The first videoconference at Q/V Band: a new era of the satellite telecommunication history

Giuseppe Codispoti

Italian Space Agency

giuseppe.codispoti@asi.it

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- **The Legacy**
- **The Experiment**
- **The Future**

The Legacy

Developments in space telecommunication is one of the an institutional duties of Italian Space Agency.

Since the mid 70s, Italy has been promoting the exploitation of the higher frequency ranges allocated to space services.

Italy pioneered the Ka-band (20/30 GHz) when it had not yet been regarded suitable for commercial applications.

SIRIO, Satellite Italiano di Ricerca Industriale e Operativa

First Italian space PPP between Consiglio Nazionale della Ricerche, CNR, and Compagnia Industriale Aerospaziale, CIA.

Launched on August 25 th 1977 from Kennedy Space Center and put in geostationary orbit.

Experimentation of propagation impairments through atmosphere at 12 (downlink) and 18 (uplink) GHz

Designed lifetime: 2 years. It was operating for more than 10 years.

SIRIO allowed the most important space agencies in the world to experiment and study propagation at those frequencies.

NASA officially expressed appreciation to Italy for the contribution given by SIRIO in the «rescuing» of Voyager spacecrats.

SIRIO 2

Derived from a modification of the ‘spare’ flight unit of SIRIO, it was supposed to put in orbit two missions from ESA:

- To provide meteorological data to Europa and North Africa
- To sincronize atomic clocks via satellite by means of lasers (‘LASSO’ experiment, Laser Synchronization Via Satellite).

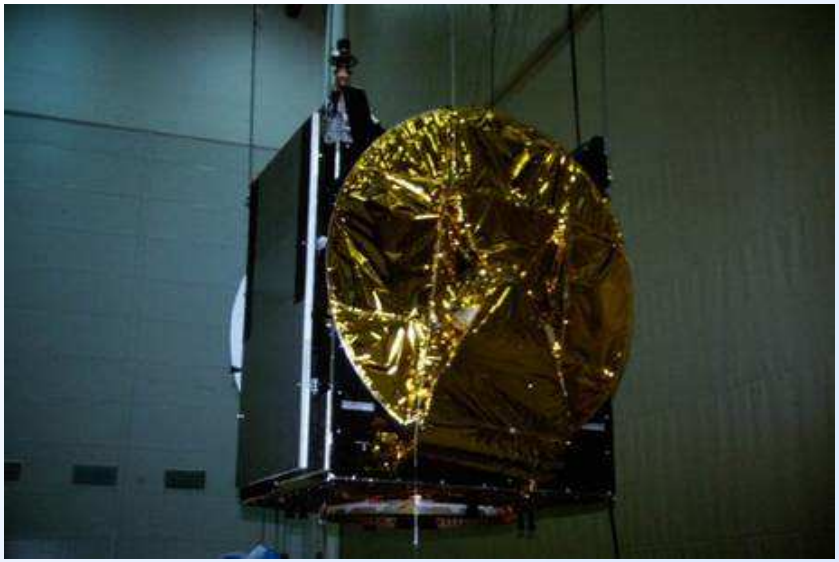
During the launch on September 9th 1982, the third stage of the Ariane launcher failed and SIRIO 2 did not reach its orbit.

ITALSAT F1

Launched on January 16th , 1991, providing a "global" national beam and six spot beams at 20 GHz (downlink) and 30 GHz (uplink) for coverage over Italy using. It also had beacons for telemetry and propagation, at 18.7 Ghz, and propagation at 40 and 50 GHz.

A large amount of data for propagation studies were collected during the operational life.

These data are still useful and used by researchers from all over the world.



ITALSAT F2

Launched on August 8th, 1996. Italsat F2 was embarking the European Mobile System (EMS).

Italsat F2 was placed in geostationary orbit at 16.4° East.

iL band (1,4 GHz - 1,6 GHz) links for mobiles, and Ku band (12 – 14 GHz) links for ground stations with coverage on Europe and North Africa.

Scientific experiments have been performed also with Italsat F2

Propagation studies did benefit from data coming from both satellites.

