In Memory of Charles J. Beanland – G3BVU

- John was an avid satellite operator and an AMSAT Area Coordinator for New England
- John helped us staff the AMSAT booth at the New England ARRL Convention for many years
- John owned Spectrum International, Inc. and operated it until his passing
  - Importing satellite rig and rotor position control systems
  - His bifilar helical antennas for 2M/70CM are still in use gathering weather satellite maps, especially in remote places like McMurdo Station, Antarctica… he was very proud of that!
- We'll all miss John, he was a gentleman, a mentor to all, a terrific OM on the bands, and a good friend to all of us

An Introduction to Amateur Satellites

PART Amateur Radio Club

16-October-2012

Ernie Bauer, N1AEW

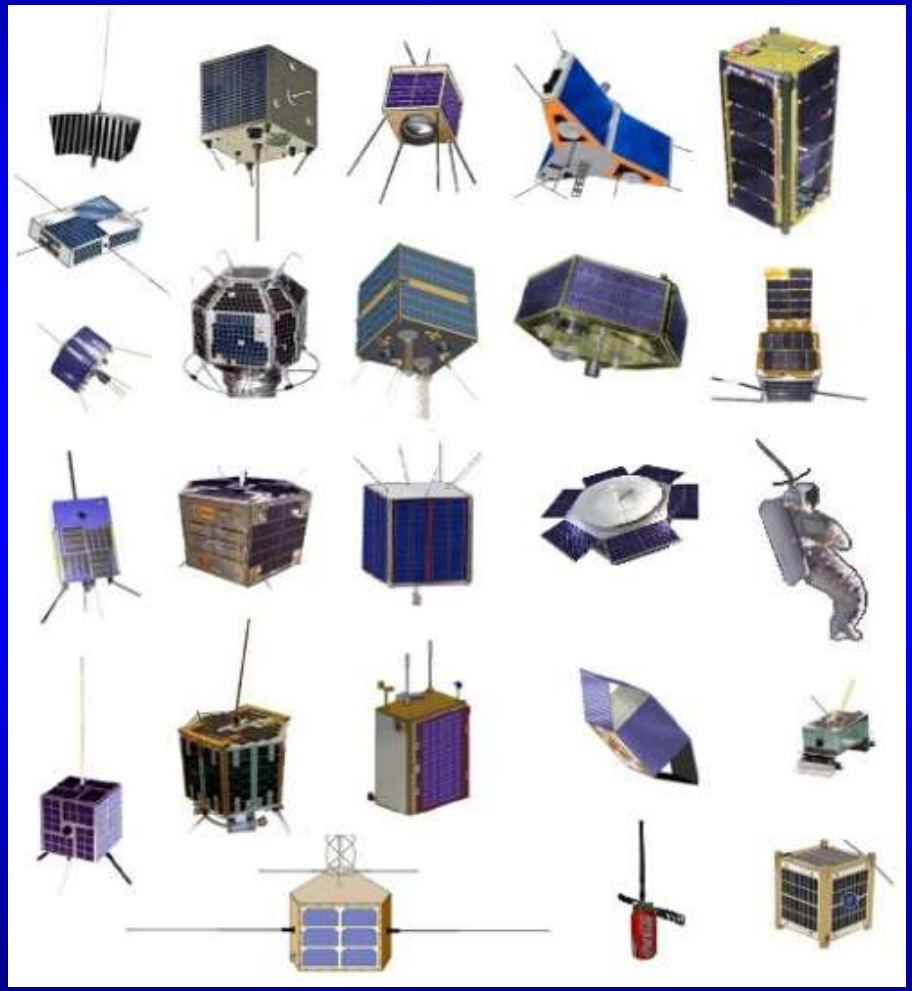
AMSAT Area Coordinator

A Wide Variety of Satellites

- 6 Analog Satellites in Operation + ISS
  (3 fully functional, 3 semi-operational)
- FM Repeater 2 Meter/435 MHz
- SSB/CW 2 Meter/435 MHz
  2 Meter/10 Meter

