

AMSAT, IARU & The Cubesats

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Cubesat Conference

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AMSAT®

Who is AMSAT ?

- ◆ We've been designing, building and flying small satellites for 35+ years.
- ◆ Our efforts are all done by volunteers.
- ◆ *AMSAT-NA* serves North America, with affiliates in other countries.
- ◆ You can visit some of the *AMSATs* at:
 - ◆ <http://www.amsat.org/>, <http://www.uk.amsat.org/>,
<http://www.amsat-dl.org/>, <http://www.projectoscar.net/>

AMSAT's Volunteers are eager to help YOU

- ◆ Help you to find mentors – local and around the world:
 - ◆ Spacecraft and experiment design
 - ◆ Construction of flight hardware
- ◆ Provide Design Review teams
- ◆ Help you with the licensing/coordination process
- ◆ Literature and WWW information – examples:
<http://www.amsat.org/> and Davidoff's *Satellite Handbook*

AMSAT's Mission Statement

- ◆ **AMSAT is a non-profit volunteer organization which designs, builds and operates experimental satellites and promotes space education. We work in partnership with government, industry, educational institutions and fellow amateur radio societies. We encourage technical and scientific innovation and promote the training and development of skilled satellite and ground system designers and operators.**

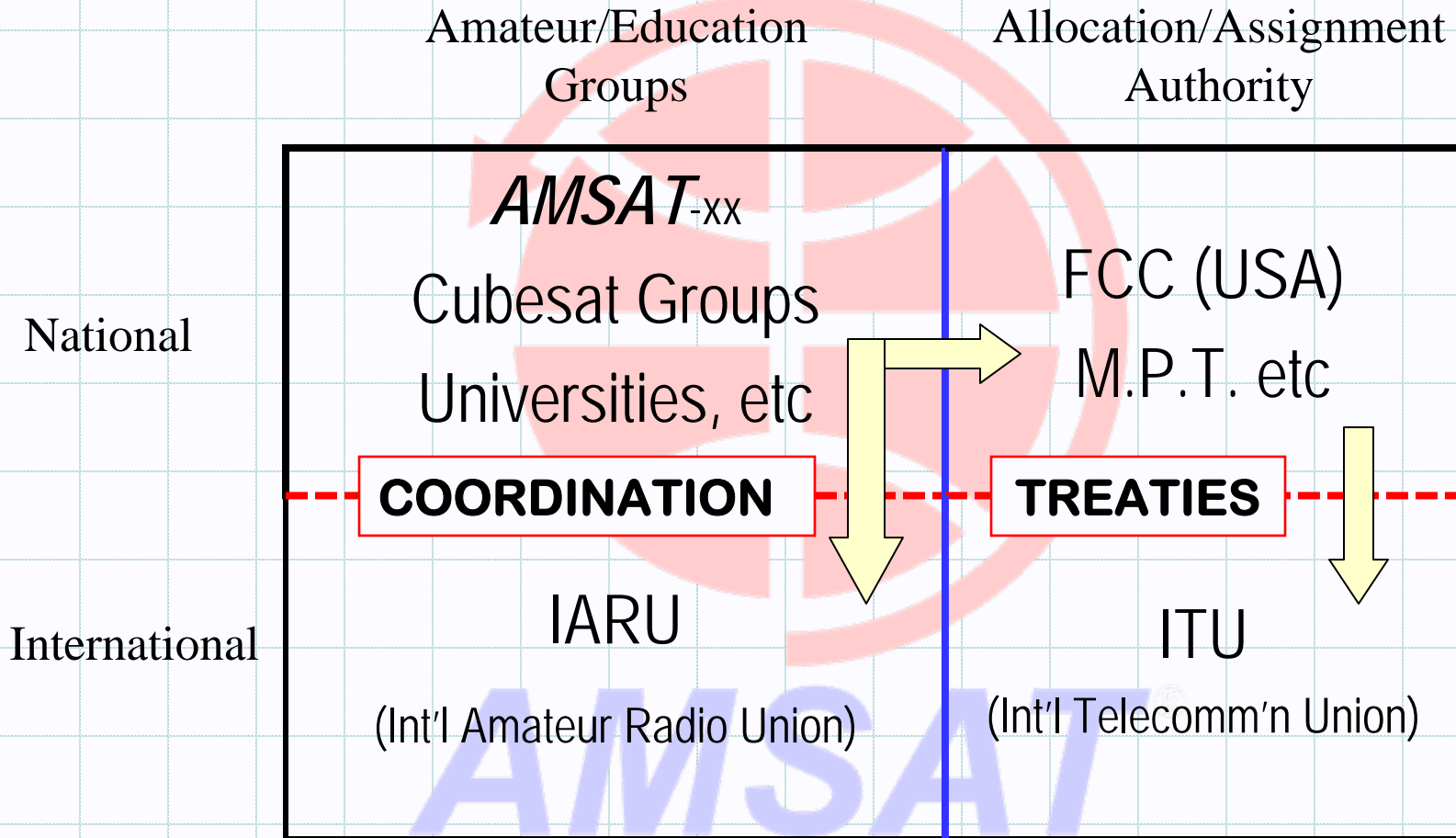
AMSAT BoD, Feb 2004

AMSAT's Vision

- ◆ **Our Vision is to deploy High Earth Orbit satellite systems that offer daily coverage by 2009 and continuous coverage by 2012. AMSAT will continue active participation in human space missions and support a stream of LEO satellites developed in cooperation with the educational community and other amateur satellite groups.**

AMSAT BoD, Feb 2004

Who's Who ??



Why do we need coordination??



