AMSAT-Italia

"SPAZIO E RADIOAMATORI"

Fabio Azzarello

IW8QKU

Propagazione

onde corte

onde ultracorte

microonde

- **lunga distanza**
  - variazioni giorno/notte
  - variazioni stagionali
- **breve distanza**
  - risente degli ostacoli
- **portata ottica**
  - risente degli ostacoli
  - varia su condizioni meteo

Propagazione

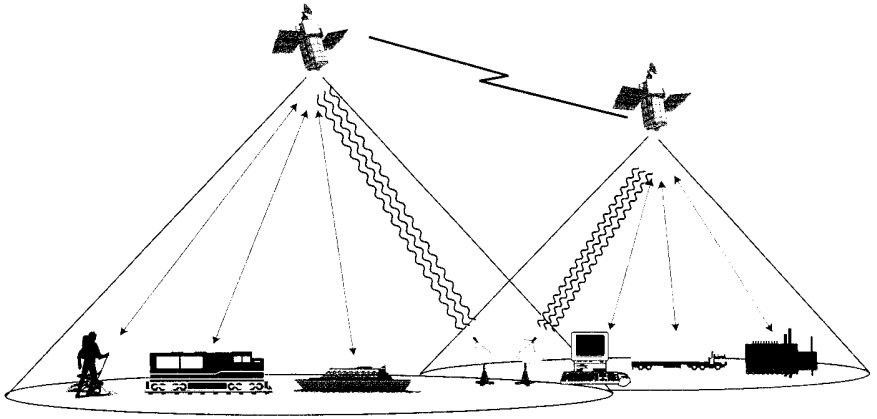
- evanescenza (fading)
- disturbi atmosferici
- perturbazioni dal Sole

...problemi per comunicazioni stabili

Soluzione

SATELLITI

- Ripetitori posti in posizione “unica” per la loro altezza
- Distanze e percorsi dei segnali ben noti
- Accessibilità simultanea da punti geograficamente distanti



SATELLITI

Tipo

- comunicazioni
- analisi della superficie
  - fotografia
  - radar-mapping
- analisi dell'atmosfera
  - meteorologia
  - monitoraggio ozono
- studio dello spazio
  - misure
  - osservazioni

Suddivisione in categorie

- commerciali
  - (comunicazione, dati, TV, radio)
- militari
  - (spia, comunicazione, gps)
- scientifici
  - (studio dello spazio e della terra)
- radioamatoriali

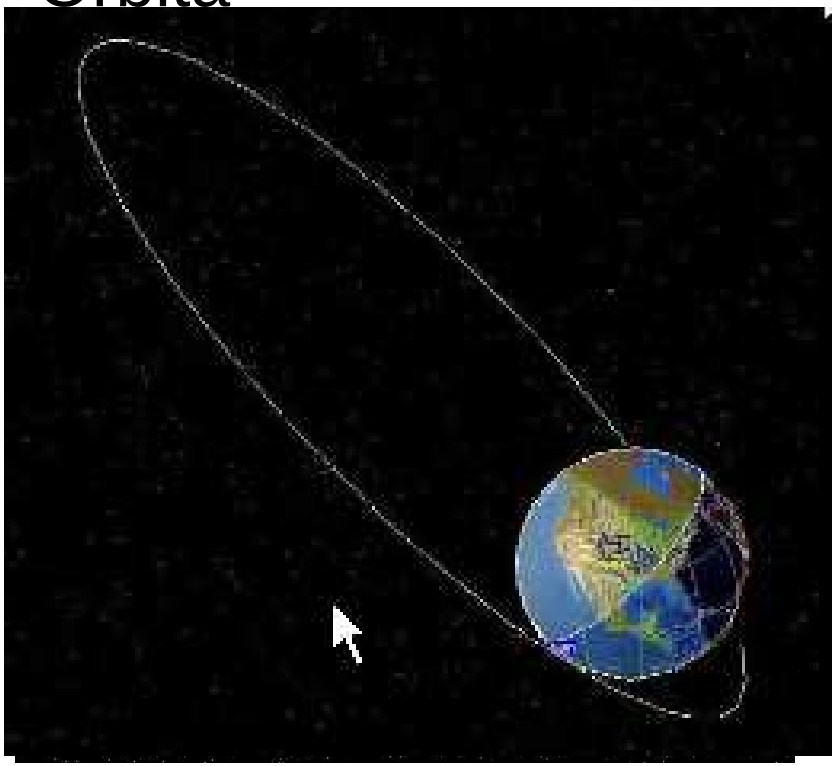
SATELLITI

Durata Operativa

- Legata al tipo di carico (payload)
- legata all'orbita
- legata ai sistemi di alimentazione di bordo

SATELLITI

Orbita



- Circolare
  - bassa (LEO)
  - media (MEO)
  - alta (HEO)
  - → Solare Sincrona (FO29)
  - → "Dawn to Dusk" (AO7)
  - → "Inclinata" (SO50, ISS)
- Ellittica "Molniya" (AO40)
- Geostazionaria (GEO)

Satelliti Radioamatoriali

- La storia inizia il 12 dicembre 1961 con il lancio di OSCAR I (Orbiting Satellite Carrying Amateur Radio)
- *lo stesso giorno, sessanta anni prima, Guglielmo Marconi, autodefinitosi "radio-amatore" effettuava la prima trasmissione radio transatlantica*
- *ad oggi, sono 59 gli OSCAR lanciati, diversi RS...*
- nel settembre 1993 è stato lanciato anche un OSCAR italiano:

ITAMSAT (ITalian AMateur SATellite) – IO26

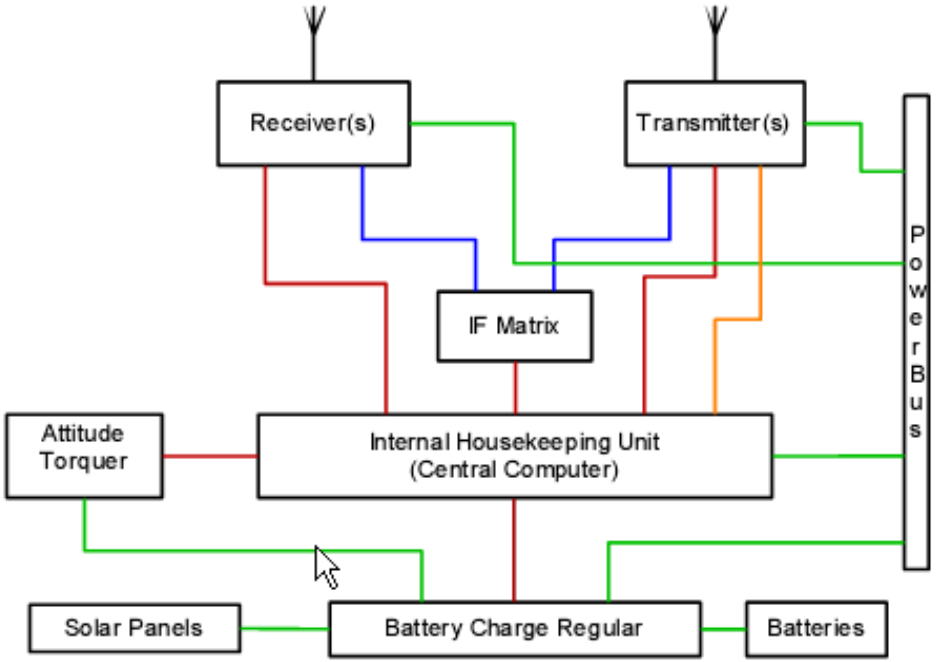
Satelliti Radioamatoriali

- Progettati e realizzati da radioamatori
- messi in orbita mediante vettori di organismi nazionali
- gestiti da gruppi di radioamatori (stazioni di comando)
- utilizzati dai radioamatori di tutto il mondo senza limitazioni

Satelliti Radioamatoriali

- impiego per comunicazioni a distanza
  - analogiche
  - digitali
- controllo e comando a distanza
  - telemetria
  - telecomando