Satellite Characteristics Differ

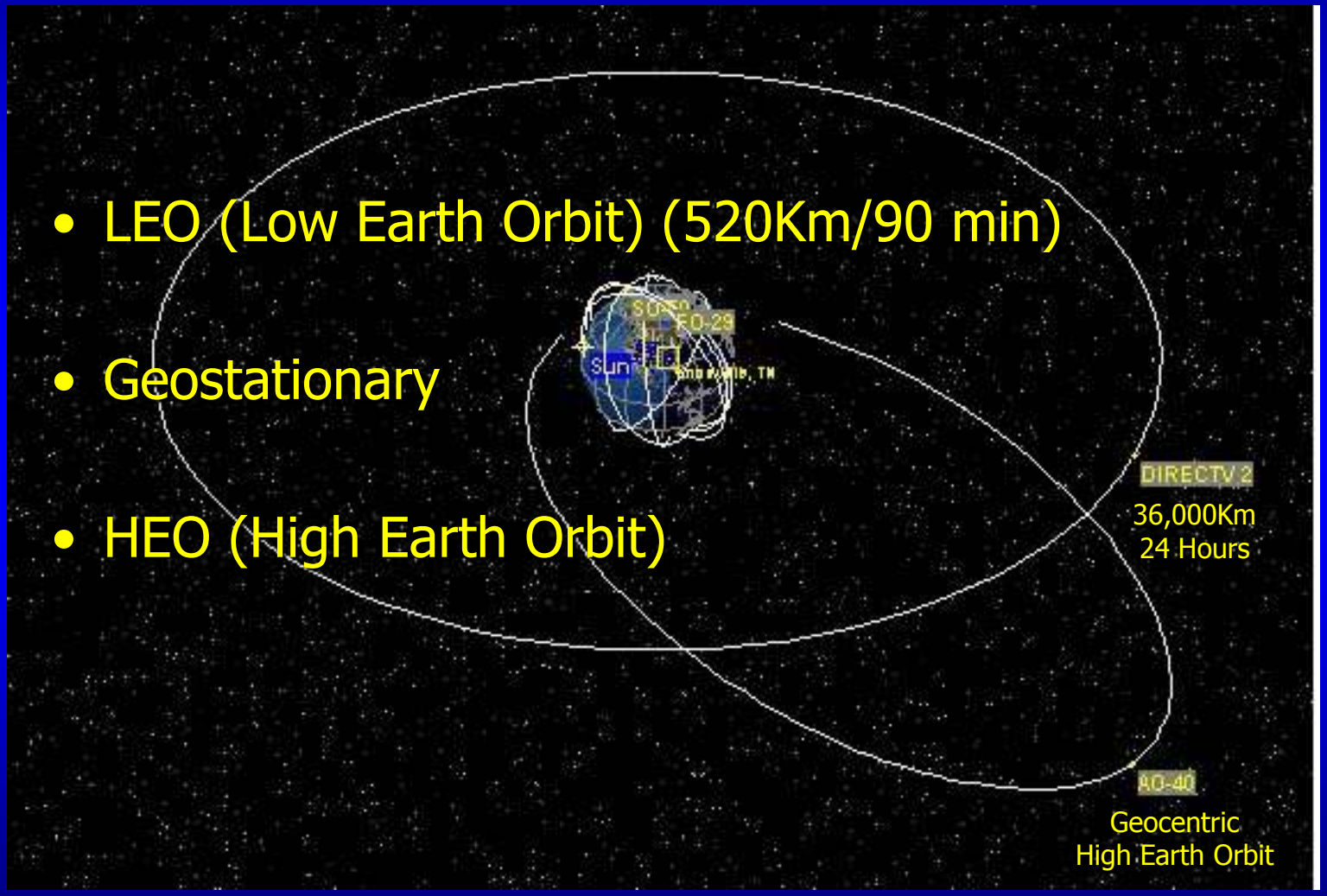
- Size and mass
- Digital/Analog
- Orbital Parameters
- Frequencies Utilized
- "Payload"



Available Satellite Bands

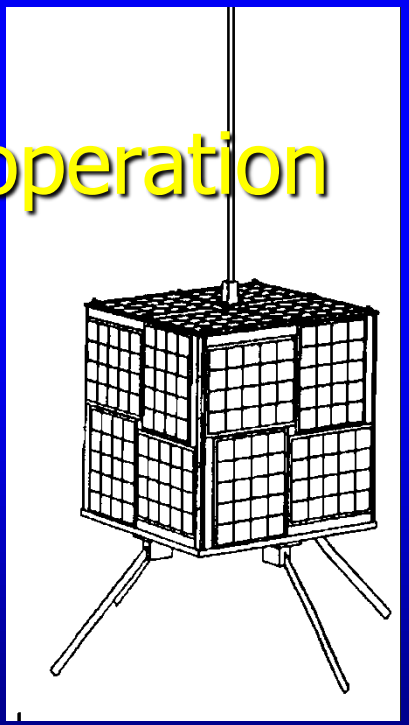
- Bands Exist from 15 Meters to 24 GHz
  - Set by International Convention
  - Not all Amateur Bands allocated for Satellites (e.g. 6 Meters, 220 MHz)
- 70 cm/2M Most Often Used
- Various 'Modes'
- There is a shift towards Higher Frequencies
- "Use It or Lose It"

Satellite Orbits



There are Three Types of Amateur Satellites

- Analog FM Repeater operation
- Analog SSB/CW Transponder operation
- Digital Operation



How satellites operate like single channel repeaters

- Retransmit what they "hear"
- Have Optimized Receivers, Transmitters, Antennas
- Great Location!
- Allows Communications Over Great Distances

