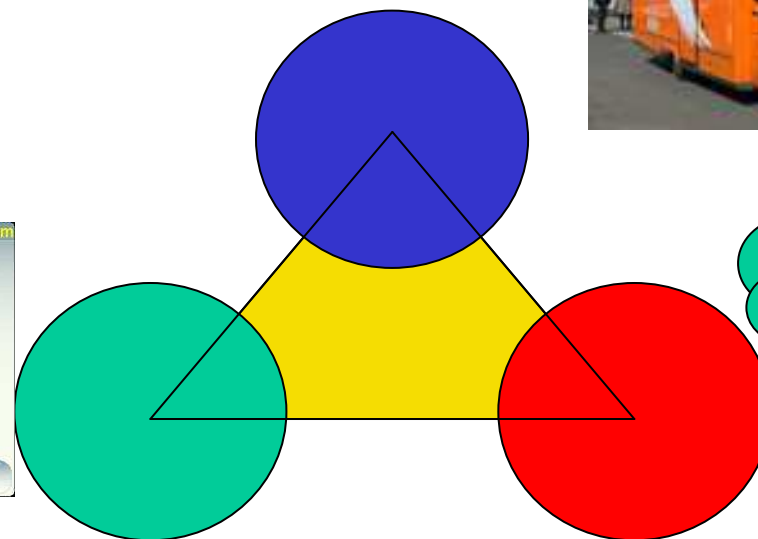
What we are
mostly doing today

What do you want to report about? 1 of 2   8:42pm

Existing street   Missing street   City

POI   Highway entrance/exit   ▶

Current position: Damrak   Done

Note: STAR-3/uses GPS ground station for differential processing; no other ground control points are required.

What we are
thinking about
doing tomorrow

Any man or woman
on the Street
Crowdsourcing

Automated
Sources

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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.

