



AMSAT Italia ®

HAMTV

***Proposta AMSAT Italia
per un down link televisivo dal modulo
ESA Columbus***

by

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Meeting Annuale- Frascati 24 Settembre 2010

CONTENUTO DELLA PRESENTAZIONE

- **Nascita della Proposta**
- **Identificazione della banda di frequenza**
- **Limiti dell'uso della banda 2.4 GHz**

- **Selezione dello Standard trasmissivo**
- **Link Budget**
- **Primi esperimenti e risultati**



NASCITA DELLA PROPOSTA

- **Viaggio per Pozzuoli De Paolis - Nespoli**
- **Scambiate alcune prime idee su Skype**
- **Preparazione della struttura dello studio**
- **Finalizzazione ed Invio ad ARCOL WG**
- **Idea per una “unsolicited proposal”**
- **Incontro Tognolatti e D’Andria con Kayser**
- **Proposta di Kayser Italia ad ESA**

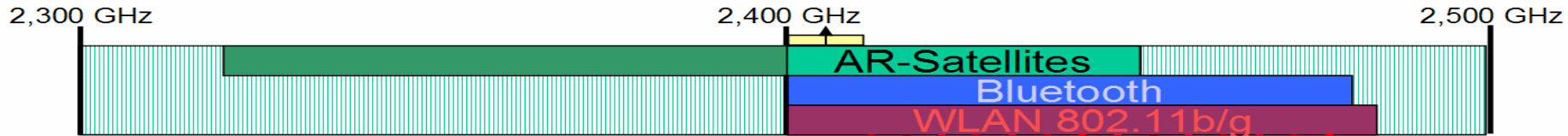


IDENTIFICAZIONE DELLA BANDA DI FREQUENZA

- **Tabella di attribuzione dei servizi dell'ITU – Footnote 5.282**
- ***5.282 In the bands 435-438 MHz, 1 260-1 270 MHz, 2 400-2 450 MHz, 3 400-3 410 MHz (in Regions 2 and 3 only) and 5 650-5 670 MHz, the amateur-satellite service may operate subject to not causing harmful interference to other services operating in accordance with the Table No. 5.43). Administrations authorizing such use shall ensure that any harmful interference caused by emissions from a station in the amateur-satellite service is immediately eliminated in accordance with the provisions of No. 25.11. The use of the bands 1 260-1 270 MHz and 5 650-5 670 MHz by the amateur-satellite service is limited to the Earth-to-space direction.***
- **Per ovvi motivi la scelta è caduta sulla banda 2400-2450 MHz in quanto è l'unica utilizzabile in downlink, con adeguata larghezza di banda per consentire un collegamento televisivo) e di cui si dispone di una antenna sulla ISS .**



LO SPETTRO IN S-BAND



Amateur Radio 13cm Band:

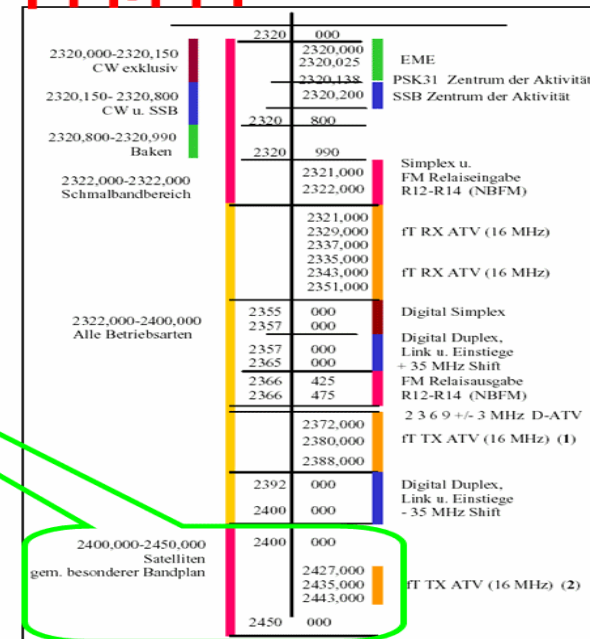
- 2,320 GHz to 2,450 GHz
- 2,400 GHz to 2,450 GHz allocated to satellites

Bluetooth:

- 2,402 GHz to 2,480 GHz
- 79 separate frequencies, 1MHz spacing
- Frequency Hopping, up to 1600hps

WLAN (IEEE 802.11b/g):

- 2,400 GHz to 2,483.5 GHz
- US: 11 channels, EU: 13 channels
- 5 MHz spacing
- 802.11b: max 11Mbps, 802.11g: max 54Mbps



- Ch 01: 2.412 GHz
- Ch 02: 2.417 GHz
- Ch 03: 2.422 GHz
- Ch 04: 2.427 GHz
- Ch 05: 2.432 GHz
- Ch 06: 2.437 GHz
- Ch 07: 2.442 GHz
- Ch 08: 2.447 GHz
- Ch 09: 2.452 GHz
- Ch 10: 2.457 GHz
- Ch 11: 2.462 GHz
- Ch 12: 2.467 GHz
- Ch 13: 2.472 GHz
- Ch 14: 2.484 GHz



LIMITI DELL'USO DELLA BANDA 2.4 GHz

I Parte

- **Attribuzione al servizio di Radioamatore via satellite con statuto secondario (o anche meno)**
- **Banda ISM (Wi-Fi, Bluetooth, Forni a Microonde, Apparati Radiomedicali, WLAN, etc.)**
- **Applicazioni Wi-Fi su ISS**
- **Ricezione a terra condizionata da applicazioni pervasive (Wi-Fi, Bluetooth, Forni domestici, etc.)**



LIMITI DELL'USO DELLA BANDA 2.4 GHz

II Parte

- **Proposta di un canale alternativo (i.e. 2395 MHz) nella parte alta della banda 2300-2400 MHz su base non-interferente (RR. 4.4) in aggiunta a quello nominale a 2422 MHz (canale 3 del Wi-Fi)**
- **Consapevolezza di non disporre di alcuna banda attribuita a titolo primario al servizio di radioamatore via satellite nella banda UHF (300 – 3000 MHz) con adeguata larghezza di banda.**



SELEZIONE DELLO STANDARD TELEVISIVO

Confronto tra:

- ***standard analogico (FM)***

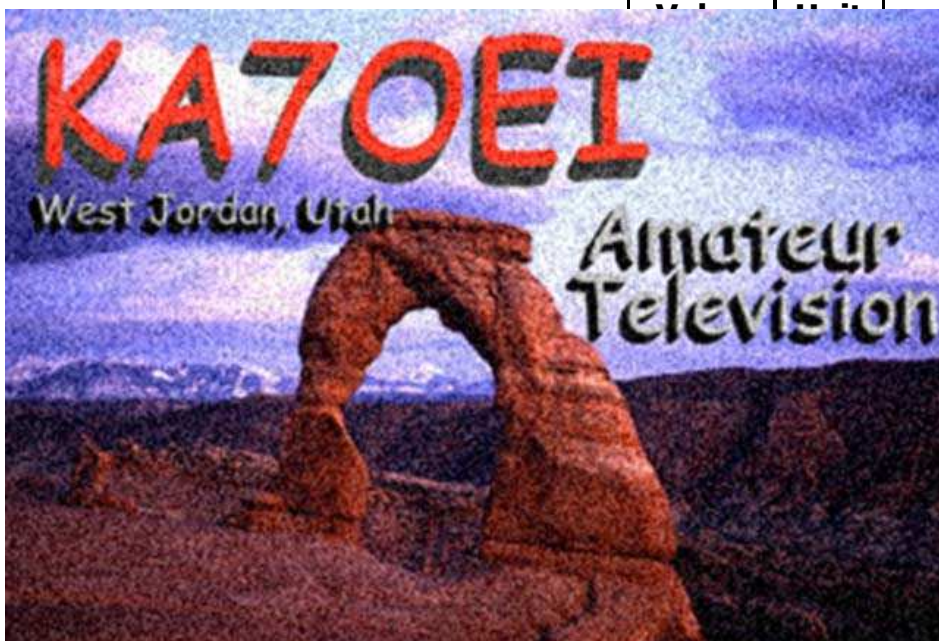
$\Delta F_{pp}=16$ MHz, $BW=28$ MHz

- ***standard digitale (DVB)***

DVB-S (QPSK)



FM TV from Columbus



System Noise Temp	1.9	K
System Noise Figure	1.9	dB
G/T	2.3	dB/K

CARRIER CHARACTERISTICS		
Peak to Peak frequency deviation ΔF_{pp}	16	MHz
TV signal bandwidth B_v	6	MHz
Modulation	FM	
Carrier's occupied bandwidth	28	MHz
<i>pw [Unified] CCIRR Rep. 637 pre/de-emphasis</i>	13.2	dB

TX & Downlink		
TX power	10.0	dBW
cable & connector losses	7.0	dB
TX Antenna gain (boresight)	8.0	dBi
pointing losses	10.5	dB
Downlink e.i.r.p. toward earth receive station	0.5	dBW
Downlink path loss (free space)	160.3	dB
Atmospheric losses	0.0	dB
Rain attenuation losses	0.0	dB

C/N (Available)	-3.4	dB
C/N (required due to demod. threshold)	7.0	dB
Margin on C/N	-10.4	dB
S/N (Required for P3 video quality)	25.0	dB
C/N0 (Required for P3 quality)	69.3	dBHz
C/N0 (available)	71.1	dBHz
Margin on C/N0	1.8	dB
Link Margin	-10.4	dB

$$\frac{S}{N} = \frac{3}{2} \frac{\Delta F_{pp}^2}{B_v^3} \frac{C}{N_0} pw$$

Antenna noise temperature DO NOT include noise contributions from interfering systems close to the receiving station (e.g. WiFi access point, microwave ovens, video senders, etc.). A preliminary measurement of G/T is strongly recommended. Sun-noise measurement at sunrise or sunset should be a convenient method to test RX station figure-of-merit at low elevations.