How satellites differ from Repeaters

- **Have a Moving Footprint!**
  - Location Changes / Availability Varies
  - Frequency Changes due to Doppler Shift
- **Full Duplex**
  - Simultaneous Uplink and Downlink on Different Bands
  - Multi-mode (CW/SSB/Digital/SSTV/PSK31)
- **"World Wide" Coverage**

Some satellites are "Transponders"

- Receives a SEGMENT of one band (50-200 kHz)
- Retransmits EVERYTHING it hears on another band
- Inverting & Non-inverting Transponders
  - –FM Sat Retransmit one station (up 2m/dwn 70cm)
  - –Inverting retransmits low receive frequency at high transmit frequency (and inverts USB to LSB)

Example for VO-52:

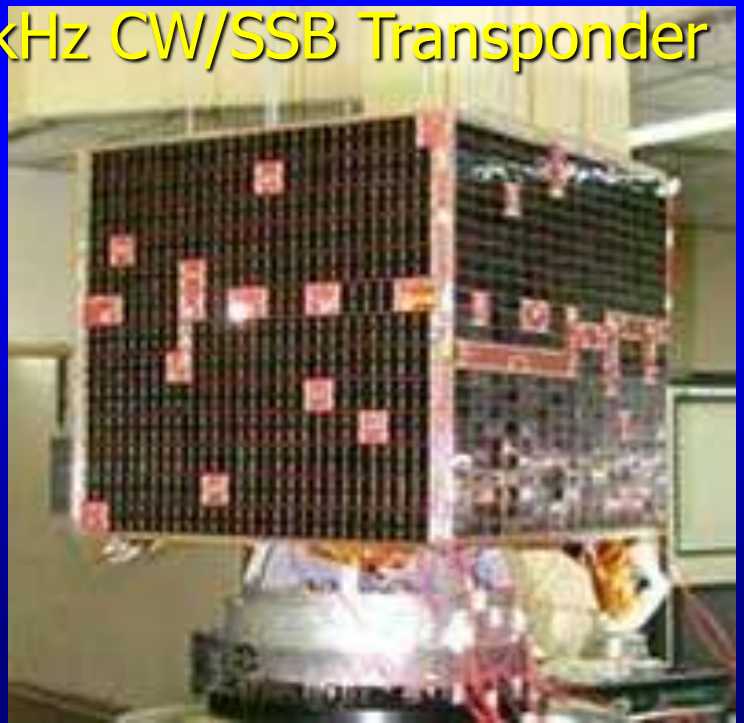
Mode B Uplink: 435.225 - 435.275 MHz LSB/CW

Mode B Downlink: 145.875 - 145.925 MHz USB/CW

VO=Carrier 145.940/PA=CW Msg at 145.860 Mhz.

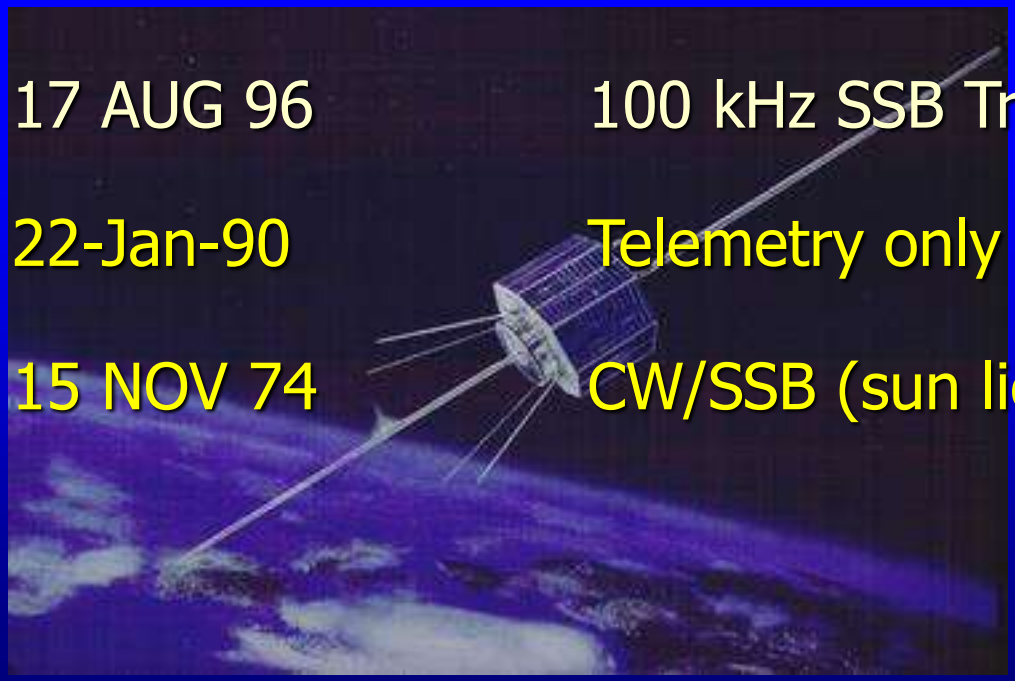
OSCAR Satellites Operational

Satellite	Launch	Comments
AO-27	26 Sep 1993	FM repeater* (up 10/20)
SO-50	20 Dec 2002	FM repeater*/74.4/67.0
VO-52	5 May 2005	60kHz CW/SSB Transponder