It is rare that the masses have a voice in map updates

High

| Employees | Trusted Agents | Road Warriors | The Masses |

Reliability of Information

Possibility to Spot Errors

Numbers of Eyeballs

Few
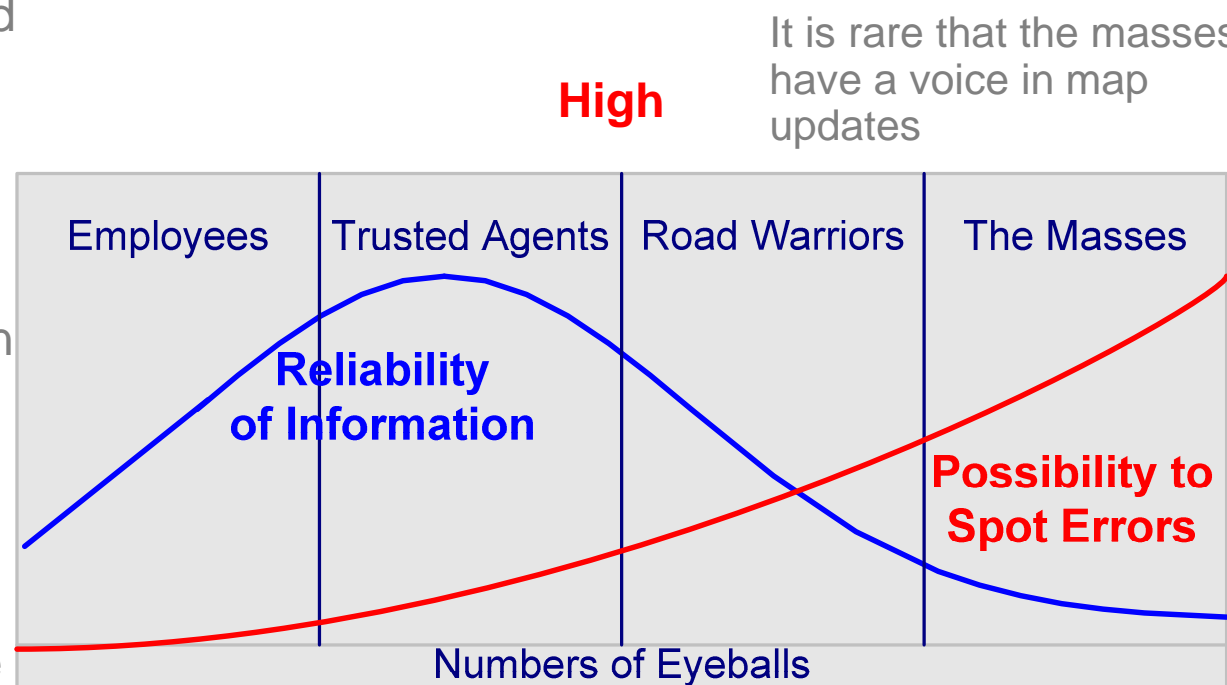
Many

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

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From consumers to **pro**(ducers/con)**sumers**: Cocreating goods and services
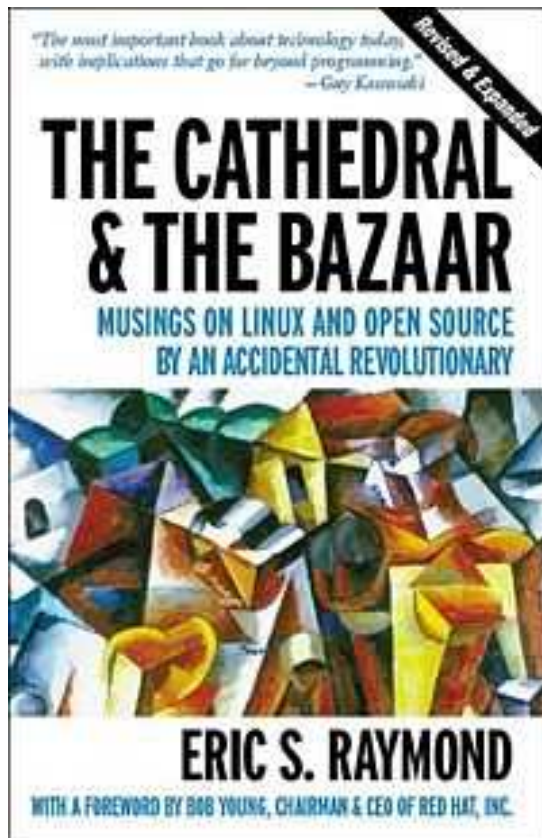
•The *Cathedral* model, in which source code is available with each software release, but code developed between releases is restricted to an exclusive group of software developers.

•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.

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Linus + Unix = Linux

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

Linus Torvalds

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Open Source versus Proprietary Information

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 modifty 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.

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A Dialectic: Objectivism verus Post Modernism

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 concensus of many observers.
- Jimmy Wales, founder of **Wikipedia**

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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)

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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

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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. (for those who remember Etak, the word also had Pacific Island <Polynesian> roots and means "navigation".)

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.

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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

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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

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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.
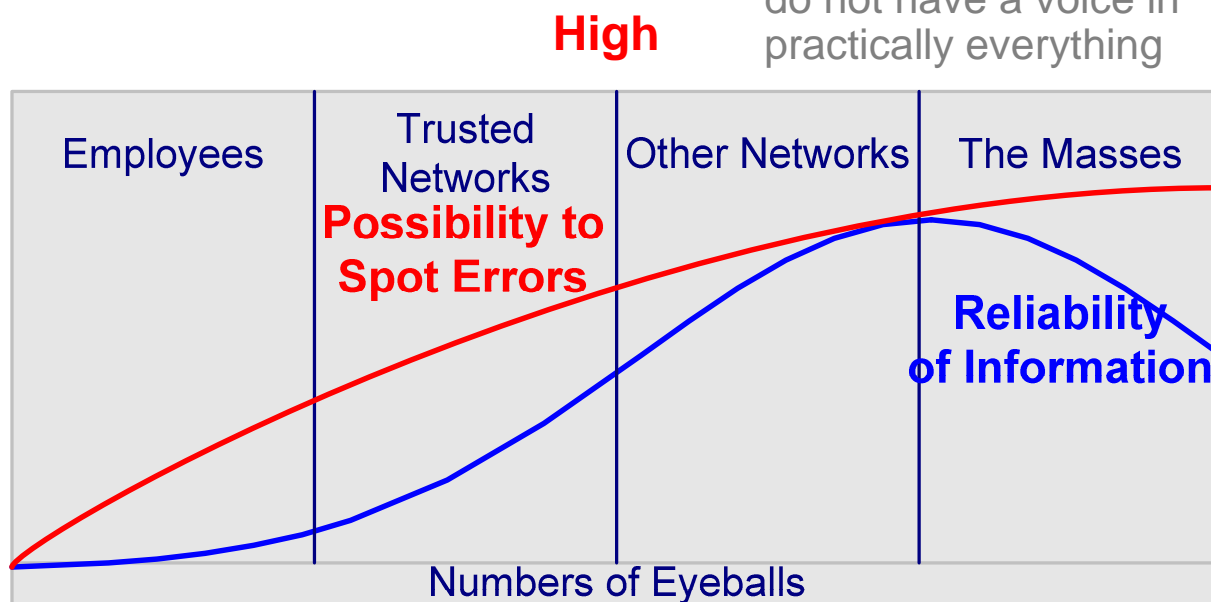
- Crowds make good guesses.

