GIS och Positionering

GIS 101

Satellit/GPS

Mobil positionering

Windows Sensor and Location Platform

W3C Geolocation

Google Street View

General GIS Concepts 1

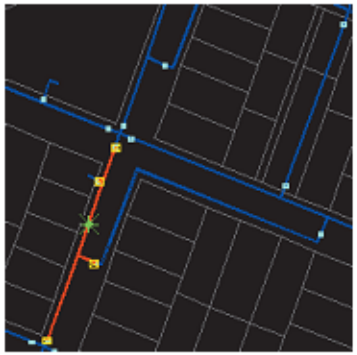
- **What is GIS?**
  - **G**eographic **I**nformation **S**ystem offer a dynamic digital environment for visualizing and analyzing geographic information
  - A GIS is constituted by the interaction between tabular and spatial data, where the tables contain information related to map features
  - For this reason, one often speak of *Relational Databases* when discussing GIS
- **When to use it?**
  - To find spatial data
  - To analyze data using geospatial methods
  - To map information

What can you do with GIS 1?

A tax assessor's office produces land use maps for appraisers and planners.

An engineering department monitors the condition of roads and bridges and produces planning maps for natural disasters.

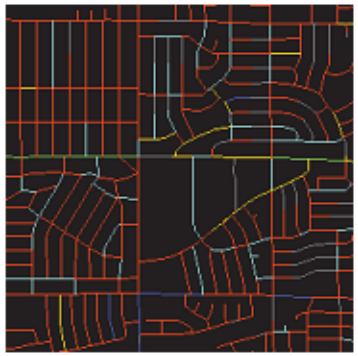
A water department finds the valves to isolate a ruptured water main.



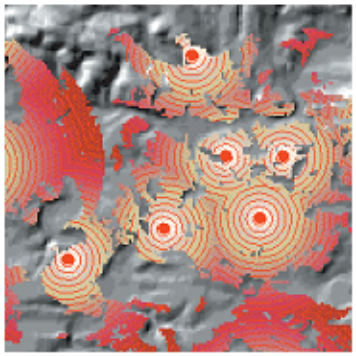
A transit department produces maps of bicycle paths for commuters.

A police department studies crime patterns to intelligently deploy its personnel and to monitor the effectiveness of neighborhood watch programs.

A wastewater department prioritizes areas for repairs after an earthquake.

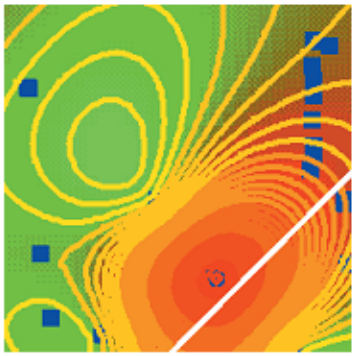


What can you do with GIS 2?

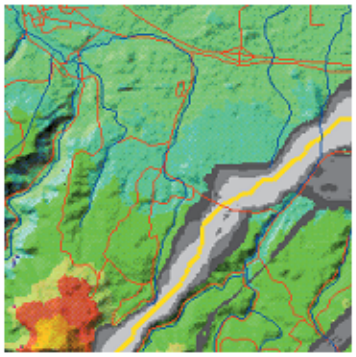


A telecommunication company studies the terrain to find locations for new cell phone antennae.

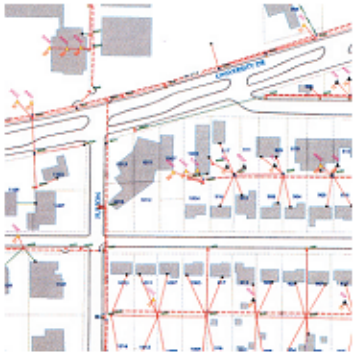
A hydrologist monitors water quality to protect public health.



A pipeline company finds the least-cost path for a new pipeline.

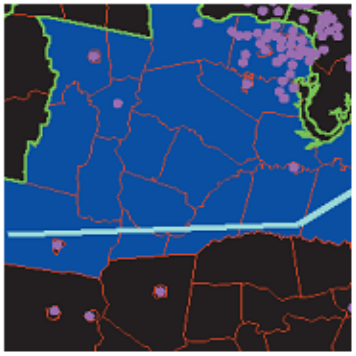


A biologist studies the impact of construction plans on a watershed.

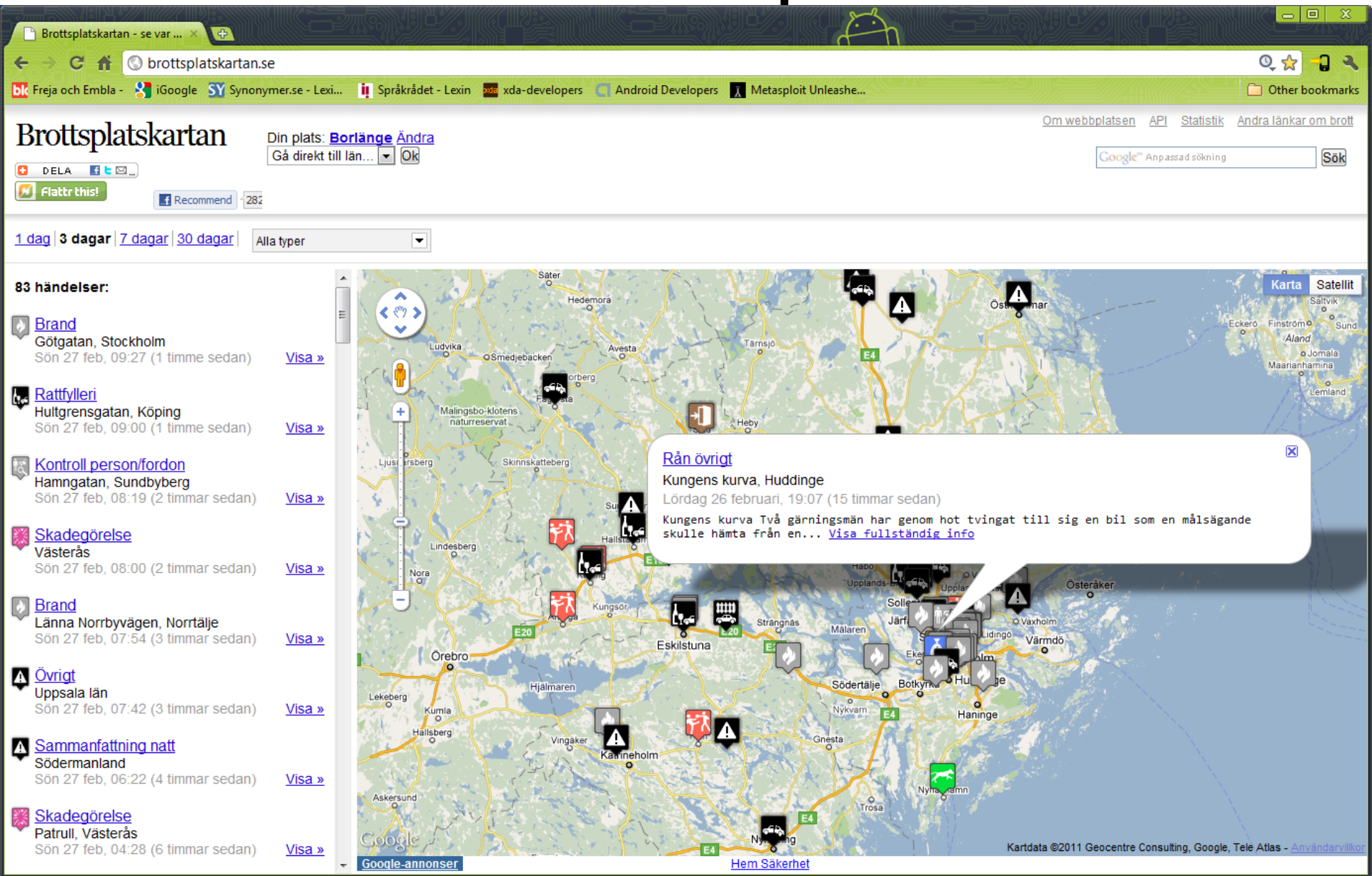


An electric utility models its circuits to minimize power loss and to plan the placement of new devices.

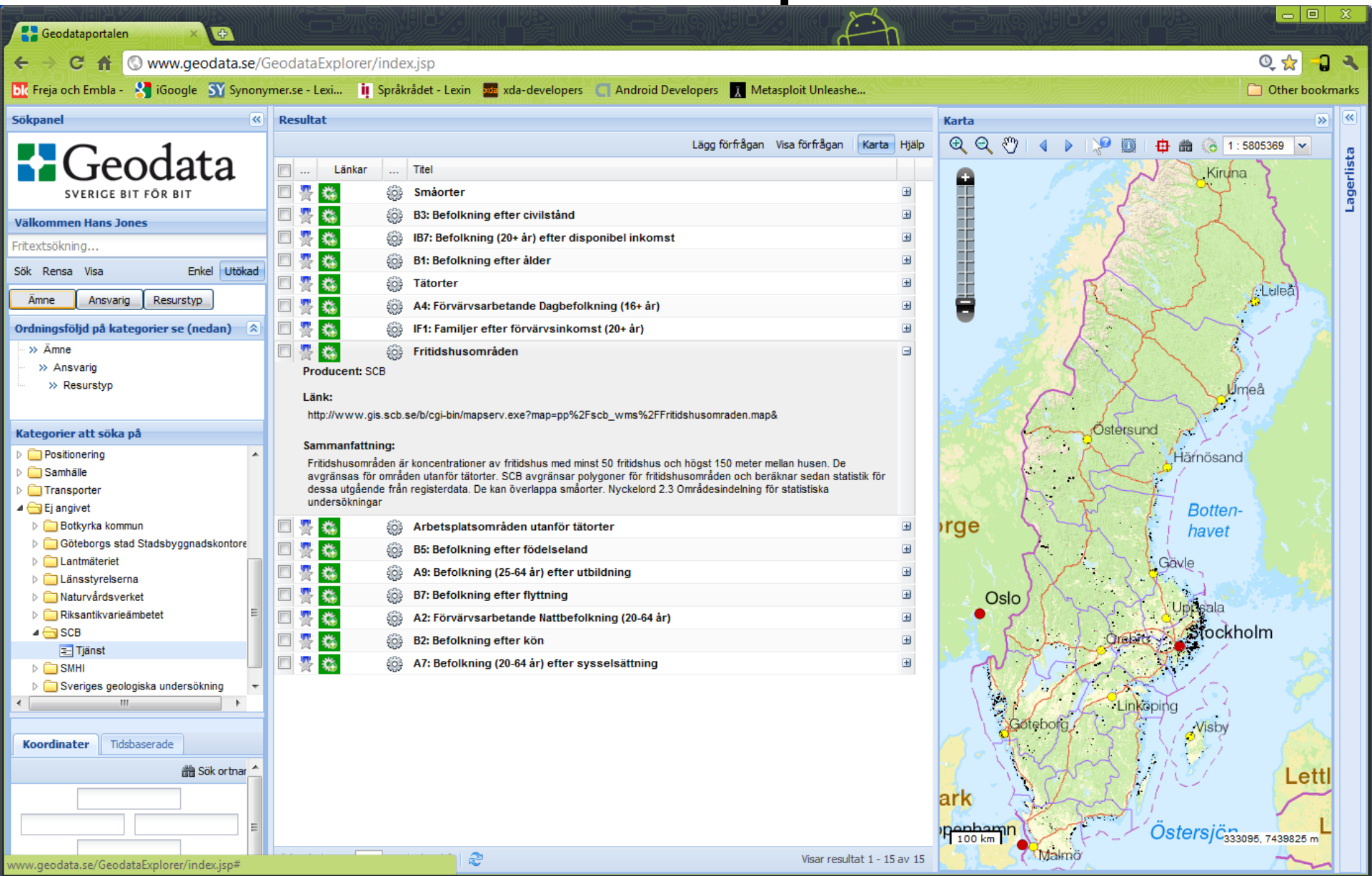
A meteorologist issues warnings for counties in the path of a severe storm.



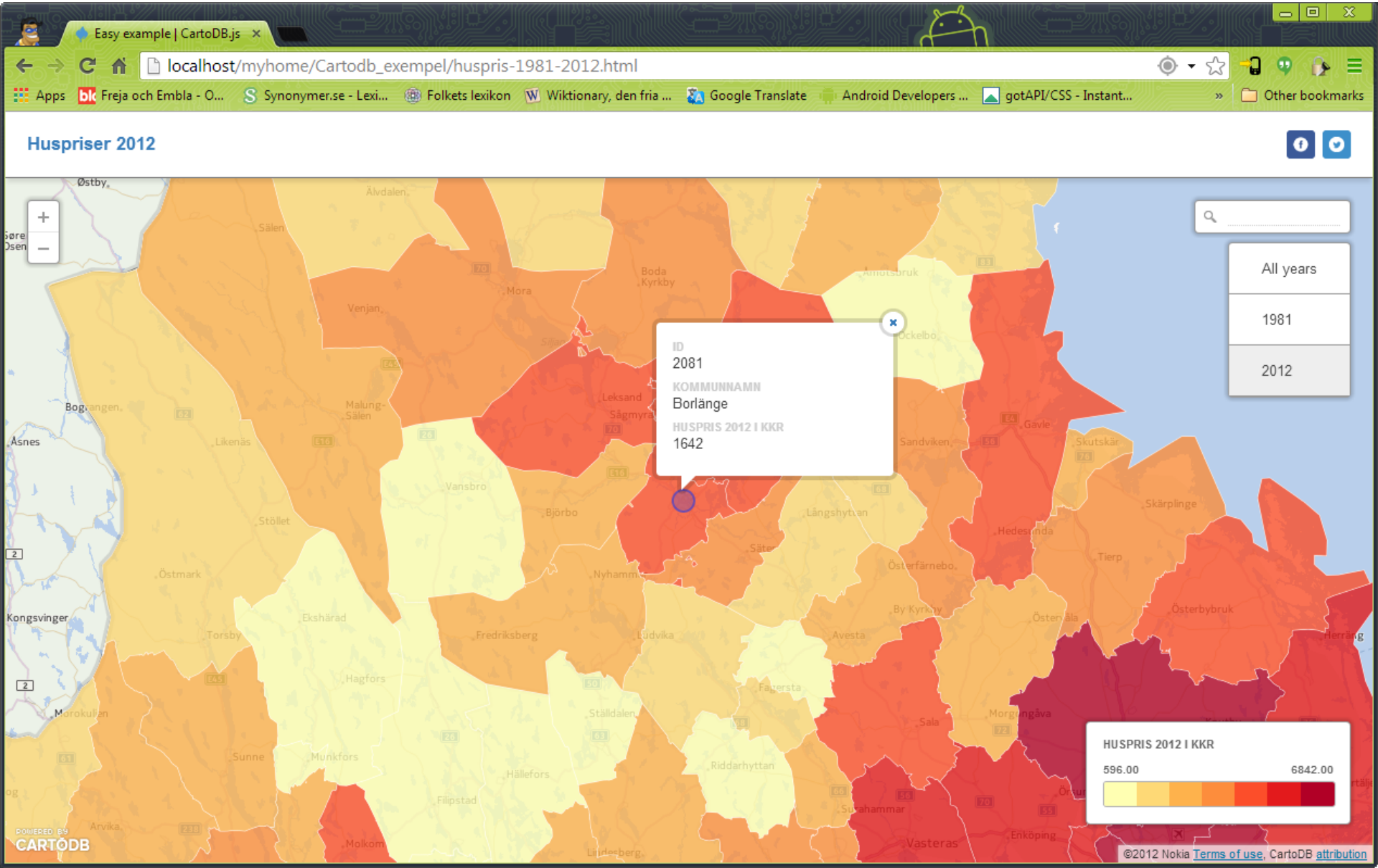
GIS example 1



GIS example 2



GIS example 3



General GIS Concepts 2

- **Tabular Data**
  - Tabular data consists of ***attribute tables*** that define the parameters of the map features
  - There is really no limit to what the tables can contain, whether boolean values, text, or numeric data
    - A text entry may have the city's name, or some other description etc.
    - A numeric entry could have population figures, lat/long coordinates or date time
  - The advantage of the relational database system is that the different columns can be sorted and selected according to the user's need
    - These selections then appear highlighted on the map