Besides their operational applications, these programs allowed to test and anticipate the main ‘large band’ satellite and ‘mobile’ user service applications

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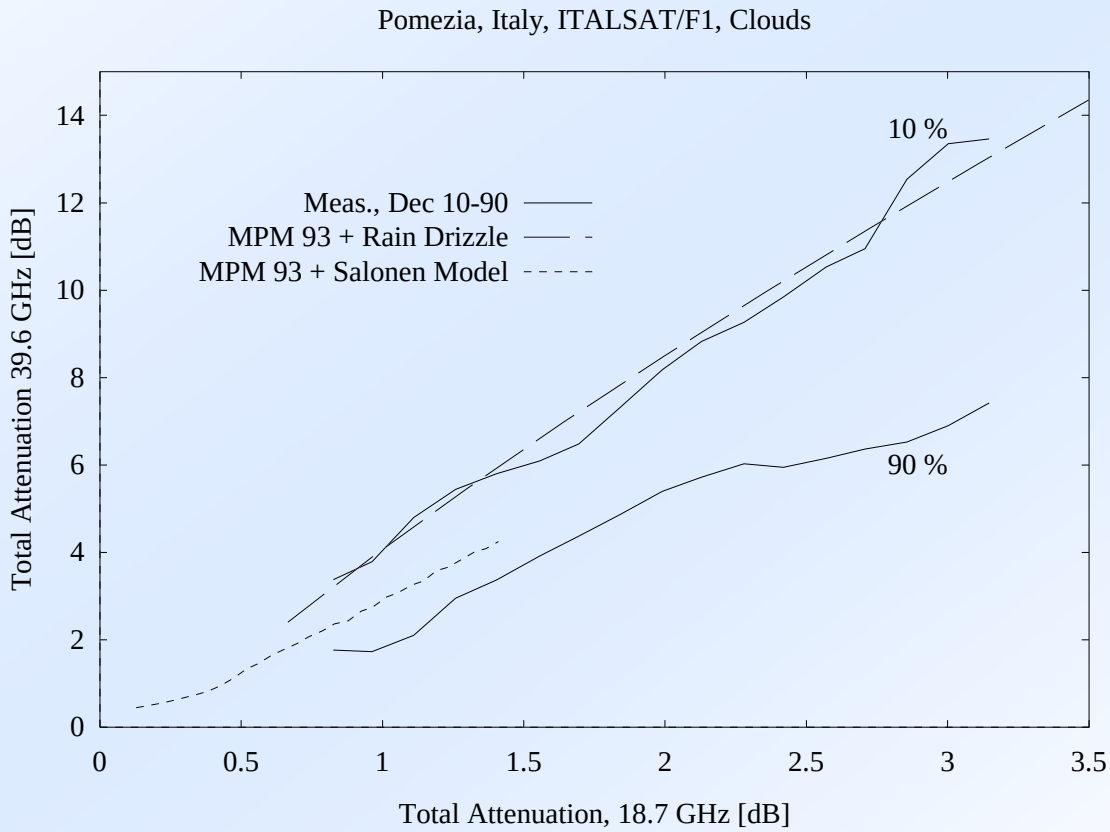
These data are still useful and used by researchers from all over the world.

