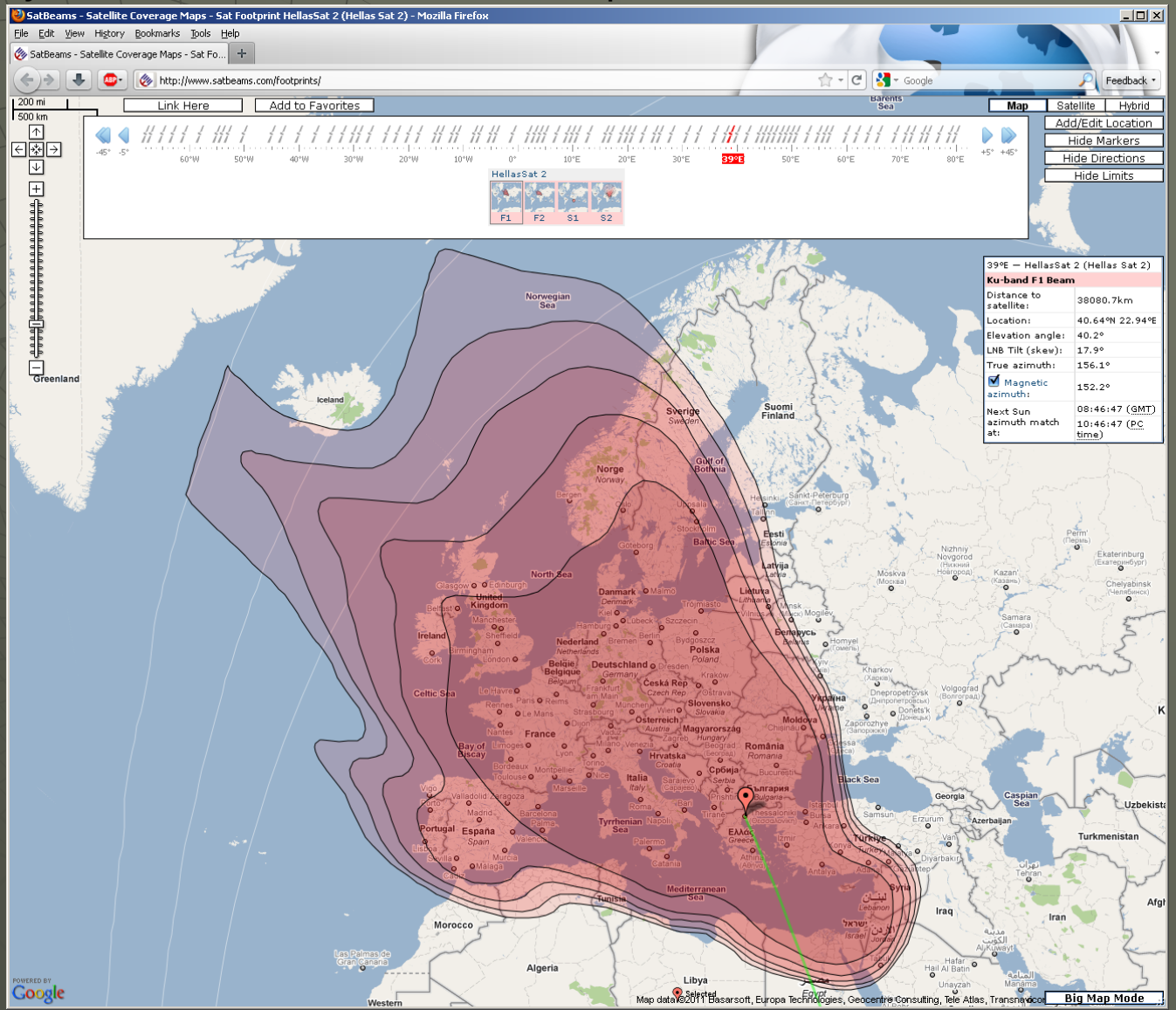
Understanding the simplicity of using Satellite Links and methods of using, abusing and denying service to them

