

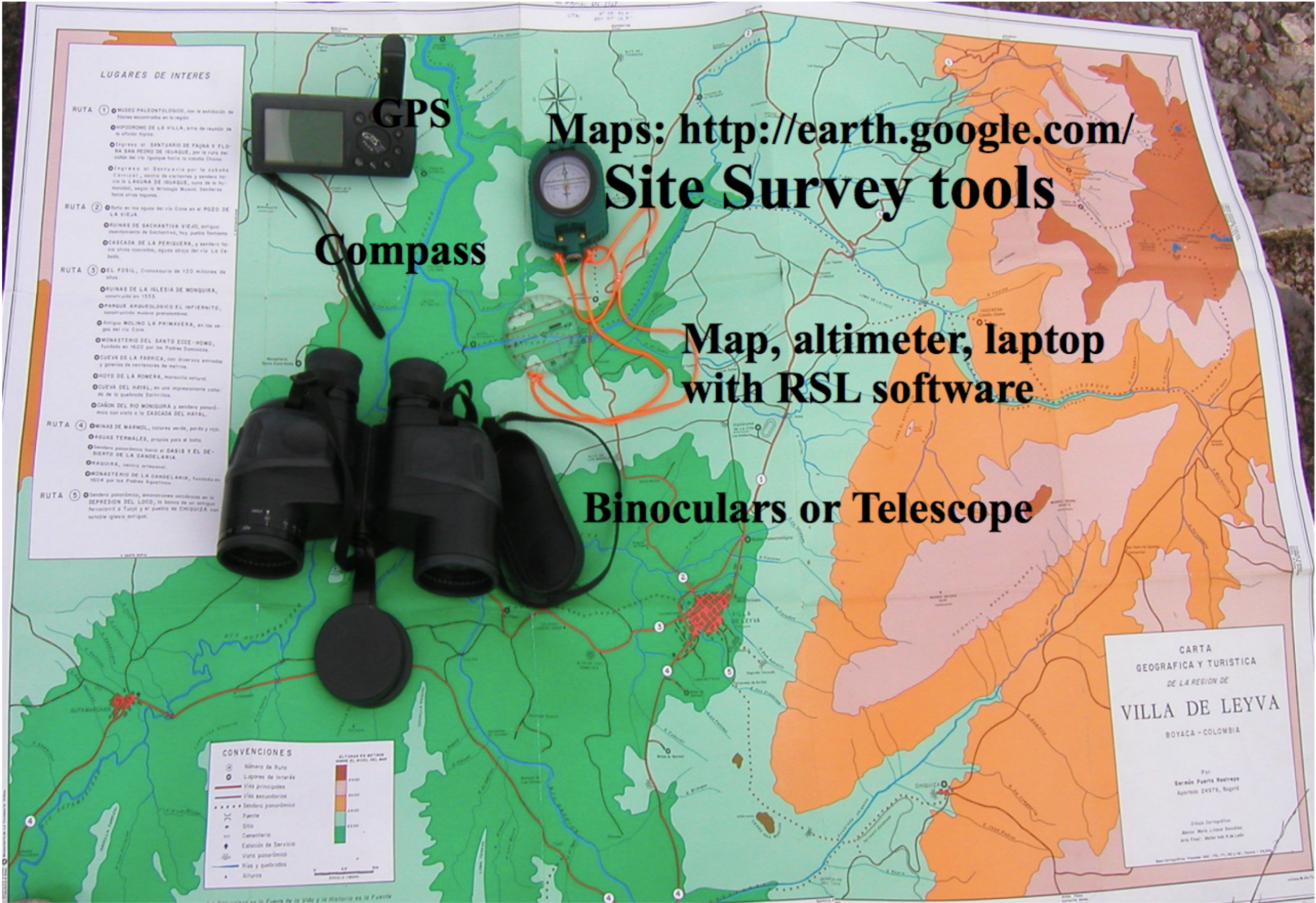
# Site Survey

Training materials for wireless trainers



*The Abdus Salam*  
**International Centre  
for Theoretical Physics**





**LUGARES DE INTERES**

- RUTA 1**
- MUSEO PALEONTOLOGICO, con la exhibición de fósiles encontrados en la región.
  - POZOROMO DE LA VILLA, sitio de reunión de la etnia Wayana.
  - Ingreso al SANTUARIO DE FAJNA Y FLORA SAN PEDRO DE IGUAQUE, por la ruta del valle del río Iguaque hacia la Estación Chacón.
  - Ingreso al Santuario por la cascata Carrizal, centro de visitantes y sendero hacia la LAGUNA DE IGUAQUE, ruta de la Humareda, según el Mirador Museo. Senderos hacia otras lagunas.
- RUTA 2**
- Baño en las aguas del río Coza en el POZO DE LA VIEJA.
  - RUINAS DE SACHANTIVA VIEJO, antiguo asentamiento de Sachantiva, hoy pueblo fantasma.
  - CASCADA DE LA PERIGUERA, y sendero hacia otras cascadas, aguas abajo del río La Caballo.
- RUTA 3**
- EL FOSIL, Conocedor de 120 millones de años.
  - RUINAS DE LA IGLESIA DE MONQUIRA, construida en 1553.
  - PARQUE ARQUEOLOGICO EL INFIERNITO, construido museo precolombino.
  - Antiguo MOLINO LA PRIMAVERA, en las vegas del río Coza.
  - MONASTERIO DEL SANTO ECCE-HOMO, fundado en 1620 por los Padres Dominicos.
  - CUEVA DE LA FABRICA, con diversos estratos y galerías de centenas de metros.
  - CHOYO DE LA ROMERA, maravilla natural.
  - CUEVA DEL HAYAL, en una impresionante cascada de la quebrada Sotriveros.
  - CACION DEL RIO MONQUIRA y sendero panorámico con vista a la CASCADA DEL HAYAL.
- RUTA 4**
- MINAS DE MARMOL, aguas verde, parda y roja.
  - AGUAS TERMALES, propicias para el baño.
  - Sendero panorámico hacia el OASIS Y EL DEBIENTO DE LA CANDELARIA.
  - DRAGUERA, centro artesanal.
  - MONASTERIO DE LA CANDELARIA, fundado en 1604 por los Padres Agustinos.
- RUTA 5**
- Sendero panorámico, emocionante aventura en la DEPRESION DEL LOCO, la banca de un antiguo ferrocarril a Tunja y el pueblo de CHIGUIZA, con notable iglesia del siglo.

**CONVENCIONES**

①	Número de Ruta
○	Lugares de Interés
—	Vías principales
- - -	Vías secundarias
•••••	Sendero panorámico
⌒	Puente
⊕	Sitio
⊕	Cementerio
+	Estación de Servicio
⊕	Vista panorámica
—	Ríos y quebradas
•	Alturas

ALTIMETRO EN METROS  
DEBE EL MODO 100,00

0 1000 2000 3000 4000 5000

0 1 2 3 4 5

ESTRADA A CALDAS

CARTA  
GEOGRAFICA Y TURISTICA  
DE LA REGION DE  
**VILLA DE LEYVA**  
BOYACA - COLOMBIA

Por  