ITALSAT F1 Attenuation Measurements



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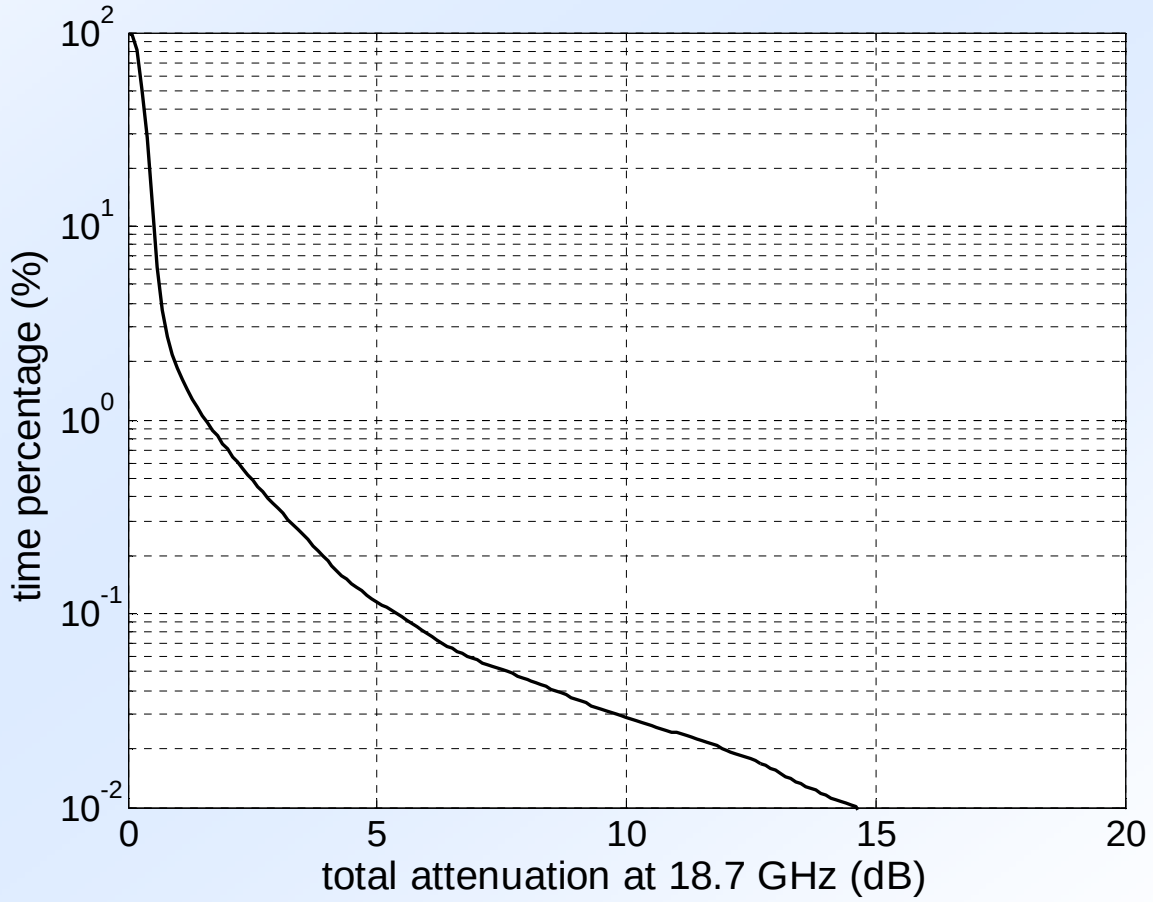
Italsat F2 Total attenuation at 18.7 GHz (2001, avail. 96.1%)



The Experiment

The ASI Q/V Band Program

- In 2004 ASI decided to investigate on the highest usable frequencies for communication payloads
- The frequency bands selected are at Q/V band, i.e. 40/50 GHz
- Adopting the Q/V-band for commercial systems was previously considered to be hardly viable.
- With the traditional design approach links must be oversized to counteract the deep fading occurring in coincidence with atmospheric events

Q/V Band Opportunities

But the reference scenario today has rapidly evolved:

- novel Adaptive Interference / Fading Mitigation Techniques (DVB-S2) allow Q/V-band systems to operate efficiently with good service performance

- Technology, today state of the art, will become shortly no longer the main issue, also thanks to the possible synergies with the commercial world

Q/V Band Opportunities

Q/V-band is appealing thanks to the very wide available bandwidth:

- systems with very high-capacity become feasible
- economy of scale, lower service fees
- better satellite systems positioning with respect to competing alternatives

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The ASI Q/V Band Program

- A telecommunication and propagation experimental payload was developed in cooperation with the European Space Agency to be embarked on ESA's Alphasat satellite

- Alphasat is a Commercial Telecommunication Geostationary satellite using the ESA developed Alphabus Platform

Alphasat «Aldo Paraboni» (TDP5) - The Experimental Mission

Main objectives:

- **Telecommunications**: optimizing and assessing, over-the-air, the performance of the indispensable adaptive access techniques to be used at Q/V-band

- **Propagation**: obtaining new data from the so-called *2nd-order* measurements, bound to the variability and space-time correlation of the most significant propagation parameters, which are necessary to correctly design the adaptive access techniques

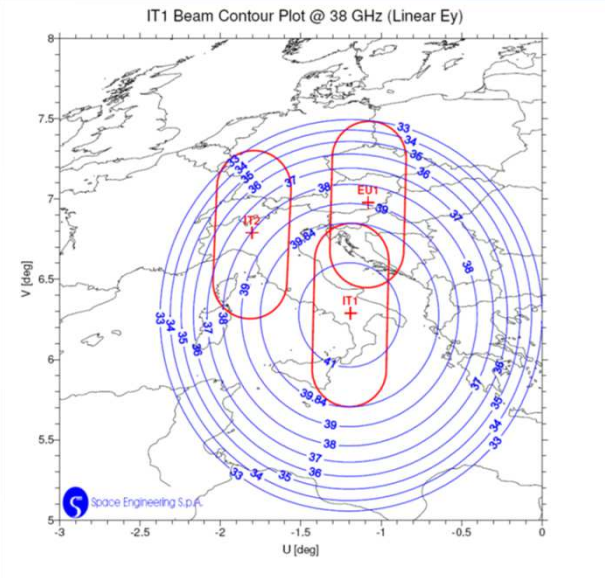
Tx and Rx antenna coverage

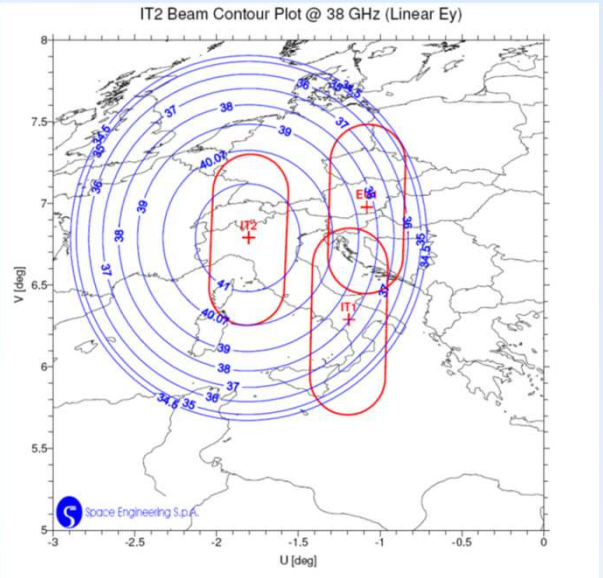
- Fixed beam over IT1 Tito Scalo, S-Italy (40° 35'55"N, 15° 43'23"E)
- Selectable second beam between two areas:
  - ✓ IT2 Spino d'Adda, North Italy (45° 24'N, 9° 29'E)
  - ✓ EU Graz, Austria (47° 05'07"N, 15° 27'54"E)

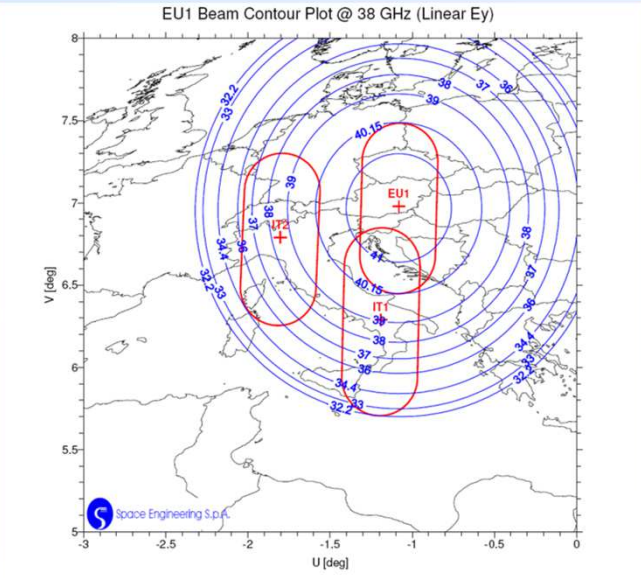
Main Parameters

•Rx Freq. 47.850 - 48.150 GHz (V-Band)
•Tx Freq. 37.850 - 38.150 GHz (Q-Band)
•Bandwidth: 2 x 10 MHz
•Polarization (Rx & Tx) Linear Vertical
•Receive Gain 38.3 dBi EOC
•Transmit Gain 37.5 dBi EOC

