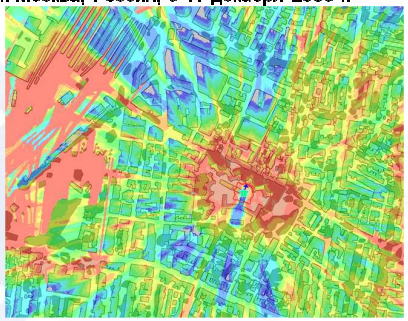
Принципы частотно-территориального планирования сетей DVB-H

Часть 3

Типы цифровых карт для частотно-территориального планирования

Семинар БРЭ МСЭ: «Переход от аналогового к цифровому вещанию»
г. Москва, Россия, 9-11 декабря 2008 г.



DVB-H Radio-planning : Cartographic data

Principles of cartography

- Geodesy : representing the Earth
- Cartographic data as a calculation basis for DVB-H Radio-planning
- Production/update of cartographic data

Different cartographic datasets for different DVB-H planning exercises

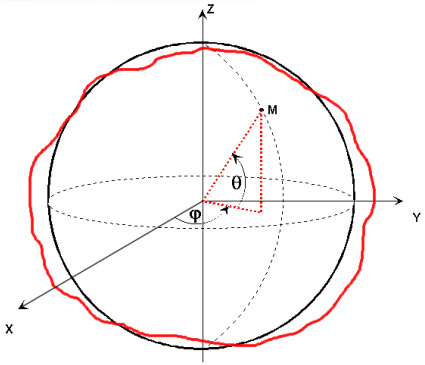
- Low resolution data
- Medium resolution data
- High resolution data

Cartographic data: geodesy in a nutshell

The Earth can be represented by the equipotential of the electro-magnetic field.

This shape is not a perfect sphere.

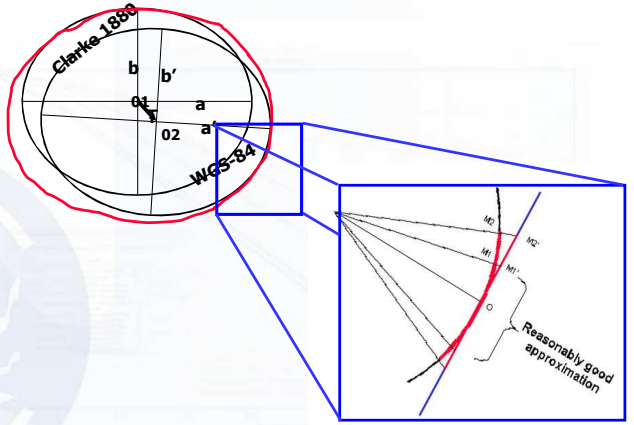
Locating a point using XYZ coordinates only is not accurate enough.



Cartographic data: geodesy in a nutshell

The Earth is therefore represented by a mathematical entity called ellipsoid.

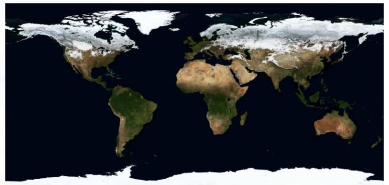
There are as many possible ellipsoids as areas in the world! The chosen ellipsoid and its location according to the centre of the Earth is called a datum.

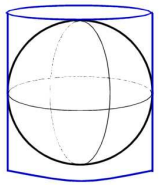


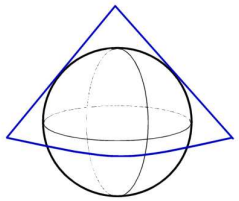
Cartographic data: geodesy in a nutshell

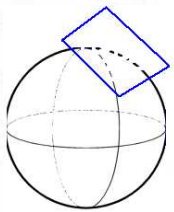
For radio-planning and ray-tracing purposes, it is necessary to project the datum on a flat shape.

U.T.M. is one of the most common projection all over the world.





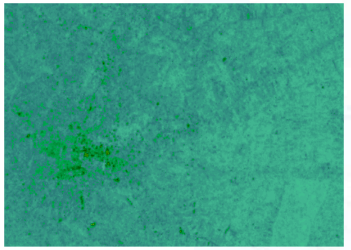


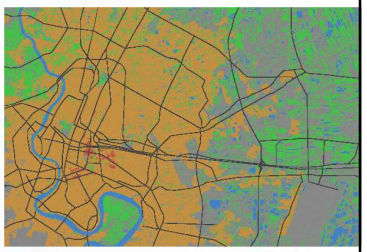


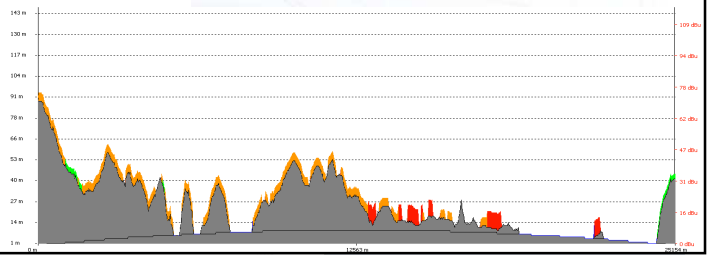
Cartographic data: files used by a planning tool