Sernán Puerta Restrepo  
Aparición 24979, Bogotá

Diseño Cartográfico:  
Boris Melo, Liliana González  
Arte Final: María Inés de León

Mapa Cartográfico: Provisor 600, 170, 171, 180 y 181, Escala 1:25,000

**GPS**

**Maps: <http://earth.google.com/>  
Site Survey tools**

**Compass**

**Map, altimeter, laptop  
with RSL software**

**Binoculars or Telescope**



# Site Survey

The site survey is paramount for a successful install.

- Besides the previously listed tools, a digital camera will help in the documentation process and facilitate the work should another team undertake the install
- Spotlights and mirrors may be used in long distance links.
- A balloon may also be useful to verify line of sight and the height of the required tower.
- An umbrella is useful for shielding the laptop's screen.

# Site Survey

Site survey means working in roofs and elevated structures

- Remember to wear a hat, sunglasses and sunscreen.
- Gloves and harness are a must for climbing towers.
- Plan ahead for the permits to access roofs and ladders, find out who has the keys.

# Link simulation

There are many programs that can be used to simulate radio links and base station coverage, some costing thousand of dollars.

They are based on different assumption about the model to represent the actual terrain, and some are specifically suited for certain frequency bands, but all of them use digital elevation maps.

Radio Mobile is a free program developed for radio amateurs by Roger Coudè that is based in the well known Longley-Rice Irregular Terrain Model and predicts radio propagation from 20 MHz to 20 GHz making use of several sets of freely available DEMs.

# Radio Mobile

You can even use your own digitized maps with radio mobile, but Nasa provides free digital maps for most of the world with a resolution of 3 arc sec (about 90m).

For some countries, the resolution can be improved to 1 arc sec.

We have used this program for a number of years with good results, provided that sound judgment is employed, since like every model has limitations and in particular the free digital maps do not include buildings and other structures

# Radio Mobile

Radio Mobile runs in Windows but it can be used in Linux or MAC by means of emulators.

It will provide all sort of details for point to point links, including expected signal level at any point along the path, including diffraction losses due to obstacles.