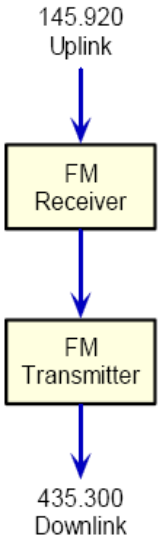
Satelliti Radioamatoriali



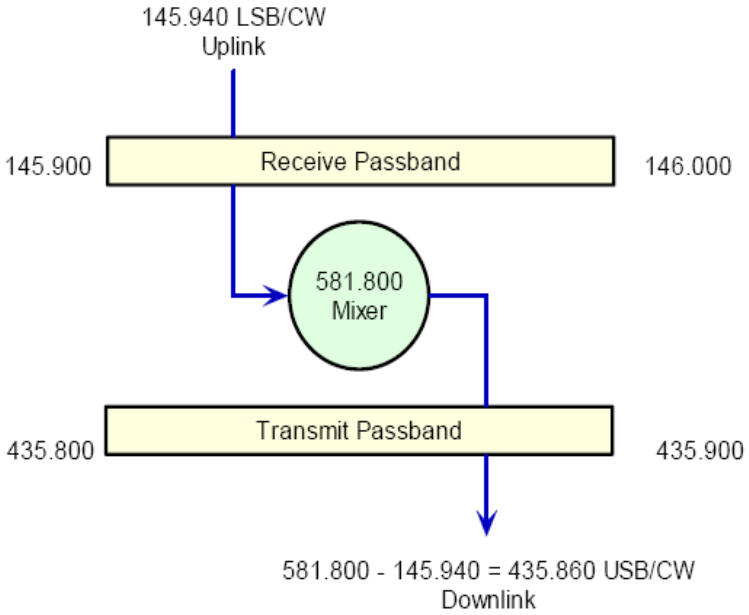
- Ricevitori e trasmettitori operanti simultaneamente su bande diverse
- trasposizione in frequenza dei segnali
- ampia larghezza di banda
  - da 30 a 800KHz (superiore ad un singolo canale standard)
  - possibilità di far transitare più segnali simultaneamente (collegamenti multipli e simultanei)
- Transponder lineare
- possibilità di controllo e autoregolazione

Satelliti Radioamatoriali

Single ch Repeater



Transponder



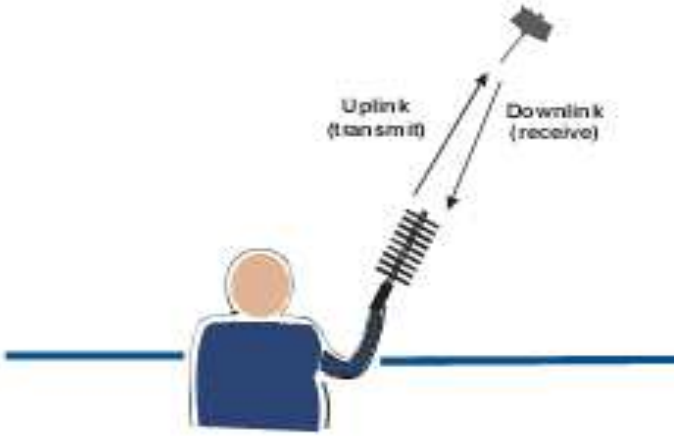
Satelliti Radioamatoriali

Modi Operativi

- Combinazione di bande per i sistemi di bordo

V=2m
U=70cm
L=23cm
S=13cm

C=7.5cm
X=3cm
K=1.5cm



Traditional LEO Modes:
Mode A = 10m/2m
Mode B = 2m/70cm
Mode J = 70cm/2m

Satelliti Radioamatoriali

Fuji-OSCAR 29 (JAS-2)

- Built by Japan Amateur Radio League
- Launched July 1996 into a polar orbit
- Mode JA Linear Transponder
  - 145.900-146.000 LSB/CW Uplink
  - 435.800-435.900 USB/CW Downlink
  - Inverting
- Digital Store and Forward BBS (non-operational)
- Digitalker

Satelliti Radioamatoriali

AMSAT OSCAR - 7

- Launched Nov 1974 into sun-synchronous orbit
- Mode A Linear Transponder
  - 29.450 USB/CW Downlink
  - 145.900 USB/CW Uplink
- Mode B Linear Transponder
  - 145.950 USB/CW Downlink
  - 432.150 LSB/CW Uplink
- Battery failure in 1981, resurrected 2002
- Operational only in sunlight (no batteries)

Satelliti Radioamatoriali

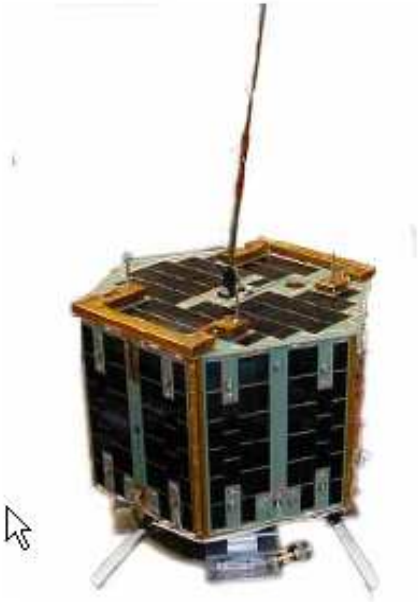
Packet Satellites

APRS Digipeaters

- PacSAT (AO-16)
- ISS (Zarya)

Bulletin Boards

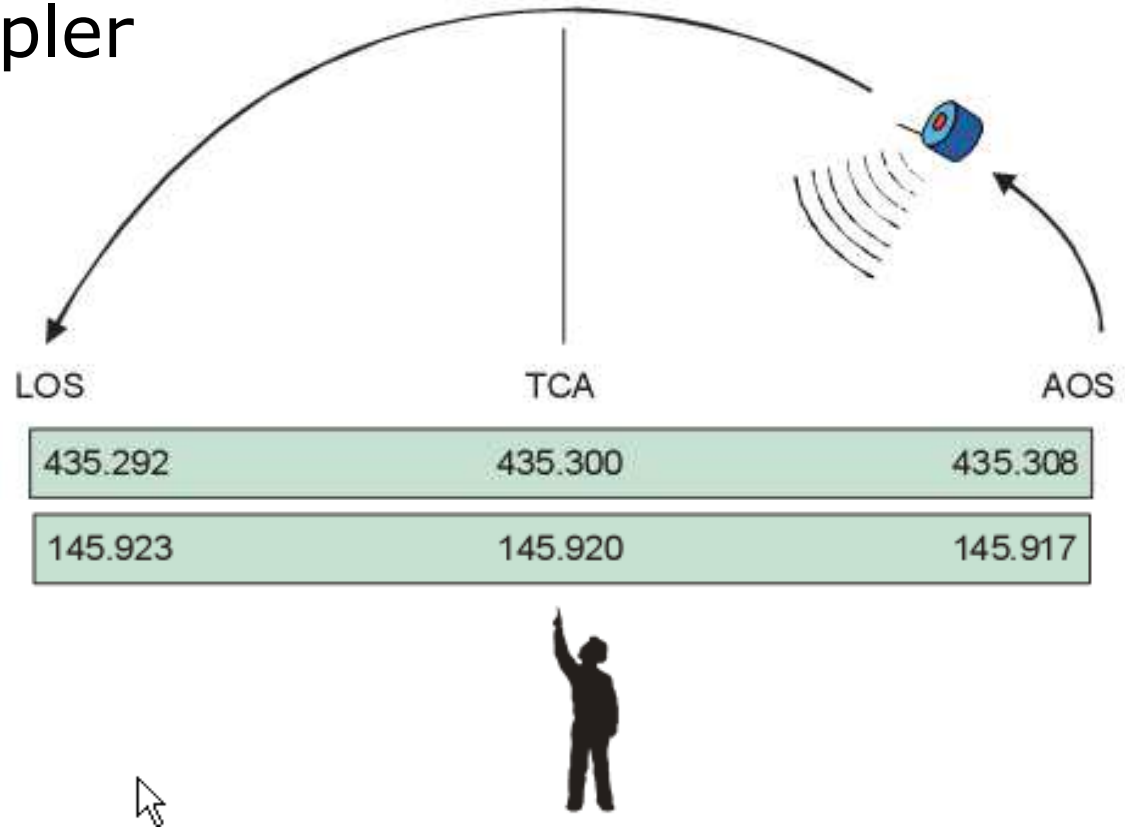
- UOSat-5 (UO-22)
- ISS (Zarya)
- GerwinSat (GO-32)
- TuingSat (MO-46)
- Echo (AO-51)



Sapphire (NO-45)

Satelliti Radioamatoriali

Doppler



Satelliti Radioamatoriali

...usare i SATELLITI è difficile?
...usare i SATELLITI è costoso?