Calculation basis:

- Terrain data
- Ground occupancy







Cartographic data: files used by a planning tool

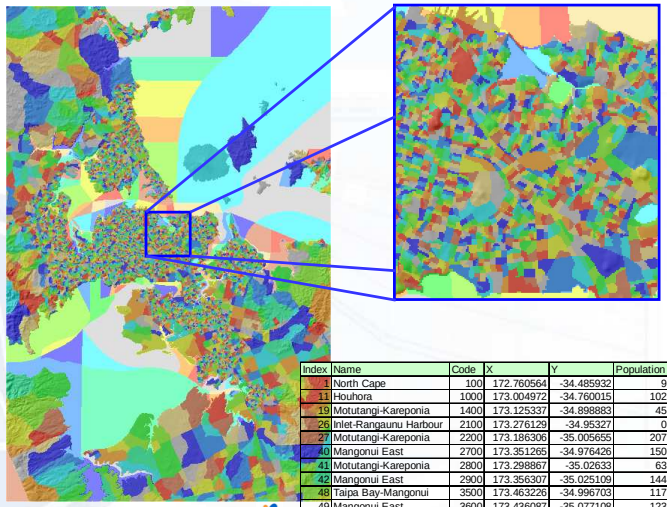
Graphical display:

- Topographic maps
- Aerial/satellite imagery
- Vector files

Cartographic data: files used by a planning tool

Geo-marketing analysis:

- Population map per county
- Population per building block



Index	Name	Code	X	Y	Population	Surface
1	North Cape	100	172.760564	-34.485932	9	157.57
11	Houhora	1000	173.004972	-34.760015	102	36.01
19	Motutangi-Kareponia	1400	173.125337	-34.898883	45	38.03
26	Inlet-Rangaunu Harbour	2100	173.276129	-34.95327	0	99.91
27	Motutangi-Kareponia	2200	173.186306	-35.005655	207	31.04
40	Mangonui East	2700	173.351265	-34.976426	150	51.31
41	Motutangi-Kareponia	2800	173.298867	-35.02633	63	3.35
42	Mangonui East	2900	173.356307	-35.025109	144	20.88
48	Taipa Bay-Mangonui	3500	173.463226	-34.996703	117	0.53
49	Mangonui East	3600	173.436087	-35.077108	123	18.72
54	Taipa Bay-Mangonui	4101	173.475809	-34.995314	162	1.47

Cartographic data: where does the data come from ?

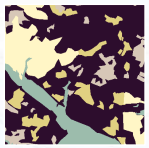
Cartographic data for radio-planning:

- From the corresponding National Geographical Institute
- Produced by ATDI
- Provided by a third-party company
- Generated by the radio-planner

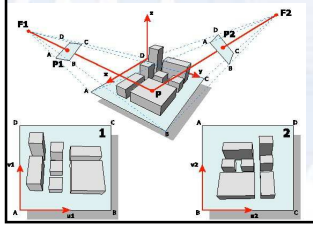
Contour line interpolation

Correlation from aerial/satellite imagery

Remote sensing



Digital photogrammetry



Cartographic data: where does the data come from ?

This :

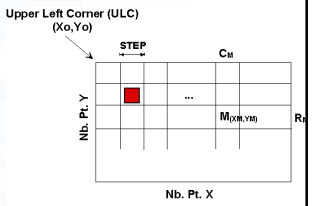
Or this :

Are copyrighted cartographic data viewers, that cannot be used as a production source for cartographic data/professional radio-planning

Cartographic data: Is there a need to update the data ?

Medium resolution cartography

- Resolution : 20/30m
- Features the urban data as aggregates
- Roll-out every 10 years, except MAJOR modifications over the Aera Of Interest



$X_M = X_o + C_M \times STEP$
$Y_M = Y_o - R_M \times STEP$

High resolution cartography

- Resolution : 5m or better
- Each building is outlined with its height
- Manual correction in the planning tool itself, or roll-out every 4 years

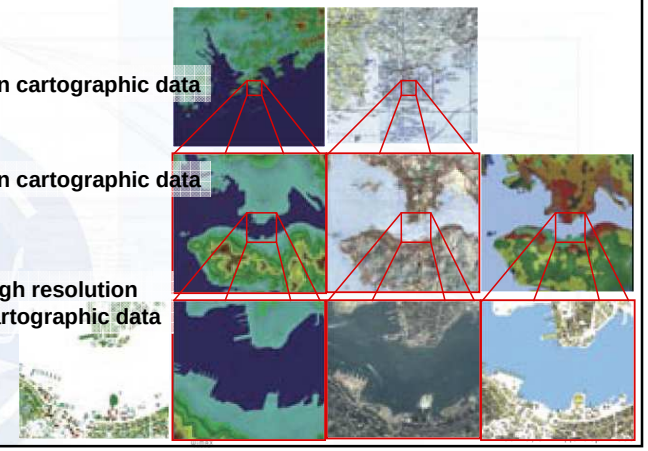
Cartographic data:

What kind of data for what kind of DVB-H planning exercise ?