Wise Crowds are

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

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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 *peer production or 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

High

| Employees | Trusted Networks | Other Networks | The Masses |

Possibility to Spot Errors

Reliability of Information

Numbers of Eyeballs

Few

Many

Is there a way for the reliability of error reports to increase along with the possibility to spot errors—if the correct conditions are met?

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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

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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

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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.
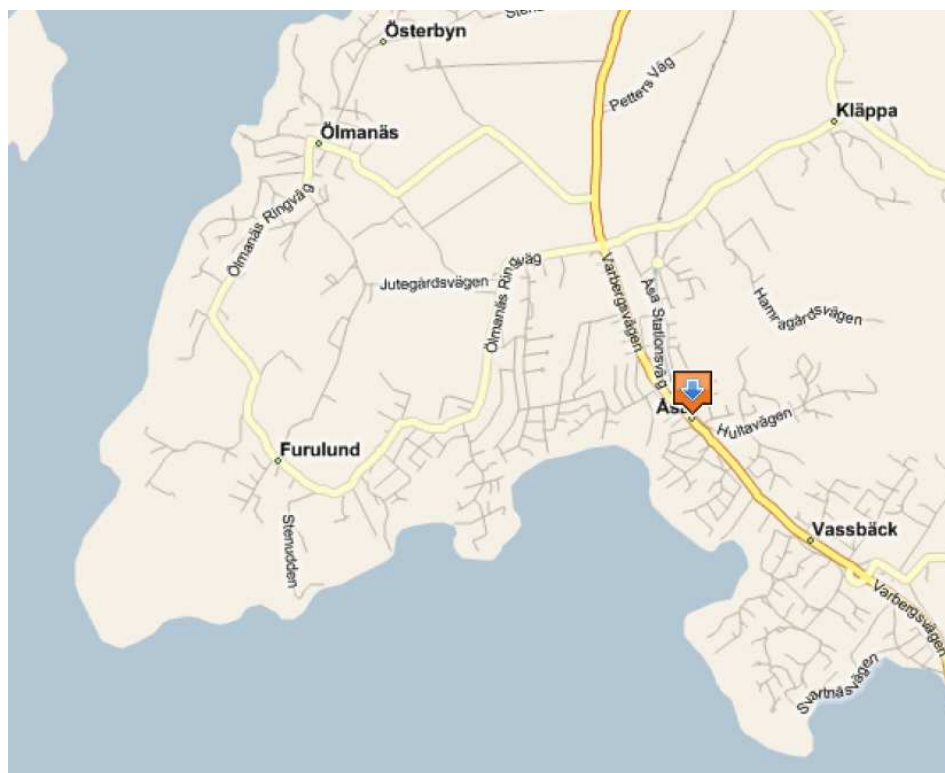
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Open Street Map

- 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.
- The initial map data was all built from scratch by volunteers performing systematic ground surveys using a handheld GPS unit and a notebook.

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.

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Open Street Map

At least somebody got
the railroad track in the
right location

…but we have not
gotten around to much
else

Navteq in Microsoft Mappoint

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

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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.

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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.

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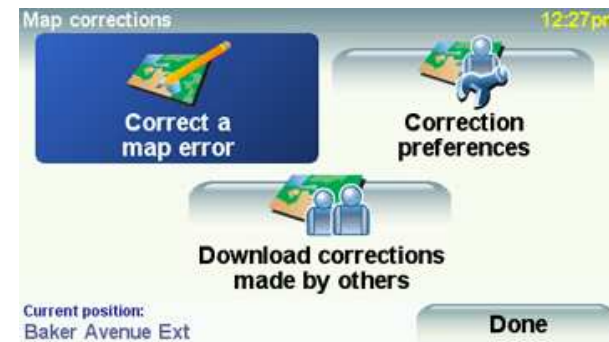
TomTom's Map Share

What you can do with
MapShare

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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? Prosumers are doing that already.