NO!

Stazione minima

RTX: Handheld oppure all mode 2m/70cm;

Antenna: Arrow antenna;

...e un pò di pazienza!

Satelliti Radioamatoriali

Stazione Tipo

- RTX e/o convertitori
- Antenne Yagi, Elica
- Preamplifacatori
- Rotori di Zenith ed Azimuth
- Sistema “Tracking”
- TNC o soundcard (TLM, PKT)

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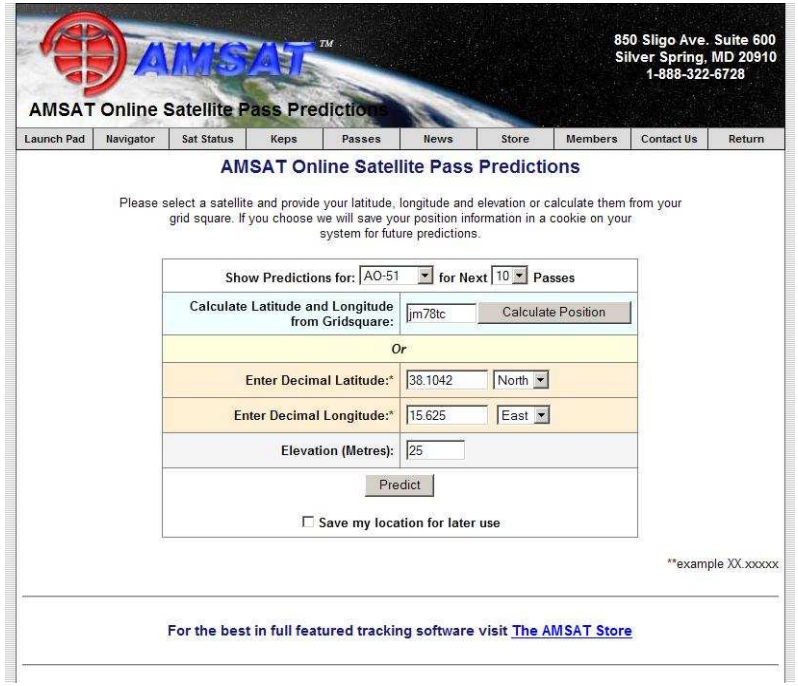
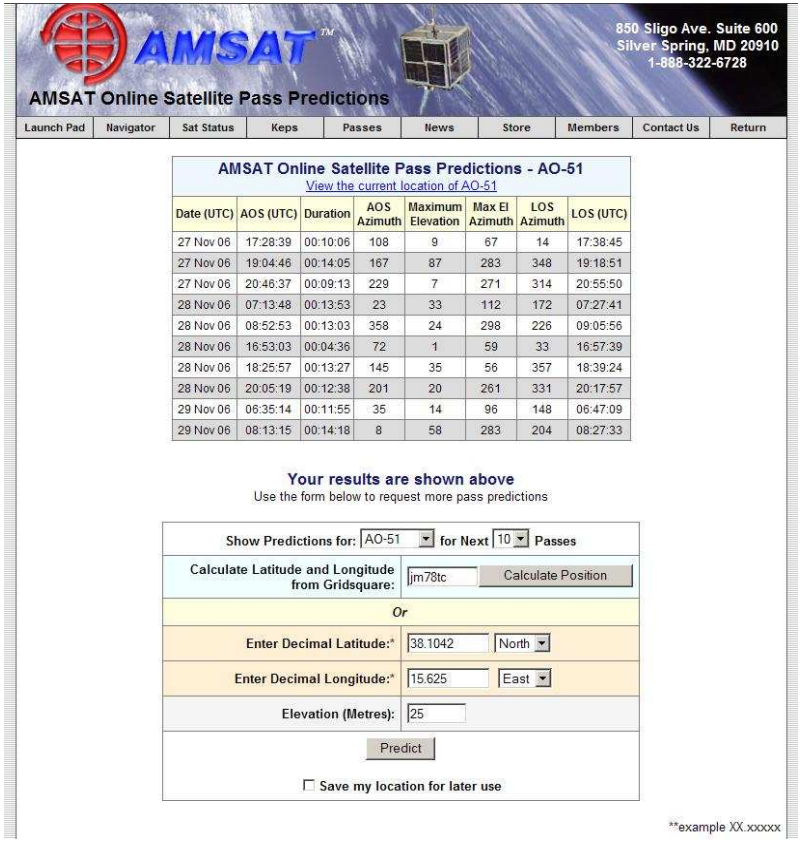
Sezione: Passes





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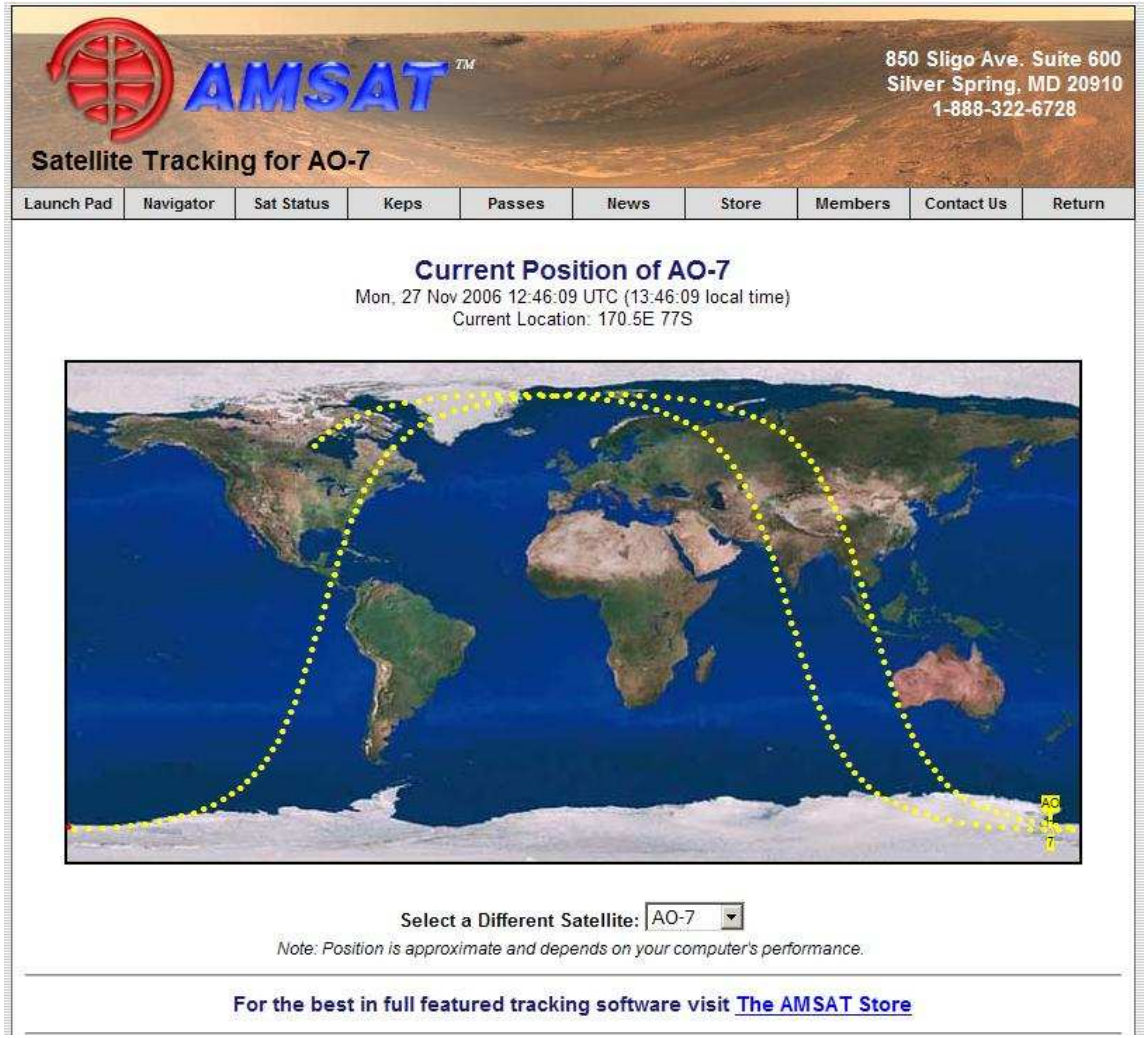