DVB-S TV from Columbus

	Value	Unit
Downlink frequency	2.450	GHz
ISS to E/S range	1000	Km

EARTH STATION CHARACTERISTICS

Antenna diameter	0.90	meters
Efficiency	50%	
Rx Antenna gain	24.3	dBi

Antenna Noise Temperature	100	K
LNB gain	35	dB
LNB noise figure	0.8	dB
LNB equiv noise temp	58.7	K

FIGURE of MERIT G/T

System Noise Temp	158.7	K
System Noise Figure	1.9	dB
G/T	2.3	dB/K

CARRIER CHARACTERISTICS

Data Rate	922	kbps
Reed Solomon	188/204	
Modulation	QPSK	
FEC	1/2	
Symbol Rate	1000	kbaud
Carrier's occupied bandwidth	1.35	MHz

TX & Downlink

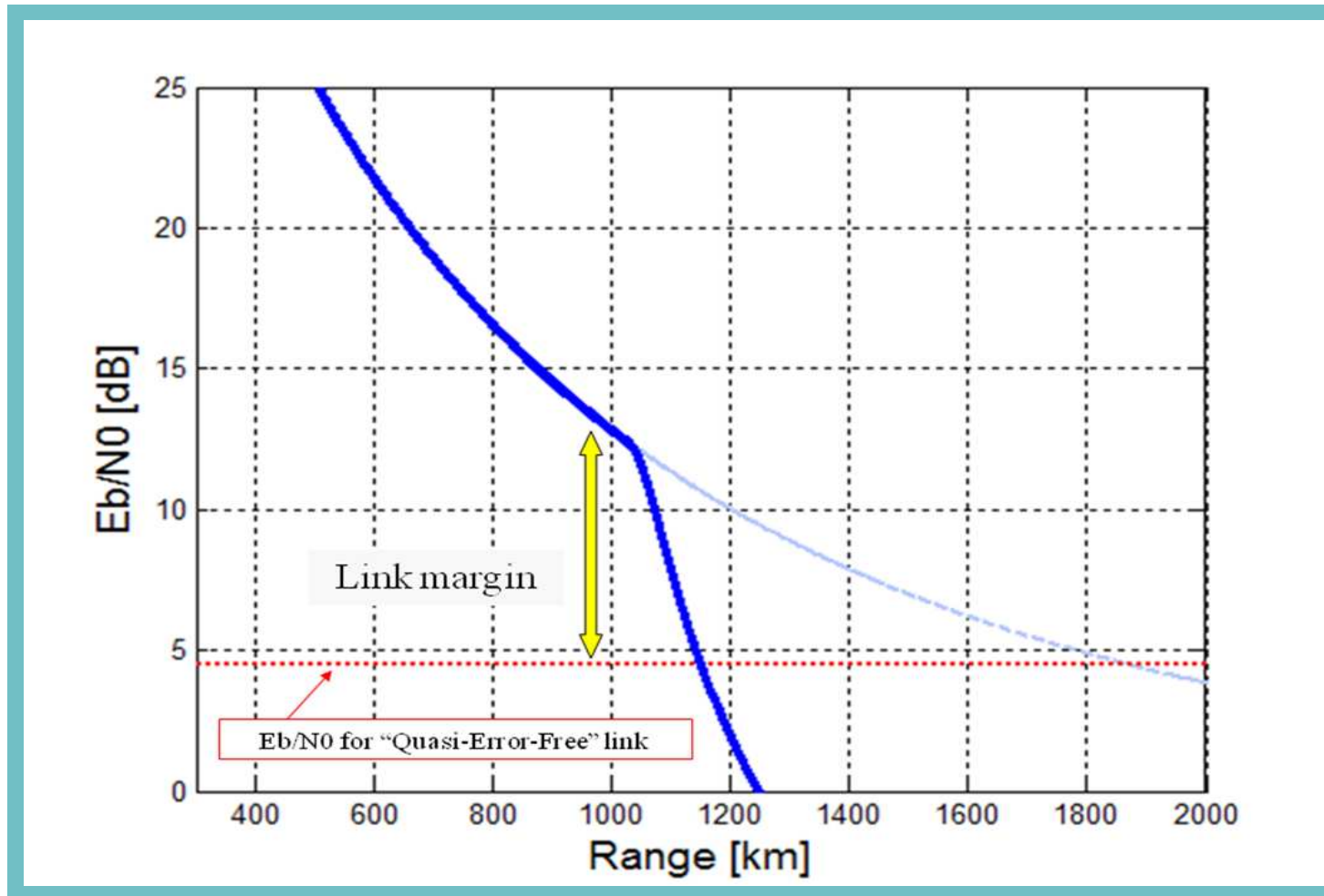
TX power	10.0	dBW
cable & connector losses	7.0	dB
TX Antenna gain (boresight)	8.0	dBi
pointing losses	10.5	dB
Downlink e.i.r.p. toward earth receive station	0.5	dBW
Downlink path loss (free space)	160.3	dB
Atmospheric losses	0.0	dB
Rain attenuation losses	0.0	dB

C/No	71.1	dBHz
C/N	9.8	dB
Eb/No (Available)	11.4	dB
Eb/No (Required)	4.5	dB
Link Margin	6.9	dB

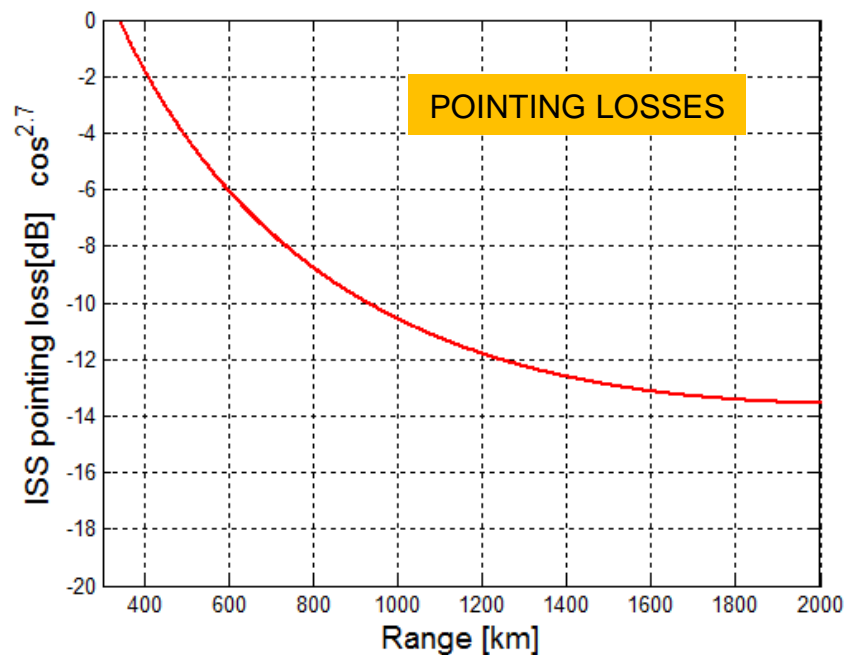
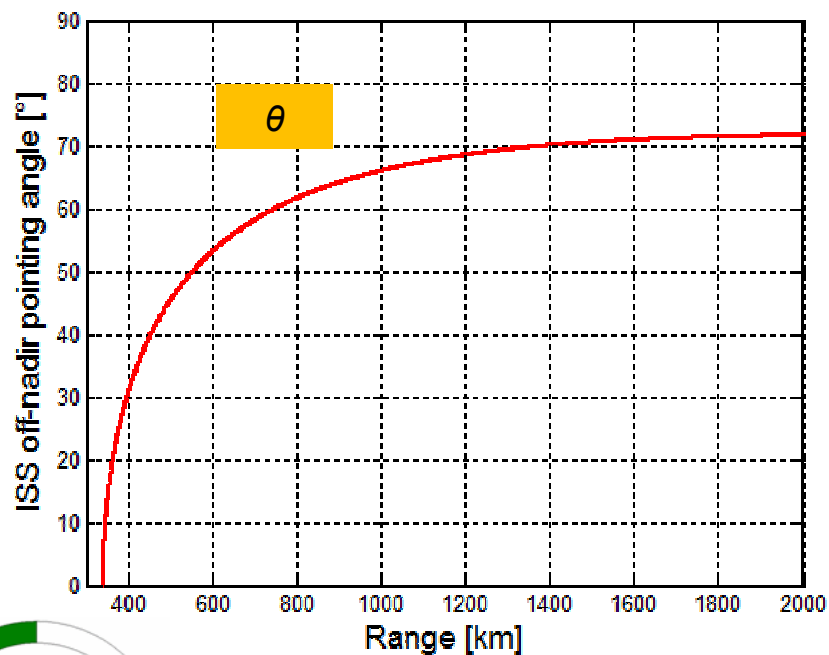
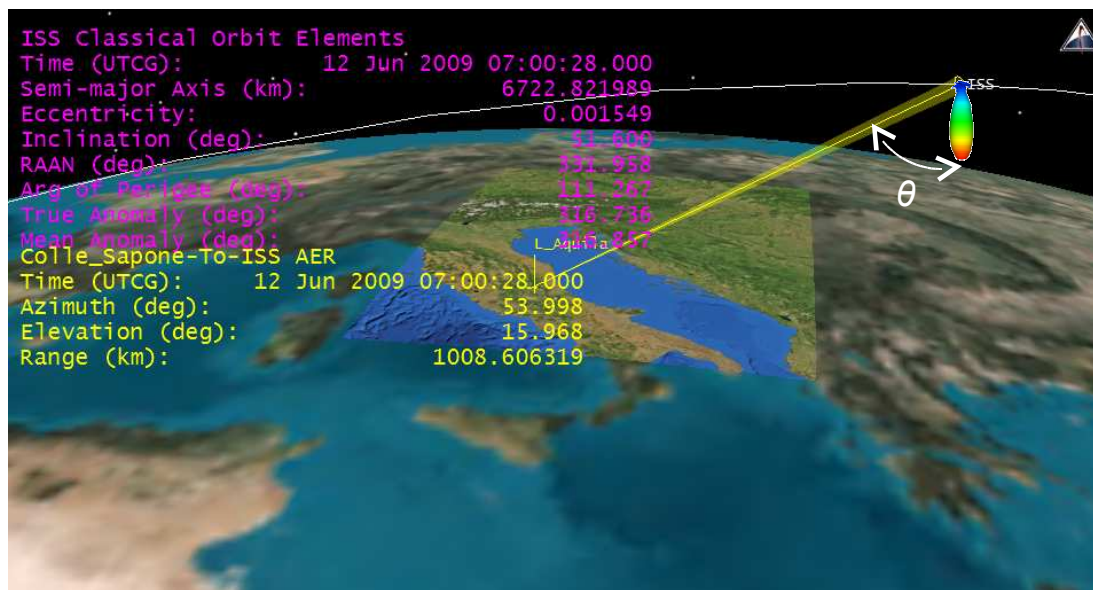
Salvo diversa indicazione, questi saranno i parametri trasmissivi considerati nel seguito