Low resolution cartographic data

Medium resolution cartographic data

High resolution cartographic data



One basic rule :

from 30 MHz to 3 GHz

Optimum planning resolution

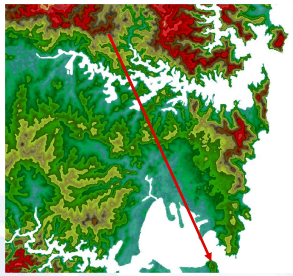
= Wave length (m) x 50

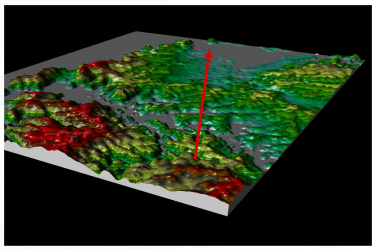
= 15.000 / Freq (MHz)

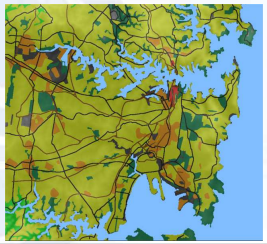
Cartographic data for macro-scale DVB-H planning

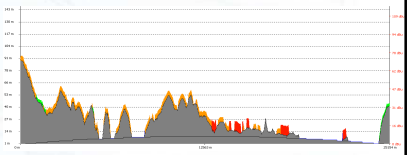
Calculation basis:

- Terrain data
- Ground occupancy









Cartographic data for macro-scale DVB-H planning

Predictable effects

- **Rough coverage of the macro-sites**
- **Highlight the major coverage holes**
- **SFN networks : Configure the launch delays in order to avoid SFN/COFDM interference**
- **MFN networks : assign the frequencies in order to avoid both intra-network or inter-network (migration from analogue) interference**

Applicable propagation model (section 2)

- **Deterministic with appropriate planning margins**
- **Empirical with appropriate model tuning based upon a DVB measurement campaign in the Area Of Interest**

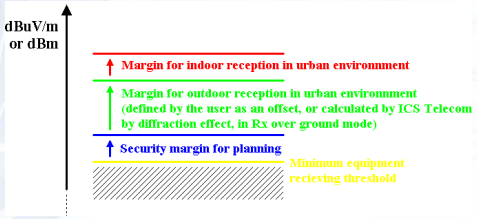
Cartographic data for macro-scale DVB-H planning

Assets

- Covers large areas
- Reasonable results if proper planning margins are taken (QC)

Drawbacks

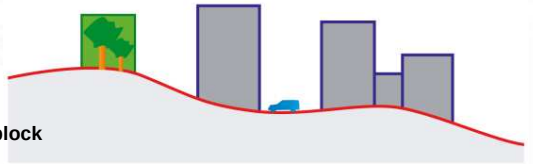
- The urban propagation is simulated using offsets
- The building penetration is simulated by applying an additional offset
- The in-building and small coverage holes cannot be highlighted : the planning of gap-fillers or transponders cannot be done accurately

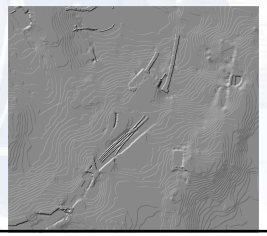


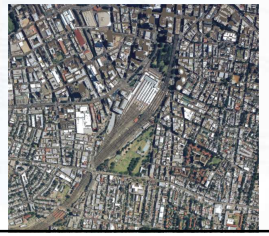
Cartographic data for micro-scale DVB-H planning

Typical content

- DTM at 2m
- True-Orthophoto
- Building height
- Clutter file
- Population per building block







Cartographic data for micro-scale DVB-H planning

Predictable effects

- Detailed DVB coverage
- Canyon effect with constructive/destructive C-OFDM signals
- Diffusion effect for in the in-building penetration
- Multi-path effect
- Power delay spread

Applicable propagation model

- Deterministic
- Empirical with appropriate model tuning based upon a DVB measurement campaign in the Area Of Interest
- 3D ray tracing

Broadcast radio-planning

Cartographic environment for microscale design

Assets

- Very good accuracy
- The building penetration can be evaluated according to its shape, height and type

Drawbacks

- Requires HR cartographic data
- Dedicated to smaller AOI (CBD for instance)
- Slower and more expensive

Что следует?
Часть 4: Расчёт и анализ покрытия DVB-H