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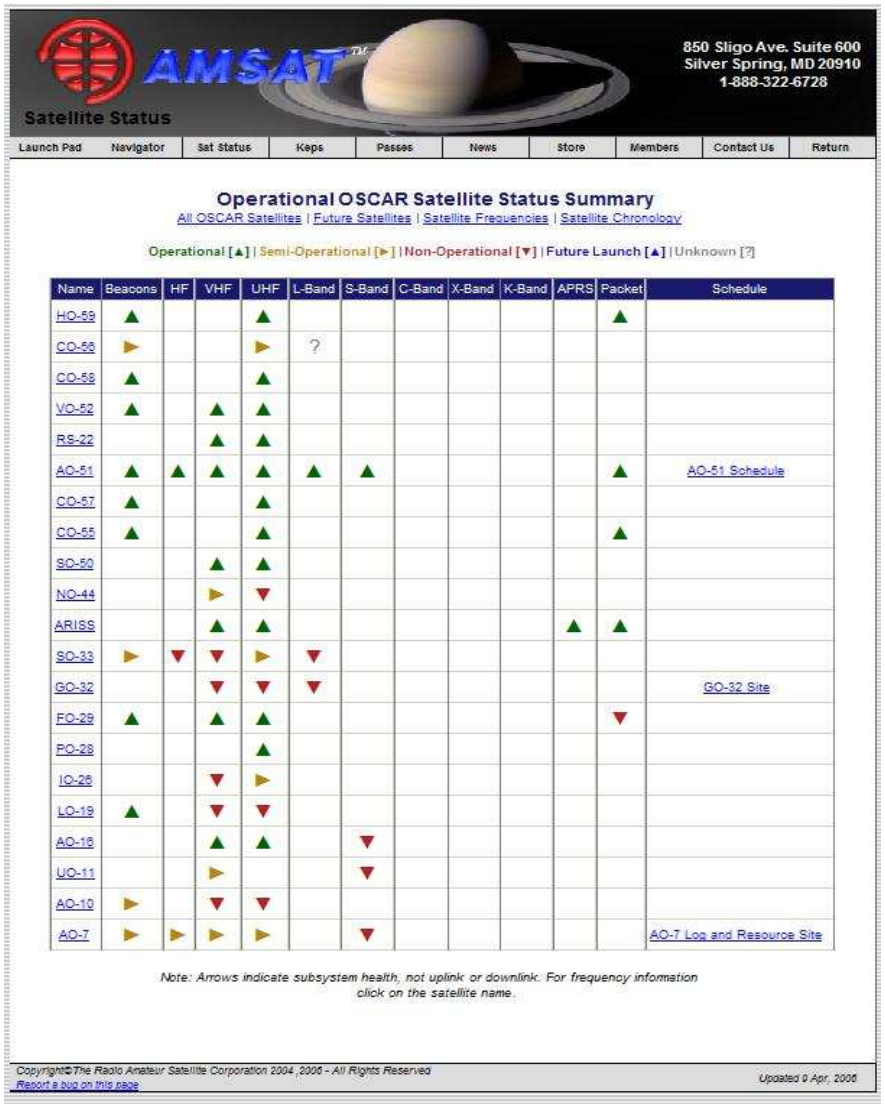
Sezione:

Sat Status

E’ possibile informazioni sullo stato operativo dei satelliti



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Satellite Status

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Operational OSCAR Satellite Status Summary

All OSCAR Satellites | Future Satellites | Satellite Frequencies | Satellite Chronology

Operational [▲] | Semi-Operational [►] | Non-Operational [▼] | Future Launch [▲] | Unknown [?]

Name	Beacons	HF	VHF	UHF	L-Band	S-Band	C-Band	X-Band	K-Band	APRS	Packet	Schedule
HO-59	▲			▲							▲	
CO-56	►			►	?							
CO-58	▲			▲								
VO-52	▲		▲	▲								
RS-22			▲	▲								
AO-51	▲	▲	▲	▲	▲	▲					▲	AO-51 Schedule
CO-57	▲			▲								
CO-55	▲			▲							▲	
SO-50			▲	▲								
NO-44			►	▼								
ARISS			▲	▲						▲	▲	
SO-33	►	▼	▼	►	▼							
GO-32			▼	▼	▼							GO-32 Site
FO-29	▲		▲	▲							▼	
PO-28				▲								
IO-26			▼	►								
LO-19	▲		▼	▼								
AO-16			▲	▲		▼						
UO-11			►			▼						
AO-10	►		▼	▼								
AO-7	►	►	►	►		▼						AO-7 Log and Resource Site

Note: Arrows indicate subsystem health, not uplink or downlink. For frequency information click on the satellite name.

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Updated 9 Apr, 2006

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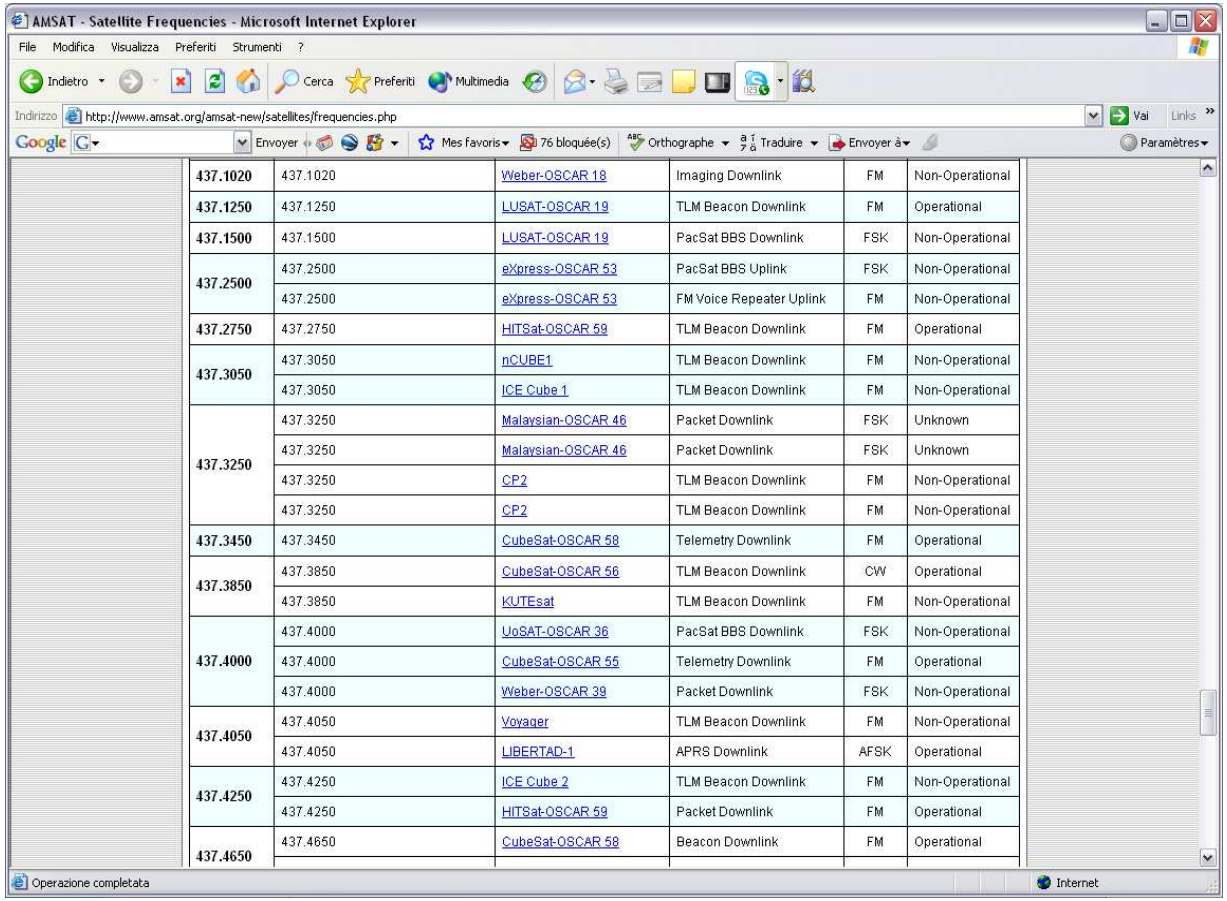
Selezionando