Automatically builds a profile between two points in the digital map showing Fresnel Zone and Earth Curvature Clearance, as well as required antenna heights and it is a wonderful tool for exploring “what if” scenarios.

# Radio Mobile

For point to multipoint links, it will provide Base Station coverage areas, suggest convenient sites for base station's placement and allows changing the antenna pattern while assessing how it will affect coverage.

It works with true bearing but it will also provide the magnetic declination of the site so you can relate the compass reading with the map data.



# Radio Mobile

Download Radio Mobile from Internet:  
<http://www.cplus.org/rmw/english1.html>

Instructions are provided there on how to get the digital elevations maps of the area of interest.

Digital elevation maps come in 1 degree longitude X degree latitude tiles so you might need to download a few tiles for your application.

Once you have downloaded the maps you no longer need Internet access.

# DEM that work with Radio Mobile

## **Free World at 3 arc second resolution (100m) SRTM version 2**

Shuttle Radar Topography Mission (SRTM) data products - Africa

Shuttle Radar Topography Mission (SRTM) data products -  
Australia

Shuttle Radar Topography Mission (SRTM) data products -  
Eurasia

Shuttle Radar Topography Mission (SRTM) data products - Islands

Shuttle Radar Topography Mission (SRTM) data products - North  
America

Shuttle Radar Topography Mission (SRTM) data products - South  
America

# Georeferencing

To relate your location to the maps, you can use Google Earth or other map, where you can identify a remarkable feature as a reference.

If you use a GPS receiver, make sure that you have the correct Datum.

*Datum* as used here refers to a smooth surface somewhat arbitrarily defined as "zero elevation," consistent with a set of surveyor's measures of distances between various stations, and differences in elevation, all reduced to a grid of latitudes, longitudes, and elevations.

WGS 84. It is currently the reference system being used by the Global Positioning System. It is geocentric and globally consistent within  $\pm 1$  m

From: Wikipedia

# What do you need to create a network

Obtain the coordinates of your stations.

From Maps, GPS, or database

For example: Site 1 (Main Repeater Galileo 13°43'11" E, 45°42'15"N)

Specifications of the system:

Topology of the network (Point to multipoint,PP).

Gain of antennas and type.

Max Transmit power (Watt or dBm).

Line or guide wave loss.

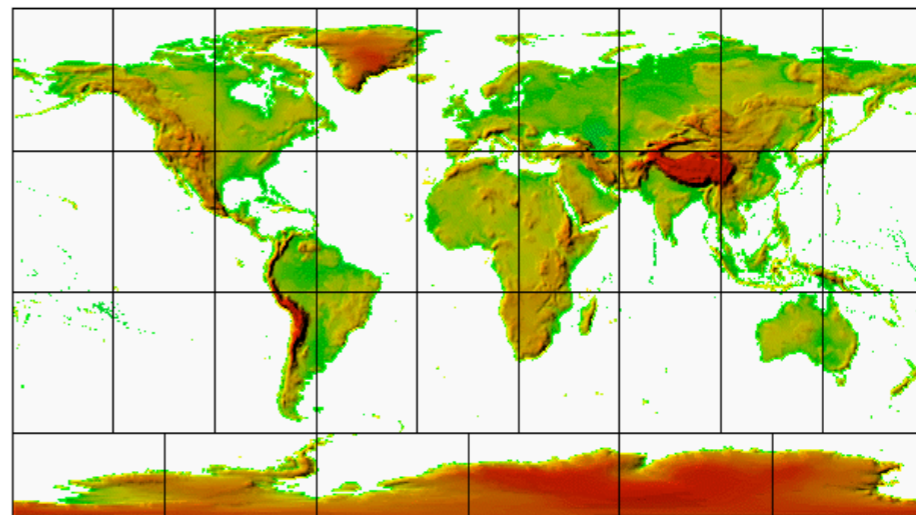
Received power level (dBm).

Antennas height in meters.

Frequency of operation.

Polarization used.

Other parameters of radio link and radio communications.





# Example

MAP ONE SYSTEM Elevation (m)

0 50 100 150 200 250 300 350 400 450 500

0 5km

## Radio Link

Edit View Swap

Elevation=2000.0m	Acimuth=43.8°	Clearance at 15.59km	Worse Fresnel=0.4F1	Distance=21.44km
Path Loss=126.8dB	E field=56.7dBuV/m	Rx level=64.7dBm	Rx level=130.0BuV	Rx Relative=18.8dB

### Transmitter

maracay

Role	Command
Tx system name	System 1
Tx power	0.032 W      15.05 dBm
Line loss	0.5 dB
Antenna gain	24 dBi      21.85 dBd
Radiated power	ERP=7.16 W      ERP=4.37 W
Antenna height (m)	100 <input type="button" value="Apply"/>