by bakira

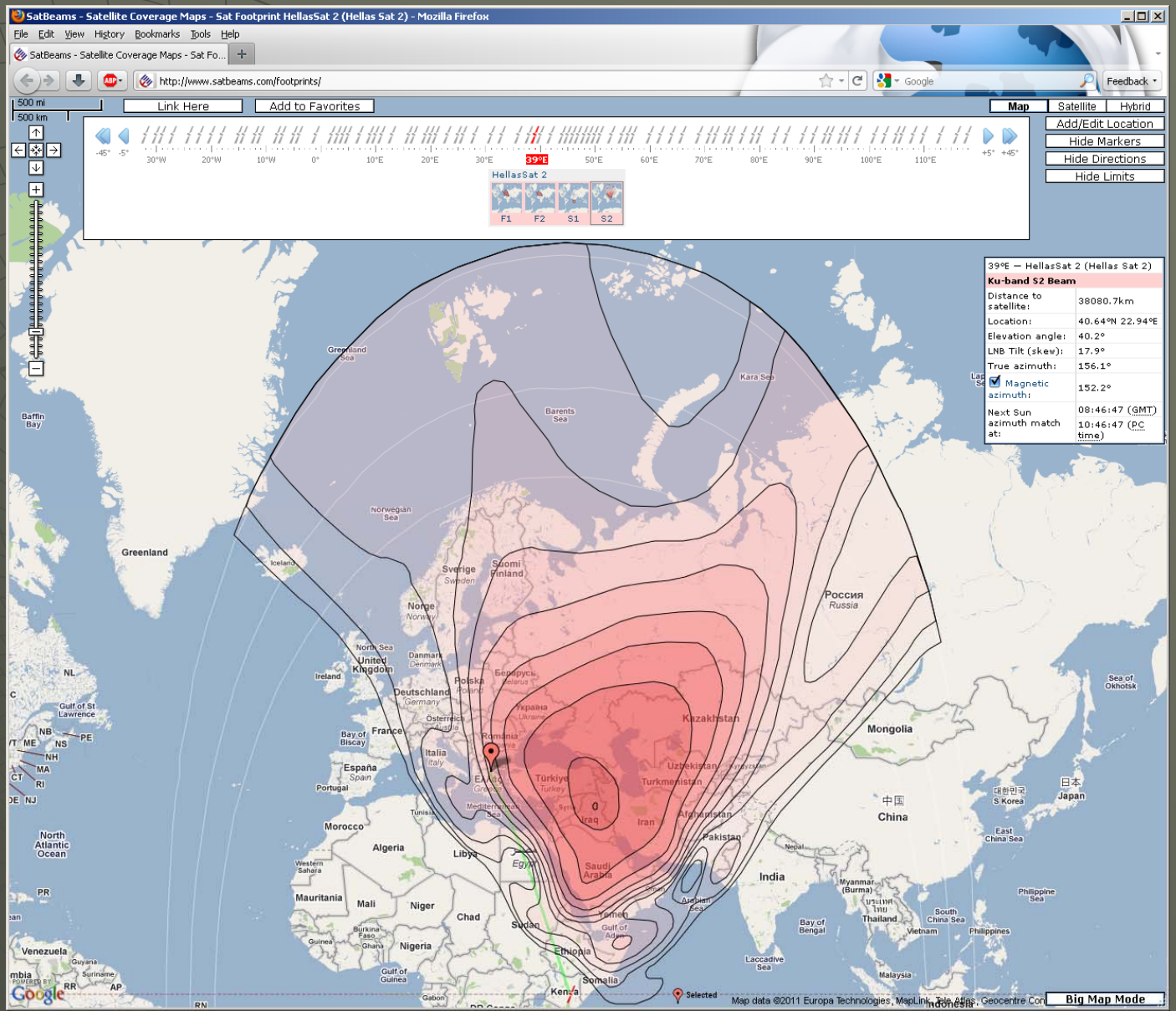
Basic Info: Satellite Operation

- Satellites are ‘like’ simple mirrors, what they receive they reflect back
- Geosynchronous orbit around the equator