General GIS Concepts 3

- **Spatial Data**
  - Spatial data places the features on the map
  - The coordinates of a point are the most obvious example of this, but it also incorporates projection systems, line and polygon attributes, and other information
  - There are two main classes of spatial data: **vector** and **raster**
  - If not DBMS is spatially enabled (support for spatial data types and functions) data is usually stored in the database as a “BLOB” (Binary Large OBject)
    - BlobDataName varBinary(n)

General GIS Concepts 4

- **Spatial Vector Data**
  - Most work developers do in GIS is based on vector data
  - This system of recording features is based on the interaction between arcs and nodes, represented by ***points, lines (or polylines), and polygons***
  - A point is a single node, a line is two nodes (points) with an arc between them (a polyline got more than 2 nodes), and a polygon is a closed group of three or more arcs
  - With these three elements, it is possible to record most or all necessary information

General GIS Concepts 5

- **Spatial Raster Data**
  - Raster data is characterized by pixel values
  - Basically, a raster file is a giant table, where each pixel is assigned a specific value from 0 to 255
  - The meaning behind these values is specified by the user, they can represent elevations, temperatures, water, etc.
  - Raster data is advantageous to vector data in constructing 3D images, as the values for every pixel are calculated through a process called ***interpolation*** – for example: oceans in Google Earth
  - Can be images as well (raster images), .jpg, .tif etc.

General GIS Concepts 6

- **Layer** – A slice of the geography of a particular area. On a paper map, one layer could be the roads, another could be water, another could be places of interest etc.
- **Base Map** – A layer that lends context to your data
- **Geocoding** – Converting street addresses etc. into spatial data that can be displayed on a map (usually latitude and longitude)
  - Reverse geocoding is more or less **Geolocation**
- **Shapefiles** – A data format that stores a particular geographic feature of a certain area and is almost the de-facto standard
- **KML/KMZ** – an XML based language schema for expressing geographic visualization. It is an official open standard for all geobrowsers
- **Projection** – transformation of a map from a spherical object with a certain ”camera view” to a flat sheet of paper

KML - Google Code

code.google.com/apis/kml/

Freja och Embla - | iGoogle | Synonymer.se - Lexi... | Språkrådet - Lexin | xda-developers | Metasploit Unleashe... | Other bookmarks

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Google code

Search

e.g. "adwords" or "open source"

KML

Home | Docs | FAQ | Articles | Blog | Forum

What is KML?

KML is a file format used to display geographic data in an Earth browser, such as Google Earth, Google Maps, and Google Maps for mobile. You can create KML files to pinpoint locations, add image overlays, and expose rich data in new ways. KML is an international standard maintained by the Open Geospatial Consortium, Inc. (OGC).

Google Earth 6 supports elements in the Google extension namespace. These elements include dual-colored line strings, GPS tracks, underwater altitude modes, time support for AbstractViews, and touring. **Download** Google Earth 6 now!

How do I start?

1. Learn the basics of KML.
2. Explore the Developer's Guide.
3. Try out the KML Interactive Sampler.
4. Find more answers in the KML Reference.

Featured Project

2010 Hurricane Season Visualization

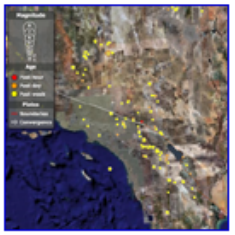
by Geodesic Development

Who uses KML?

Casual users

Placemark homes, plan and document journeys.

Everytrail Half Dome Hike



Scientists

See detailed mappings of natural resources and trends.

USGS Earthquakes

Non-Profits

Highlight problems and advocate change.

Crisis in Darfur

Students and Educators

Explore historic and current places, people and events.

City of London Timeline

View KML in Google Earth (Maps) and Mobile

http://code.google.com/apis/kml/documentation/whatiskml.html

KML (Keyhole Markup Language) vs. ESRI Shapefile

- 3 shapefiles are mandatory, may contain optional files as: prj, xml, sbx/sbn, ...
  - **.shp** - shape format; the feature geometry itself
  - **.shx** - shape index format; a positional index of the feature geometry to allow seeking forwards and backwards quickly
  - **.dbf** - attribute format; columnar attributes for each shape, in dBase III format
  - Each shape record index in a file correspond to other files records in sequence
  - http://en.wikipedia.org/wiki/ESRI_shape
- KML, KMZ = Zipped KML
  - XML based file
  - Placemark – point
  - Path – line
  - Polygon
  - Images (3D)
  - Etc.

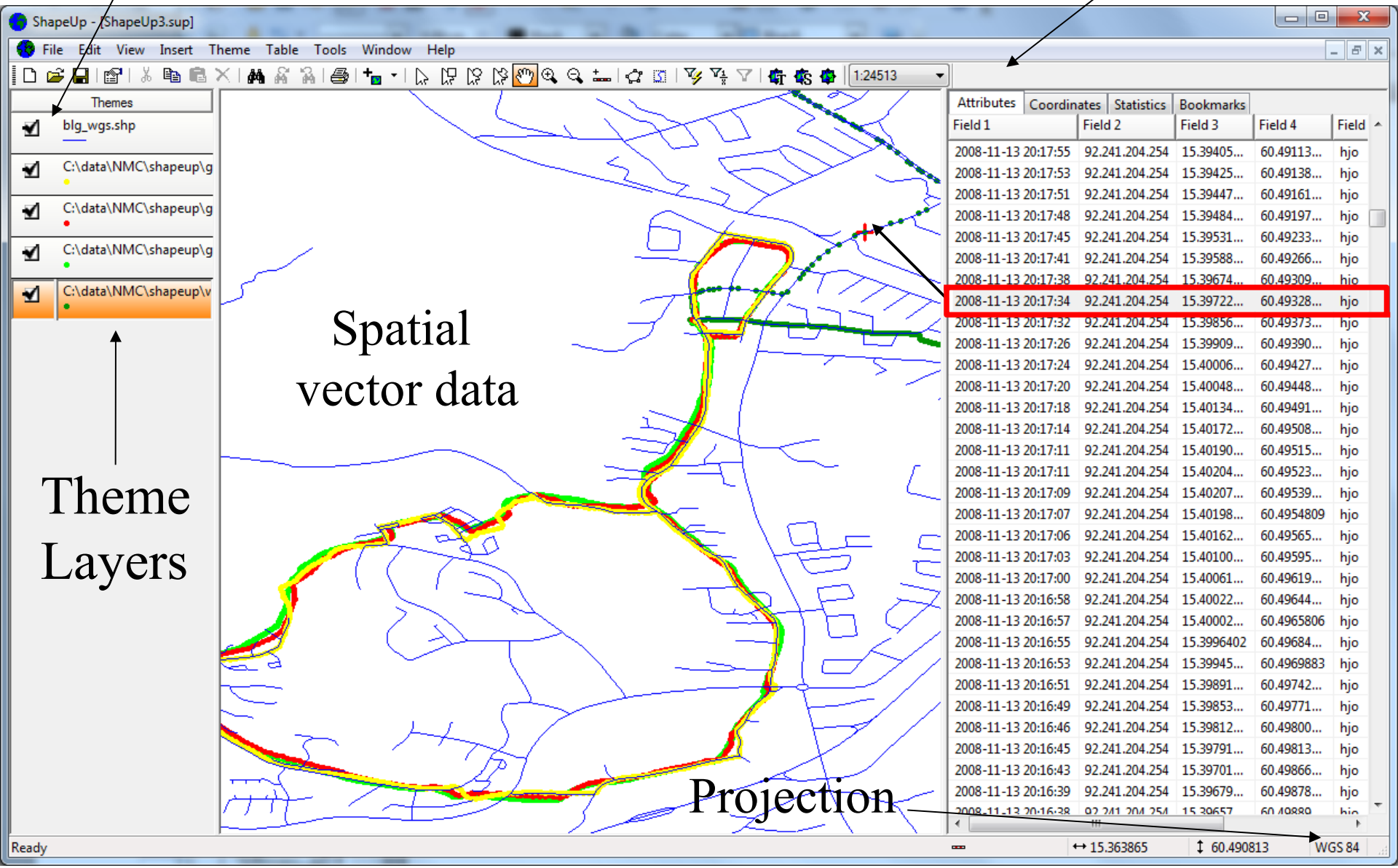
```
<?xml version="1.0" encoding="UTF-8"?>
<kml xmlns="http://www.opengis.net/kml/2.2">
<Placemark>
  <name>New York City</name>
  <description>New York City</description>
  <Point>
    <coordinates>-74.006393,40.714172,0</coordinates>
  </Point>
</Placemark>
</kml>
```

http://code.google.com/apis/kml/documentation/

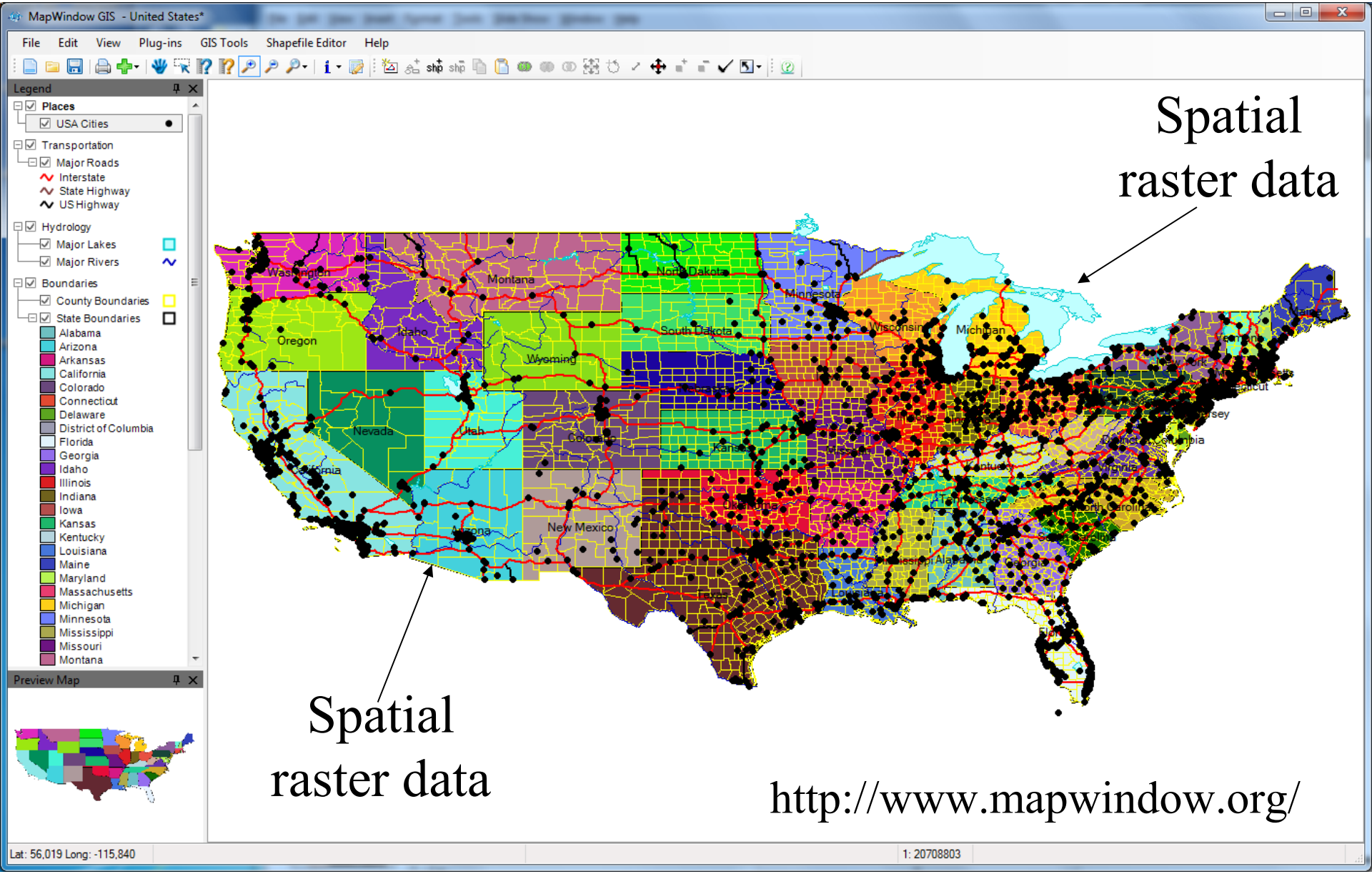
http://en.wikipedia.org/wiki/Keyhole_Markup_Language