Welcome to Pakistan Space & Upper Atmosphere Research Commission

Suparco :: Contact Us

- About Us
- Authority
- Establishments
- Long Term Programs
- Current Programs
- I.T Division
- RSA Division
- SS&AR Division
- Procurement Division
- HRD Programs
- SGS
- Research Publications
- Collaboration / Joint Projects
- Short Training On Environmental Pollution
- Contact Us

Pakistan's First Satellite Badar-1

Badr-1 - Pakistan's first indigenously developed Satellite was launched in 1990 from China aboard a Long March rocket. The satellite successfully completed its designed life.

Mission Objectives.

- To acquire know-how for indigenous development of satellites and to create infrastructure for future satellite development activities.
- To test the performance of indigenously developed satellite subsystems in space environment.
- To perform experiments in real-time voice and data communications between two user ground stations.
- To demonstrate store-and-forward type message communication.
- To educate the country's academic, scientific and amateur community in the tracking and use of low-earth-orbiting satellites.

Configuration

Structure :	26-Facet Polyhedron
Thermal Design :	Passive
Mass :	52 kg
Solar Panels :	17 Square Facets
Average Conditioned Power :	12.5 Watts
Down Link :	VHF
Up Link :	UHF
Telemetry Channels :	32
Sensors :	Temperature, current, voltage
Data Transmission Rates :	1200,600,300,150 BAUDS
DCE Memory Bank :	8 KBYTE

VHF = 144.025 MHz, in the middle of the weak-signal "moonbounce" window !

Why do we need coordination ??

- ◆ More historical examples:
 - ◆ SARA (Radio Astronomy listening to Jupiter, 1991)
 - ◆ SWATCHSat (SWATCH Watches – voice messages, 1999)
 - ◆ MAROC (Morocco -- Remote Sensing, 2001)

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Why do we need coordination ??

