PCSAT2, Synergy in the Amateur Satellite Service

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The Amateur Satellite Service partnering with DOD

- Very short development time
- Simplicity and off the shelf
- Educational Project
- Usable communications service to Users
- Telemetry for Space Environment
PEC is a suitcase that is opened on orbit to expose materials to space.

USNA Telemetry & Comm System

Test Items

Passive Experiment Container - PEC

25” square by 6” thick Suitcase

Opens to expose samples to space

We got back half!
Solar Cell Experiment

40 Solar Cell Samples
PCsat Experience

- Launched 30 Sept 2001
- Served over 2000 separate users worldwide
- Operated 22 months to 10 July 2003
The PCSAT2 Student Team
Typical Student User Station

Handheld

Mobile
APRS Packet Operation

Joint ISS/PCsat Constellation test 12 Oct 2002

Dual Hop Success
N4ZQ
KB1GVY
KB2M
KB1GUE
WB4APR

APRS did not see a DIGIPEAT of your last packet... e Input Map Ups Hz USetup
Full Duplex Voice for ISS Crew

Eliminate School Backlog with Astronaut QSO's

Using Full Duplex Crossband FM Voice Repeater
* Schools talk to Astronauts with NO BURDEN on ISS Crew
* 20 times more Astronauts Available.
* No On-board scheduling
* Any Pass. Any time (only scheduling is on ground)
* ALL schools may monitor and will hear UPLINK and DOWNLINK
* All schools will hear all questions the same as Astronaut
* Full duplex lets School hear own uplink for quality control
Multi-User Data Transponder

the digital bit for several years now and the sound

! W6YQ DE K5NY KN5NY W6YQ
Point it north, Stan
Amateur Satellite Transponders

PCsat2 COMMS FUNCTIONAL BLOCK DIAGRAM

- 28 MHz PSK Linear RX
- 145.825 MHz FM RX
- 145.800 MHz FM RX
- 435.275 MHz FM TX-A
- 435.250 MHz FM TX-B
- 145.825 MHz FM TX
- 90deg Hybrid
- 90deg Phasing

6" whips
19" whips
KPC-9612+ System
10m Uplink SSB Receiver

Mirslave Kasal

Brno University of Technology students: Michal Zamazal & Petr Kutin

OK2AQK's 10m Flight Receiver
We Wanted Constant Sun

The preferred location for PCSAT2 is out on the ISS Solar array, beyond the alpha joint so that it gets full sun when ISS is in Sun. Our preferred location is shown with the arrow.
We Wanted Constant Sun
We Got Some Sun
Amateur Satellite Service

RULES:

"Amateur-Satellite Service: A radiocommunication service using space stations on earth satellites for ...the purpose of self-training, intercommunication and technical investigations carried out by amateurs, that is, by duly authorized persons interested in radio technique solely with a personal aim and without pecuniary interest." [RR S1.56]

PCSAT2 COMMENT:

Sponsoring Organization: US Naval Academy
Operating Organization: USNA Amateur Radio Club W3ADO
Station Trustee: Bob Bruninga, WB4APR
Satellite Station Licensee: Ryan Johnson, K3FOR
Amateur Satellite Service

RULES:

"VI. OPERATIONAL GUIDELINES based on interpretations by IARU of the Radio Regulations and good amateur practice, are intended to help in planning the missions, management, and control of satellites planned to operate in the Amateur-Satellite Service.

A. The purposes of an amateur satellite should be:

(1) To provide communication resources for the general amateur radio community and/or

(2) To conduct technical investigations in all respects consistent with the Radio Regulations. [See RR S1.56 and RR S1.57.]

PCSAT2 COMMENT:

(1) Three HAM communications transponders
Amateur Satellite Service

RULES:

(2) To conduct technical investigations in all respects consistent with the Radio Regulations. [See RR S1.56 and RR S1.57.]

Technical investigations in the Amateur-Satellite Service should be relevant to the development of "radio technique," that is, have a reasonable possibility of application to the development of radio communication systems. [See RR S1.56 and RR S1.57.

Examples include: propagation studies, analysis of protocols for digital voice and data, development of attitude determination methods, of command and control procedures, studies of radiation effects on components, studies of meteor trail reflection, and measurement of the orbital environment useful in designing future amateur satellites.

PCSAT2 COMMENT:

(2) Advanced Technology Solar Cell experiment
Amateur Satellite Service

RULES: B. Station Control.

Space and Earth stations, must be controlled by "duly authorized persons," that is, licensed amateur radio operators who must be acting "solely with a personal aim and without pecuniary interest." [See | RR S1.56 and S1.57.]

Commonly, the licensee is an unpaid member of the organization which owns the amateur station equipment or is a volunteer acting in close association with it. In these cases, the owner's interest and the licensee's "personal interest" are usually the same.

Thus, the individual responsibility of the licensed operator, effectively imposed by the Radio Regulations, works as a kind of legal safety check for the organization and the amateur to protect both of their interests as well as that of the Amateur Satellite Service itself.

PCSAT2 COMMENT:

Station Trustee: Bob Bruninga WB4APR
Station Licensee: Skip Johnson, K3FOR
Amateur Satellite Service

RULES: D. Plain Language and E. Open Access:

The international Amateur-Satellite service, involves communications between amateur stations in different countries and must be in plain language. [See RR | S25.2.] Including telemetry and data between users.

Technical descriptions of all emissions, codes, and formats must be made publicly available. No system intended to conceal the meaning of a transmission may be used.

All facilities, except telecommand, should be open for use by licensed amateur radio operators world-wide. All experiments should be freely available for use by radio amateurs world-wide and for reception by students and educators.

PCSAT2 COMMENT:

• Voice Repeater, PSK-31 and AX.25 data Protocols.
• Full system design available on line WEB page.
Our Solar Panel and Antennas

PCSAT RF Model
Final Antenna Design
Come See our Display

**PCSAT2 is on the air at Small Sat Conference**

- Repeater on 145.800 up / 435.975 downlink
- APRS Packet is on 145.825
- PSK-31 is on 435.275

(or tune us in)…