Shp2kml, kml2shp, online KML Toolbox
http://www.zonums.com/

ShapeUp GIS tool

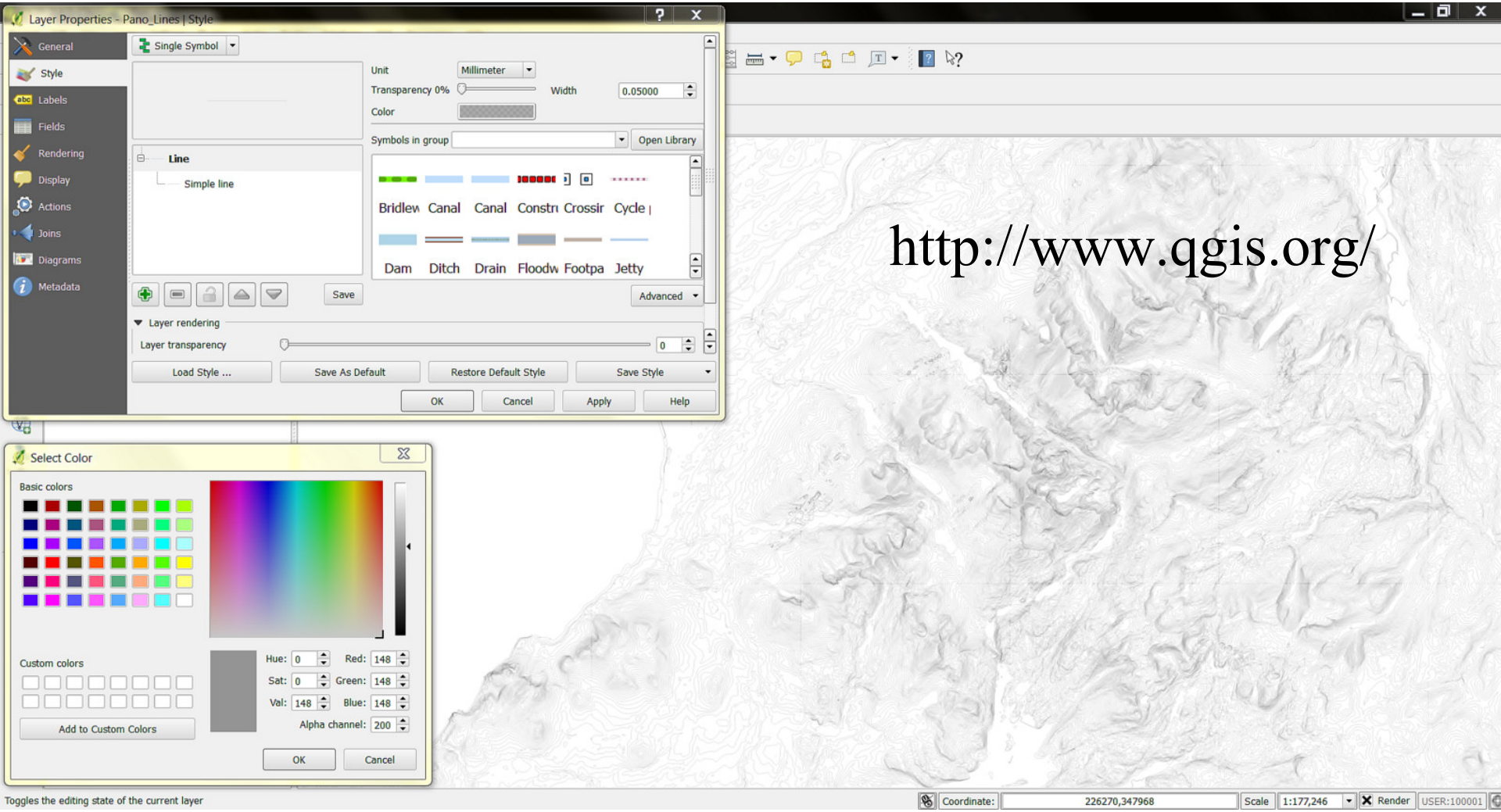


MapWindow GIS tool



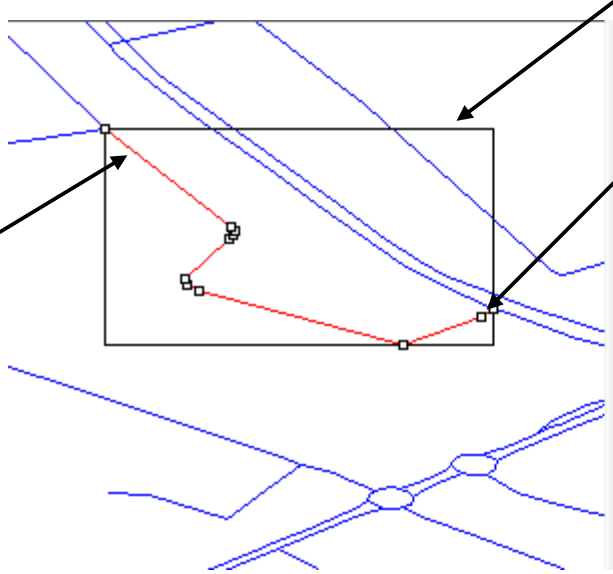
QGIS GIS tool

- **Probably the most open and best free GIS tool**



Vector vs. Raster

- ShapeUp
  - .shp



Attributes	Coordinates	Statistics	Bookmarks
X	Y	Z	
Part 1 of 1:			
15.412564	60.488057	146.777980	
15.412437	60.487980	-99999.000000	
15.411686	60.487701	-99999.000000	
15.409723	60.488234	-99999.000000	
15.409608	60.488280	-99999.000000	
15.409585	60.488340	-99999.000000	
15.410010	60.488724	-99999.000000	
15.410055	60.488775	-99999.000000	
15.410066	60.488817	-99999.000000	
15.410036	60.488852	-99999.000000	
15.408818	60.489787	-99999.000000	

Shape Type = PolyLineZ

raster representation

A	A	A	A	0	0	0	0
A	A	A	A	A	0	0	0
A	A	A	A	0	B	0	0
A	A	A	A	0	0	0	0
A	A	A	0	0	0	C	C
0	0	0	0	0	C	0	0
C	C	C	C	C	0	0	0
0	0	0	0	0	0	0	0

pixel	value
1	A
2	A
3	A
4	A
5	0
6	0
7	0
8	0
9	A
10	A
11	A
12	A
13	A
14	0
15	0
16	0
.	.
.	.
.	.
62	0
63	0
64	0

raster representation

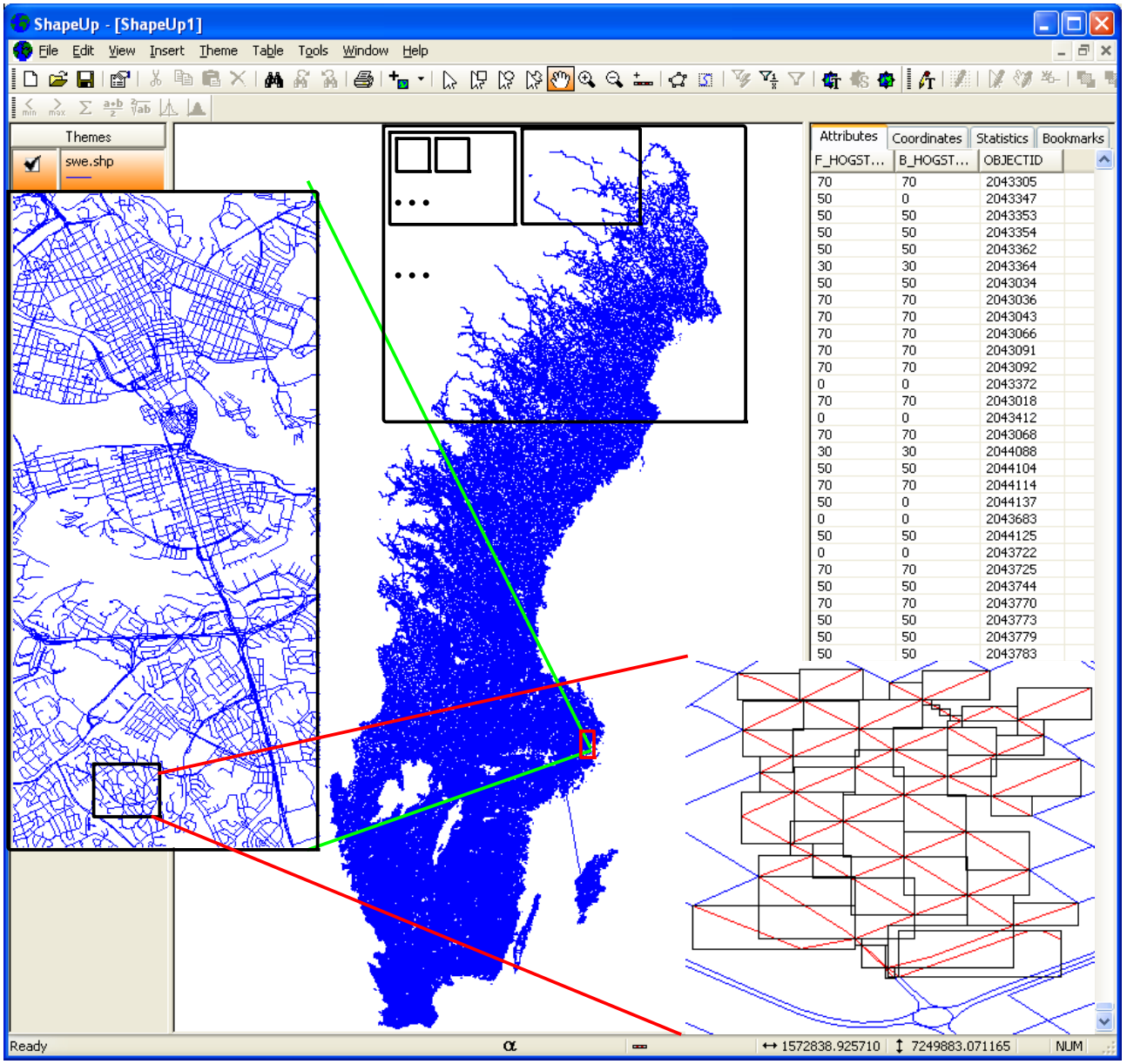
A	A	A	A	0	0	0	0
A	A	A	A	A	0	0	0
A	A	A	A	0	B	0	0
A	A	A	A	0	0	0	0
A	A	A	0	0	0	C	C
0	0	0	0	0	C	0	0
C	C	C	C	C	0	0	0
0	0	0	0	0	0	0	0

Run-length encoded raster

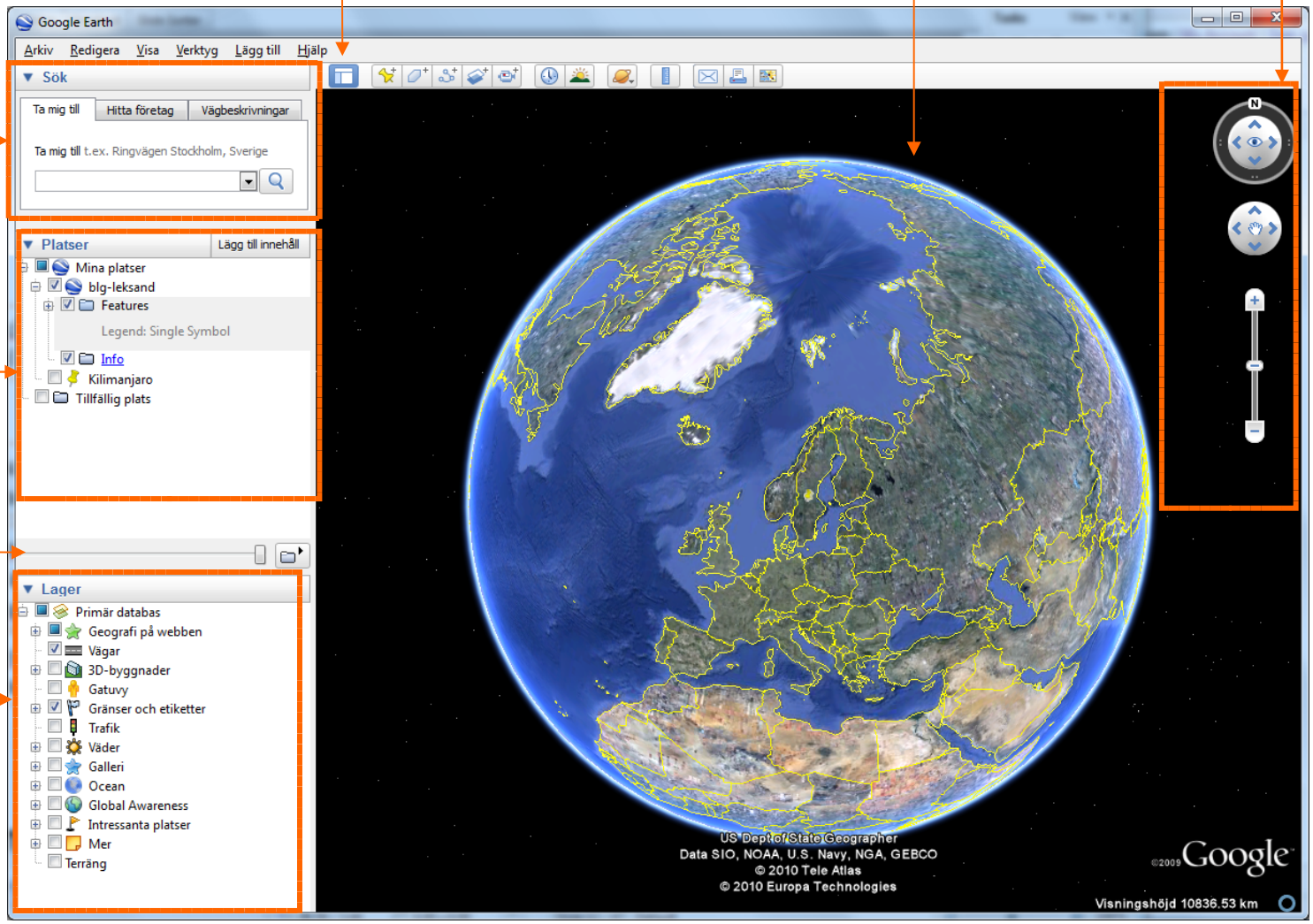
```
A,  4  0,  8
A,  5  0,  8
A,  4  0,  5  B,  6  0,  8
A,  4  0,  8
A,  3  0,  6  C,  8
0,  5  C,  6  0,  8
C,  5  0,  8
0,  8
```

Spatial index and Geolocation

- Swedish roads = 2.1*10^6 polylines
- Makes queries on vector data very fast!
- Usually 3 or 4 spatial levels is followed by a bounding box
- Selection is made upon best probability of a candidate according to a certain algorithm

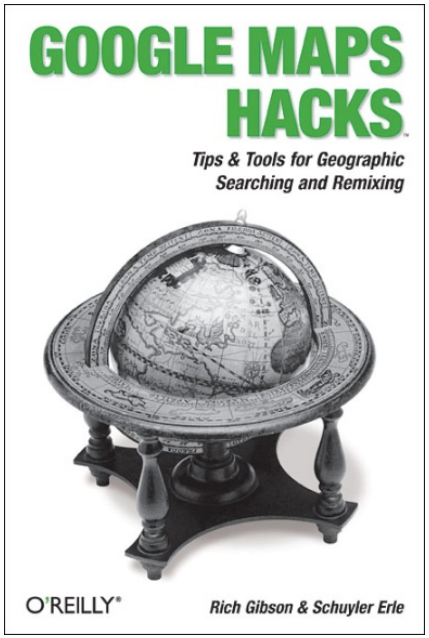


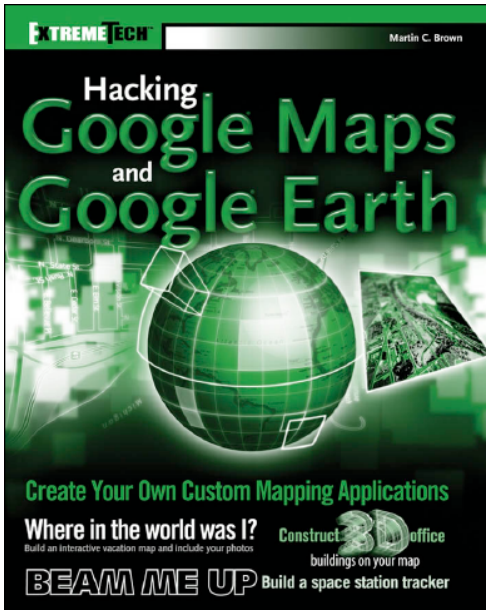
Google Earth



Google Maps API etc.