Satellite Frequencies



437.1020	437.1020	Weber-OSCAR 18	Imaging Downlink	FM	Non-Operational
437.1250	437.1250	LUSAT-OSCAR 19	TLM Beacon Downlink	FM	Operational
437.1500	437.1500	LUSAT-OSCAR 19	PacSat BBS Downlink	FSK	Non-Operational
437.2500	437.2500	eXpress-OSCAR 53	PacSat BBS Uplink	FSK	Non-Operational
	437.2500	eXpress-OSCAR 53	FM Voice Repeater Uplink	FM	Non-Operational
437.2750	437.2750	HITSat-OSCAR 59	TLM Beacon Downlink	FM	Operational
437.3050	437.3050	nCUBE1	TLM Beacon Downlink	FM	Non-Operational
	437.3050	ICE Cube 1	TLM Beacon Downlink	FM	Non-Operational
437.3250	437.3250	Malaysian-OSCAR 46	Packet Downlink	FSK	Unknown
	437.3250	Malaysian-OSCAR 46	Packet Downlink	FSK	Unknown
	437.3250	CP2	TLM Beacon Downlink	FM	Non-Operational
	437.3250	CP2	TLM Beacon Downlink	FM	Non-Operational
437.3450	437.3450	CubeSat-OSCAR 58	Telemetry Downlink	FM	Operational
437.3850	437.3850	CubeSat-OSCAR 56	TLM Beacon Downlink	CW	Operational
	437.3850	KUTEsat	TLM Beacon Downlink	FM	Non-Operational
437.4000	437.4000	UoSAT-OSCAR 36	PacSat BBS Downlink	FSK	Non-Operational
	437.4000	CubeSat-OSCAR 55	Telemetry Downlink	FM	Operational
	437.4000	Weber-OSCAR 39	Packet Downlink	FSK	Non-Operational
437.4050	437.4050	Voyager	TLM Beacon Downlink	FM	Non-Operational
	437.4050	LIBERTAD-1	APRS Downlink	AFSK	Operational
437.4250	437.4250	ICE Cube 2	TLM Beacon Downlink	FM	Non-Operational
	437.4250	HITSat-OSCAR 59	Packet Downlink	FM	Operational
437.4650	437.4650	CubeSat-OSCAR 58	Beacon Downlink	FM	Operational

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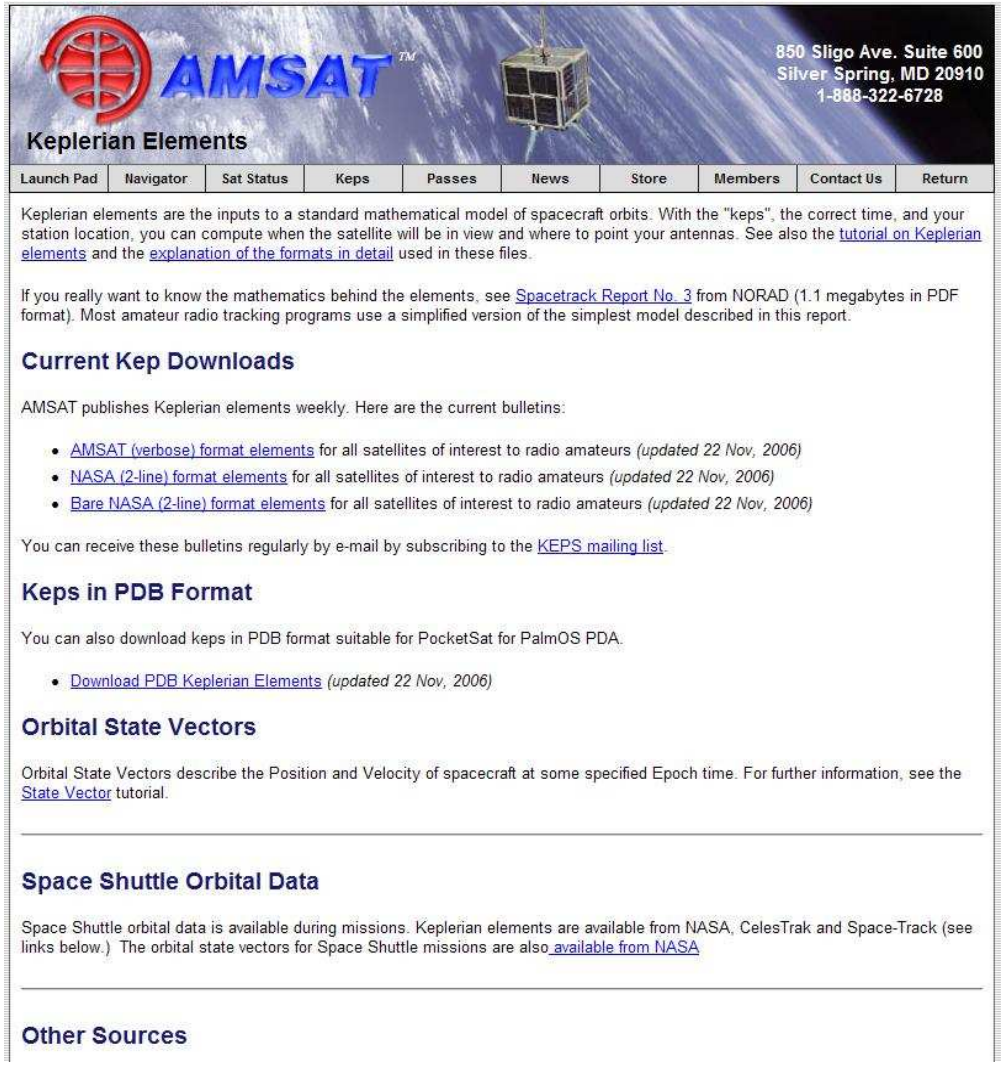
Sezione:

KEPS

E’ possibile scaricare i dati orbitali in formato TLE



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Keplerian Elements

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Keplerian elements are the inputs to a standard mathematical model of spacecraft orbits. With the "keps", the correct time, and your station location, you can compute when the satellite will be in view and where to point your antennas. See also the tutorial on Keplerian elements and the explanation of the formats in detail used in these files.

If you really want to know the mathematics behind the elements, see Spacetrack Report No. 3 from NORAD (1.1 megabytes in PDF format). Most amateur radio tracking programs use a simplified version of the simplest model described in this report.