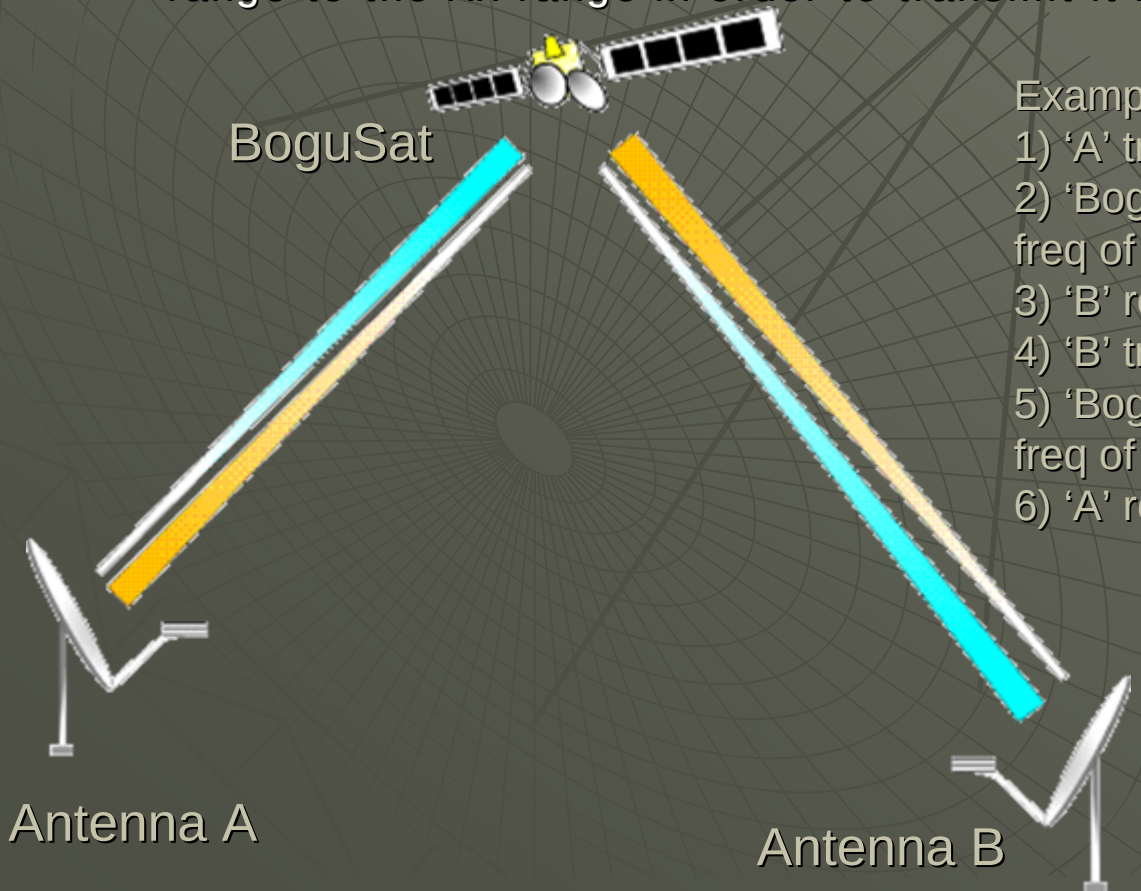
Basic Info: Satellite Operation

- They have multiple ‘beams’ that may cover different areas of Earth



Basic Info: Satellite Operation

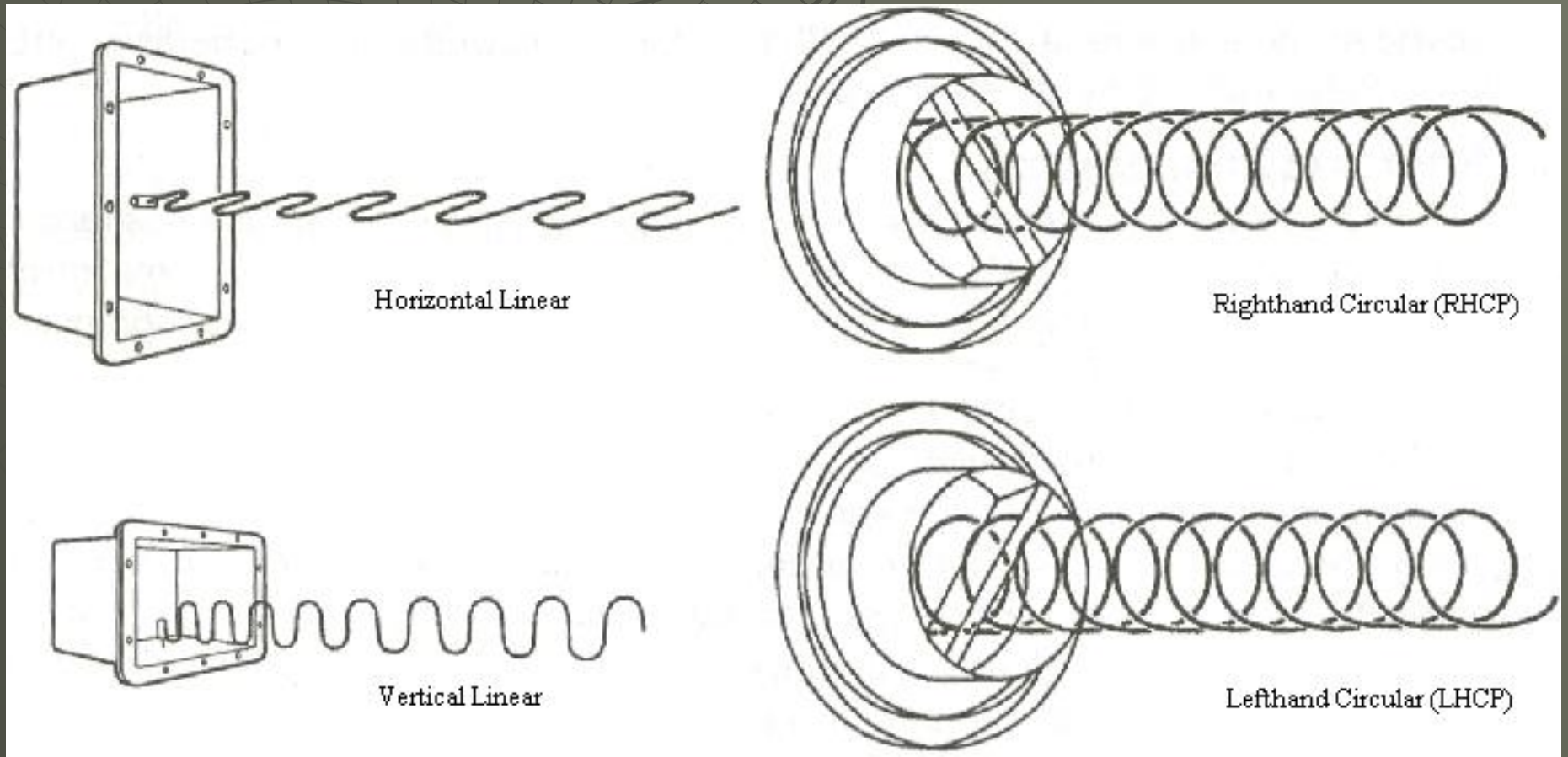
- Each beam works within a specific frequency range
- Usual frequency ranges are:
  - C-Band: Tx 5.85 to 6.725GHz / Rx 3.4 to 4.2GHz
  - Ku-Band: Tx 13.75 to 14.5GHz / Rx 10.95 to 12.75GHz
  - Ka-Band: Tx 27.5 to 29.5GHz / Rx 19.7 to 20.2GHz
- Frequency Translation: Downconverting the received carrier from the Tx range to the Rx range in order to transmit it back down



Example:
1) 'A' transmits a carrier on 14.05GHz
2) 'BoguSat' downconverts carrier with L.O. freq of 1.5GHz (14.05–1.5=12.55GHz)
3) 'B' receives 'A's carrier on 12.55GHz
4) 'B' transmits a carrier on 14.13GHz
5) 'BoguSat' downconverts carrier with L.O. freq of 1.5GHz (14.13–1.5=12.63GHz)
6) 'A' receives 'B's carrier on 12.63GHz