- Maps API and sign up for API key etc.
  - Maps JavaScript API currently in version 3
  - Static Maps API
  - https://developers.google.com/maps/
- Further reading
  - http://googlemapsmania.blogspot.com/
  - http://www.postneo.com/2007/09/10/google-maps-geoxml-crash-course
- Test Google API functions
  - http://hobbiton.thisside.net/advmap.html
  - http://koti.mbnet.fi/ojalesa/exam/index.html



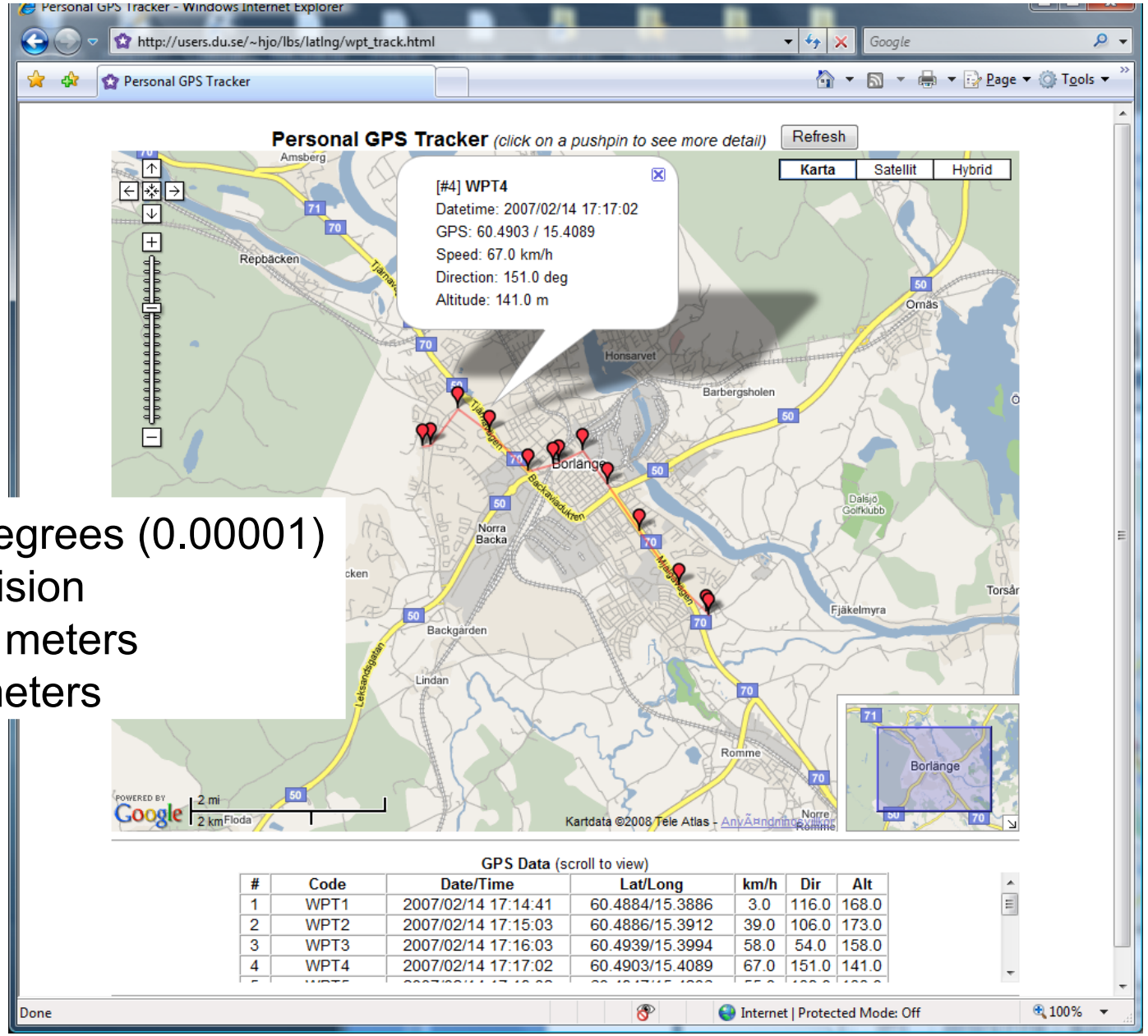


Powered By GPSBabel

GPSBabel converts waypoints, tracks, and routes between popular GPS receivers and mapping programs

http://www.gpsbabel.org/

View on a map



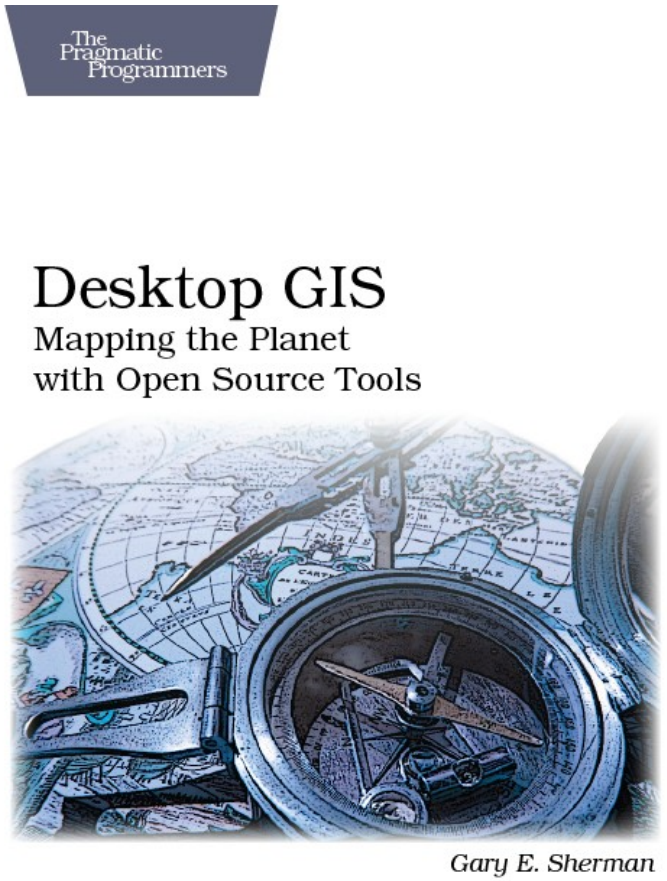
5 decimals degrees (0.00001) give the precision
Long/X: 0,88 meters
Lat/Y: 1,11 meters

The Geospatial Desktop

From Google Maps to iPhone apps, geographic data and visualization is quickly becoming a standard part of life.

The Geospatial Desktop (former Desktop GIS) shows you how to assemble and use an Open Source GIS toolkit. You'll find strategies for choosing a platform, selecting the right tools, integration, managing change, and getting support.

You'll get a good introduction to using the many tools available so you can visualize, digitize, and analyze your own mapping data.



http://geospatialdesktop.com/

VigerGIS

VigerGIS is a collection of GIS software packages which you can run from a VM as VirtualBox

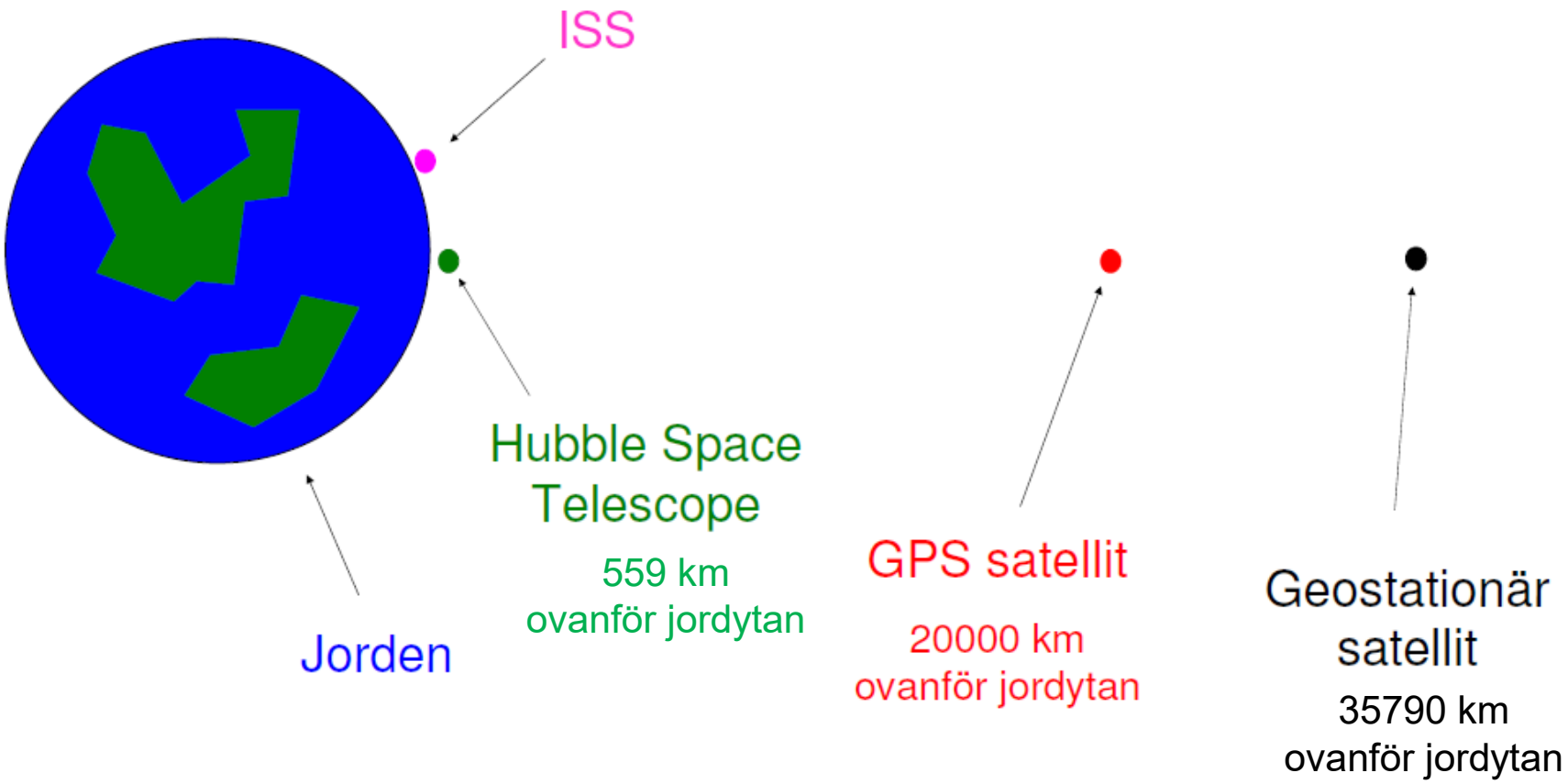
slaxGIS includes the following software:

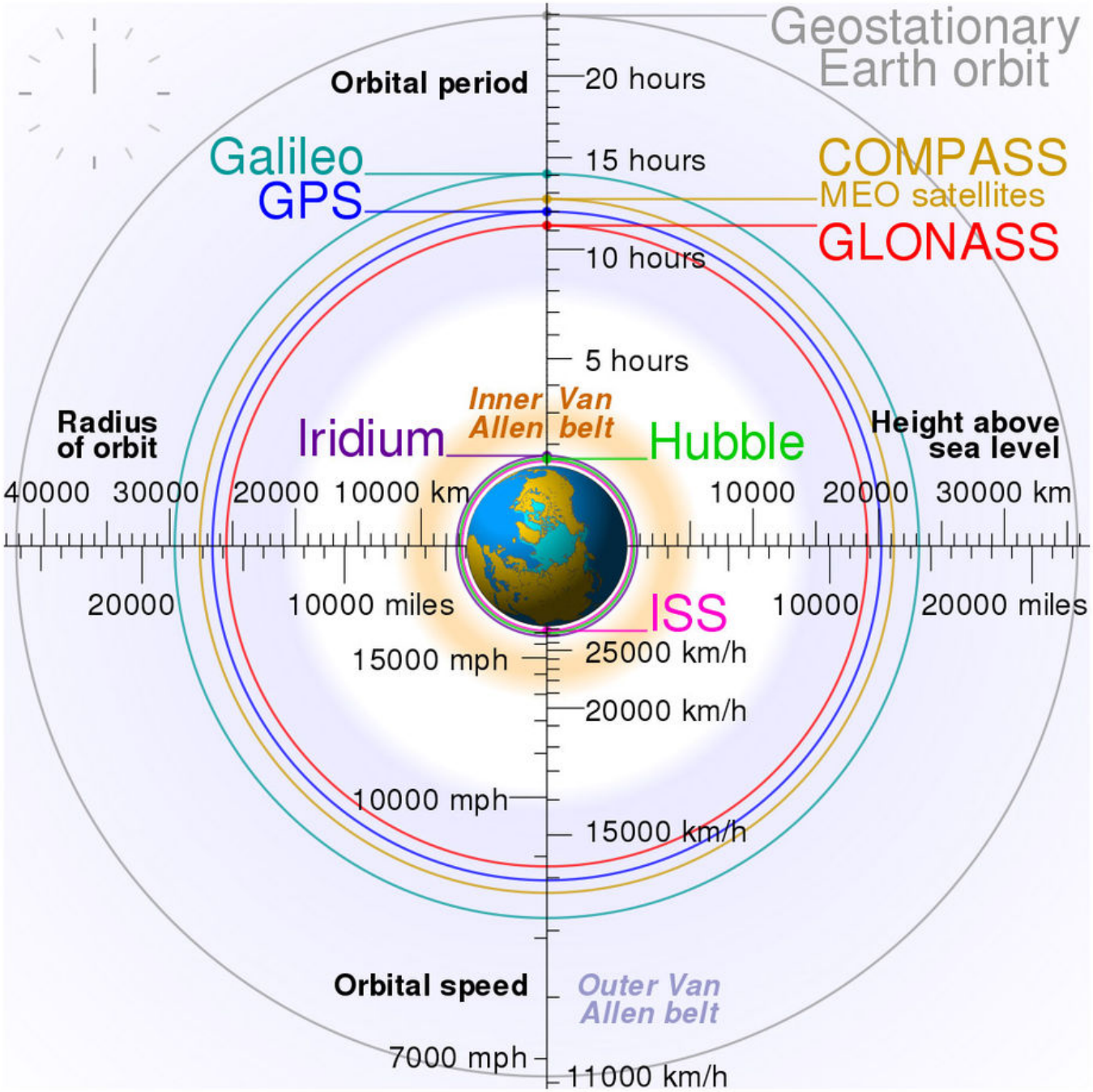
- MapServer
- OpenLayers
- uDig
- OpenJUMP PIROL
- PostgreSQL
- PostGIS
- Grass
- ...