Current Kep Downloads

AMSAT publishes Keplerian elements weekly. Here are the current bulletins:

- AMSAT (verbose) format elements for all satellites of interest to radio amateurs *(updated 22 Nov, 2006)*
- NASA (2-line) format elements for all satellites of interest to radio amateurs *(updated 22 Nov, 2006)*
- Bare NASA (2-line) format elements for all satellites of interest to radio amateurs *(updated 22 Nov, 2006)*

You can receive these bulletins regularly by e-mail by subscribing to the KEPS mailing list.

Keps in PDB Format

You can also download keps in PDB format suitable for PocketSat for PalmOS PDA.

- Download PDB Keplerian Elements *(updated 22 Nov, 2006)*

Orbital State Vectors

Orbital State Vectors describe the Position and Velocity of spacecraft at some specified Epoch time. For further information, see the State Vector tutorial.

Space Shuttle Orbital Data

Space Shuttle orbital data is available during missions. Keplerian elements are available from NASA, CelesTrak and Space-Track (see links below.) The orbital state vectors for Space Shuttle missions are also available from NASA

Other Sources

File TLE

nasa.all - WordPad

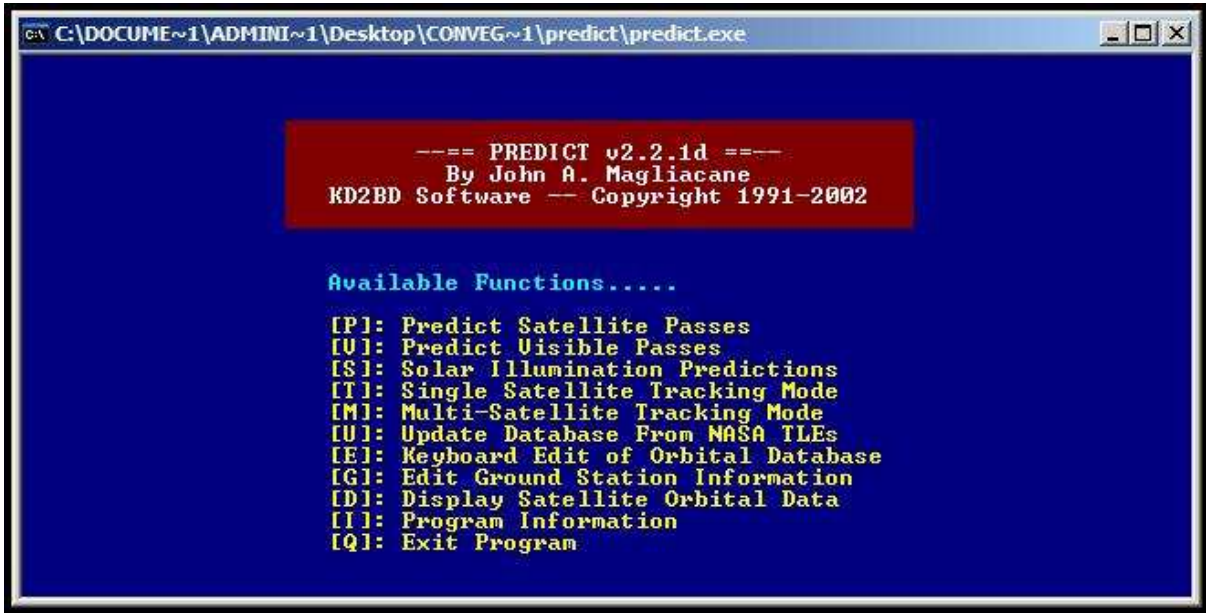
File Edit View Insert Format Help

```
SB KEPS @ AMSAT  $ORB06326.N
2Line Orbital Elements 06326.AMSAT

HR AMSAT ORBITAL ELEMENTS FOR AMATEUR SATELLITES IN NASA FORMAT
FROM WA5QGD FORT WORTH,TX November 22, 2006
Send SUBSCRIBE KEPS/UNSUBSCRIBE KEPS to majordomo@amsat.org only
BID: ORB06326.N

DECODE 2-LINE ELSETS WITH THE FOLLOWING KEY:
1 AAAAAU 00  0  0 BBBBB.BBBBBBBB  .CCCCCCCC  00000-0  00000-0 0  DDDZ
2 AAAAA EEE.EEEE FFF.FFFF GGGGGGG HHH.HHHH III.IIII JJ.JJJJJJJKKKKKZ
KEY: A-CATALOGNUM B-EPOCHTIME C-DECAY D-ELSETNUM E-INCLINATION F-RAAN
G-ECCENTRICITY H-ARGPERIGEE I-MNANOM J-MNMOTION K-ORBITNUM Z-CHECKSUM

TO ALL RADIO AMATEURS BT

AO-07
1 07530U 74089B   06324.68701763 -.00000028  00000-0  10000-3 0 07359
2 07530 101.5480 003.5885 0011900 301.9750 058.0163 12.53571715464993
UO-11
1 14781U 84021B   06325.90464329  .00000320  00000-0  50225-4 0  2311
2 14781 098.2028 339.4572 0010005 115.7755 244.4474 14.79487944219088
RS-10/11
1 18129U 87054A   06325.76434625  .00000022  00000-0  79186-5 0  1507
2 18129 082.9276 211.5903 0012700 021.7850 338.3841 13.72780774972779
RS-15
1 23439U 94085A   06324.55699050 -.00000039  00000-0  10597-3 0 00068
2 23439 064.8210 344.3283 0165487 227.2321 131.4581 11.27551817490173
FO-29
1 24278U 96046B   06325.91236815  .00000058  00000-0  97493-4 0  3701
2 24278 098.5223 308.7008 0349779 260.6650 095.4792 13.52925729506871
SO-33
1 25509U 98061B   06324.67880400  .00000152  00000-0  19955-4 0 07981
2 25509 031.4334 324.5929 0355224 044.4942 318.3646 14.28137359421420
VO-52
1 28650U 05017B   06326.33642855  .00000012  00000-0  83204-5 0  4852
2 28650 097.8573 036.4344 0026860 204.9750 155.0120 14.81211680 83798
AO-16
1 20439U 90005D   06325.60238738  .00000033  00000-0  27459-4 0  8991
```

For Help, press F1 NUM

Software di predizione

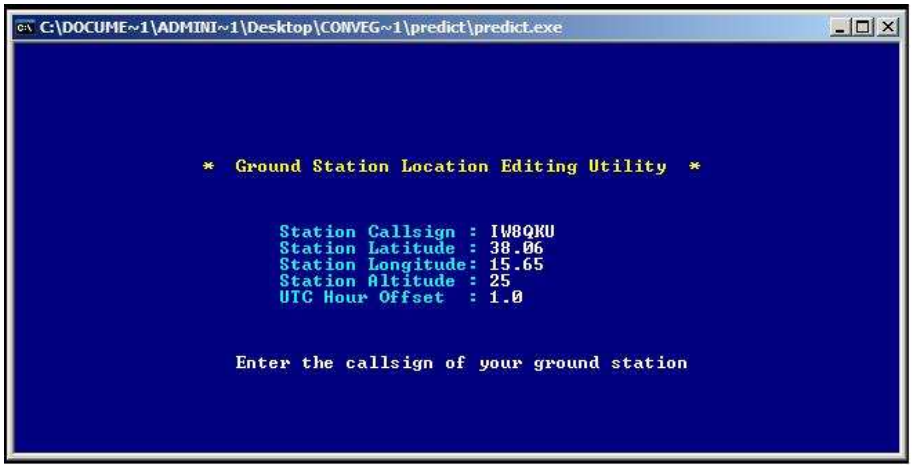
PREDICT di John Magliacane KD2BD



Software PREDICT

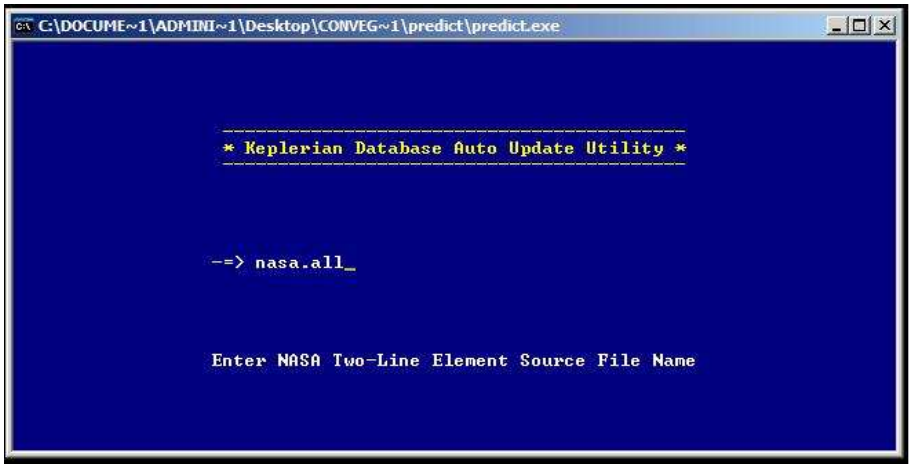
[G]