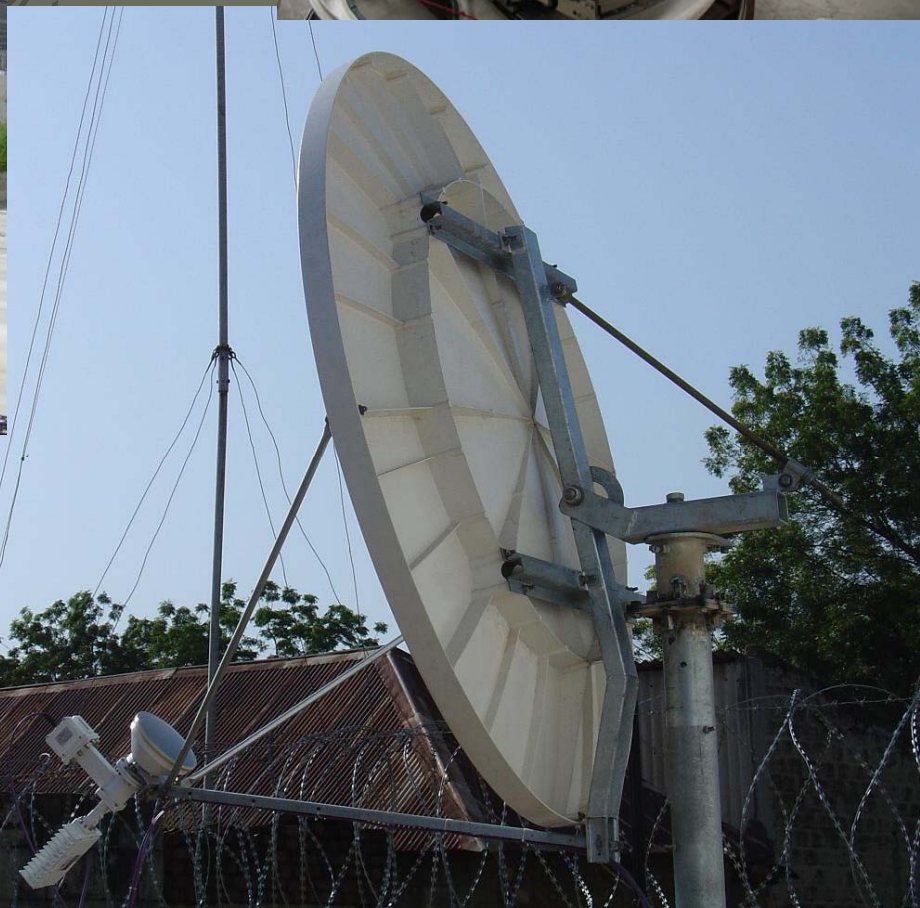
Basic Info: Satellite Operation

- Beam polarization: A simple way to double available frequency space
- Usual types
  - Linear: Horizontal polarity or Vertical polarity
  - Circular: Right hand circular polarity (RHCP) or Left hand circular polarity (LHCP)
- Two-way communication setups:
  - Co-pol: Rx and Tx with same polarity
  - Cross-pol: Rx and Tx with opposite polarity



Basic Info: Very Small Aperture Terminal (VSAT)

- Satellite Antenna Reflector (Rx/Tx)
- Az/El (Azel)



Basic Info: Very Small Aperture Terminal (VSAT)

- Low Noise Block Downconverter (LNB)

Basic Info: Very Small Aperture Terminal (VSAT)

- Block UpConverter (BUC)

Basic Info: Very Small Aperture Terminal (VSAT)

- Orthogonal Mode Transducer (OMT)
- OMT can be Co-pol or Cross-pol
- Transmit Reject Filter (TRF)
- Feed Horn

Basic Info: Very Small Aperture Terminal (VSAT)

- VSAT modem
- Different freq bands:
  - L-Band :950 - 2000MHz
  - IF 70MHz: 50 - 90MHz
  - IF 140MHz: 100 – 180MHz