- ◆ After BADR-1 and SARA, *AMSAT-NA*'s Board asked the question:
JUST WHAT IS AN AMATEUR SATELLITE ???
- ◆ We decided the answer involved some simple rules:
 - ◆ Amateur Radio requires non-commercial
 - ◆ Must meet all legal rules (FCC/ MPT, ITU registry)
 - ◆ Must have an amateur radio involvement and interest
 - ◆ Downlink format and content should be publicly available
 - ◆ Amateur community should be told of mission
 - ◆ Frequency/modulation should be coordinated with IARU
- ◆ These were incorporated into the IARU “rules”
 - ◆ See <http://www.iau.org/satellite/sat-freq-coord.html>

The Shoehorn Problem

- ◆ Two frequency ranges are “easy” with lots of existing hardware and a strong world-wide network of amateurs to support satellite missions:
- ◆ 2 Meters: ITU permits 144.0 – 146.0 MHz
But the 2 Meter band is busy everywhere in the world, so IARU (with AMSAT’s concurrence) has set aside sub-band of 145.80 – 146.00 for Satellites
- ◆ 70 cm: ITU & IARU permit 435.0 – 438.0 MHz

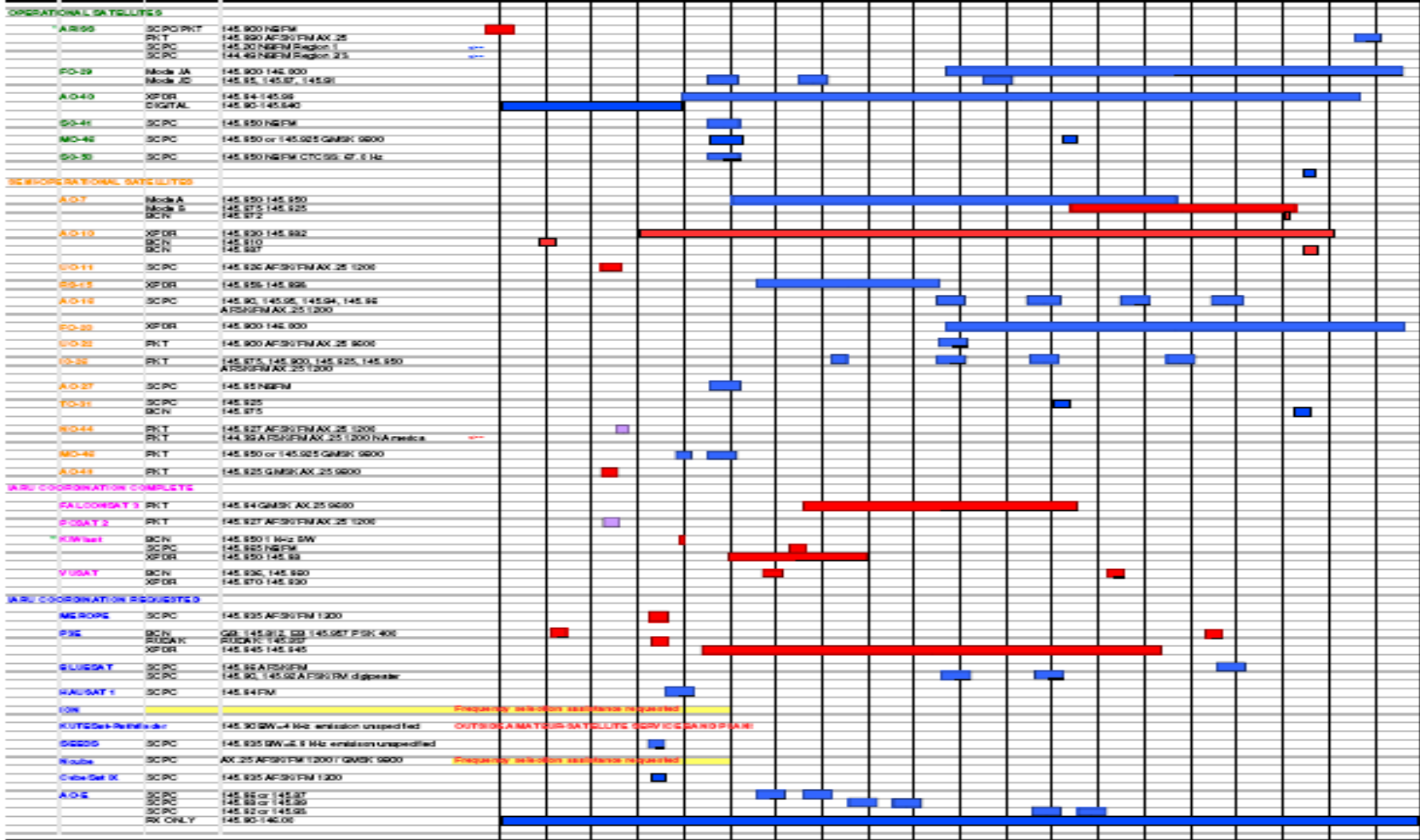
2 Meters 145.8-146.0 MHz

IRIDIUM Satellite Frequency Coordination Status Chart

DATE: 04 JAN 2004

DRAFT DRAFT DRAFT DRAFT DRAFT DRAFT DRAFT