http://geomatica.como.polimi.it/software/vigerGIS/index.php?lang=en

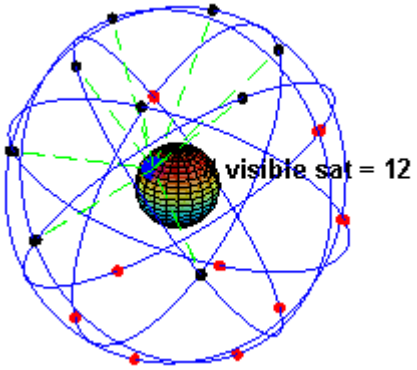
Satellitbaserade positioneringssystem

- http://sv.wikipedia.org/wiki/Geostation%C3%A4r_omloppsbana

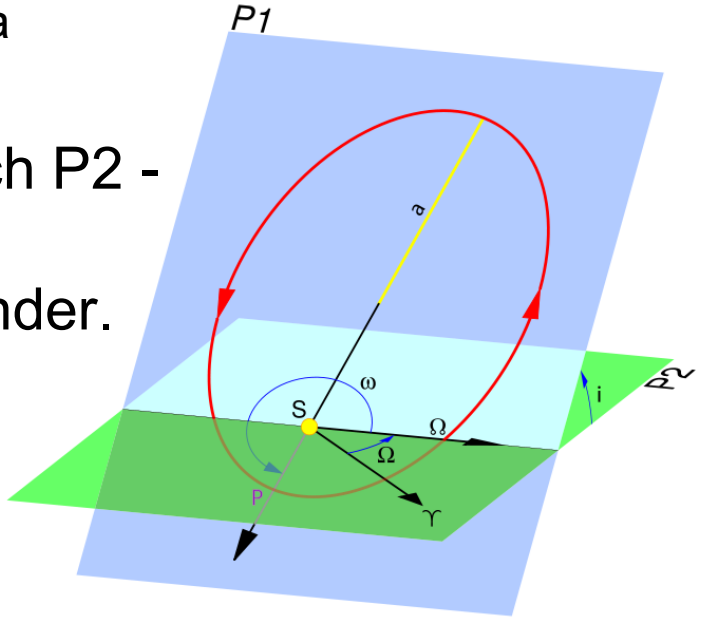



Geostationary
Earth orbit
Orbital period
20 hours
15 hours
10 hours
5 hours
Galileo
GPS
COMPASS
MEO satellites
GLONASS
Inner Van
Allen belt
Iridium
Hubble
Radius
of orbit
Height above
sea level
40000 30000 20000 10000 km
10000 20000 30000 km
20000 10000 miles
10000 20000 miles
ISS
15000 mph
25000 km/h
20000 km/h
10000 mph
15000 km/h
Orbital speed
Outer Van
Allen belt
7000 mph
11000 km/h

Satellitbaserade positioneringssystem



- Interactive Satellite Tracker - Science @ NASA
  - http://science.nasa.gov/iSat/
- Global Navigation Satellite Systems (GNSS)
  - GPS (Global Positioning System), USA
  - GLONASS (GLObal Navigation Satellite System), Ryssland
  - Compass (Beidou Navigation System), Kina
  - Galileo, (efter Galileo Galilei), EU mfl.
- Inklinationen (vinkeln ”i” mellan P1 och P2 - tilt relativt ekvatorn) är den latitud där satelliternas banor (6 st. för GPS) vänder. Över denna latitud (ca: 55° för GPS) minskar noggrannheten
- http://en.wikipedia.org/wiki/Inclination



GPS

- Tänkt som ett militärt system från början, störnings signal borta 2000
- Första satelliten skickades upp 1978
- 1994 hade alla 24 satelliter samt tre reservsatelliter skickats upp
- För närvarande (dec 2012) 32 satelliter
- En ny per år har sänts upp 2010 - 2013
- Noggrannheten är ca: 2 - 8 m (stand alone)
- Inklination, 55 grader
- http://en.wikipedia.org/wiki/Global_Positioning_System

GLONASS

- Startade 1982 som ett militärt projekt, fritt 2007
- Alla 24 satelliterna i omlopp 1996, sedan sönderfall
- För närvarande (2013) är 29 satelliter i bruk
- Noggrannhet 4 – 8 m, bättre närmare polerna än GPS
- Kraftig restaurering sedan 2010 vilket pågår ännu
- Så här har ryska försvarets apparater sett ut... Förmodligen kan den köras över med stridsvagn ☺
- Inklination, 64.8 grader över 3 omloppsbanor
- http://en.wikipedia.org/wiki/GLONASS

GALILEO

- Första testsatelliten skickades upp 2005 (första skarpa 2011)
- Alla 30 satelliterna (inklusive tre i reserv) planeras vara uppe 2020
  - 18 st. uppe hittills (dec -16)
  - Finansieringsproblem
- Utlovar (mycket) bättre noggrannhet än GPS
- Förmodas ge 150 000 nya jobb i Europa
- Kompatibelt med GPS och GLONASS
- Inklination, 56 grader

- 3 omloppsbanor (9 st. + 1 reserv per bana)
- http://en.wikipedia.org/wiki/Galileo_(satellite_navigation)

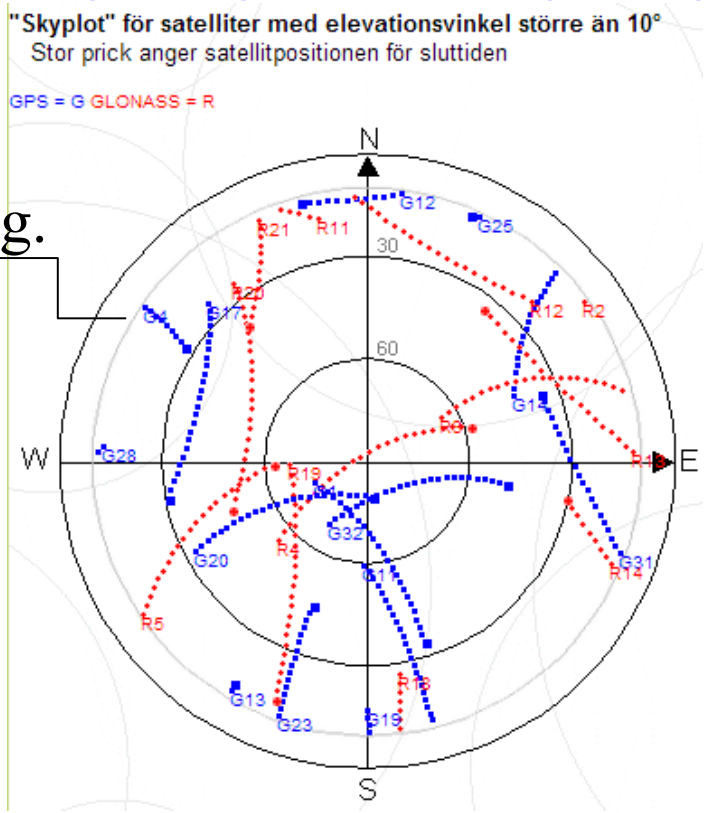
BeiDou Navigation Satellite System

- BeiDou 1
  - Tänkt som ett militärt system från början men är öppet från 2008 ->
  - Första satelliten skickades upp 2000
  - 2007 hade 5 satelliter skickats upp
  - Satelliterna befinner sig i geostationär bana ca: 35000 km över jordytan
  - Noggrannheten är ca: 10 m
- BeiDou 2
  - Globalt system med 35 satelliter, 10 st. uppe 2011
  - Fungerar i asien sedan dec 2012, ska vara klart 2020
- http://en.wikipedia.org/wiki/Beidou_Navigation_Satellite_System

Precision och tillgänglighet

- 1D (no fix), 2D or 3D Fix
  - At least 4 satellites is necessary to have a 3D position fix
- Satellitprediktering
  - http://swepos.lmv.lm.se/preddop/in.asp

10deg.



Stationsinformation

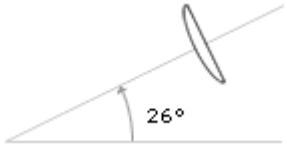
Koordinater
Geografiska: 60°29' N, Lon=15°27' E
Datum/Tid
Startdatum =2013-12-11, GPS-dag=345, GPS-vecka=1770, Svensk tid: 13:00 - 15:00
Övrigt
Intervall: 5min. Elevationsmask: 10°

Antal satelliter samt PDOP vid en elevationsvinkel större än 10°

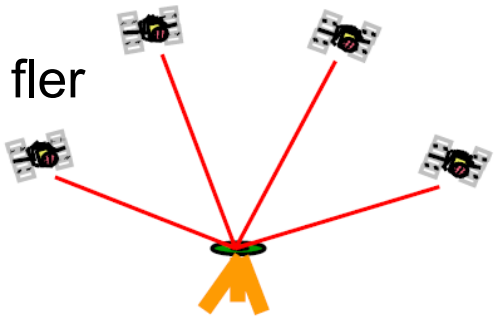
Tid	GPS / GLONASS	PDOP
13:00	16 (8/8)	1,2
13:05	15 (8/7)	1,3
13:10	14 (7/7)	1,3
13:15	15 (7/8)	1,2
13:20	16 (7/9)	1,1
13:25	15 (7/8)	1,3
13:30	15 (7/8)	1,3
13:35	14 (7/7)	1,5
13:40	14 (7/7)	1,6
13:45	15 (8/7)	1,4
13:50	15 (8/7)	1,4
13:55	15 (8/7)	1,4
14:00	16 (8/8)	1,3
14:05	17 (9/8)	1,3
14:10	17 (9/8)	1,3
14:15	17 (9/8)	1,4
14:20	19 (10/9)	1,2
14:25	19 (10/9)	1,2
14:30	19 (10/9)	1,2
14:35	18 (9/9)	1,2
14:40	18 (9/9)	1,2
14:45	17 (9/8)	1,2
14:50	16 (9/7)	1,3
14:55	17 (10/7)	1,2
15:00	17 (10/7)	1,3

Satellitplanera

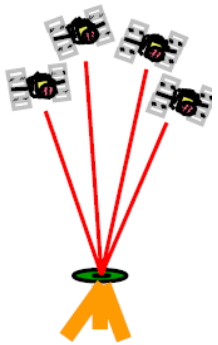
Elevationsvinkel = vinkeln från markplan



- DOP = Mått på geometrisk spridning
  - Diluton Of Precision
  - HDOP, VDOP, PDOP, TDOP, GDOP…
  - http://en.wikipedia.org/wiki/Dilution_of_precision_(GPS)
- Ju lägre DOP-tal-desto bättre geometrisk spridning
  - PDOP (position 3D) bör inte överstiga 4 - 5
- Elevationsmask bör vara 10-15 grader
  - 0 – 89 grader är teoretiskt
  - En lägre elevationsmask ger fler satelliter och ett bättre lägre DOP värde
  - Men ofta också ett högre ”brus”, reflektioner, atmosfär etc.



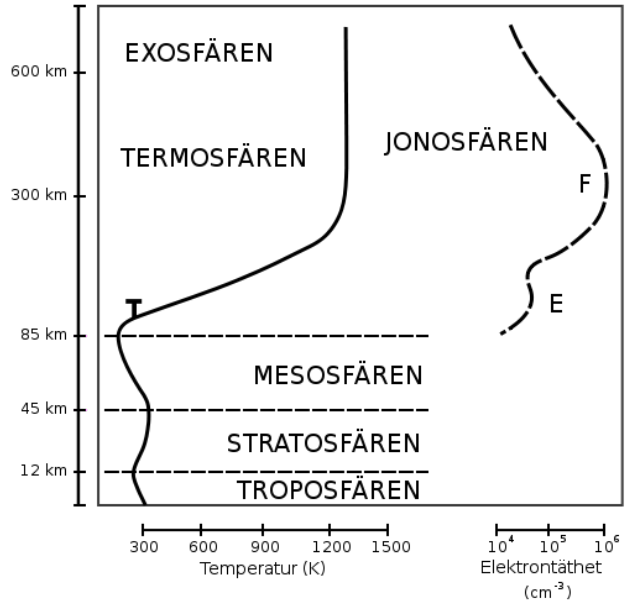
Lågt DOP



Högt DOP

Felkällor och felreducering

- Klockfel
  - Tidstolerans ca: 1-50 ns/dygn
  - Allmänna relativitets teorin - tiden går snabbare med låg gravitation,16s sedan start
  - Gravitationen är proportionell mot tiden
  - http://www.youtube.com/watch?v=Ev50_rFGFs8
  - http://www.imdb.com/title/tt2364345/
- Osäkerhet i satellits position i satellitbana
- Jonosfären
  - http://sv.wikipedia.org/wiki/Jonosf%C3%A4r
- Troposfären
- Studsande signaler
- Dåliga mottagare/antenner
- Systematiska fel reduceras genom att ”rättad” data skickas till GPS-mottagare från platser med kända positioner
  - Felen kan reduceras från 10-15 m till 1-2 m