CDM-570 Satellite Modem Back Panel

CDM-570L-IP Satellite Modem Back Panel

Basic Info: Very Small Aperture Terminal (VSAT)

- LNB Downconverting Ku-Band to L-band:
  - Can't downconvert all the Rx Ku-Band to L-Band, so it segments it
  - Various Local Oscillation frequencies (L.O.) : 9.75-10-10.6-11.3GHz

Ku-Band	L.O. Frequency	L-Band
10.95-11.70GHz	10.00GHz	950-1700MHz
12.25-12.75GHz	11.30GHz	950-1450MHz
10.70-11.70GHz	9.75GHz	950-1950MHz
11.70-12.75GHz	10.60GHz	1100-2150MHz

- BUC Upconverting Ku-Band to L-band:
  - Can Upconvert all the Tx Ku-Band to L-Band

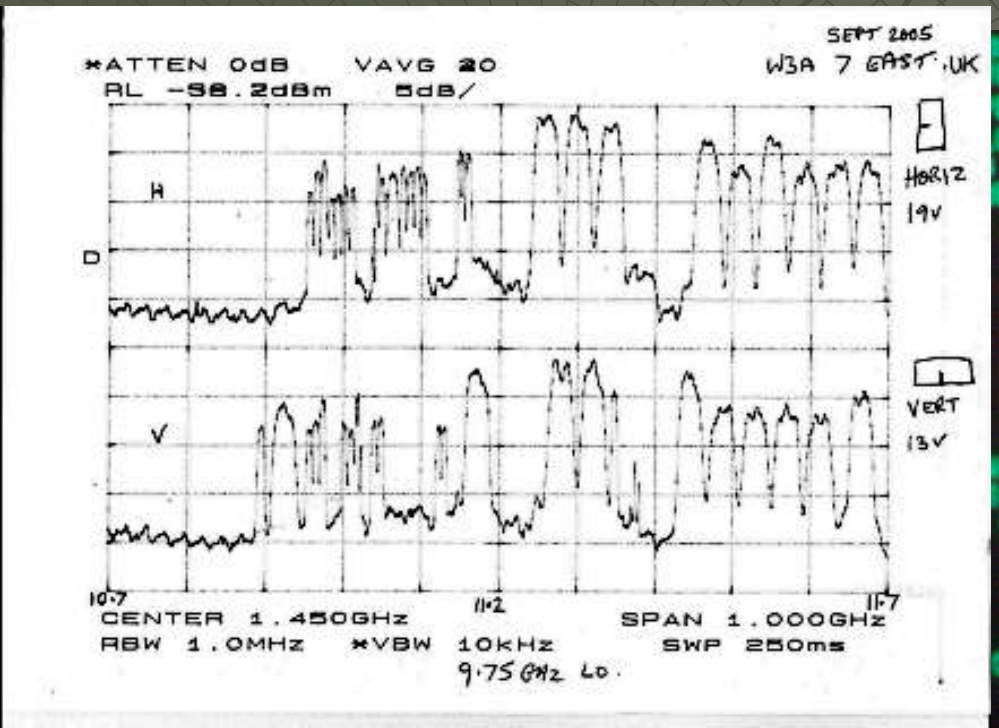
Ku-Band	L.O. Frequency	L-Band
13.75-14.50GHz	12.8GHz	950-1700MHz