OSCAR Satellites Semi-Operational

Satellite	Launch	Comments
ISS		2m digi, 2m simplex, 70cm/2m cross band repeater, BB
FO-29	17 AUG 96	100 kHz SSB Transponder
LO-19	22-Jan-90	Telemetry only
AO-7	15 NOV 74	CW/SSB (sun light ops only)



Getting Started

EASY 'sats' FM Birds (Low Earth Orbit)

- **FM Satellites: AO-27, SO-50**
- **Human Spacecraft (ARISS)**

Minimum Ground Station:

- **Dual Band Handheld (2m/70cm) full duplex mode**
- **Dual Band Arrow, Elk, or yagis**
- **Verticals with gain**

SSB & CW sats

- **SSB/CW VO-52 HAMSAT (India)**
- **SSB/CW AO-7**
- **SSB/CW FO-29 Satellites (Japan)**
- **Longer, multiple QSOs because 50 kHz + bandwidth**

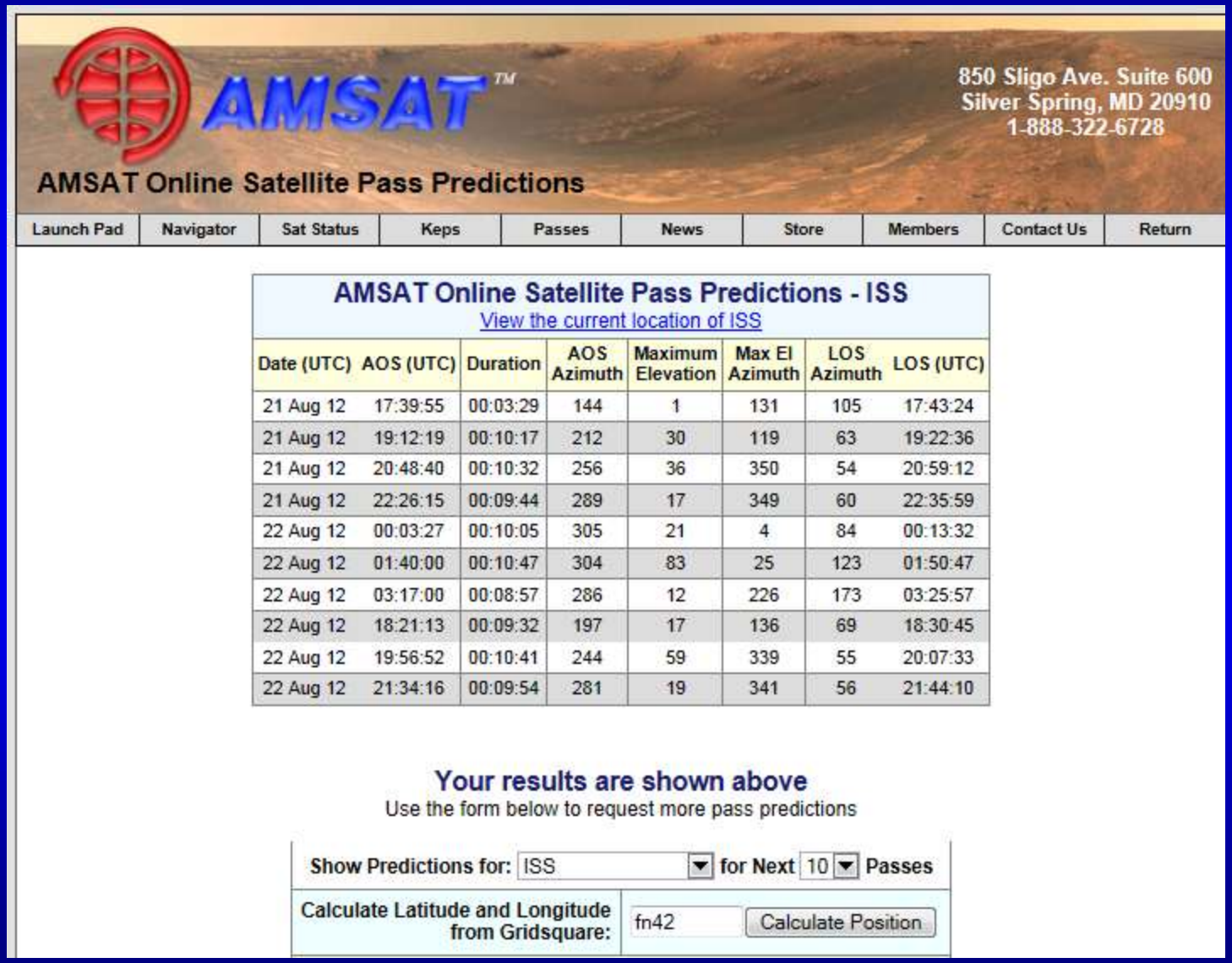
Minimal equipment needed to operate the FM sats