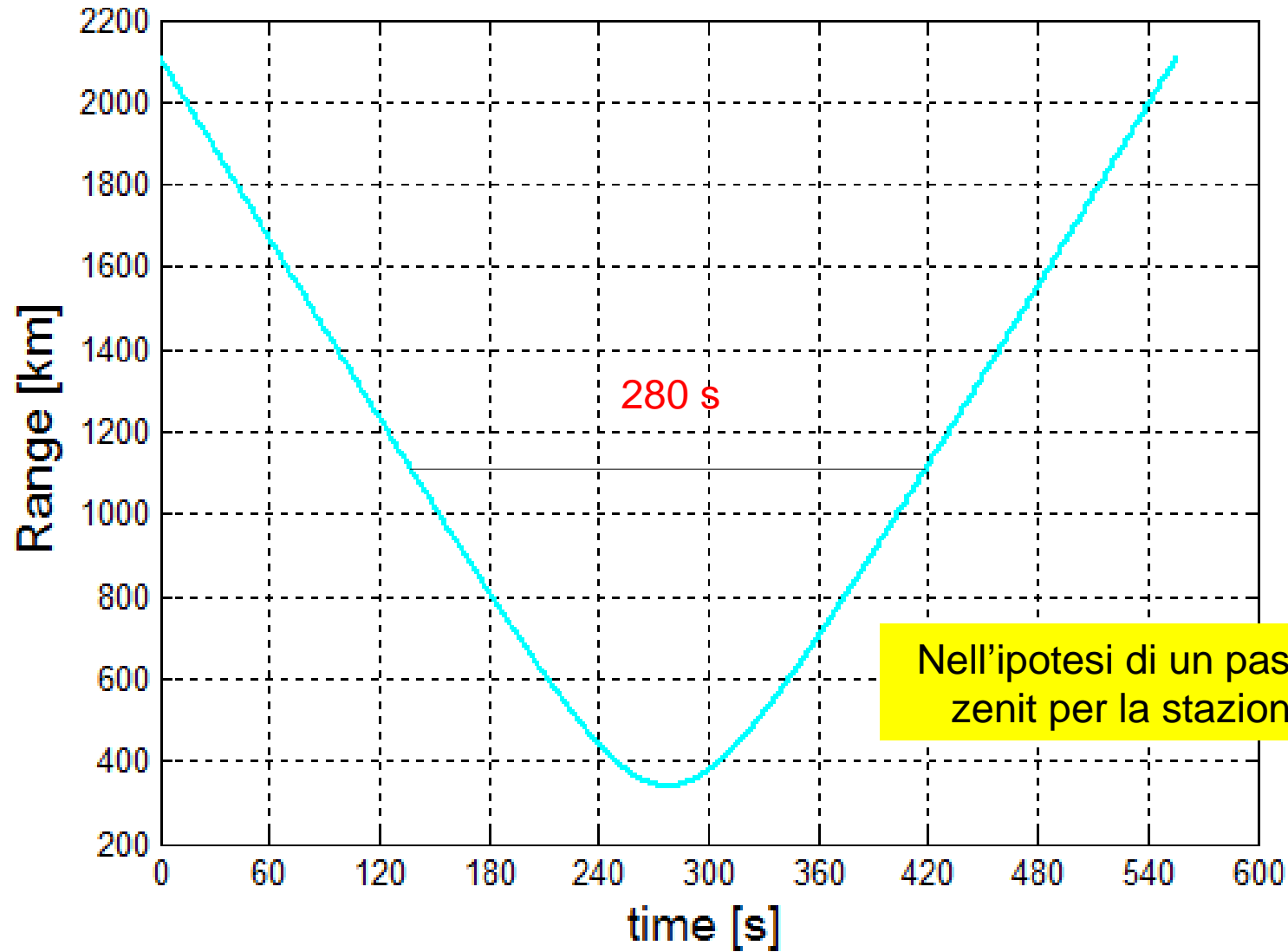
Margine di link durante il collegamento



Perdite di puntamento durante il collegamento



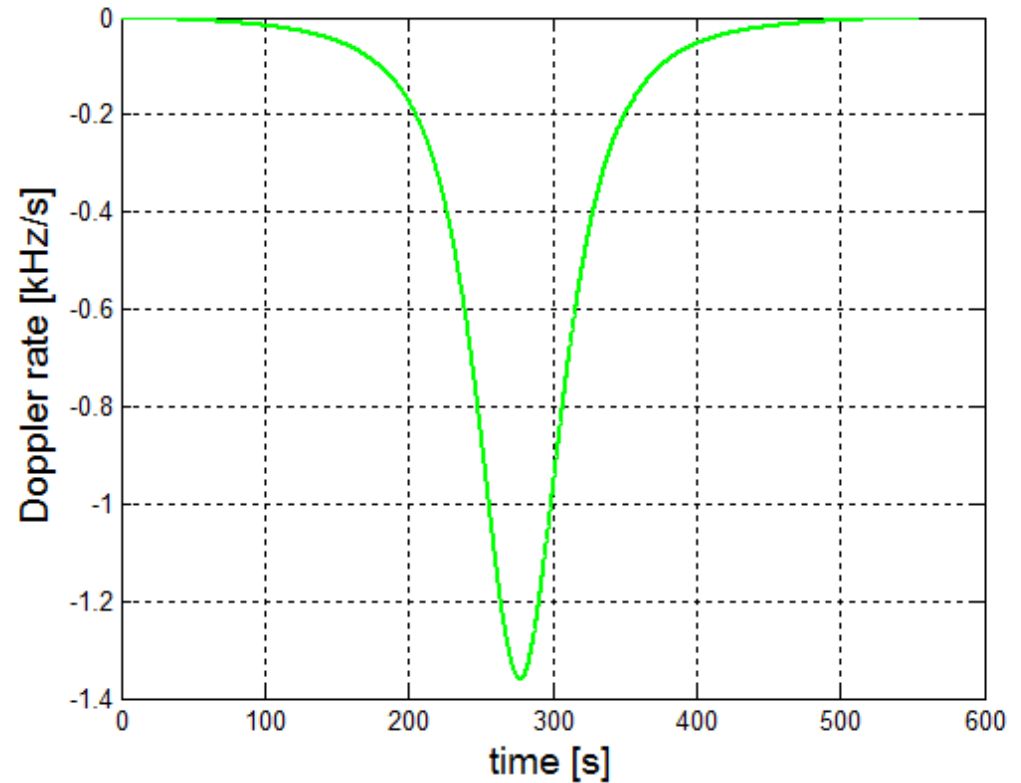
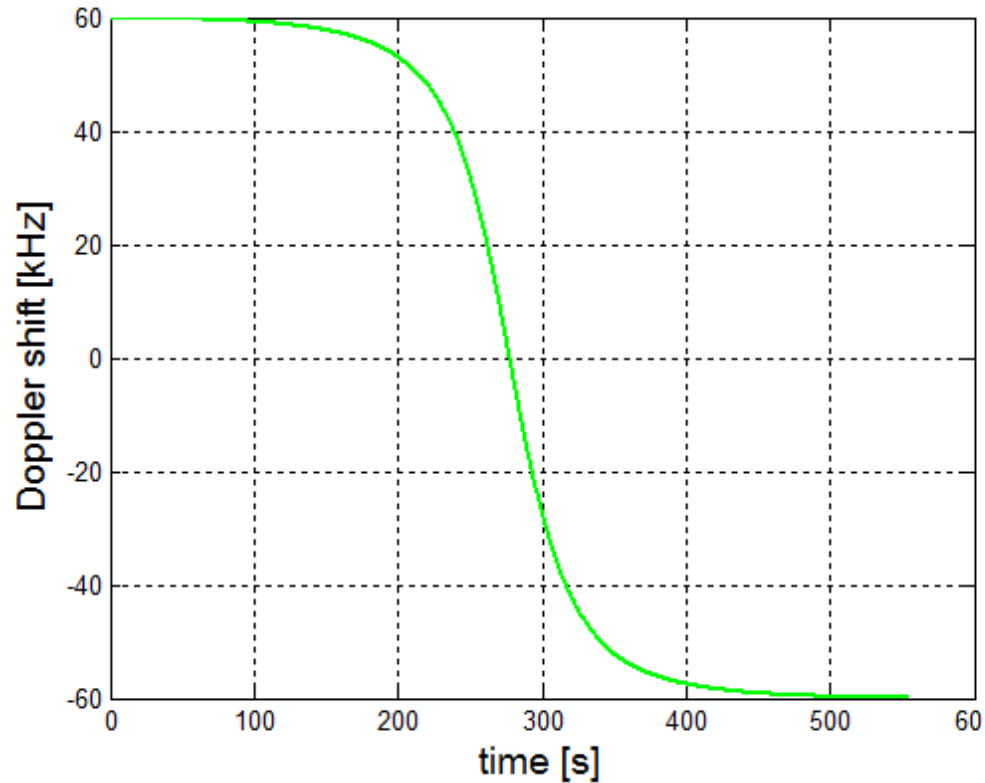
Durata del collegamento video



Nell'ipotesi di un passaggio allo zenit per la stazione di terra



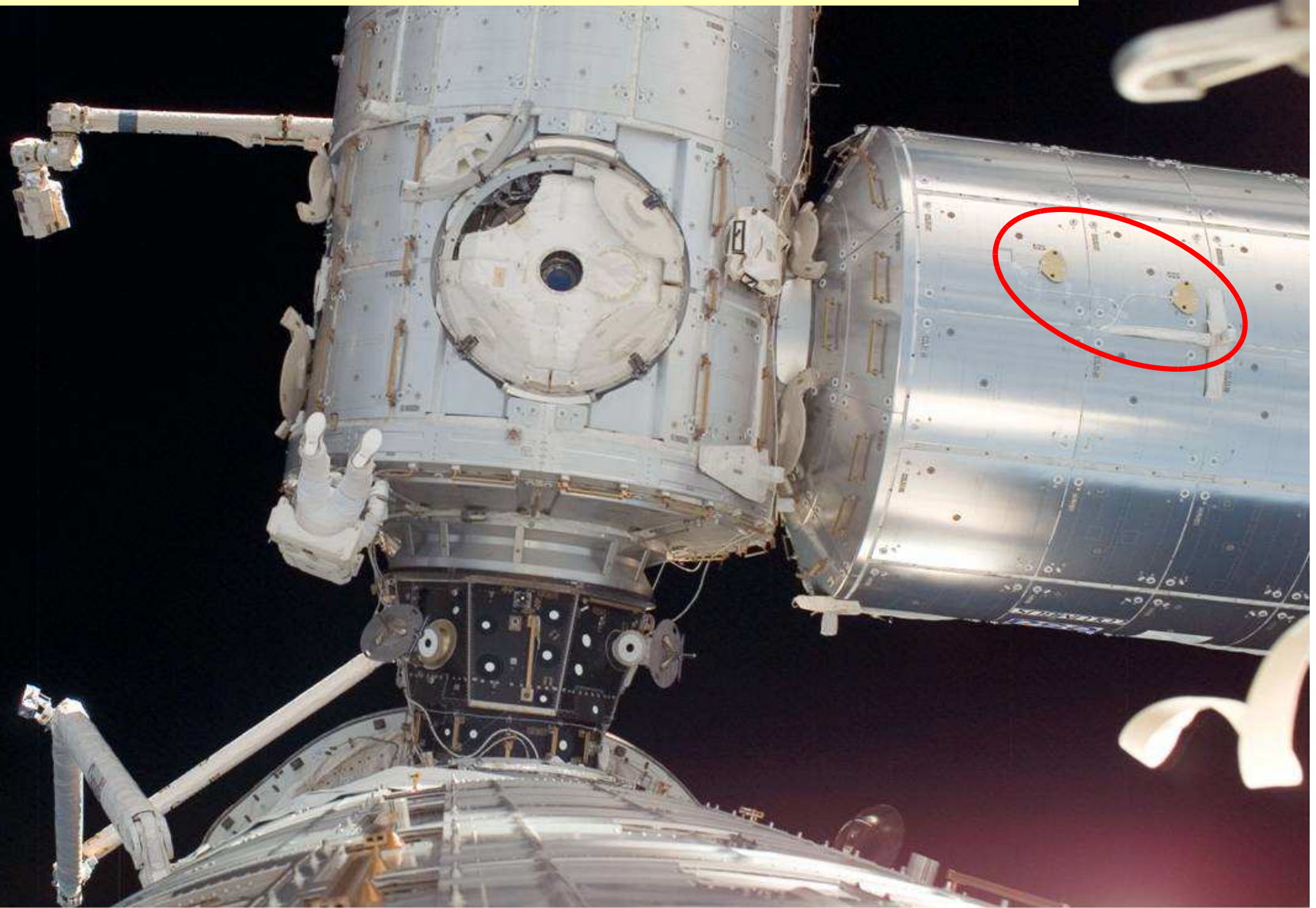
Effetto DOPPLER



Misure preliminari a cura del Centro Ricerche RAI, Torino, mostrano l'assenza di effetti nocivi dovuti al Doppler-rate