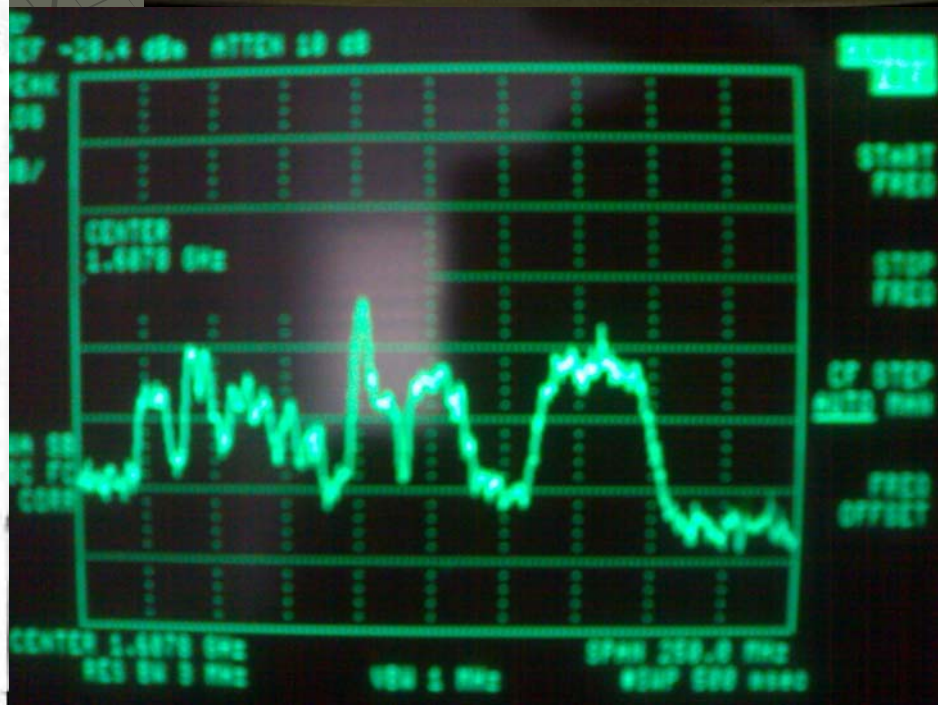
Basic Info: Hardware Costs! (ebay quick check on 22/03/2011)

- C/Ku-Band 1.8m Rx/Tx Satellite Antenna: $189 !
- Ku-Band LNB: $23
- Ku-Band 8Watt BUC: $275 !
- Vsat modem: $401
- Bottom line: With around $1000=703 Euro, you can have a fully working VSAT system
- Make sure you know exactly what you need to buy, for what Band, type of antenna, L.O. freq, polarity, etc..

Basic Info: Very Small Aperture Terminal (VSAT)

- Spectrum analyzer: Sat Guy's best friend!
  - Should be able to see L-band range
- Carrier Types:
  - Single Channel Per Carrier (SCPC)
  - Digital Video Broadcast (DVB-S, DVB-S2)
  - Time Division Multiple Access (TDMA)
  - Many more…
- Satellite Link types





The Unspoken Truth

Use/Abuse: Finders Keepers, Hijacking frequency space

- Available frequency space is finite on a satellite
- Frequency space is bought/rented even before the satellite is up in orbit
- Frequency space usage:
  - TVRO
  - DATA
  - SNG
  - Other..
- Even though it should, Not all frequency space is utilized
- Unused frequency space is not ‘disabled’
- ‘Anyone’ can transmit a carrier on unused frequency space
- Unless they try to use it, frequency space is not checked usually

Uses:

- SCPC/SCPC link within the satellite footprint
- DVB-S carrier Media Broadcast
- Egypt Internet block
- Creativity/necessity is the limit

Denial of Service: My Jutsu is stronger than your Jutsu!

- Don’t want everyone else to see how your favorite team is losing on Satellite TV?
- Want to deny your favorite politician’s speech transmitted live over SNG?
- Hate your Satellite Internet Provider for giving you such a crappy service?
- Don’t like how expensive Nova charges are?

Solution:

- Transmit a carrier with enough power on the same Tx frequency of their carrier and all your problems go away!

- Have something against a satellite company?
- Want to keep a satellite as hostage? (or its frequency space at least!)
- Want to deny service to a whole satellite?