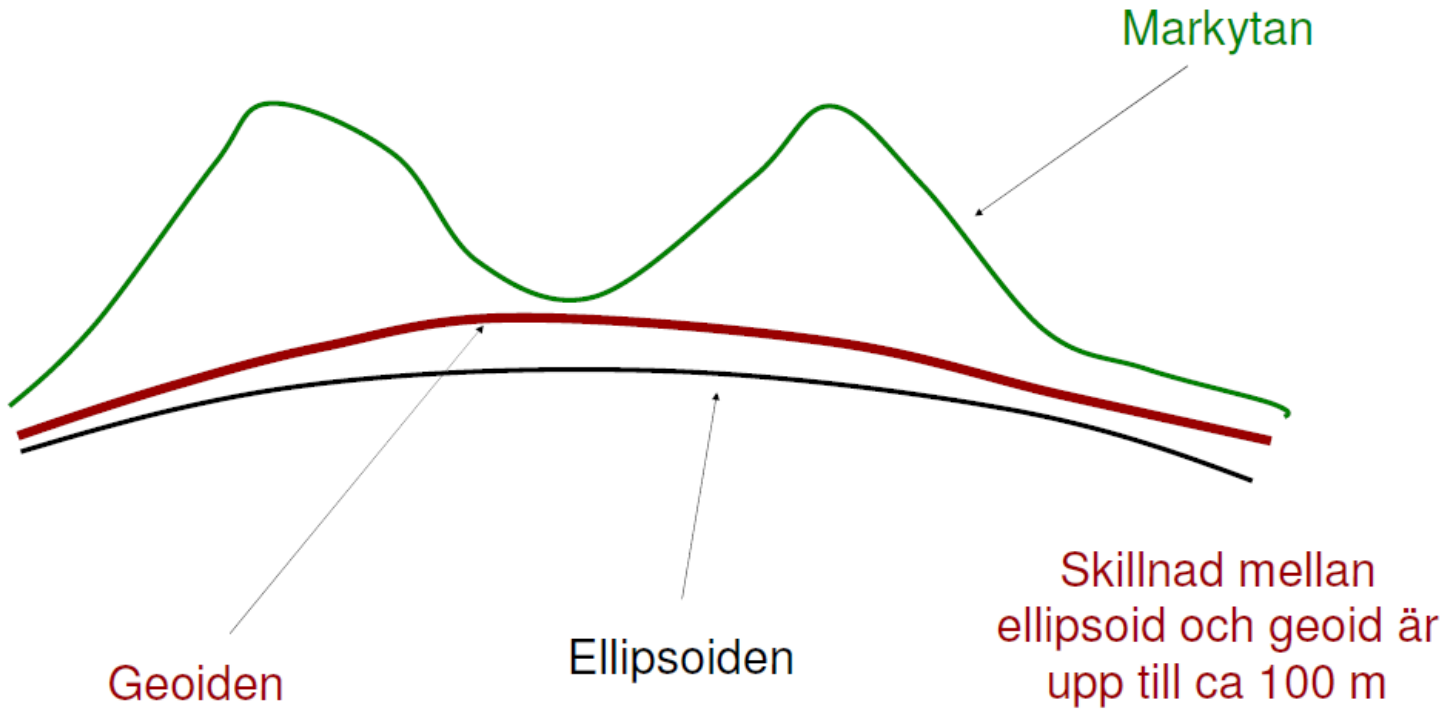


Augmentation

- Systemlösningen kontrollerar integritetsgränser och beräknar korrektionsfaktorer för att slutligen sända rättad positionsdata till GPS-mottagaren (på samma frekvens) endera via markstationer (GBAS) eller via satellitstationer (SBAS)
- GBAS (Ground Based Augmentation System)
  - SWEPOS (LMV) och EPOS (Teracoms dGPS tjänst)
  - Förbättrar precisionen ner mot centimetern
  - http://swepos.lmv.lm.se/
- SBAS (Satellite Based Augmentation System), geostationära
  - WAAS (Wide Area Augmentation System, USA)
  - MSAS (Multi-functional Satellite Augmentation System, Asien)
  - EGNOS (European Geostationary Navigation Overlay Service)
    - Förbättrar precisionen - bättre än 2 meter fel
    - EGNOS är påslaget sedan 2005 men kan ha problem i norrland

Geoiden och ellipsoiden

- Jordens form approximeras med en ellipsoid, dvs. en roterande ellips
- GPS mottagaren ger höjden relativt ellipsoiden
- ”Höjd över havet” beräknas relativt geoiden (jorden är inte en exakt ellips)

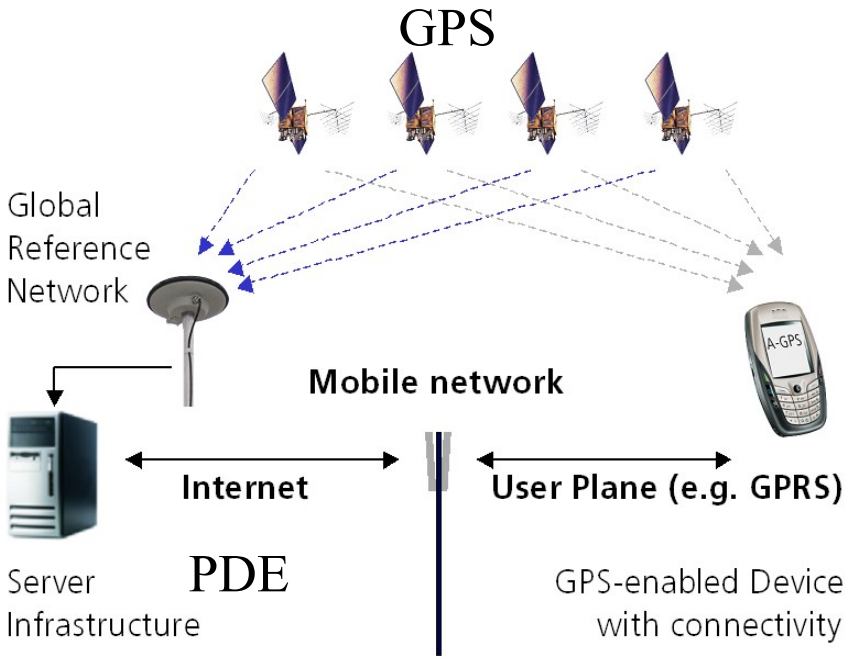


GPS devices & phones 1

- Built-in
  - Qualcomm gpsOne and other proprietary solutions
  - http://www.prisjakt.nu/kategori.php?k=v615
- Bluetooth (GPS chipsets)
  - U-blox, SiRF, RFMD and MTK etc.
- Static navigation filter
  - Bad for pedestrian mode
  - http://etn.se/index.php?view=article&catid=27%3Aprodukt&id=47540%3Aantenn-fo
- Almanac
  - En förutsägelse om alla satelliternas bana och position runt jorden
  - Giltig uppemot flera månader
- Ephemeris
  - Innehåller enskilda satellitens exakta positionsdata vid given tid och annan information nödvändig för positionering, uppdateras var 30 sec.
  - Max uppemot 2-4h timmar gammal, 30 minuter i praktiken
  - http://www.satellitetrackingsystem.co.uk/satellite_tracking_software.htm

GPS devices & phones 2

- User plane vs. Control plane
- A-GPS (Assisted)
  - Hjälper till med att få igång positioneringen genom att ge bla. aktuell GPS **Almanac** och **Ephemeris** via nätet
  - Mobilnäts data (almanac)
  - Många fler parametrar kan ges: http://en.wikipedia.org/wiki/GPS_Phone
- TTFF (Time To First Fix)
- Cold start vs. warm start
  - Super cold start
- Qualcomm Snapdragon gpsone gen8 supports Glonass as well
  - http://en.wikipedia.org/wiki/GpsOne

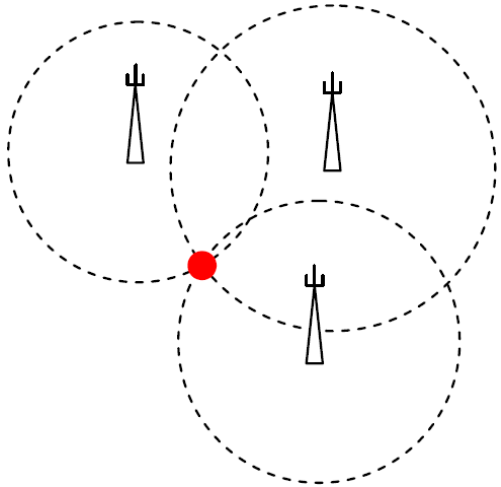


Position Determination Entity

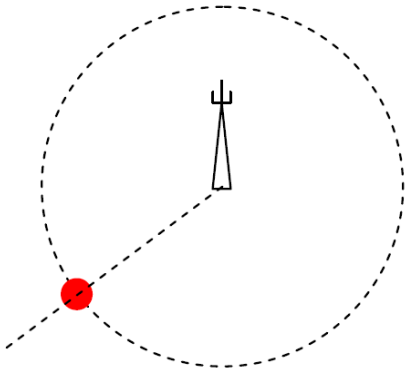
Mobila Positioneringsmetoder

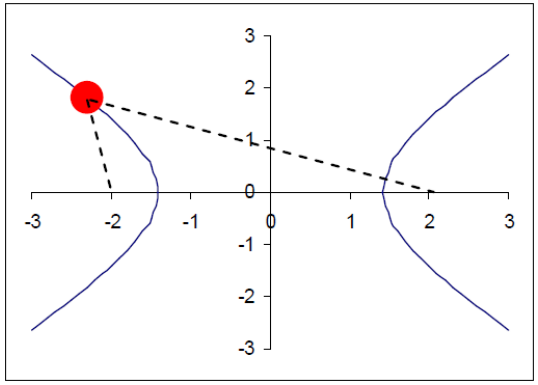
- Mobilbaserad positionering
  - Mobilen tar emot signaler från positionssatta basstationer och positionerar sig med hjälp av informationen
- Nätverksbaserad positionering
  - Mobilnätverket positionerar den för det mesta passiva mobiltelefonen
- Mobilassisterad positionering
  - Mobilen gör alla mätningarna själv men skickar mätsignaler till nätverket för beräkning

Mobila Positioneringsmetoder



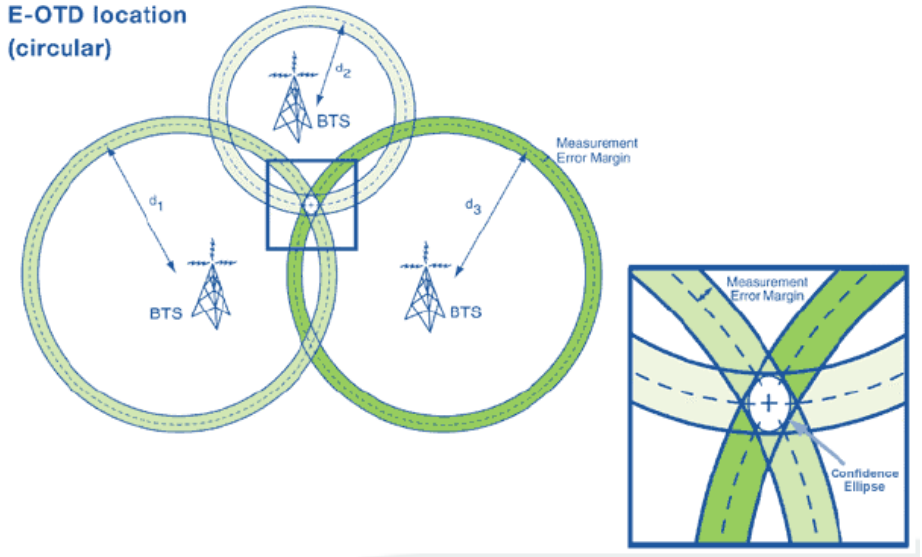
- Radiell-radiell metoden
  - Avståndsmätningar kombineras
- Vinkel-radiell metoden
  - Avståndsmätningar och vinkelmätningar kombineras
- Hyperbolisk-Hyperbolisk metoden
  - Avancerad radiell-radiell metod
    - TOA (Time of Arrival)
    - Time Difference Of Arrival (TDOA)
  - BTSer på x-axel vid -2 och 2





Triangulation

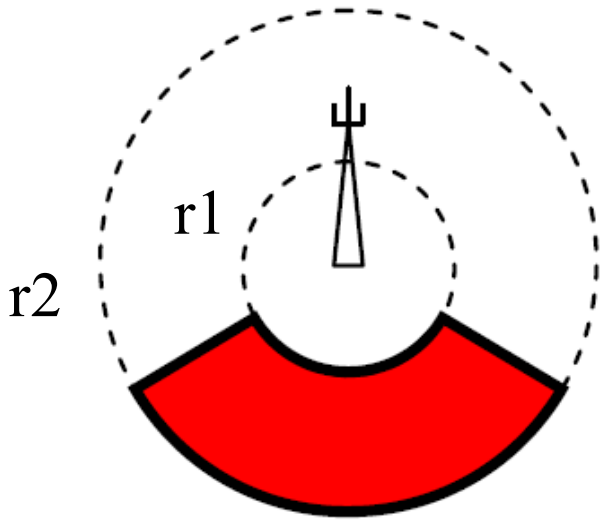
- OTDOA (Observed Time Difference Of Arrival), WCDMA
- AFLT (Advanced Forward Link Trilateration), CDMA
- E-OTD (Enhanced Observed Time Difference of arrival), GSM
- TTFF around 6-8 sec
- Precision 100-1000 meters
  - Hur korrekt är PDE:ns (Position Determination Entity) almanac för alla basstationer?
  - Terminalens kalibrering
  - Antalet pilotkanaler från basstationer som är synliga för terminal som skall positioneras
  - Basstationers cellstorlek



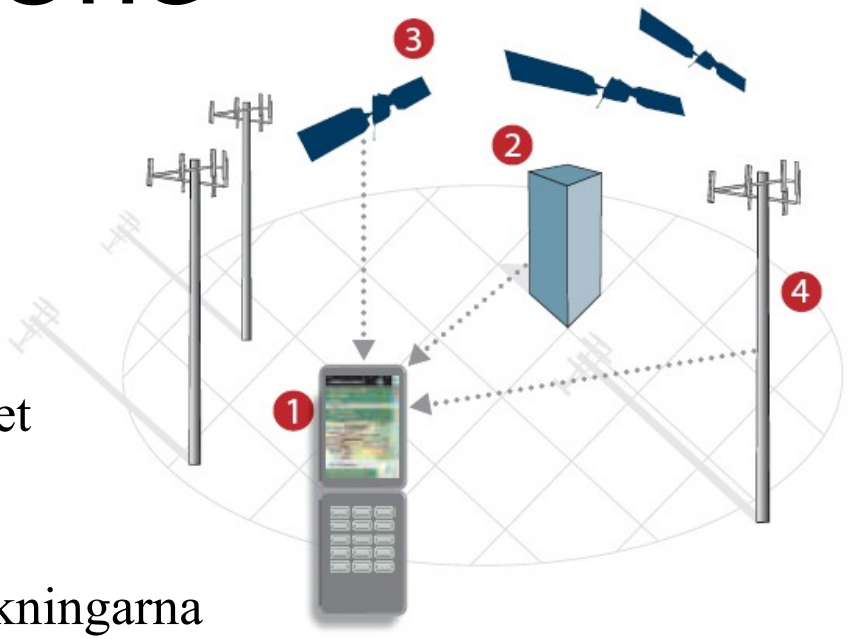
Cell ID

- Med Cell ID menas täcknings-området av basstationens antenn/antenner (sektorer)
  - Stort om den är rundstrålande
- CGI-TA
  - Cell Global Identity-Timing Advance
  - Del av sektor i basstationen vilka för det mesta strålar 120 grader
  - I GSM kan r2 - r1 som lägst bli 550 m, om inte cellen är mindre än 550 m
- Angel of Arrival (AOA)
  - Vinkel-radiell metod, kräver antenner som strålar mycket snävt