145.800-146.000MHz (IRIDIUM based plan) (F2M) (IRIDIUM) see plan 05 3 1200



LEGEND TRANSMITTING

RECEIVING

IRIDIUM based plan or IRIDIUM

AIRISS exception to IRIDIUM based plan coordinated world-wide

NO LAUNCH SCHEDULED

OK = baseline

PNT = packet

RK ONLY = receiver only

SCPC = single channel per carrier

XPCR = transponder

Note 1: Frequencies plotted are approximate.

Note 2: Frequencies do not account for Doppler shift.

Note 3: Orbital locations not taken into account.

2 Meters 145.8-146.0 MHz

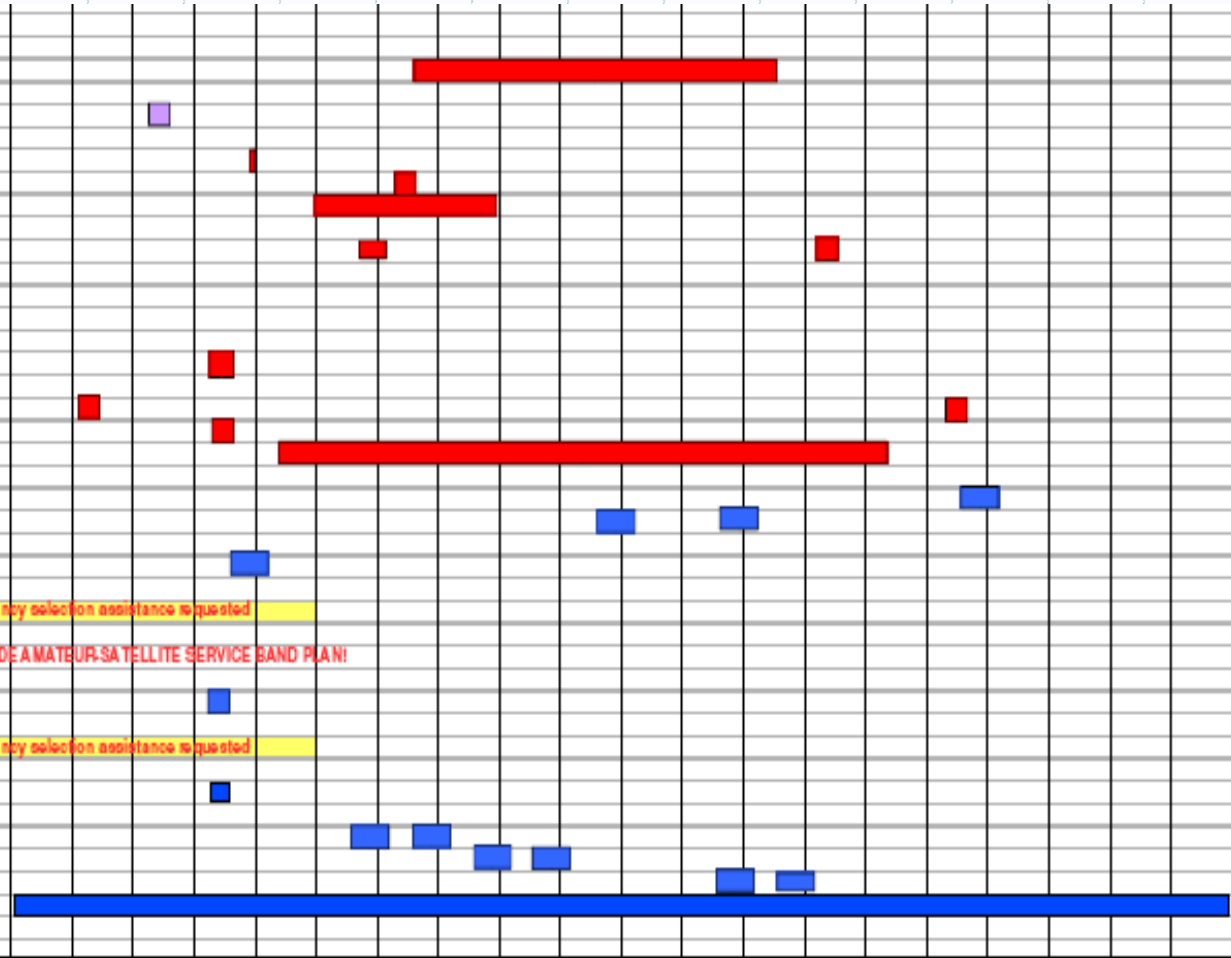
(As of Jan.2004)