Hardware Store Special with Armstrong Rotators

Fixed Station Example

- Small yagis, fixed elevation, TV rotor
- 70 cm preamp at the antenna
- Satellite radio or two radios
- Low power
- Optional computer control of rotor and Doppler

AMSAT Online Pass Predictions



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Silver Spring, MD 20910
1-888-322-6728

AMSAT Online Satellite Pass Predictions

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AMSAT Online Satellite Pass Predictions - ISS

View the current location of ISS

Date (UTC)	AOS (UTC)	Duration	AOS Azimuth	Maximum Elevation	Max El Azimuth	LOS Azimuth	LOS (UTC)
21 Aug 12	17:39:55	00:03:29	144	1	131	105	17:43:24
21 Aug 12	19:12:19	00:10:17	212	30	119	63	19:22:36
21 Aug 12	20:48:40	00:10:32	256	36	350	54	20:59:12
21 Aug 12	22:26:15	00:09:44	289	17	349	60	22:35:59
22 Aug 12	00:03:27	00:10:05	305	21	4	84	00:13:32
22 Aug 12	01:40:00	00:10:47	304	83	25	123	01:50:47
22 Aug 12	03:17:00	00:08:57	286	12	226	173	03:25:57
22 Aug 12	18:21:13	00:09:32	197	17	136	69	18:30:45
22 Aug 12	19:56:52	00:10:41	244	59	339	55	20:07:33
22 Aug 12	21:34:16	00:09:54	281	19	341	56	21:44:10