Frequency (MHz)	Cell radius (km)	Cell area (km²)	Relative cell count
450	50	7521	1
950	26.9	2269	3
1800	14.0	618	12
2100	12	449	16



Qualcomm gpsOne

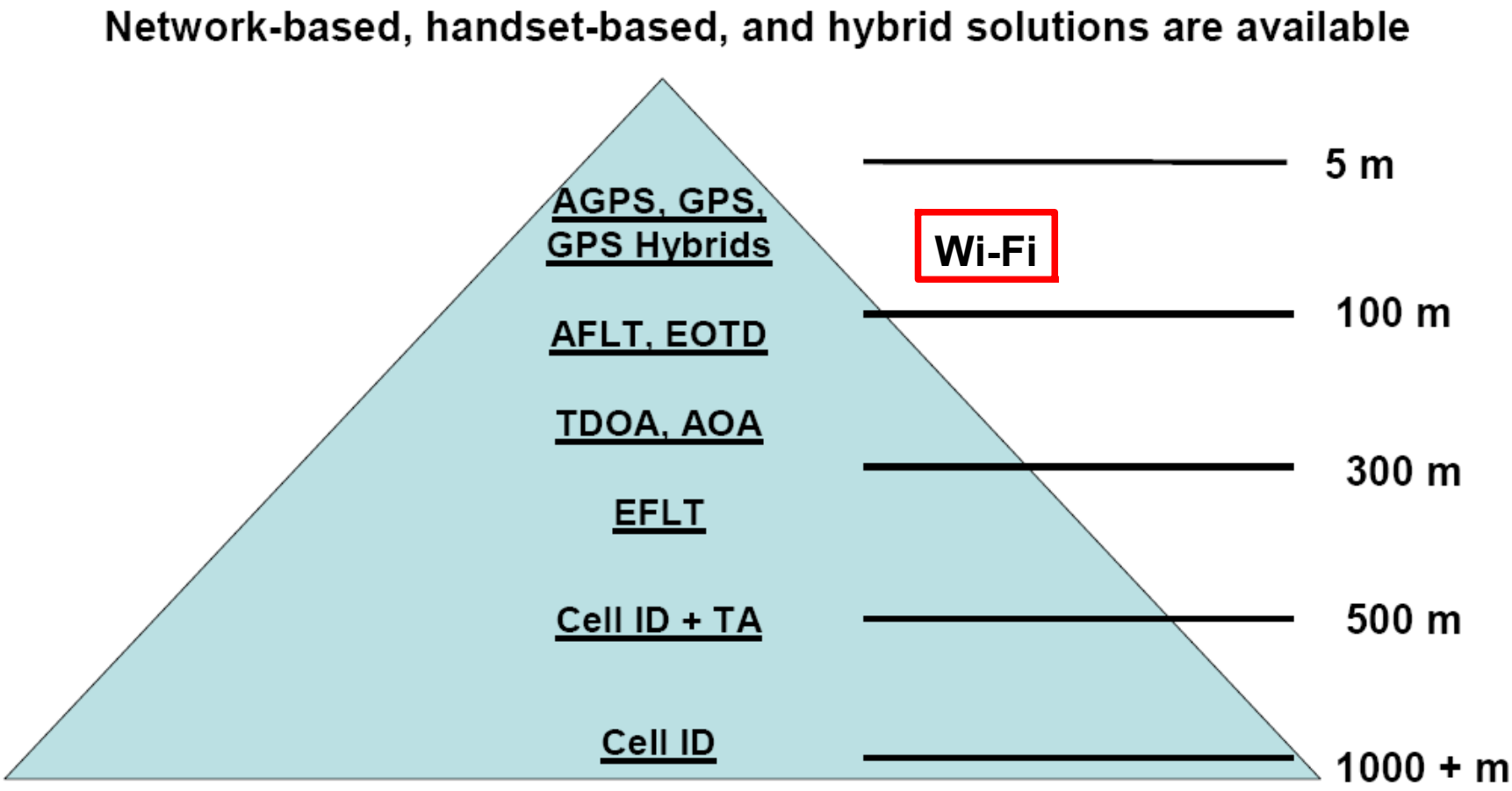


- Helt integrerad i chipset
- Kan arbeta i 4 lägen
  - Fristående GPS
  - MS (Mobile Station) baserad
    - GPS och location signal från nätet
  - MS assisted
    - Samma som ovan samt att en PDE server hjälper till med beräkningarna
  - MS assisted/hybrid
    - Samma som ovan men Internet funktionen består
  - Eliminerar fördröjningen för första ”fixen”
  - Finns i över 300 miljoner telefoner och +40 operatörer - 2009
    - http://en.wikipedia.org/wiki/GpsOne
- Qualcomm Snapdragon SoC sitter i många smartphones
  - http://en.wikipedia.org/wiki/Snapdragon_%28processor%29

Sammanfattning positionering 1

Technique	Method and strengths	Examples
Data-based	Location calculated with reference to a single base station. Fast and cheap but reliant on density of base station distribution and provide limited accuracy	Cell-ID, Time Advance, MAHO/NMR.
Network-based	Location calculated based on triangulation of three base stations. Fast and accurate, but increased overheads	TOA, TDOA, AOA
Handset-based	Location calculated by handset based GPS receiver or packet switching capabilities. Very accurate position fix, increasingly affordable and GPS technology costs drop	GPS, A-GPS, E-OTD

Sammanfattning positionering 2



Sampling GPS, NMEA 0183

- The National Marine ElectronicsAssociation (NMEA)
  - http://en.wikipedia.org/wiki/NMEA_0183
- **GGA** - Essential fix data which provide 3D location and accuracy data
- **GSA** - GPS *DOP (dilution of precision) values and active satellites
- **GSV** - Satellites in view - 1 sentence data = max 4 satellites
- **RMC** - NMEA has its own version of essential GPS PVT (position, velocity, time) data
  - http://www.gpsinformation.org/dale/nmea.htm#nmea
- Draw a track on Google Map from a NMEA GPS log file
  - http://franson.com/forum/topic.asp?TOPIC_ID=4058 (GPS Visualizer)
- Example, 1 sec

$GPGGA,133851.996,**6046.3885**,N,**01501.1250**,E,1,04,04.1,00172.3,M,30.0,M,,*63

$GPGSA,A,3,06,30,,02,,05,,,,,,,**07.3**,04.1,06.0*07

$GPGSV,3,1,**11**,06,71,206,39,30,52,136,43,25,46,270,20,02,29,051,35*7B

$GPGSV,3,2,**11**,23,15,340,30,05,22,127,35,21,12,181,35,10,11,093,*7B

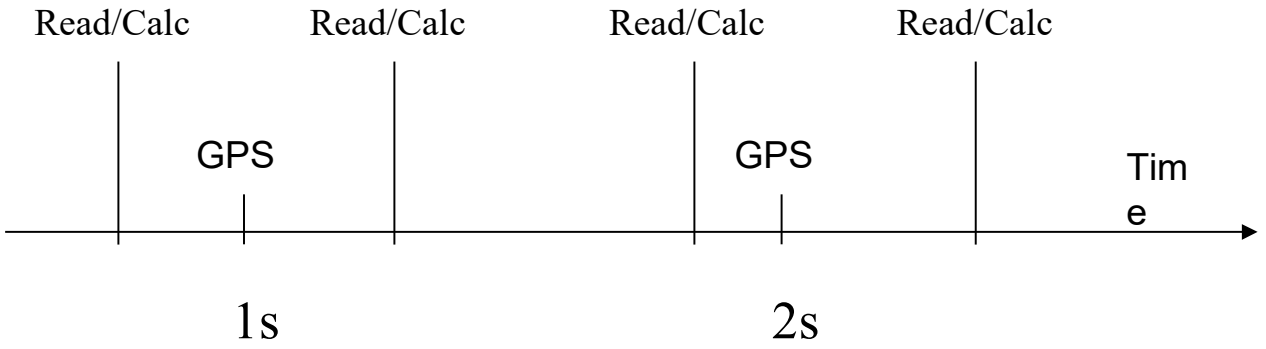
$GPGSV,3,3,**11**,16,11,291,,01,08,259,,33,01,251,*44

Max 12 sat.

$GPRMC,**133851.996**,A,6046.3885,N,01501.1250,E,064.7,194.4,**131105**,003.1,E*6ª

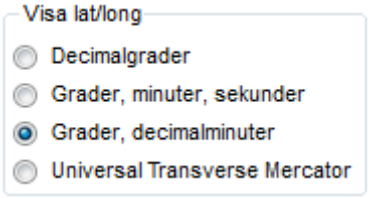
Sampling GPS

- Principle for sampling of GPS with at least the double speed to ensure that a valid sample is obtained in the software (sampling theorem)
  - If read/Calc is done in one thread and GPS is a callback
- GPS problems?
  - A number of!
- Solutions
  - Prediction
  - Dead reckoning (accelerometer, gyro, step counter sensors)
  - Magnetic electronic compass (not dependent of GPS)



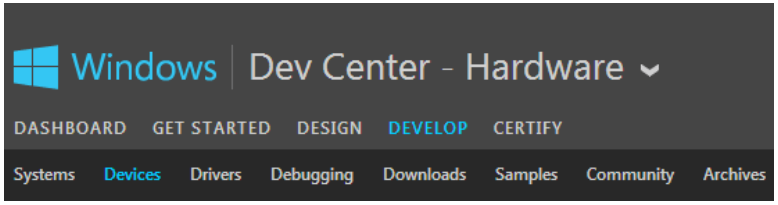
Projections, reference systems

- WGS 84 (World Geodetic System 1984)
  - Decimal Degrees
    - Lat/Long: 60.483494,15.411272
  - Degrees/Minutes/Seconds
    - Lat/Long: N 60° 29' 0.58", E 15° 24' 40.58"
  - Degrees/Decimalminutes
    - Lat/Long: 6029.3240,N,01523.3028,E
  - UTM (meters)
    - Cylindric map projection in 60 zones, SE=32-35
    - http://en.wikipedia.org/wiki/Transverse_Mercator_projection
    - http://sv.wikipedia.org/wiki/UTM
- RT90 - Swedish grid
  - X= 6707377 , Y= 1478345
- SWEREF 99 TM (använder UTM zon 33)
  - SWEdish REference Frame 1999
  - N: 6705329.393, E: 522604.151
- http://sv.wikipedia.org/wiki/WGS_84



To convert coordinates from degrees, minutes, seconds format to decimal format, use this formula:
degrees + (minutes/60) + (seconds/3600)

To convert coordinates from degrees, decimal minutes format to decimal format, use this formula:
degrees + (decimal minutes/60)



http://msdn.microsoft.com/en-us/library/windows/hardware/gg463473.aspx

Sensors measure a physical phenomenon or a physical interaction
Sensor Types
- Ambient Light Sensors (ALS)
- Accelerometers
- Location Sensors
- GPS, Wi-Fi /cell tower triangulation, IP Geolocation
- Proximity Sensors
- Temperature Sensors
- Biometric Sensor*
- Others (Human presence, RFID)

Windows Sensor and Location Platform

The Windows Sensor and Location platform simplifies the integration and use of sensors. The platform consists of a driver component and a client component. For Windows 8, the platform includes the following new features for hardware engineers and driver developers:

- An inbox class driver for sensors that supports the Human Interface Device (HID) protocol.
- Reference code for this class driver which ships as a sample in the Windows Driver Kit.
- Inbox support for screen rotation and brightness adjustments.
- Support for the Windows Location Provider which is capable of retrieving location data using Wi-Fi triangulation or IP addresses.
- Support for GPS devices.
- A sample Geolocation driver that demonstrates a simulated GPS device.
- A new Sensor Diagnostic Tool for testing your hardware and device-driver.

The platform includes the following new features for modern-sensor app developers:

- A Sensors namespace (Windows.Devices.Sensors) that includes support for a variety of motion, device-orientation, and light sensors. (The output for one motion, and one device-orientation, sensor is the result of sensor fusion—the combining of data from multiple sensors.)
- Support for Javascript/HTML apps
- Support for VB/C#/C++ XAML apps

The platform includes the following new features for modern-location app developers:

- A Geolocation namespace (Windows.Devices.Geolocation) that is capable of retrieving the computer's location using either the Windows Location Provider or GPS input.
- Support for Javascript/HTML apps
- Support for VB/C#/C++ XAML apps

Note that Microsoft is shipping a number of apps that use the Windows Sensor and Location platform. For an example, see the Star Chart app that is available on the store.