L'antenna ARISS per bande L&S



ISS017E008746



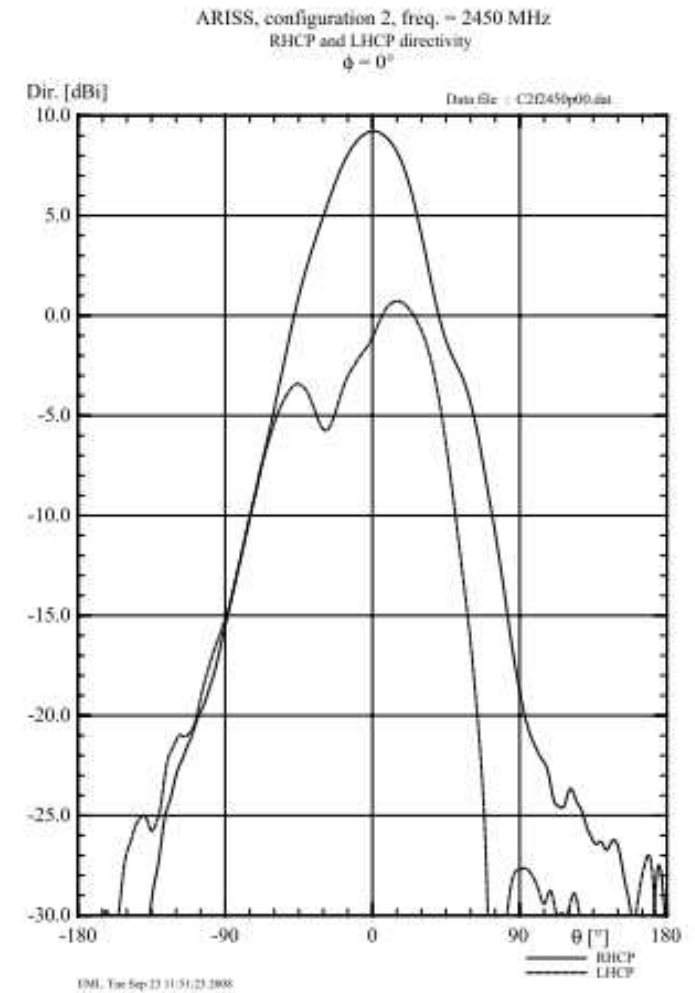
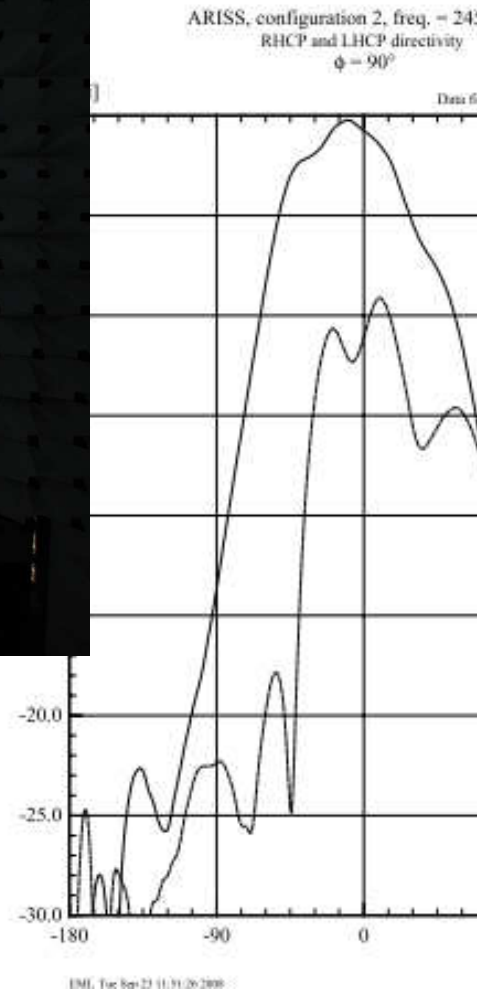
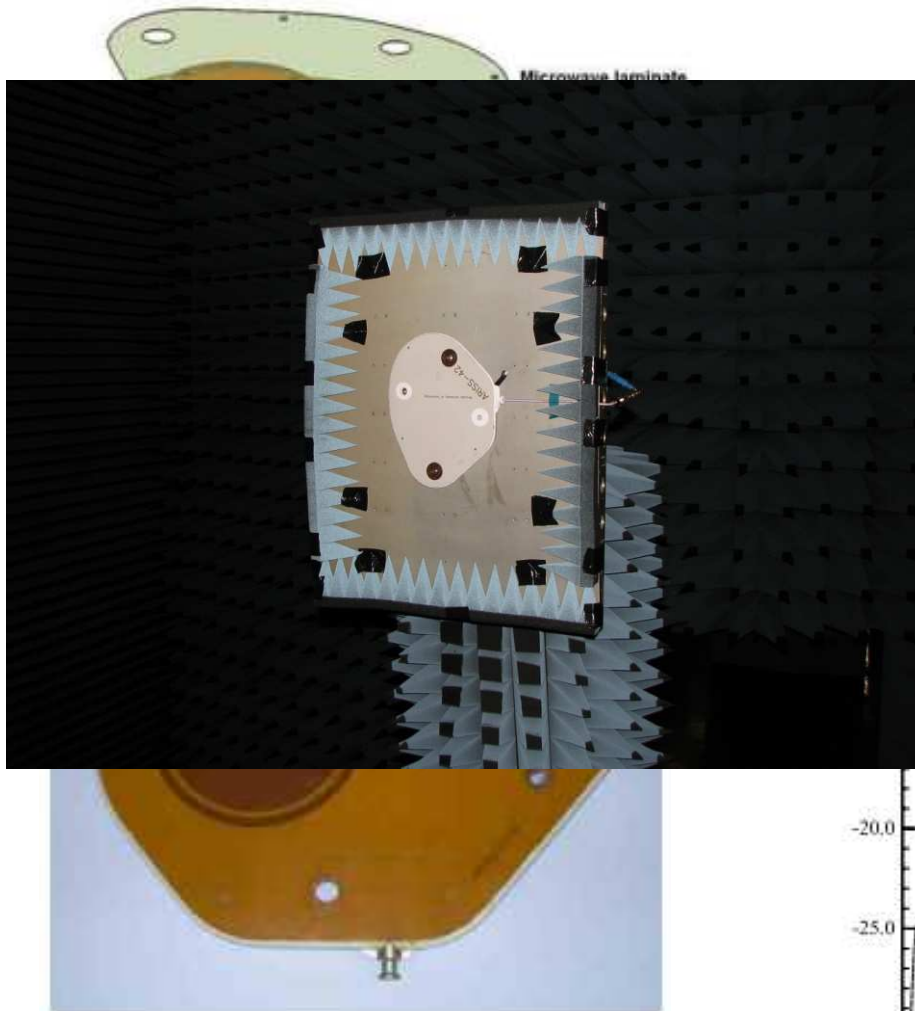
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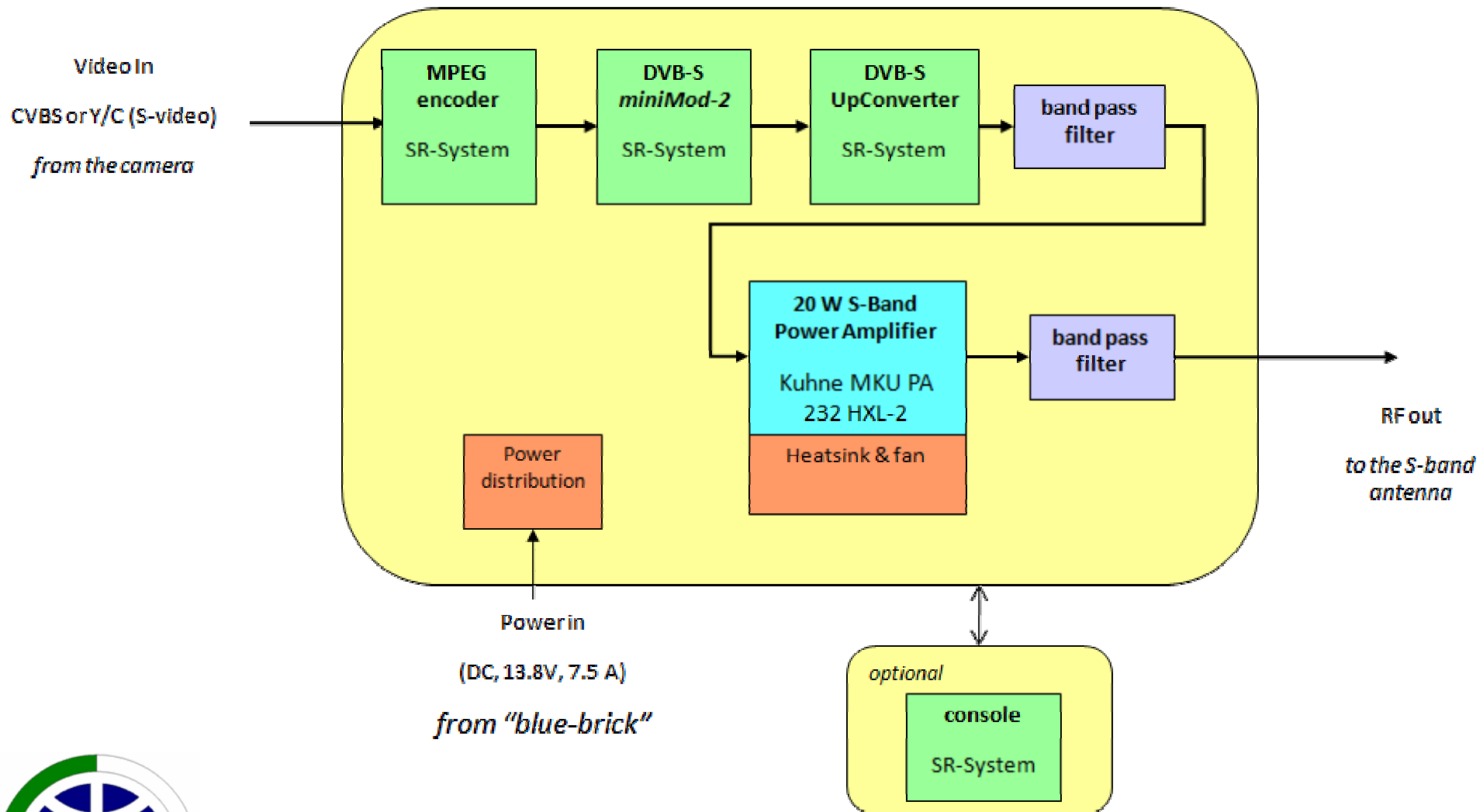
L'antenna ARISS per bande L&S