IARU COORDINATION COMPLETE

FALCONSAT 3	PKT	145.84 GMSK AX.25 9600
PCSAT 2	PKT	145.827 AFSK/FM AX.25 1200
KWleaf	BCN	145.850 1 kHz BW
	SCPC	145.865 NBPM
	XPDR	145.850-145.88
VUSAT	BCN	145.936, 145.860
	XPDR	145.870-145.930

IARU COORDINATION REQUESTED

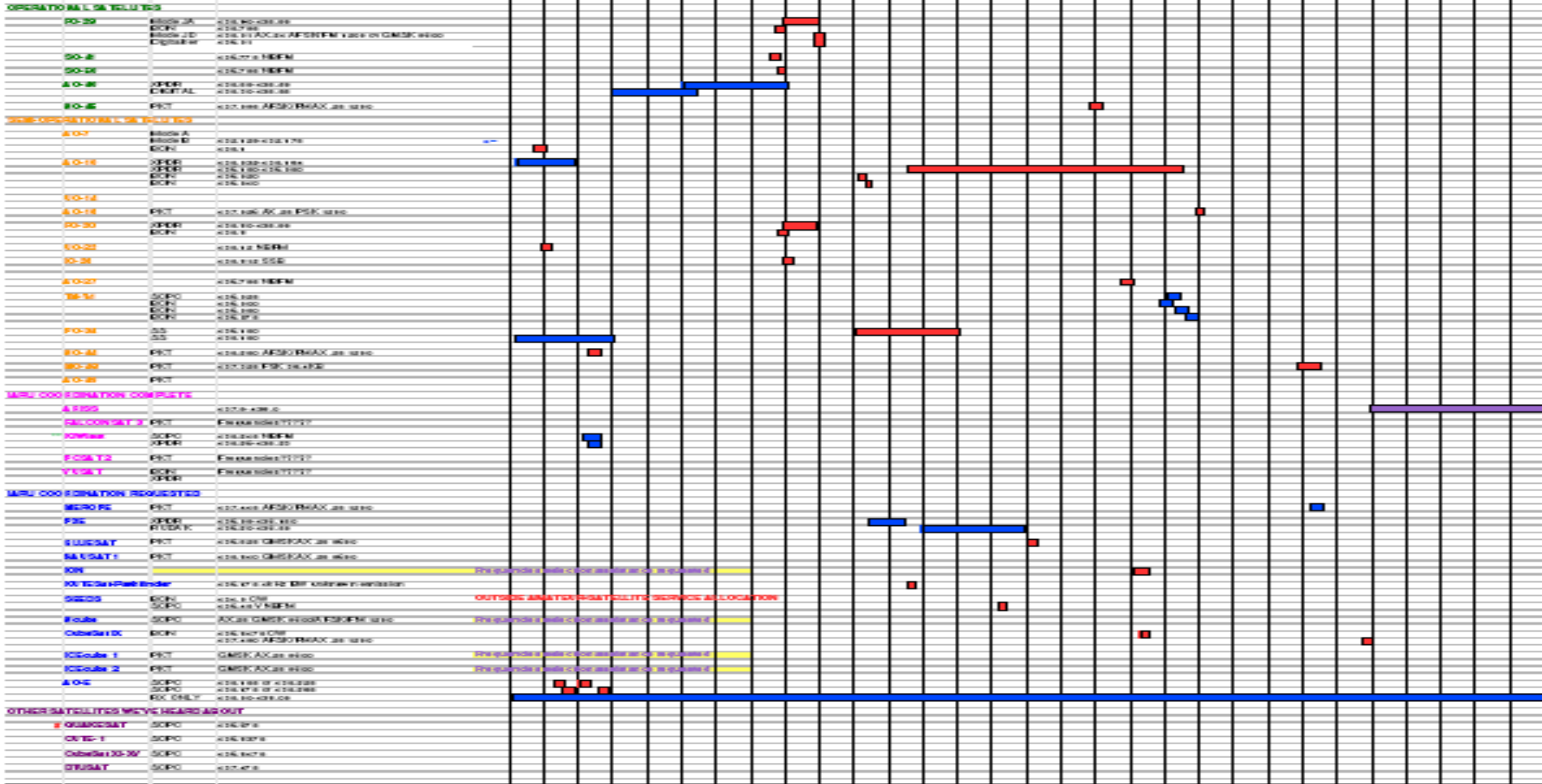
ME ROPE	SCPC	145.835 AFSK/FM 1200
P9E	BCN	GB: 145.812, EB 145.857 PSK 400
	RUDAK	RUDAK: 145.837
	XPDR	145.845-145.945
BLUESAT	SCPC	145.96 AFSK/FM
	SCPC	145.90, 145.92 AFSK/FM digipeater
HAUSAT 1	SCPC	145.84 FM
ION		Frequency selection assistance is requested
KUTESat-Pathfinder		145.30 BW=4 kHz emission unspecified
SEEDS	SCPC	145.835 BW=6.8 kHz emission unspecified
Ncube	SCPC	AX.25 AFSK/FM 1200 / GMSK 9600
CubeSat IX	SCPC	145.835 AFSK/FM 1200
AQ-E	SCPC	145.86 or 145.87
	SCPC	145.88 or 145.89
	SCPC	145.92 or 145.93
	RX ONLY	145.80-146.00



70cm 435.0-438.0 MHz

MURS 70cm Frequency Coordination Gantt Chart
DATE: 02 APR 2004

435.000-435.010 435.011-435.020 435.021-435.030 435.031-435.040 435.041-435.050 435.051-435.060 435.061-435.070 435.071-435.080 435.081-435.090 435.091-435.100