Windows 8 topics for hardware engineers and driver developers

- Integrating Motion and Orientation Sensors
- Integrating Ambient Light Sensors with Computers Running Windows 8
- GNSS (GPS) Test Guidance
- HID Sensors Usages
- The HID Class Driver for Sensors
- Sensors driver sample for geolocation
- Sensor Diagnostic Tool

Windows 8 topics for modern sensor-app developers

- Windows.Devices.Sensors namespace
- Responding to motion and orientation-sensor quickstarts
- Responding to light sensors quickstarts

Windows 8 topics for modern location-app developers

- Windows.Devices.Geolocation namespace
- Detecting geolocation quickstarts

Windows 7 topics for the sensor and location platform

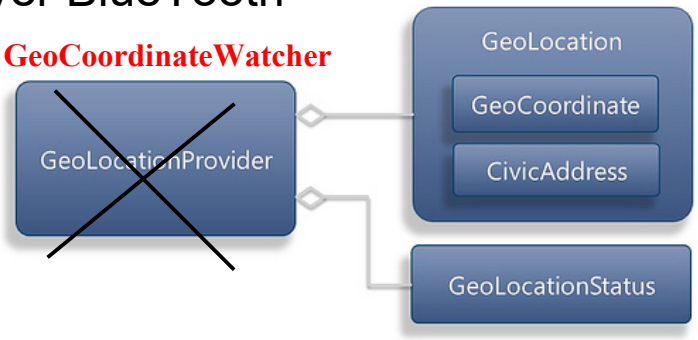
- Sensors HID driver sample
- Implementing Light-Aware UI in Windows 7
- Integrating Ambient Light Sensors in Windows 7
- Introducing the Windows Sensor and Location Platform
- Visual Variable Guidelines for Light-Aware UI

Windows 7 desktop sample code

- Build Your Own Game Controller
- Graphing Accelerometer Data in Windows 7
- Monitoring a Motion Sensor with Windows 7
- Sensor Video-Capture Solution

Windows Sensor and Location Platform

- GPS enabled mobile phone supporting development and Bluetooth
- Symarctic ExtGPS - Android program
  - Sample phone GPS and sends NMEA data over BlueTooth
- GPS Direct Virtual Sensor Driver
  - Read a COM port that contains GPS NMEA data and map it to a Windows 7 GPS Sensor
  - http://www.turboirc.com/gps7/
- LocationConsoleApp (Visual Studio 2010)
  - Simple console application that outputs Lat/Long values from Windows 7 GPS Sensor
  - http://msdn.microsoft.com/en-us/library/system.device.location.geocoordinatewatcher%28VS.100%29.aspx
- Sensor API: Make your Windows applications environment-aware in Windows 7
  - http://www.codeproject.com/KB/winsdk/sensor.aspx

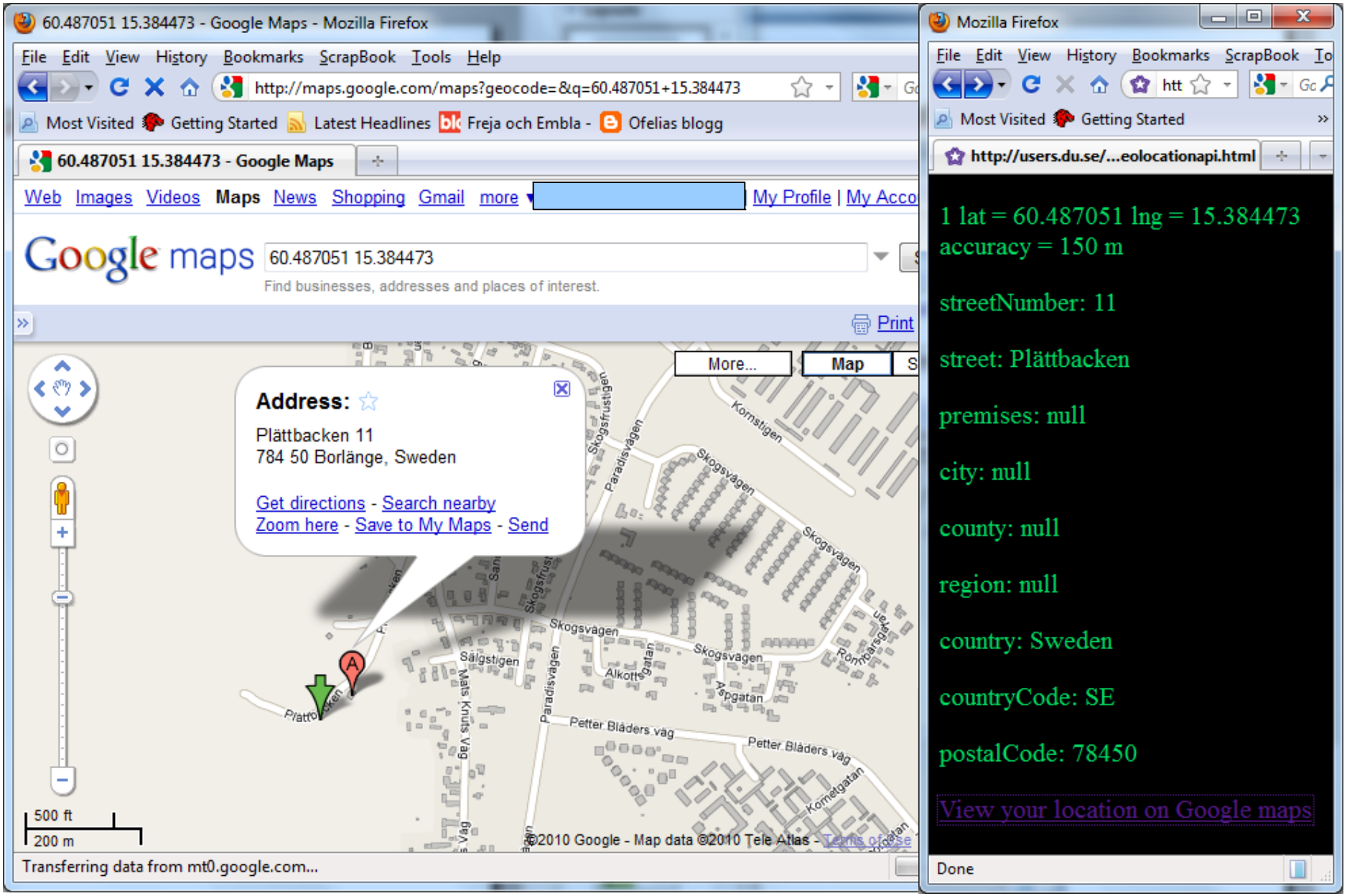


W3C Geolocation API demo

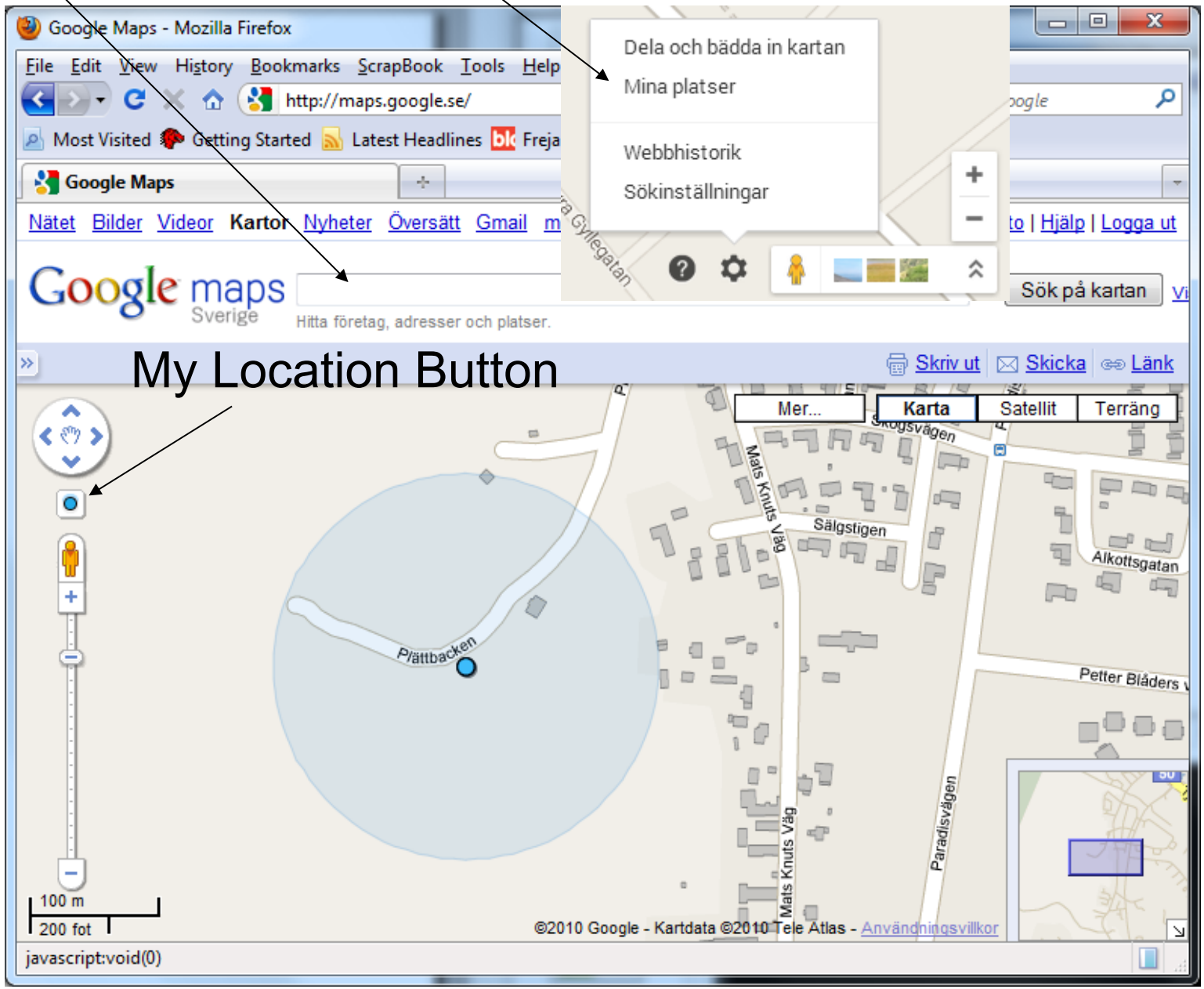
- Geolocation API Specification – **included in HTML5**
  - http://dev.w3.org/geo/api/spec-source.html
- Websites can request for "your location" if you got a supported web browser supporting HTML5 Geolocation API
  - All web browsers (IE from v9), also mobile browsers
- Using the GeolocationAPI
  - http://www.w3schools.com/html/html5_geolocation.asp
- The Geolocation API defines a high-level interface to location information associated only with the device hosting the implementation, such as latitude and longitude. The API itself is agnostic of the underlying location information sources
- Common sources of location information include **Global Positioning System (GPS)** and location inferred from network signals such as **IP address**, **RFID**, **WiFi** and **Bluetooth MAC addresses**, and **GSM/CDMA cell IDs**, as well as **user input**. No guarantee is given that the API returns the device's actual location

W3C Geolocation API example

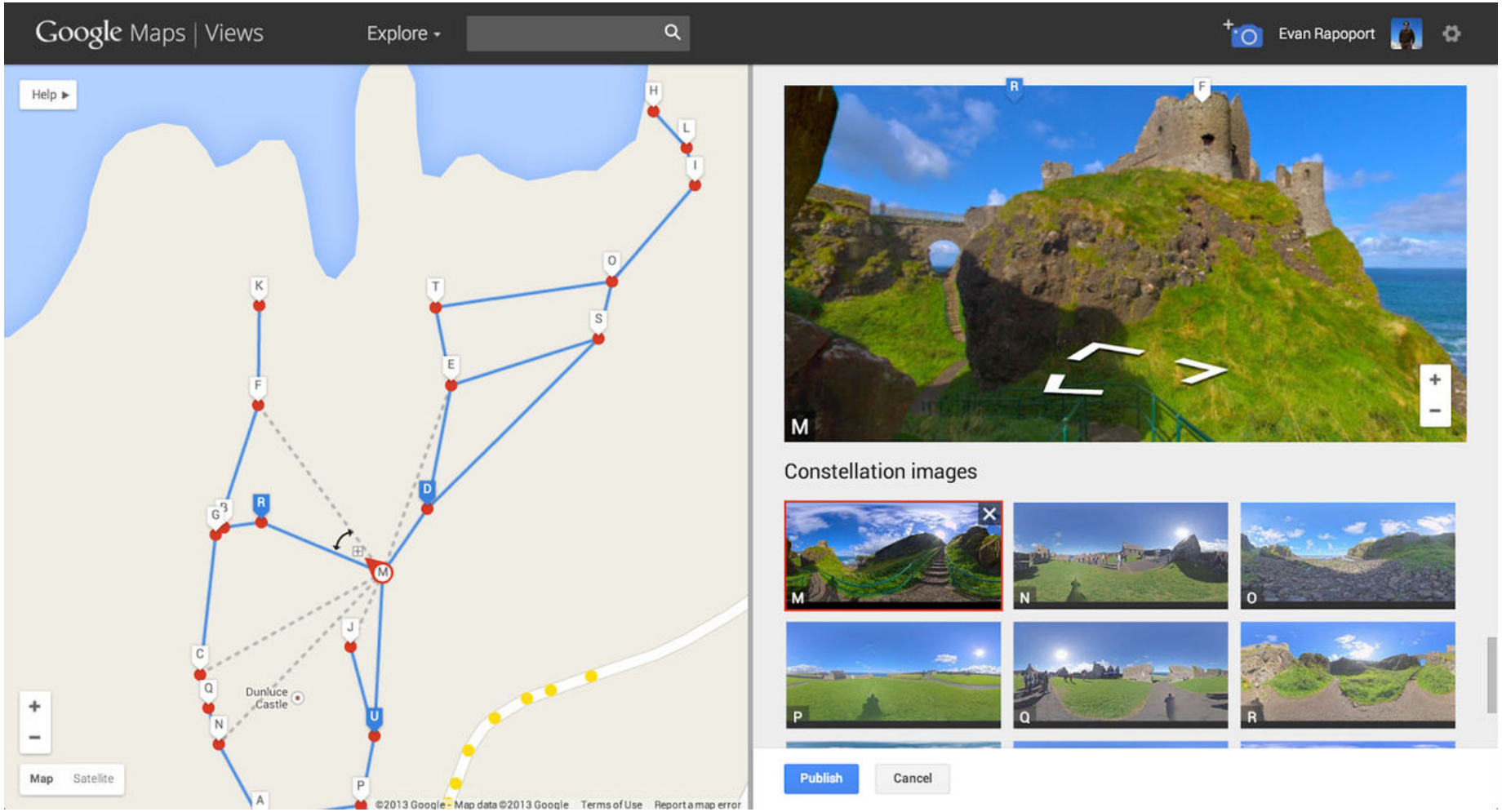
http://users.du.se/~hjo/lbs/geolocation/geolocationapi.html



First goto my places with in the new Google maps design, then put address to file in search field: http://users.du.se/~hjo/cs/dt2016/GIS/lecture-cellid.kml



Google Street View



Explore all Google maps possibilities

https://support.google.com/maps

https://www.google.com/maps/views/view/11797183716485764453 8/photo/qJpgXDHQUQMAAAQJODvovw?gl=us&heading=366&pitch=91&fovy=75

GIS, kartor och GPS länkar

- Rapport öppna karttjänster
  - http://users.du.se/~hjo/cs/dt2011/GIS/Rapport%20Kartl%c3%a4ggning%20av%20%c3%b6ppna%20karttj%c3%a4nster.pdf
- GIS self learning tool
  - http://www.geogra.uah.es/patxi/gisweb/menu.html
- http://libraries.mit.edu/gis/
- http://www.lantmateriet.se/
- http://www.utsidan.se
- http://www.gpspassion.com
- http://www.nvdb.se/