L'antenna *ARISS* per bande L&S



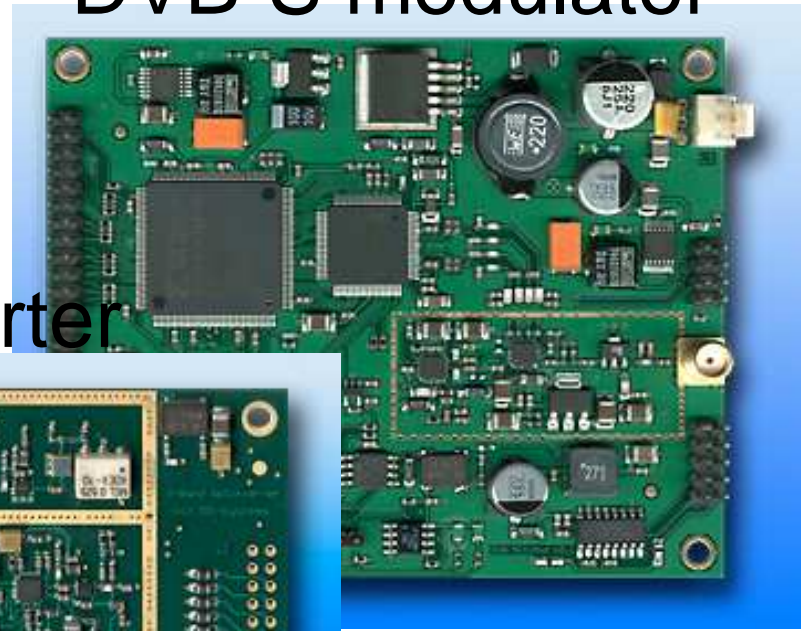
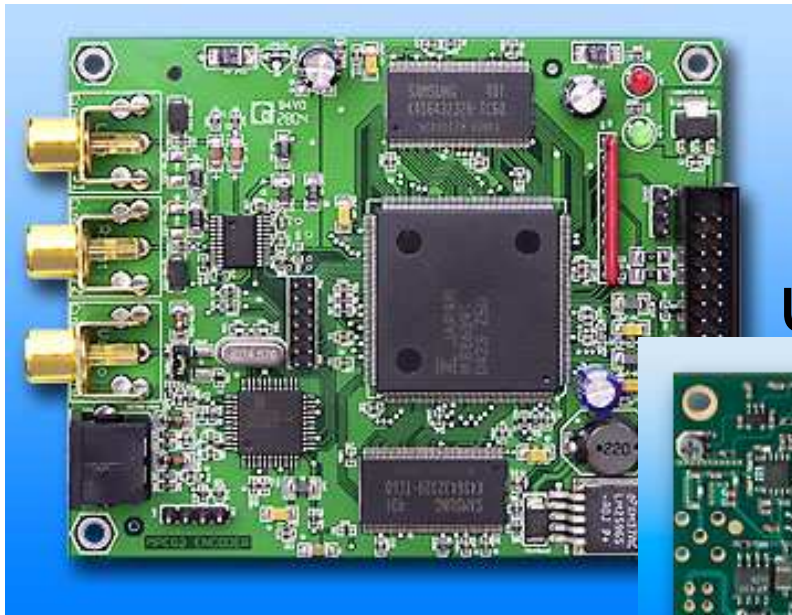
La struttura del trasmettitore HAMTV



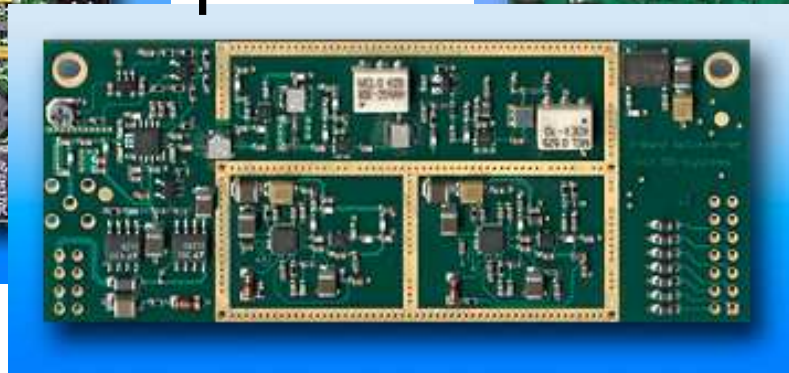
I principali sottosistemi impiegati

MPEG encoder

DVB-S modulator



upconverter



console



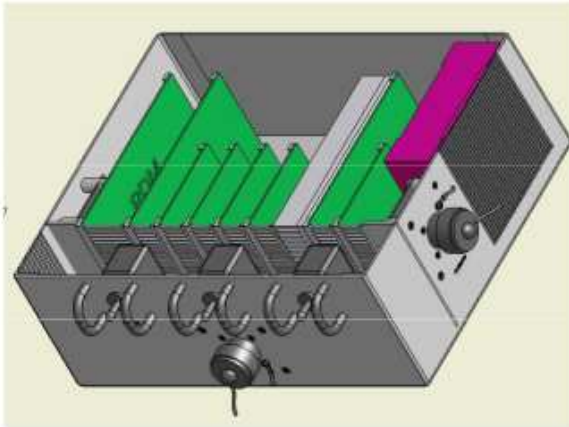
P.A.



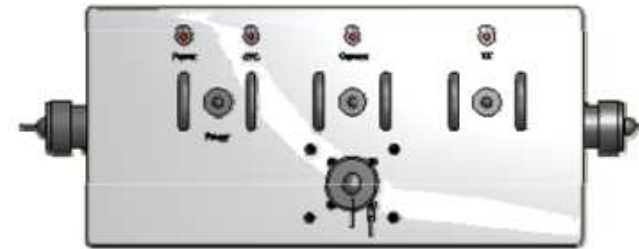
HAMVIDEO box



The HAMVIDEO payload will be accommodated inside a suitable container, developed and qualified by KI, based on the heritage of the BLOKON container.



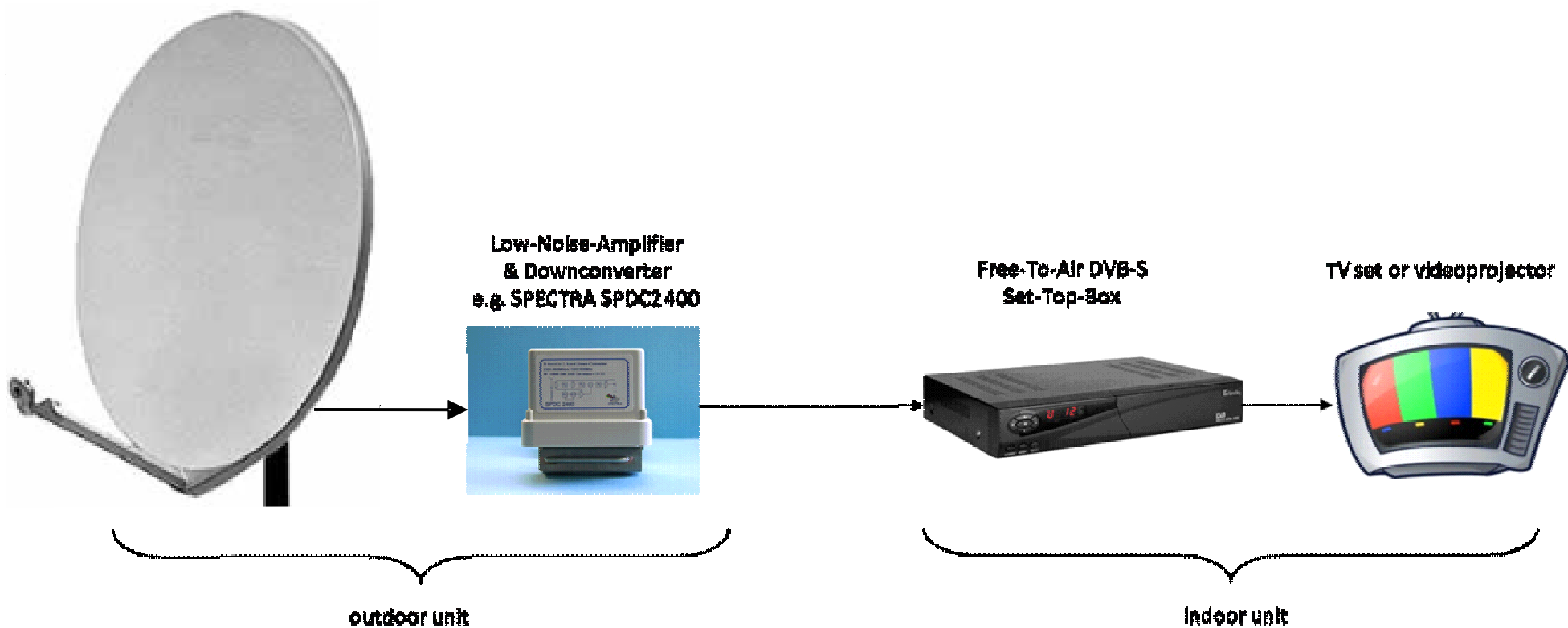
HAMVIDEO units accommodation



Front Panel



La struttura della stazione ricevente, a Terra



L'antenna della stazione di Terra



2.4 GHz Circular polarized patch feed for prime focus dishes

2G4PF1L

for every prime focus dish

2.4 GHz circular polarized helix feed for TVRO offset dishes

2G4HF1L

for every "sat-tv" offset dish

- LHCP for dish mounting
- Professional milled aluminium
- Specially designed for satellite use
- Fits to every offset TV dish
- PE low loss radome
- Male and Female N conn. available
- Very easy dish mounting

1 mounting
milled aluminium
igned for satellite use
prime focus dish
unting
male N conn. available

Order code is: 2G4PF1L/M
Der code is: 2G4PF1L/F



Polarization	LHCP
Center frequency	2400 MHz
Bandwidth	100 MHz
Gain	9.5 dB iso circ.
- 10dB Beamwidth	105°
Match to dish f/d	0.48 - 0.65
Impedance	50 ohm
Connector	N male or female
Clamp diameter	35 mm
Dimension	120 x 120 x 240 mm

Male N connector order code is: 2G4HF1L/M
Female N connector order code is: 2G4HF1L/F

 [download datasheet](#)



2.4 GHz Patch Feed



Il sistema di puntamento dell'antenna

PRO.SIS.TEL (Monopoli, BA),
capace di muovere in Az/EI un
disco da 80-cm, con
un'accuratezza di 0.2° e una
velocità di 6 seconds per una
scansione completa



Esempi di LNB commerciali



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S-Band Downconverter

Summary

Low Cost Drop-in solution
Plug and play ready for standard settop boxes.

Low phase noise
Due to a very stable and low noise internal synthesized source an ideal solution for phase noise susceptible applications.