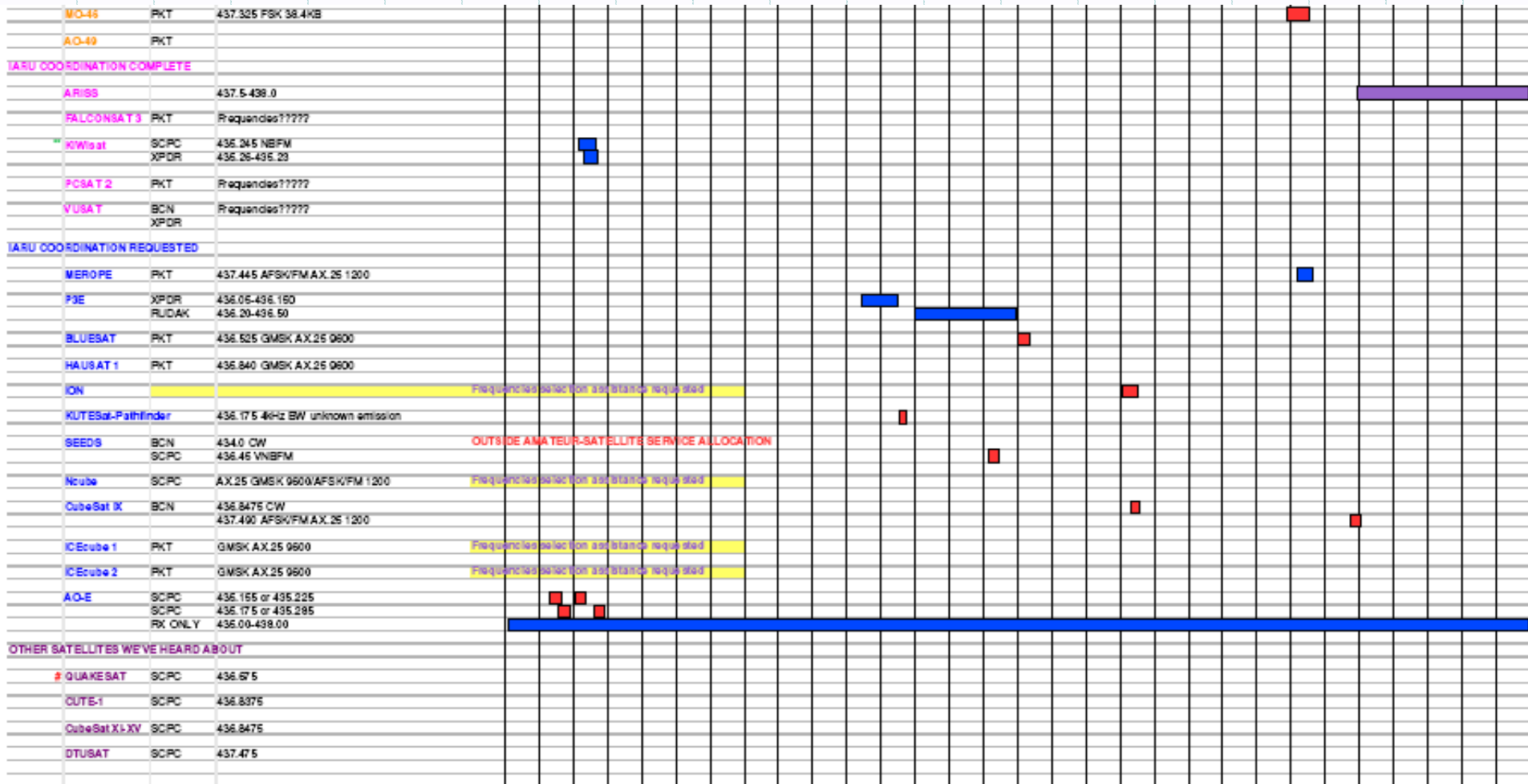


LEGEND TRANSMITTER
 ● COORDINATED
 ▲ REQUESTED (not listed on MURS) but if plan is coordinated with MURS
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 ■ COORDINATION SCHEDULE
 ● CH1 = 1st beam
 ● CH2 = 2nd beam
 ● CH3 = 3rd beam
 ● CH4 = 4th beam
 ● CH5 = 5th beam
 ● CH6 = 6th beam
 ● CH7 = 7th beam
 ● CH8 = 8th beam
 ● CH9 = 9th beam
 ● CH10 = 10th beam
 ● CH11 = 11th beam
 ● CH12 = 12th beam
 ● CH13 = 13th beam
 ● CH14 = 14th beam
 ● CH15 = 15th beam
 ● CH16 = 16th beam
 ● CH17 = 17th beam
 ● CH18 = 18th beam
 ● CH19 = 19th beam
 ● CH20 = 20th beam

Notes: Please refer to the MURS website for more information.
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70cm 435.0-438.0 MHz