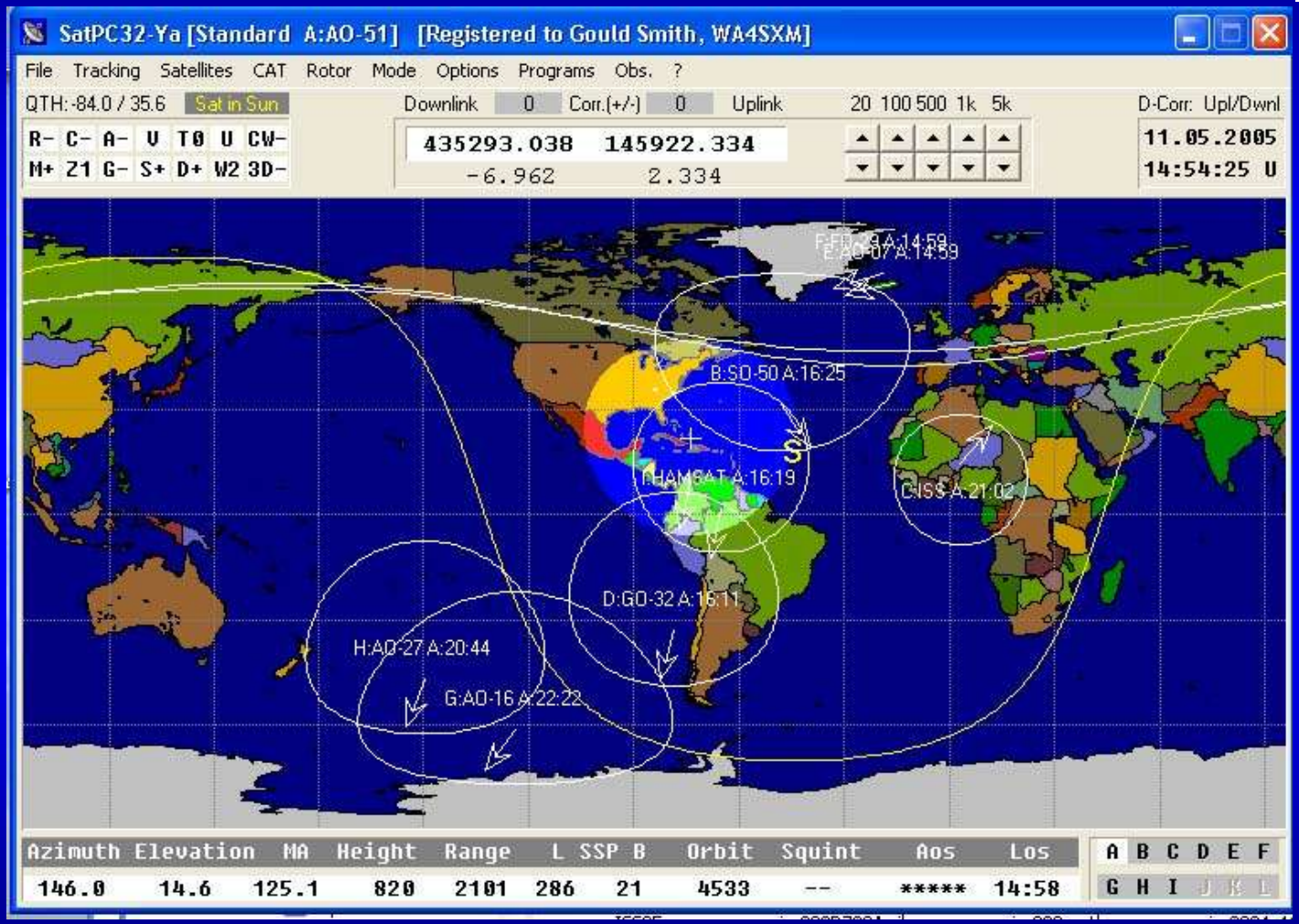
Your results are shown above

Use the form below to request more pass predictions

Show Predictions for: ISS for Next 10 Passes

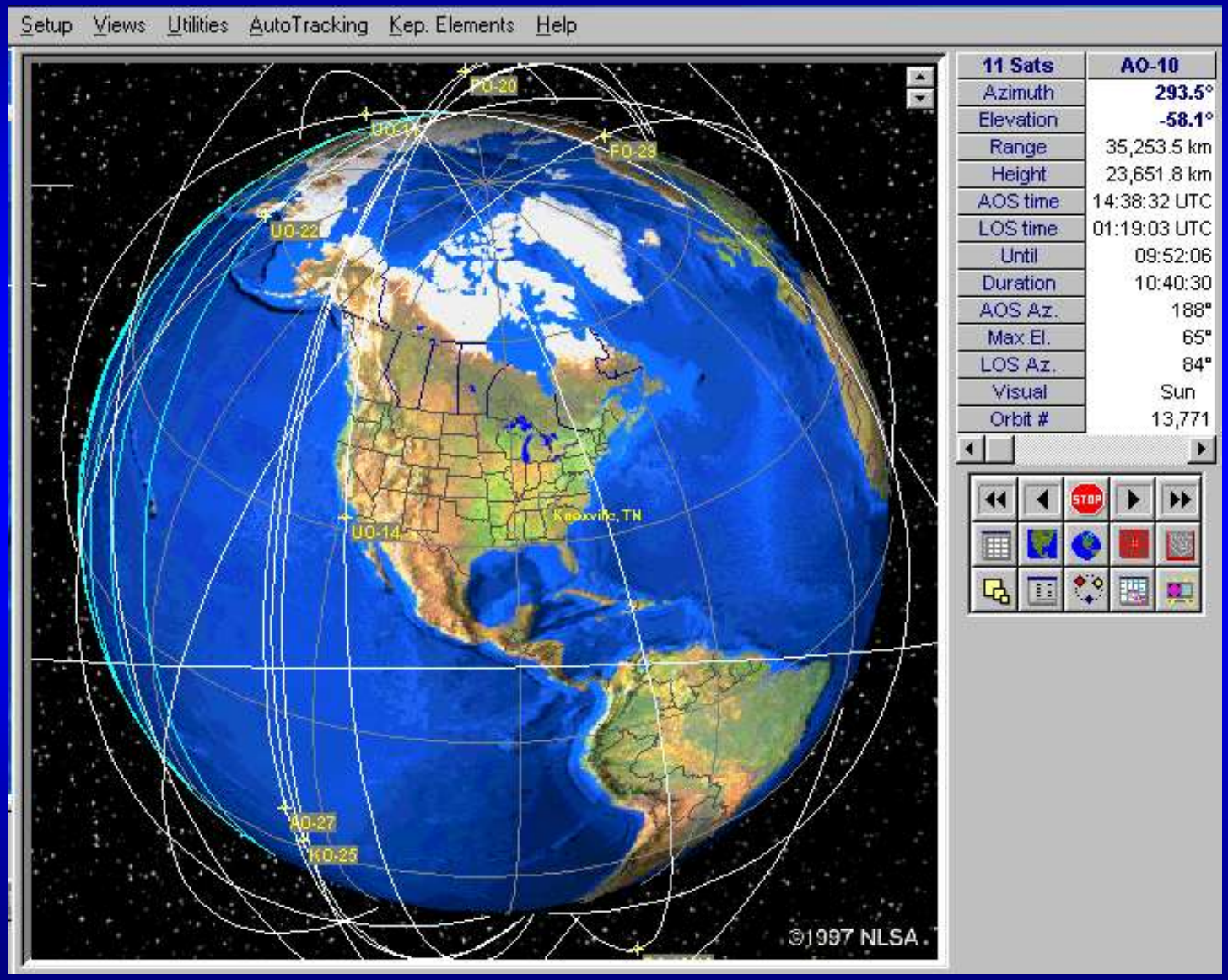
Calculate Latitude and Longitude from Gridsquare: fn42 Calculate Position