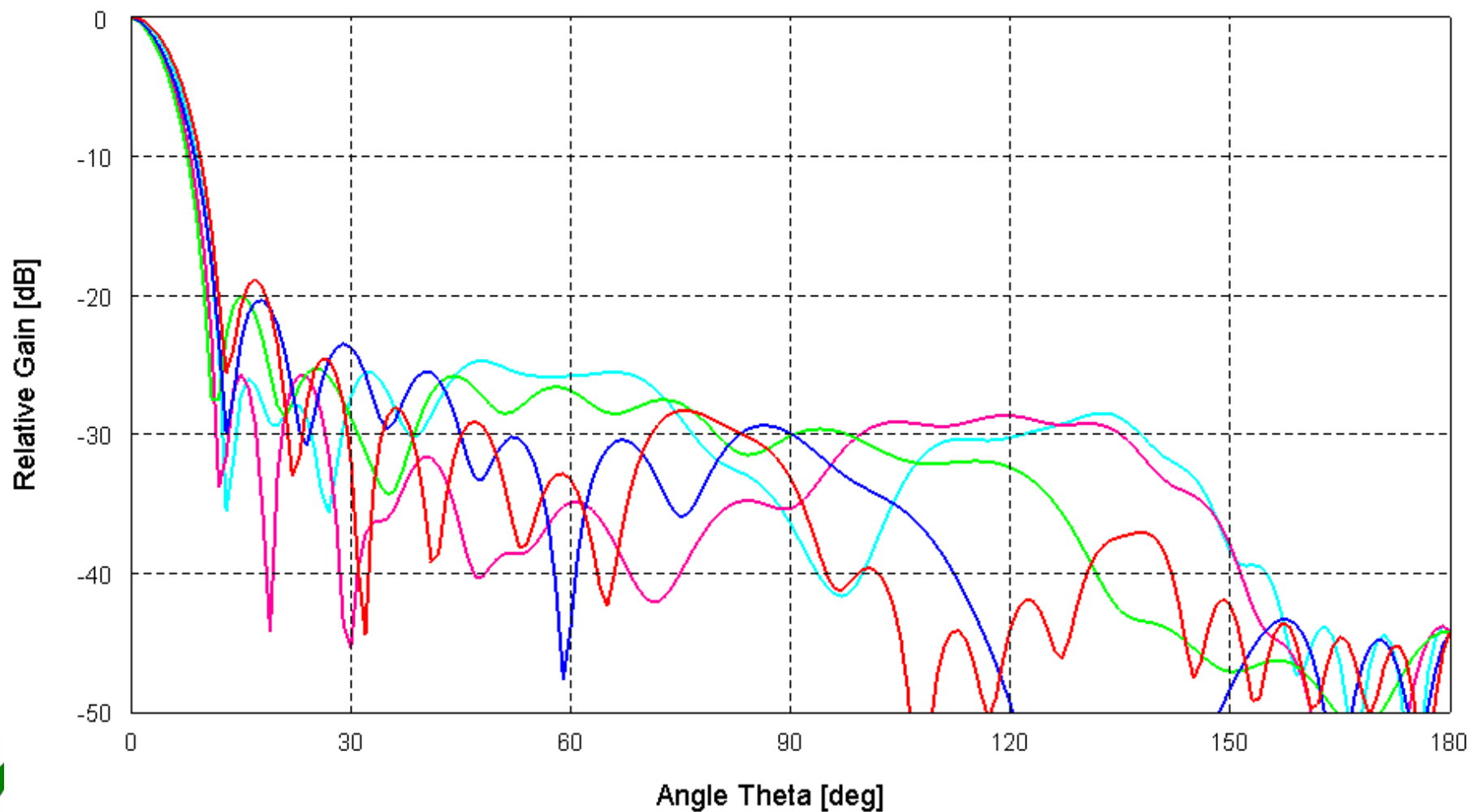
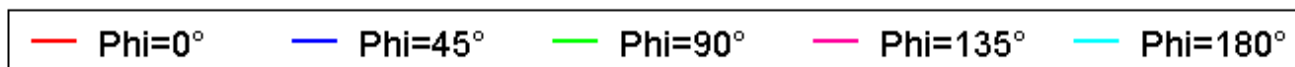
Unconditional stable design
No parasitic oscillations. Unconditional stable for a wide range of input terminations.

Excellent overall Noise Figure
With an overall noise figure of better than



Un modello al calcolatore dell'antenna

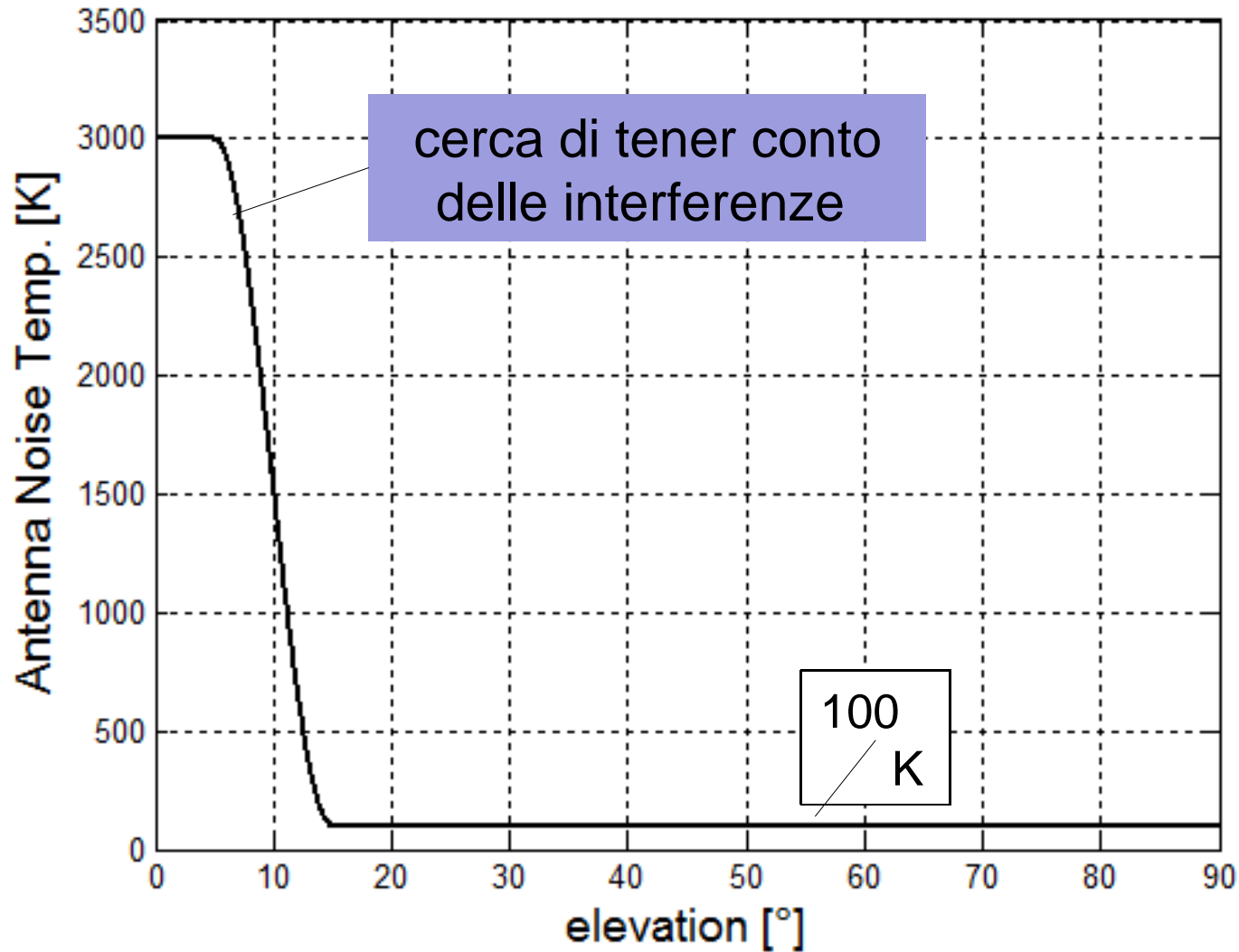
Gain



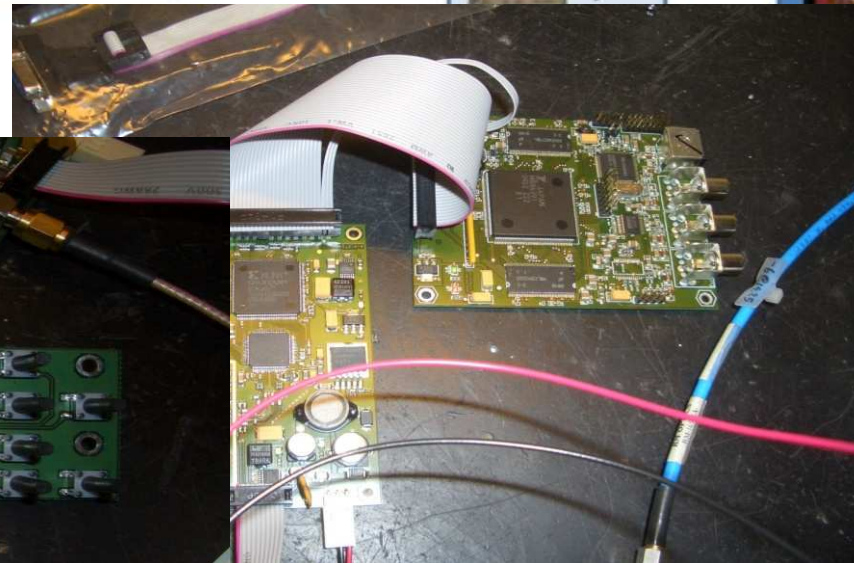
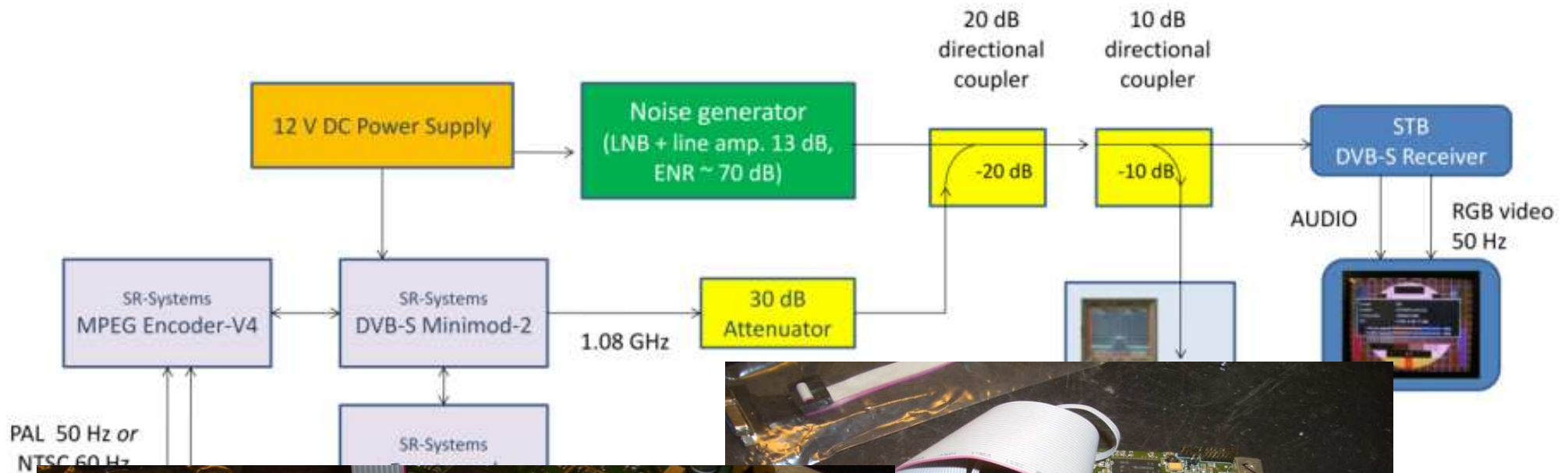
2010-04-02 : completa_90_FW_5tum