Ground Station Info



[U]

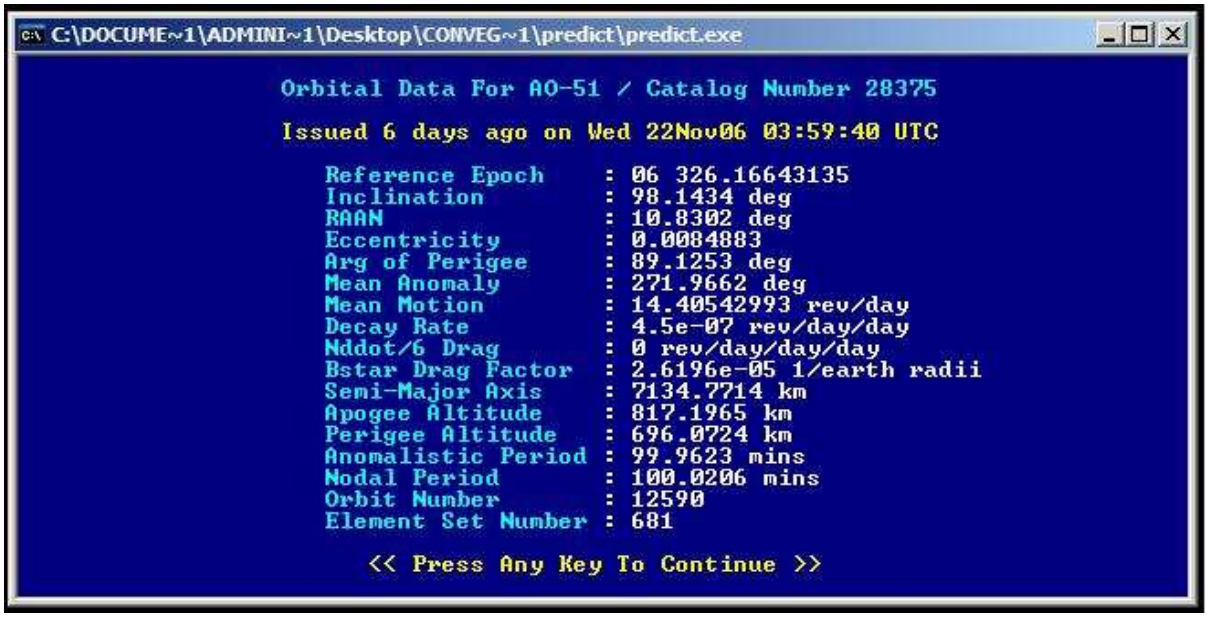
Satellite DB Update da file TLE



Software PREDICT

[D]

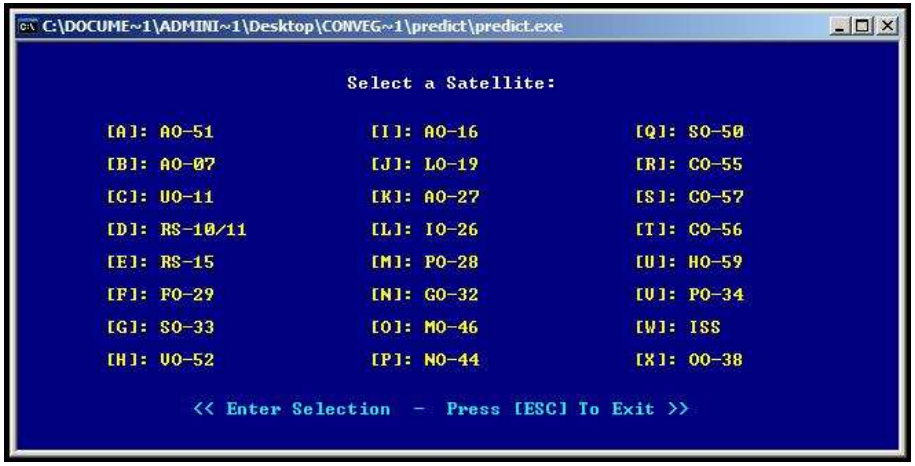
Display
Satellite
Orbital Data

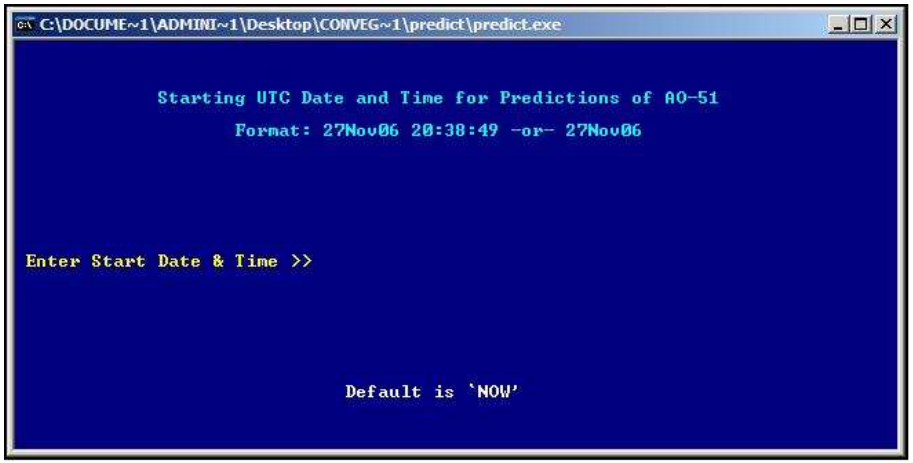


Software PREDICT

[P]

Predict
Satellite
Passes

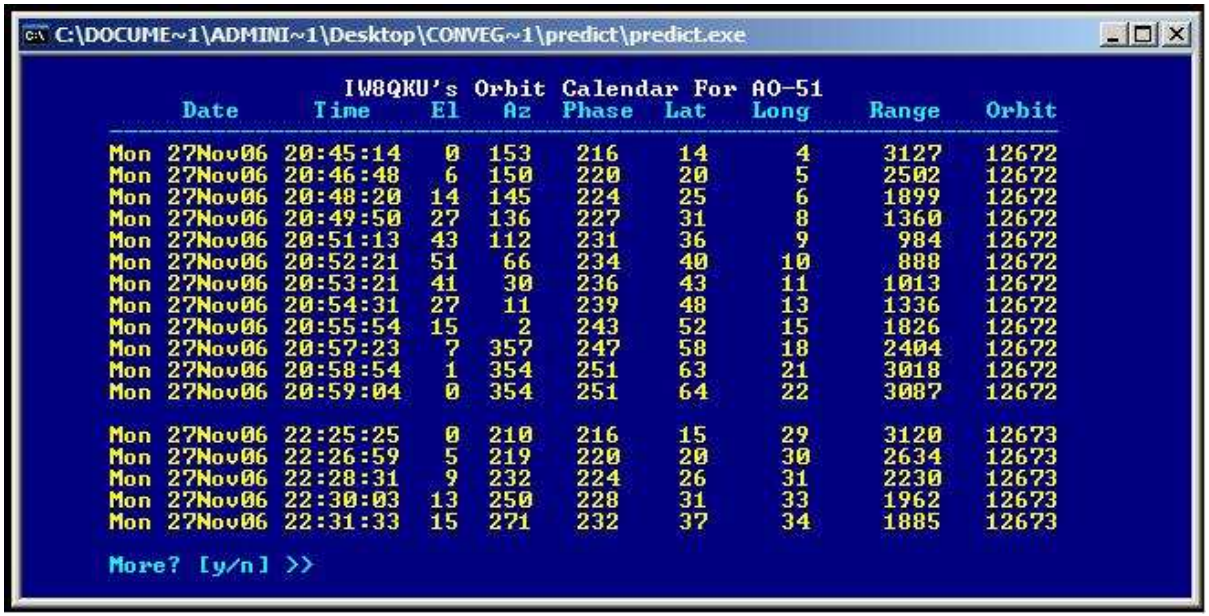




Software PREDICT

[P]