SatPC32 software



Will also do antenna and radio control

Nova


Setup Views Utilities AutoTracking Kep. Elements Help
FO-20
UO-11
FO-29
UO-22
UO-14
Knoxville, TN
AO-27
KO-25
©1997 NLSA
11 Sats
AO-10
Azimuth 293.5°
Elevation -58.1°
Range 35,253.5 km
Height 23,651.8 km
AOS time 14:38:32 UTC
LOS time 01:19:03 UTC
Until 09:52:06
Duration 10:40:30
AOS Az. 188°
Max El. 65°
LOS Az. 84°
Visual Sun
Orbit # 13,771
STOP

AO-27 (AMRAD)

- U/V FM repeater
- Uplink: 145.8500 Mhz FM
- Downlink: 436.7950 Mhz FM
- Does not tone & will ignore tone if transmitted
- Available for daylight passes over North America

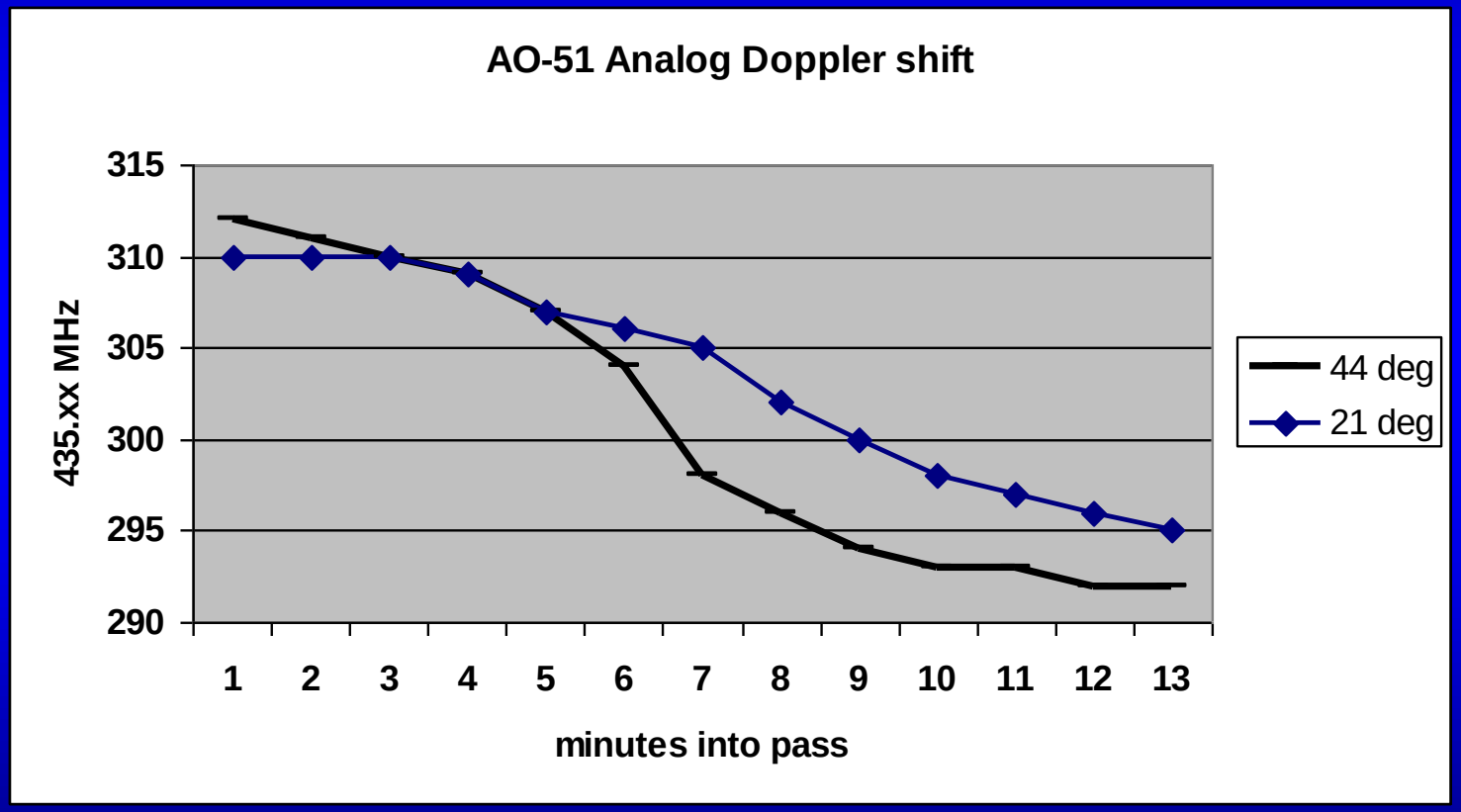
SO-50 (SaudiSat 1-C)