Communication payload beams contour plots





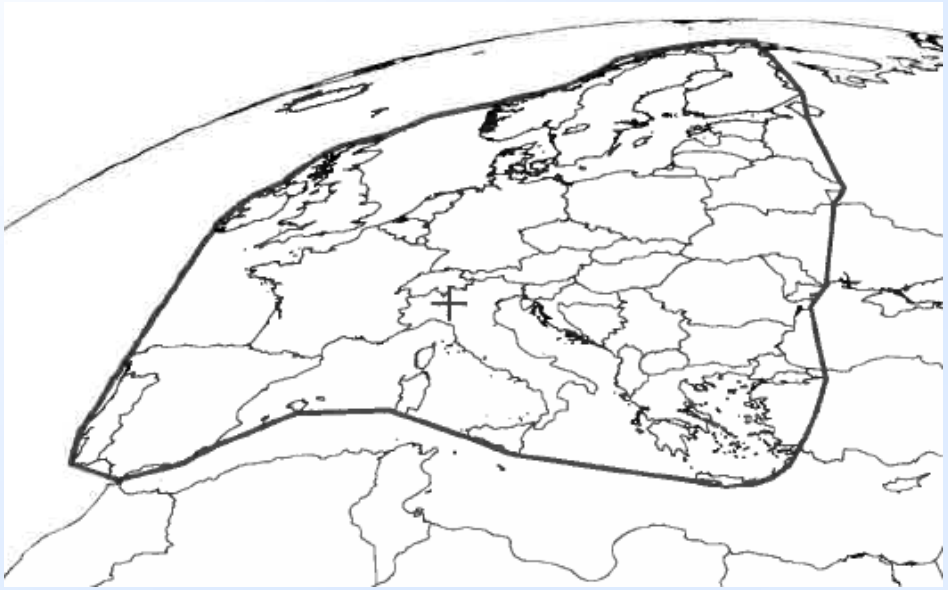


Tito

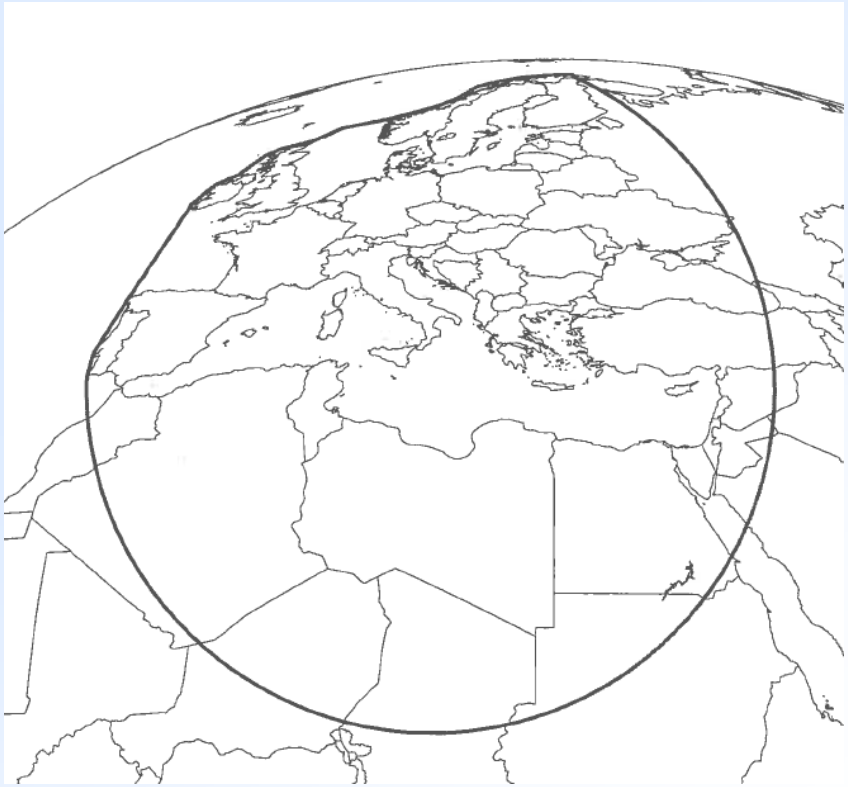
Spino d'Adda

Graz

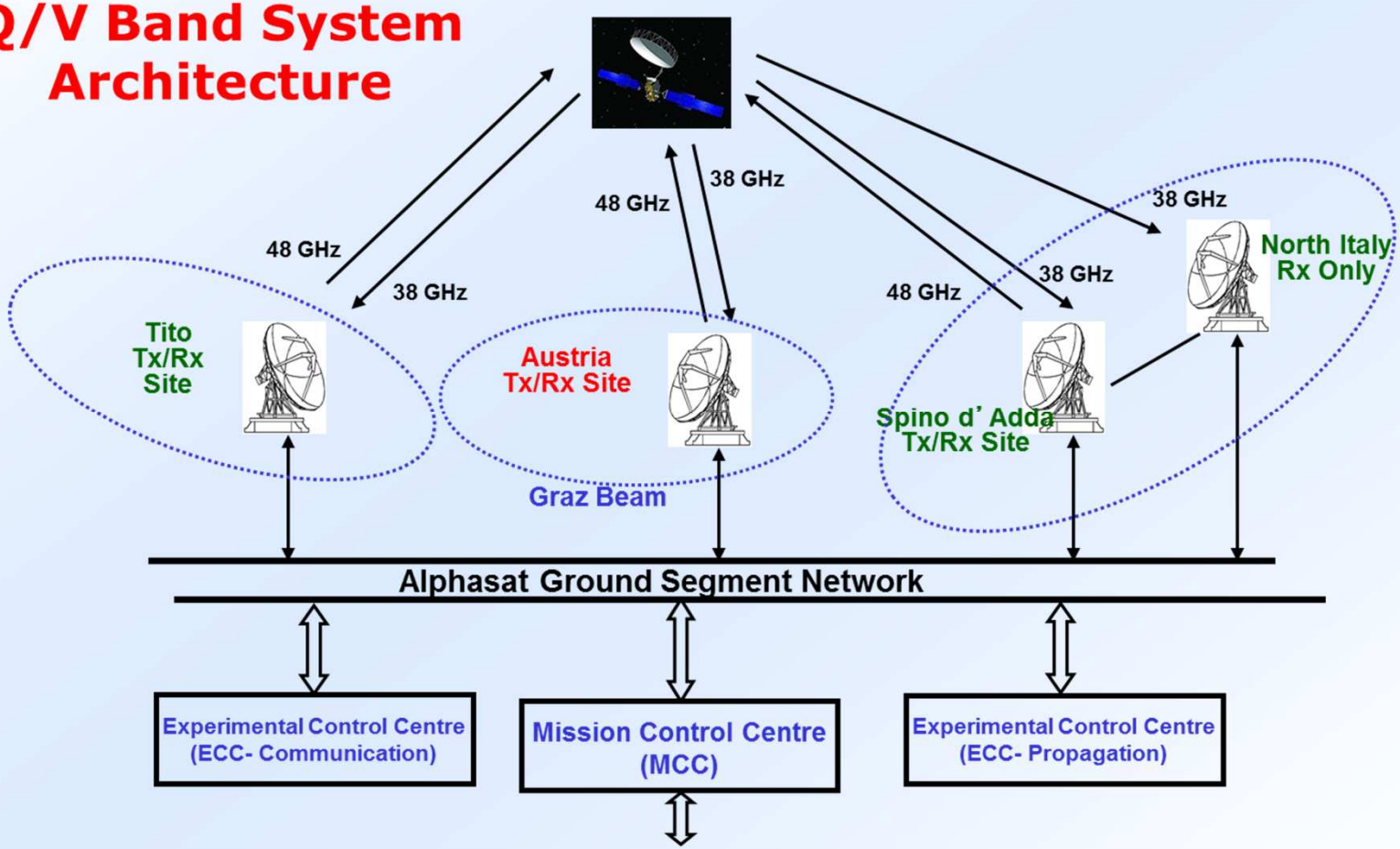
40 GHz (Q-Band) Beacon Coverage



20 GHz (Ka-Band) Beacon Coverage



Q/V Band System Architecture

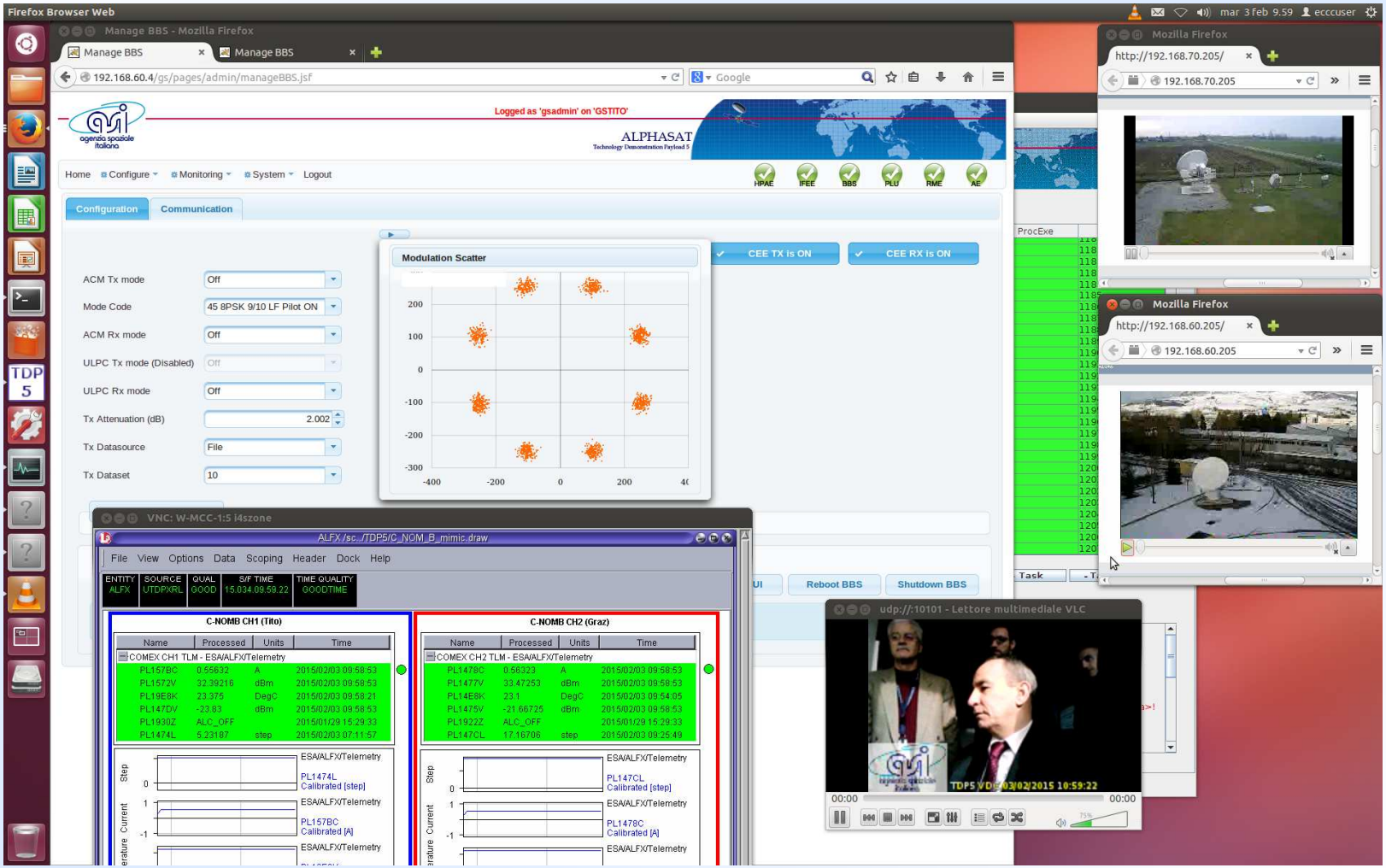


The first 40/50 GHz satellite videconference

On February 3rd 2015 the two ground stations in Tito and Spino d'Adda were connected through Alphasat.

The weather conditions were not the optimal ones fro satellite links at those frequency: snowing in Tito and raining in Spino d'Adda.

The modems were connected to camera in the two stations premises and the videoconference took place.