Net: maracay

### Receiver

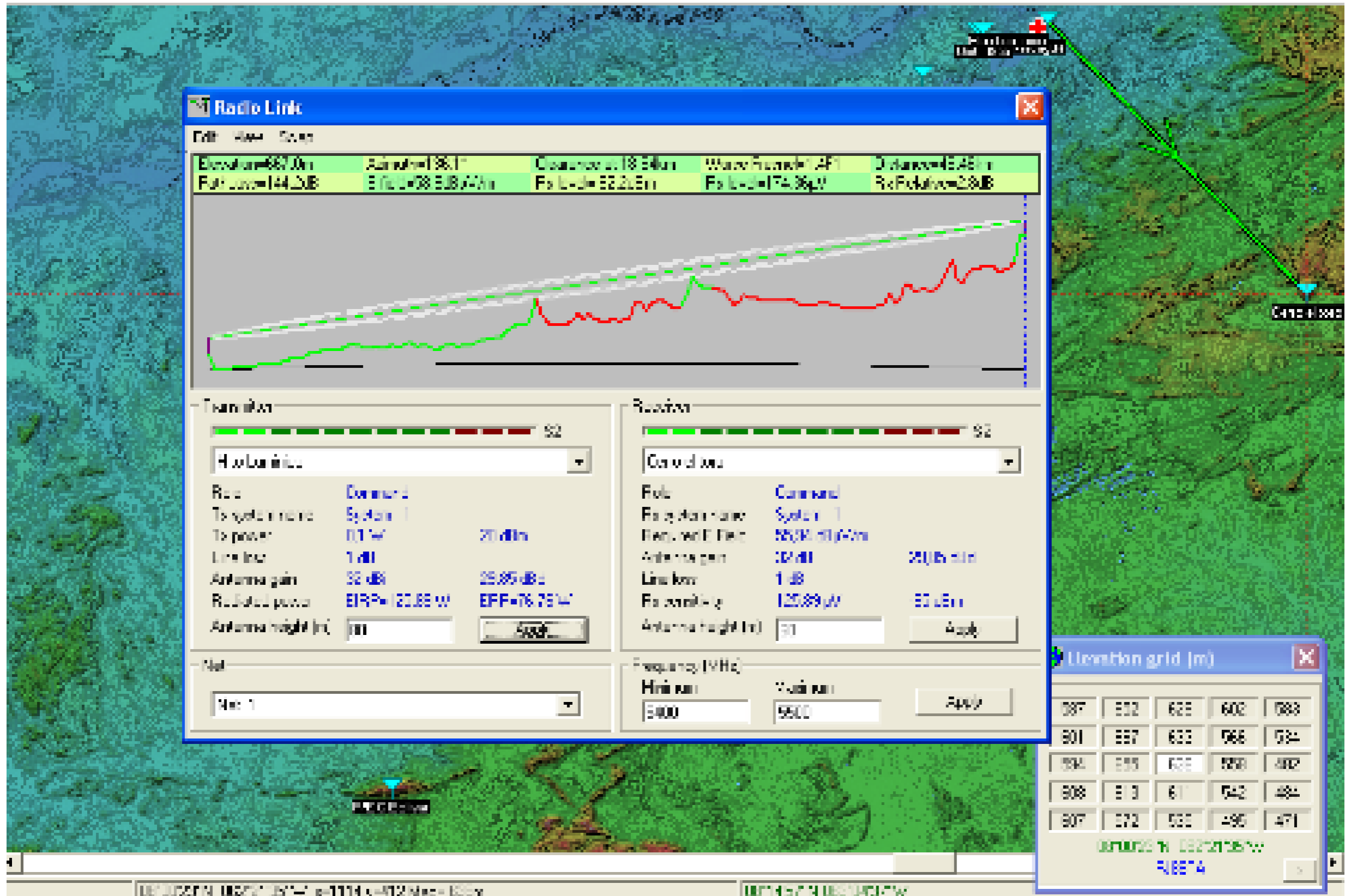
siema1

Role	Subordinate
Rx system name	System 1
Required E Field	37.98 dBuV/m
Antenna gain	24 dBi      21.85 dBd
Line loss	0.5 dB
Rx sensitivity	15 uV      -83.48 dBm
Antenna height (m)	150 <input type="button" value="Apply"/>

Frequency (MHz)

Minimum	Maximum
2400 <input type="button" value="Apply"/>	2483

# Another Example, 5.4 GHz



# Thank you for your attention

For more details about the topics presented in this lecture, please see the book ***Wireless Networking in the Developing World***, available as free download in many languages at:

<http://wndw.net>