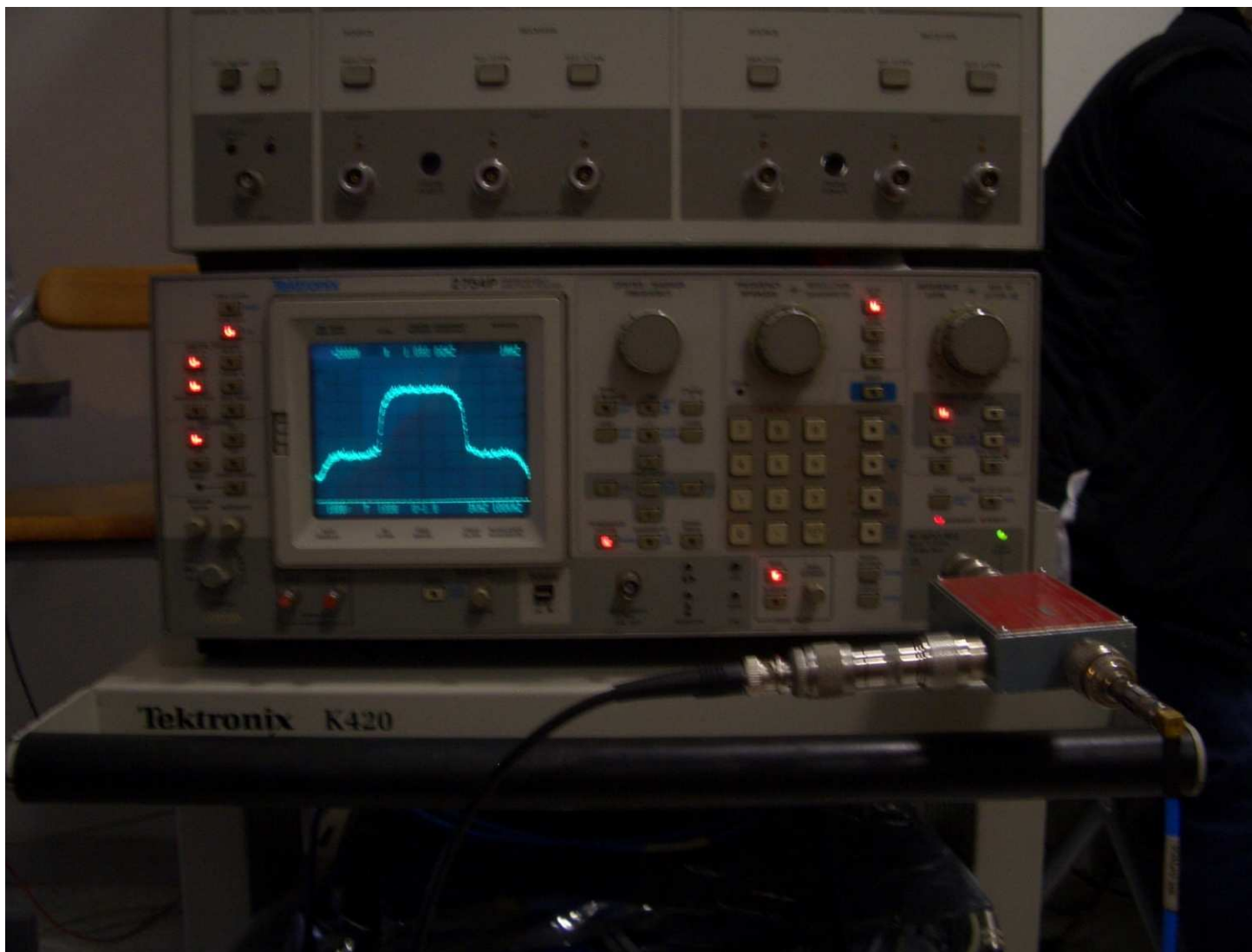
Temperatura (di rumore) dell'antenna di Terra



TEST-BED presso LTG Elettronica



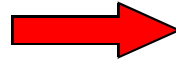
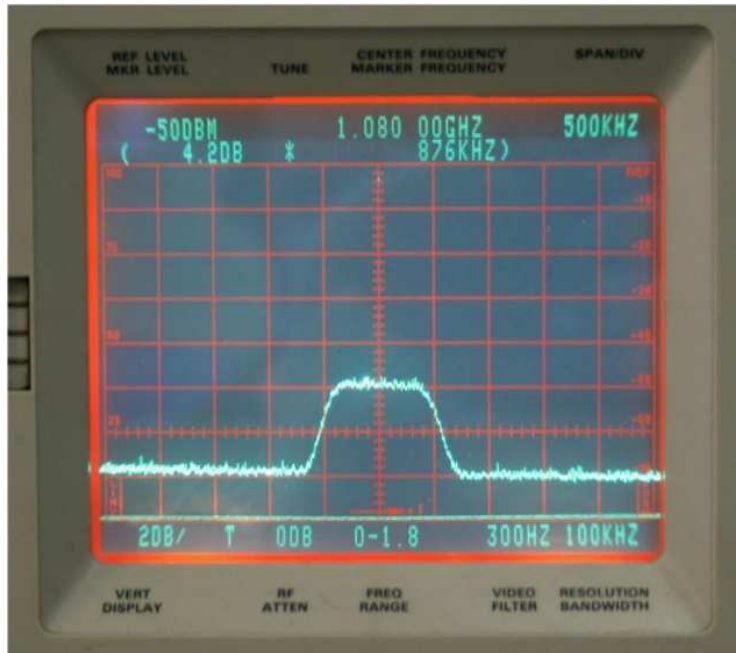
I primi risultati in IF-LOOP