- U/V FM repeater
- Uplink needs 67 Hz tone
- Not a polar orbit, so pass times change day to day
- 250 mW transmitter

Frequency Setup for AO-27 and SO-50

Ch #	Name	TX Freq	CTCSS (TX)	RX Freq
101	SO50ON	145.850	74.4	436.810
102	SO50-1	145.850	67.0	436.810
103	SO50-2	145.850	67.0	436.805
104	SO50-3	145.850	67.0	436.800
105	SO50-4	145.850	67.0	436.795
106	SO50-5	145.850	67.0	436.790
107	SO50-6	145.850	67.0	436.785
108	SO50-7	145.850	67.0	436.780

Doppler Shift



Operating Techniques During the Pass

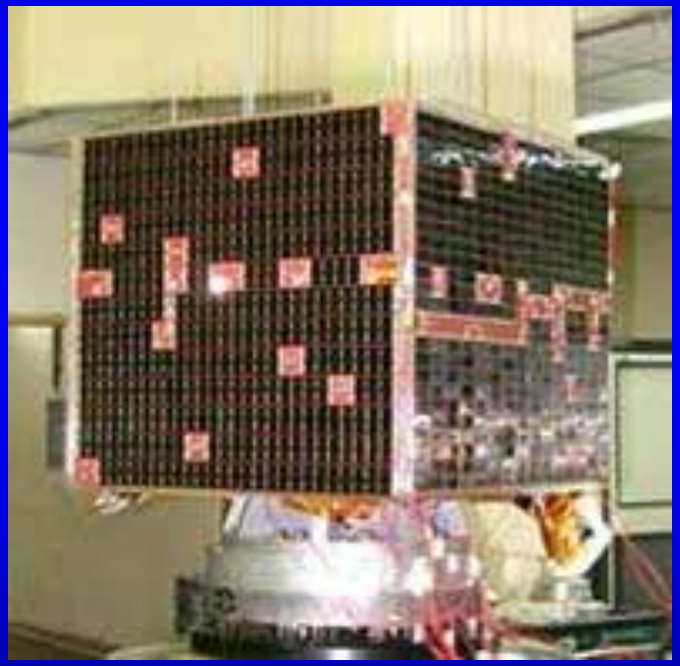
- Adjust for Doppler (20 kHz, -10 kHz to +10 kHz)
- Listen to who is talking - Note the call-sign
- Make a short call to this specific station
- Give your name, callsign, and grid square
- Have a means to record contacts
- Have patience-LEO satellites are busy, so it may take a few passes until you make a contact

Making Random Amateur Radio Contacts with ISS Crew

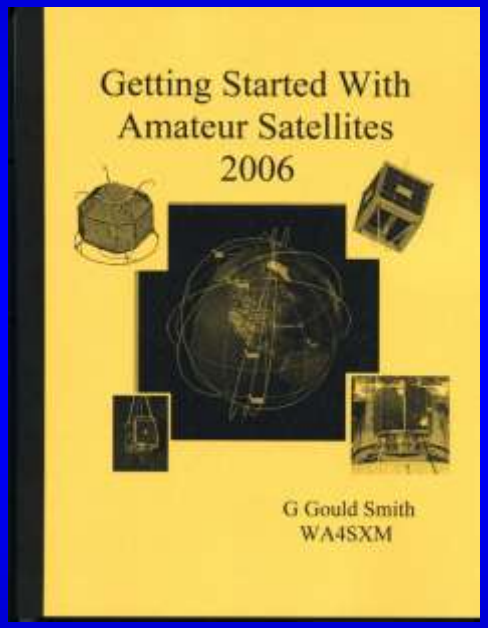
- Crew Working on UTC Time ~ 0630 – 2100
- Listen before Talking
- Hit and Miss Opportunities
- Ham operation is considered a **hazard**, so it will be QRT during EVA, docking, etc.
- Experiment and Try Different Times
- Listen to Educational Contacts Downlink on 145.800 MHz
- WWW.ISSFANCLUB.COM for current ops

VO-52

- HamSat launched in 2005
- India's first amateur satellite
- 50 kHz wide transponder
- Uplink 435.225 MHz +
- Downlink 145.925 MHz -
- SSB and CW
- Inverting Passband
- Xmtr LSB/Rcvr USB)



Getting Started with Amateur Satellites 2012



Written to guide the Beginner into satellite operation

Available from AMSAT WEB Store

Get started right now!

WWW.AMSAT.ORG

The AMSAT Web Site has it all!

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Buy Getting Started books
Use Satellite positioning tools online
Easy Satellite status & Freq charts

Check it out!

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