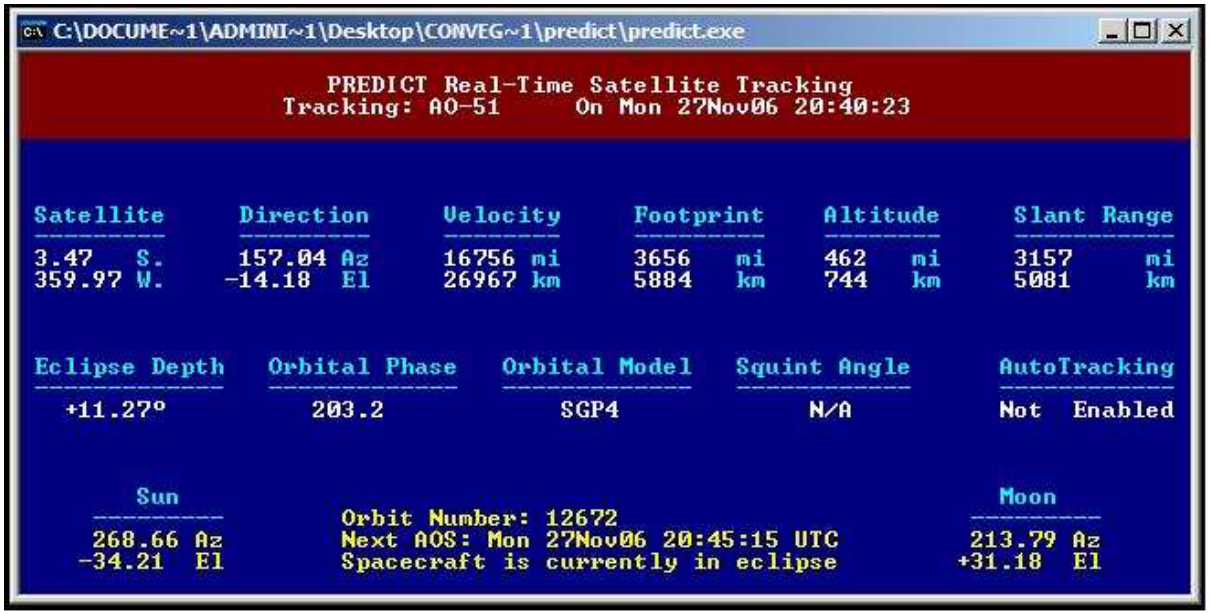
Predict
Satellite
Passes



Software PREDICT

[T]

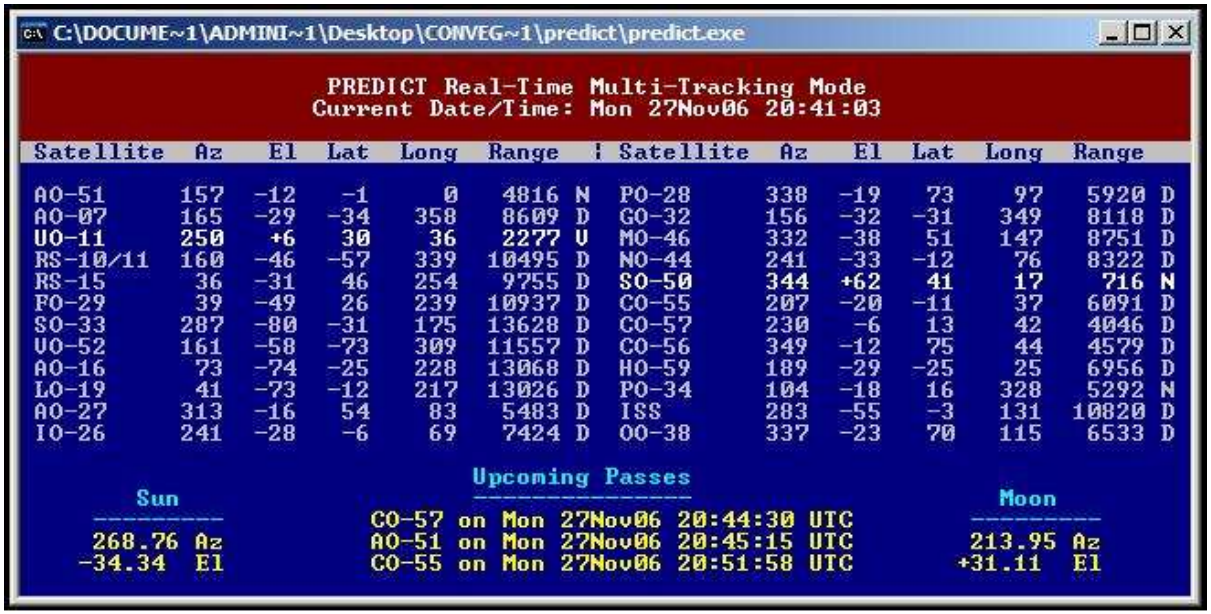
Single Satellite Tracking Mode



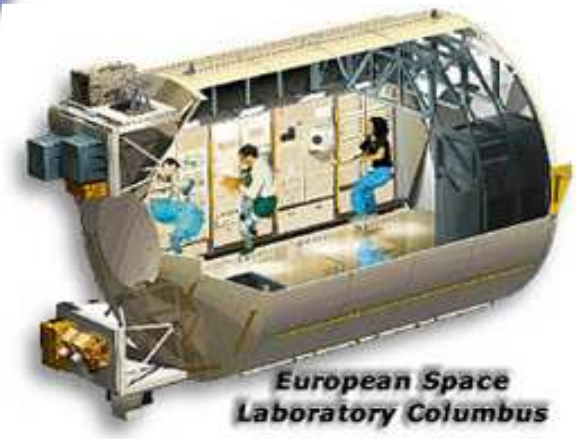
Software PREDICT

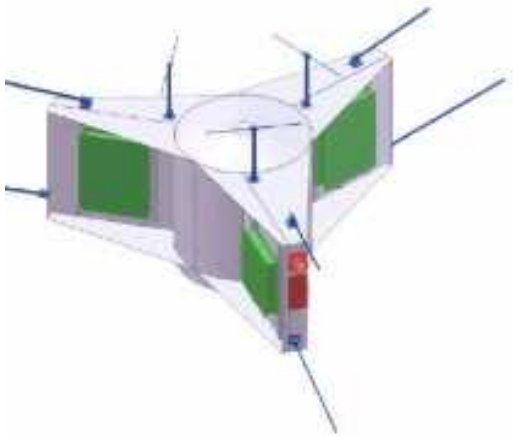
[M]

Multi-Satellite Tracking Mode



Opportunita’ future





Siti Utili:

www.amsat.org

www.amsat.it

Per il software:

http://www.amsat.org/amsat-new/tools/softwareArchive.php

http://www.qsl.net/kd2bd/predict.html

AMSAT-Italia

"SPAZIO E RADIOAMATORI"

GRAZIE