As of Jan.2004



LEGEND
 TRANSMITTING
 RECEIVING
 TRANSMITTING or RECEIVING
 * ARISS exceptions to IARU band plan coordinated world-wide
 ** NO LAUNCH SCHEDULED
 # COORDINATION DECLINED

IARU Coordination Information is available at:

- ◆ <http://www.iaru.org/satellite>
 - ◆ Coordination info, forms: <http://www.iaru.org/satellite/sat-freq-coord.html>
 - ◆ General Info, Email contact is <mailto:satcoord@iaru.org>
- ◆ To see current status of requests <http://www.amsat.org.uk/iaru>
- ◆ <http://www.amsat.org>
 - ◆ Supporting Info, FAQ, Forms, Spreadsheets, etc.
 - ◆ Link Budgets: <http://www.amsat.org/amsat/software/spreadsheet>
 - ◆ FAQ: <http://www.amsat.org/amsat/intro/using-ham-freqs.html>



The International Amateur Radio Union

Since 1925, the Federation of National Amateur Radio Societies
Representing the Interests of Two-Way Amateur Radio Communication

IARU Amateur Satellite Frequency Coordination

List of Satellite projects for which frequencies have been coordinated.

Click on the detail button, for more details

IARU – As of 4/4/04

Sat Name	Supporting Organisation	
Oscar Echo	AMSAT-NA	Detail
Falconsat 3	US Air Force Academy	Detail
ICEcube1 & 2	Cornell University	Detail
Merope	Montana State University	Detail
Ncube	Norwegian Univ of Space & Technology	Detail
PCSAT2	US Navy Academy	Detail
BLUESat	University of New South Wales	Detail
KIWI sat	AMSAT-NZ	Detail
HAUSAT-1	Hankuk Aviation University - Seoul	Detail
VUSat	AMSAT- India	Detail
ION	University of Illinois	Detail
KUTESat-Pathfinder	University of Kansas	Detail
SEEDS	Dept of Aerospace Eng - Nihon Univ Japan	Detail
Cubesat XI-V	Intelligent Space Systems Lab - Univ of Tokyo	Detail
CP1	Cal Poly Aerospace Engineering	Detail
CP2	Cal Poly Aerospace Engineering	Detail
SACRED	University of Arizona at Tuscon	Detail
Rincon	University of Arizona at Tuscon	Detail
YamSat	National Applied Research Laboratories, Taiwan	Detail
Ralphie & Sparkie	New Mexico State University Amateur Radio Club	Detail
ANDE	US Naval Academy Amateur Radio Club	Detail
Mea Huaka'i	University of Hawaii	Detail
NMSUSat	New Mexico State University	Detail



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IARU Amateur Satellite Frequency Coordination

List of Satellite requests which have formally requested coordination.

IARU – As of 4/4/04

Sat Name	Supporting Organisation	
Phase 3E	AMSAT-DL	Detail
CanX-2	Institute for Aerospace Studies-Toronto University	Detail
Pehuensat	AMSAT Argentina	Detail

List of Satellite projects about which we have some information.

Sat Name	Supporting Organisation	
Citizen Explorer 1	University of Colorado	Detail
unknown	Michigan Tech	Detail
UniSat3	La Sapienza University Roma	Detail
P5A Mars Mission	AMSAT-DL	Detail
ALMASAT	Universita di Bologna	Detail
RAFT		Detail

An Invitation to You from *AMSAT*

- ◆ The next annual AMSAT symposium will be held October 8-1, 2004 in Arlington, VA (DC suburbs).
- ◆ This is your opportunity to meet with the AMSAT community, including the operators of stations that you could use to track your satellite.
- ◆ AMSAT plans an Educational forum that would be a perfect place to present your project to "the world".
- ◆ Also planned – a trip to the new Smithsonian Udvar-Hazy Aerospace Museum at Dulles Airport.

Thank you from AMSAT

- ◆ For more details on AMSAT, see <http://www.amsat.org>
- ◆ To contact me: <mailto:w3iwi@amsat.org>