Firefox Browser Web
Manage BBS - Mozilla Firefox
Manage BBS
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Logged as 'gsadmin' on 'GSTITO'
ALPHASAT
Home
Configure
Monitoring
System
Logout
Configuration
Communication
ACM Tx mode
Off
Mode Code
45 8PSK 9/10 LF Pilot ON
ACM Rx mode
Off
ULPC Tx mode (Disabled)
ULPC Rx mode
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Tx Attenuation (dB)
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Tx Datasource
File
Tx Dataset
10
Modulation Scatter
CEE TX is ON
CEE RX is ON
Reboot BBS
Shutdown BBS
VNC: W-MCC-1:5 l4szone
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File View Options Data Scoping Header Dock Help
C-NOMB CH1 (Tito)
C-NOMB CH2 (Graz)
Mozilla Firefox
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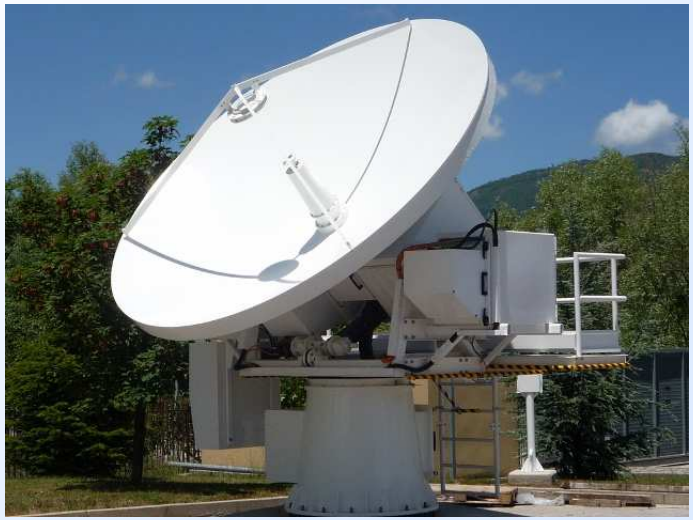

Ground Station #1
Tito (Potenza)
Antenna

Ground Station #2
Spino d'Adda (Cremona)
Antenna

Another remarkable scientific result was already obtained on December 1st 2014.

The Spino d'Adda station was able to maintain the link with the satellite and record a rain event of 60 dBs of attenuation at 40 GHz.

This is the highest attenuation level even recorded in propagation studies.

The Future

Italy is looking forward for possible cooperation, beyond the ones already existing and successful, either from scientific international community and from commercial operators in order to maximize the return from the investment in the Q/V Program.


Chilbolton, UK
Prague (CMI), Czech Rep.
Budapest, Hungary
Graz, Austria
Ljubljana, Slovenia
Spino d'Adda, Italy
Milano (NASA), Italy
Toulouse, France (ONERA)
Aussaguel, France (CNES)
Le Fauga, France (ONERA)
Vigo, Spain
Roma, Italy
Tito, Italy
Aveiro, Portugal
Madrid, Spain
Athens, Greece
US Dept of State Geographer
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Image Landsat
Google earth
Data di acquisizione delle immagini: 4/10/2013 45°00'12.55"N 11°08'41.20"E elev 12 m alt 2916.34 km

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Thank You