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

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Net Geners will force a new business model

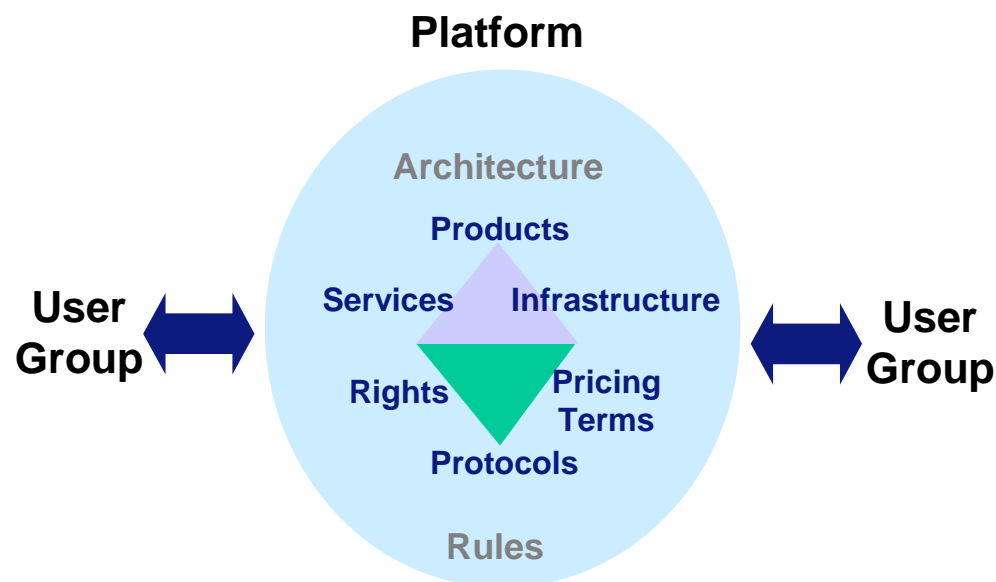## The Eight Norms of Net Geners*

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)

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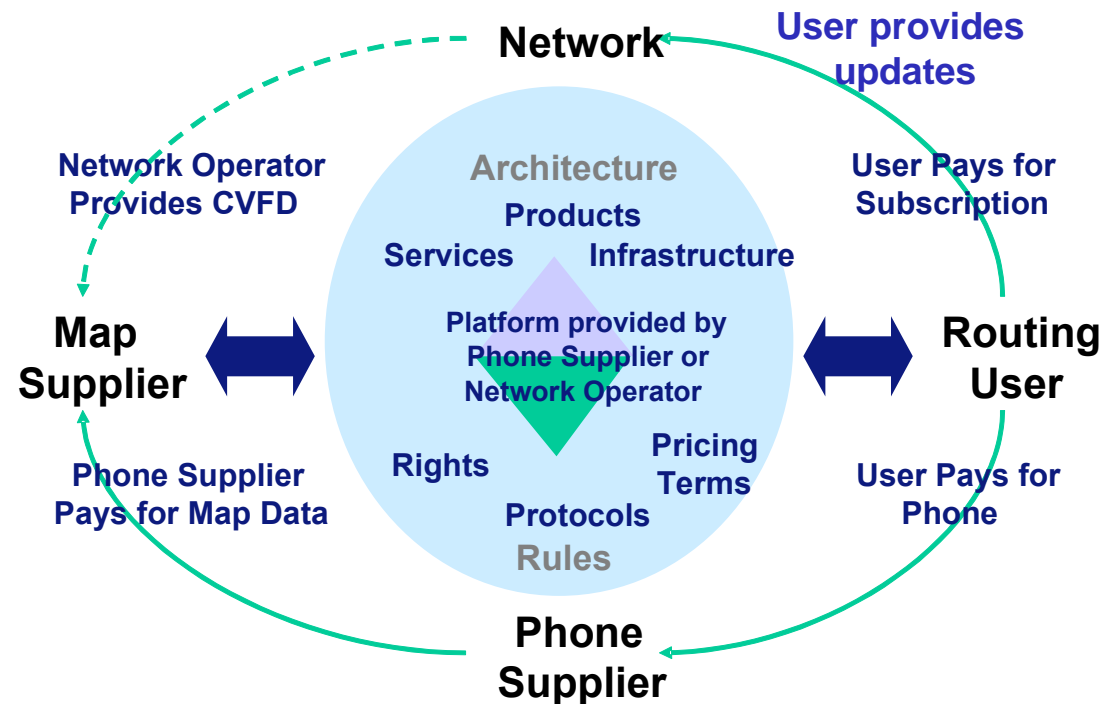*ITS Strategies*

The 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

Platform

Architecture

Products

Services **Infrastructure**

User Group **Rights** **Pricing Terms** **User Group**

Protocols

Rules

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The New Business Model in Practice

▪ 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.

Network

User provides updates

Network Operator Provides CVFD

User Pays for Subscription

Architecture

Products

Services   **Infrastructure**

Platform provided by Phone Supplier or Network Operator

Map Supplier

Routing User

Rights   **Pricing Terms**

Phone Supplier Pays for Map Data

Protocols

Rules

User Pays for Phone

Phone Supplier

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Recap

Conclusion	Qualifier
Crowdsourcing 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.

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Thank you

Is "on-the-fly" updating a possibility?

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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

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