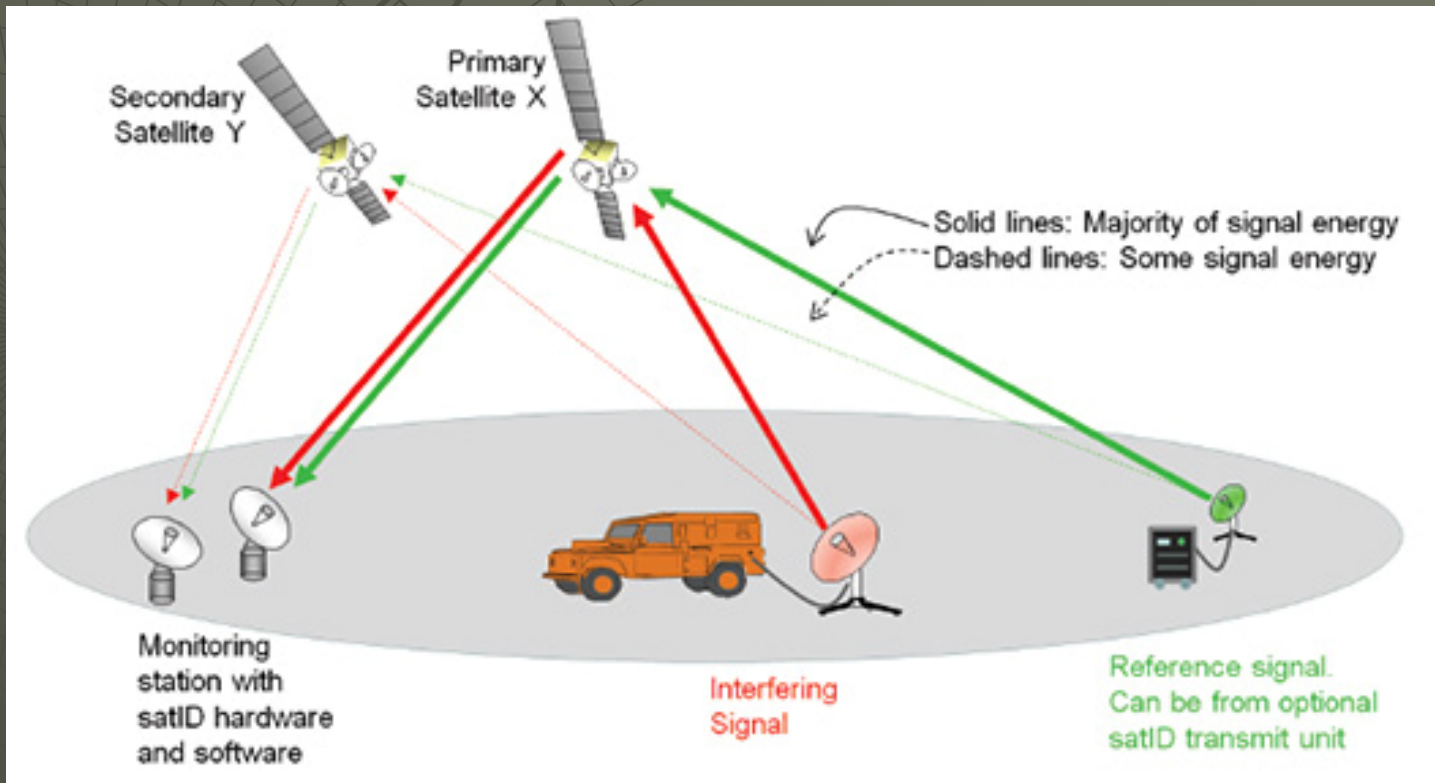
Solution:

- ‘Setup’ an RF component to transmit noise in All the Tx frequency range

Countermeasures: The Ear in the sky

- Interference detection
- Spectrum monitoring
- Geolocation system

- Countering the Counter
  - Who Cares?
  - Response times and methods
  - Distributed antennas?



Useful Stuff: Info-Trove

- http://www.satbeams.com/footprints/
- http://www.lyngsat.com/
- http://mc.njr.co.jp/eng/products.html
- http://www.satsig.net/
- http://www.satsig.net/ssazelm.htm
- http://www.satcomresources.com/
- http://www.rtlogic.com/
- http://en.wikipedia.org/wiki/Low_noise_block-downconverter
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- http://en.wikipedia.org/wiki/Digital_Video_Broadcasting
- http://www.vsat.us.com/VSAT_Satellite_Basics_Guide.htm