I primi risultati in IF-LOOP



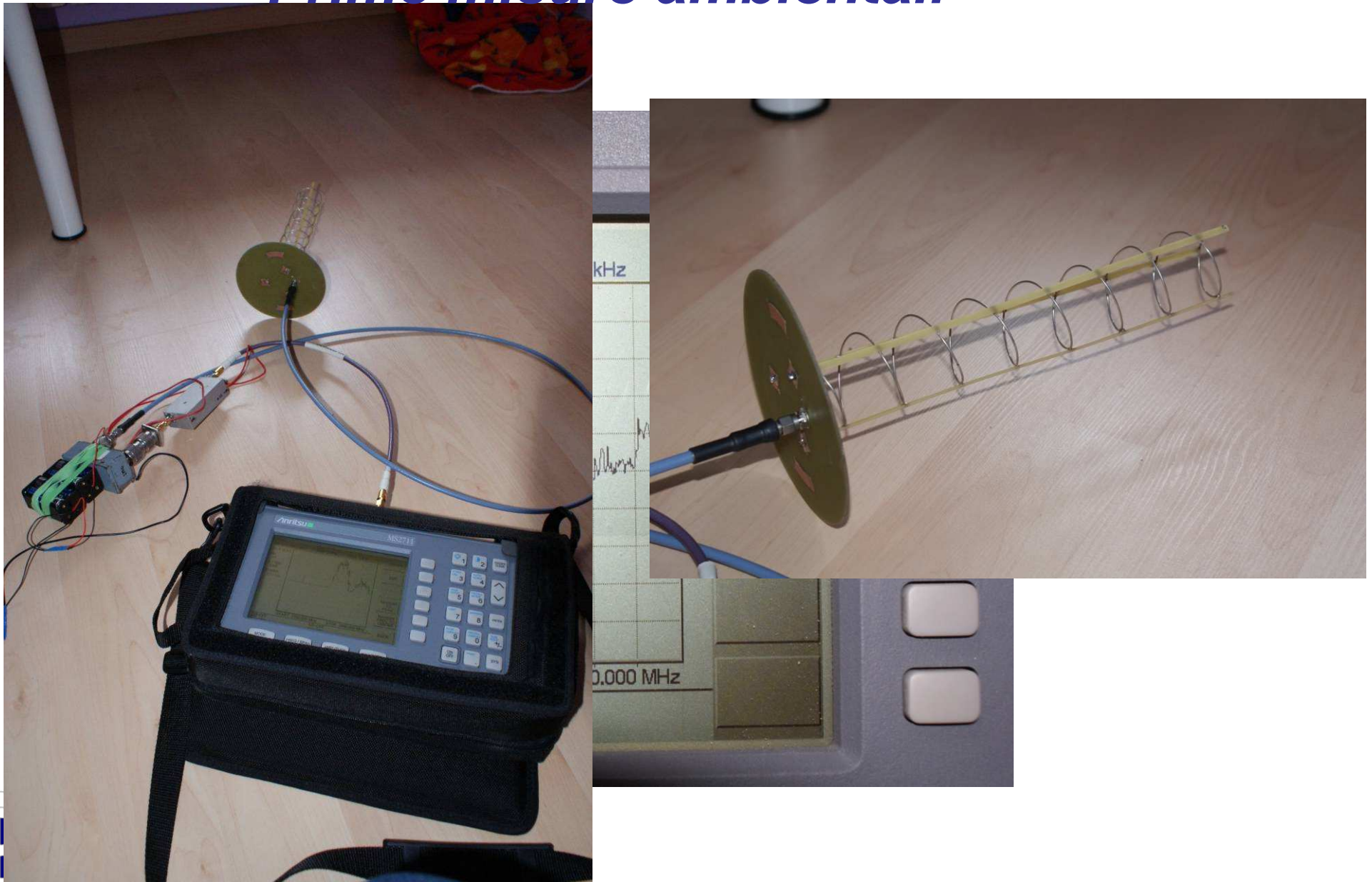
I primi risultati in IF-LOOP



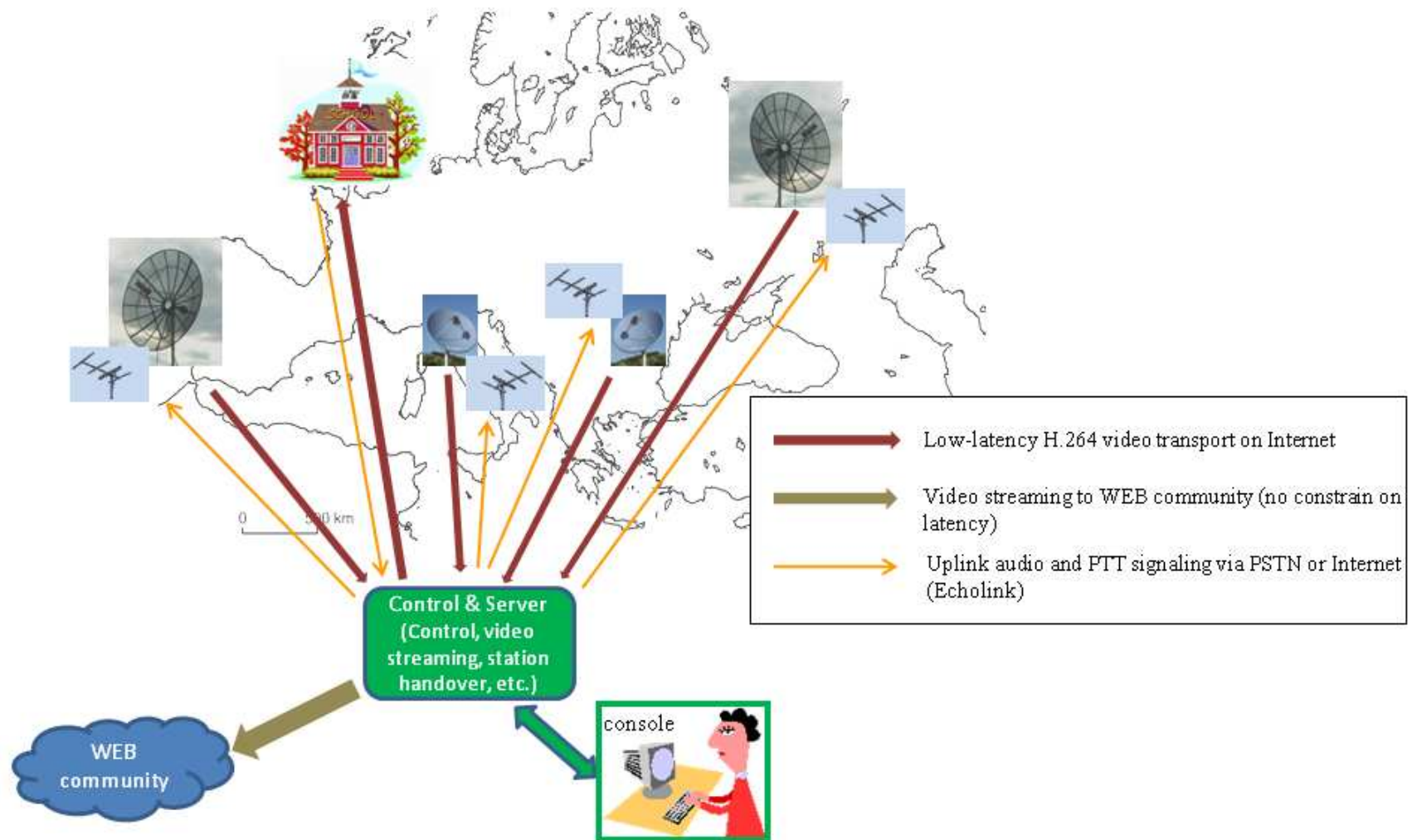
An example of noise level setting, corresponding to $(C_0+N_0)/N_0 = 4.2$ dB and its effect on video quality, as shown in the image on the right. FEC = 3/2. This situation was considered to be below the receiver threshold. The threshold was at about $(C_0+N_0)/N_0 = 4.5$ dB.



Prime misure ambientali



Una configurazione alternativa per il Ground Segment





Video contact duration for a 90 days period starting September 1st, 2010

Chained stations (and antenna diameters):

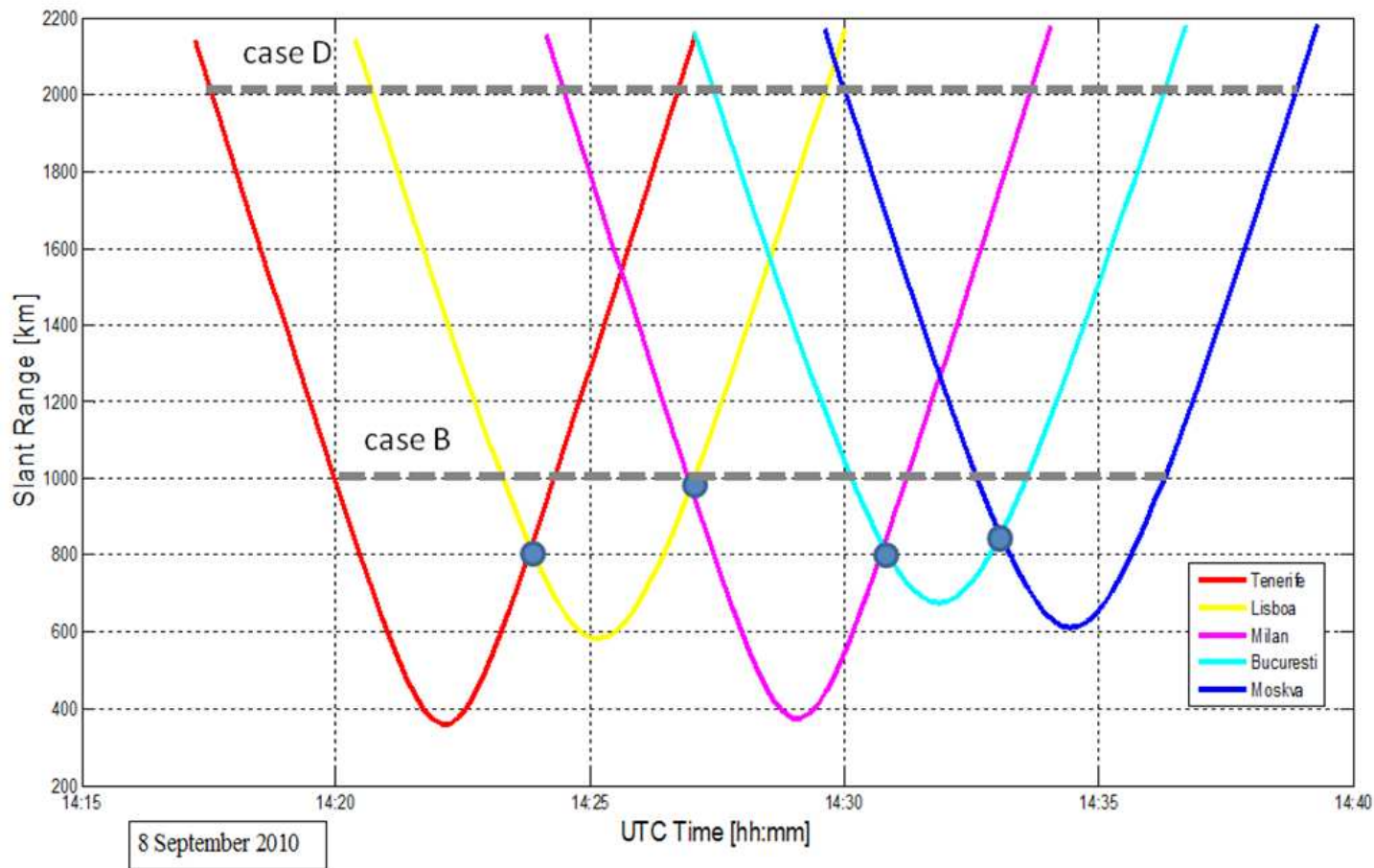
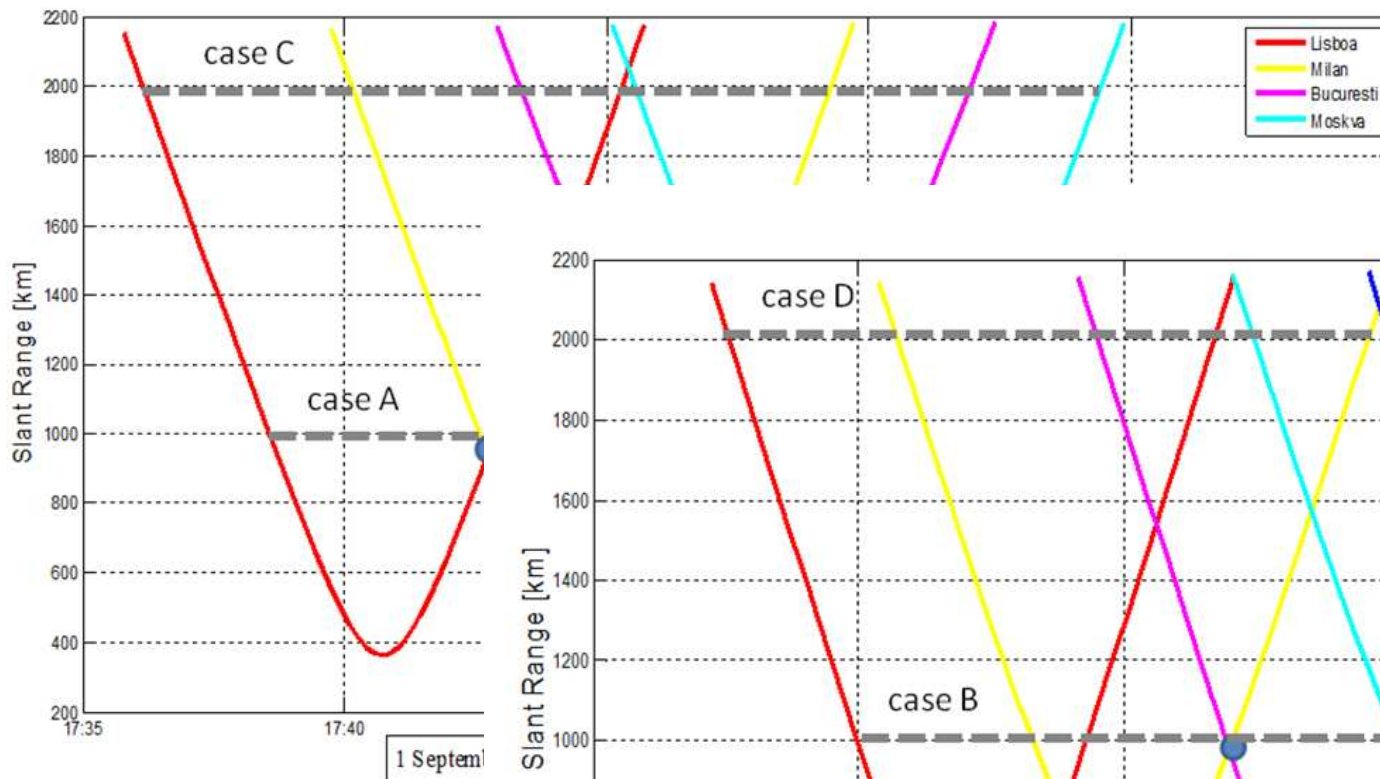
Blue: (case A) Lisboa (1 m), Milano (1 m), Bucaresti (1 m), Moskva (1 m)

Green: (case B) Tenerife (1m), Lisboa (1m), Milano (1m), Bucaresti (1m), Moskva (1m)

Red: (case C) Lisboa (2.5m), Milano (1m), Bucaresti (1m), Moskva (2.5m)

Cyan: (case D) Tenerife (2.5m), Lisboa (1m), Milano (1m), Bucaresti (1m), Moskva (2.5m)

Esempio di handover tra le stazioni di Terra



Problemi ancora aperti ...

- Valutazione della temperatura d'antenna, per un'antenna home-assembled
- Valutazione della dinamica dei STB normalmente usati (nella nostra applicazione saranno presenti segnali adiacenti con livelli molto più elevati di quello HAMTV, e questa non è la condizione in cui normalmente opera un STB satellitare)
- Messa a punto delle procedure (software) di allineamento veloce “sul campo” del posizionario d'antenna (tracking del Sole?), per le stazioni da installare presso le scuole.
- Scelta del punto di lavoro del P.A. di bordo; valutazione delle problematiche di interferenza con i servizi a bordo; progetto specifiche dei filtri del TX



Ringraziamenti

Gli autori desiderano ringraziare:

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Pierluigi Poggi IW4BLG

Gaston Bertels ON4WF

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ARISS/ARCOL.

