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# AMSAT PACSAT Payload Concept of Operations

## 1 Introduction

### 1.1 Document History

DATE	VERSION	AUTHOR	SUMMARY OF REVISION CHANGES
25 Oct 2022	V1.0	NX5R	Initial draft

### 1.2 Program Goals and Objectives

The Pacsat payload is intended to:

- Provide an orbiting BBS system using proven VHF/UHF AX25 technology permitting amateur radio operators to use familiar ground station technology.
- Explore new protocols and modulation techniques.
- Provide a platform to test and demonstrate technology for amateur radio communications using AMSAT Ground Terminal design-based ground stations.

### 1.3 Mission Overview

The Pacsat satellite will run software that follows the Pacsat protocols. This is a clever set of software routines that provide a delay tolerant network connection to the spacecraft. The protocols are split into two halves. The broadcast protocol and connected mode.

The broadcast protocol is used to receive data from the spacecraft. The files and data available on the spacecraft are broadcast as a directory listing. This means that all ground stations can listen and record the data.

Specific files are requested by transmitting a broadcast request to the spacecraft. The file is then broadcast in chunks of data and again all ground stations can receive it. Each ground station can then request the parts of the file that they missed. This makes it a very efficient way to communicate data to many stations and makes it possible to download the directory and files across fades and different passes of the spacecraft.

To upload files a ground station makes a dedicated connection to the spacecraft by logging in. The spacecraft then confirms space is available and provides the file number to use. The data is then uploaded. Again, this is very delay tolerant and picks up seamlessly across fades or passes.

## **1.4 Scope**

The scope of this Concept of Operations (CONOPS) document describes the Pacsat payload and how it will be used. This is not a requirements document but provides operational context that should be helpful in developing and understanding system requirements and interface specifications.

# **2 System Design**

## **2.1 Project Phases**

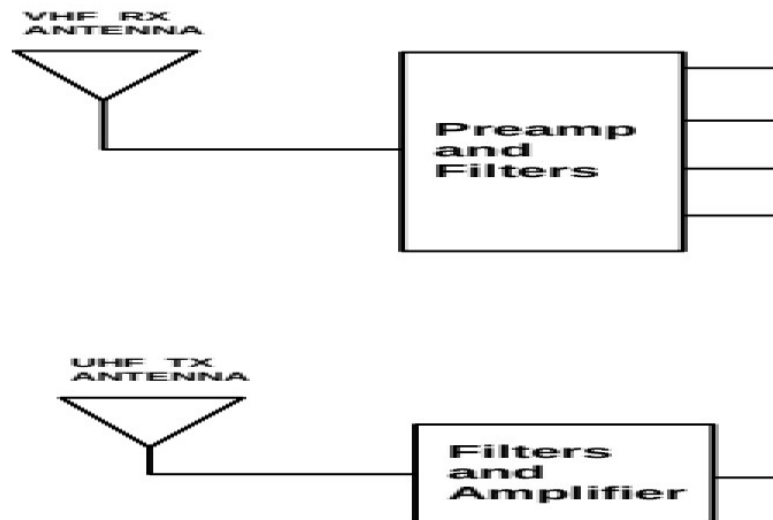
The Pacsat project will be implemented in phases.

Phase I will provide amateur radio operators with the digital Bulletin Board System that was flown on several previous amateur satellites. The immediate goal is to build a flight ready Pacsat system available for the next available launch. The original Pacsat protocol design will provide opportunities for the many packet enthusiasts with existing packet stations to operate the satellite BBS system.

Phase II Pacsat payloads will incorporate advanced communications protocols, improving the operation and reliability of the BBS system.

## 2.2 Phase I Concept

This drawing shows one possible design of the Phase I Pacsat payload. It is comprised of multiple VHF digital uplinks and a single UHF digital downlink. It will use the Pacsat BBS protocol as previously flown on several amateur satellites.



## 2.3 Phase I Design

The phase I Pacsat payload is based upon the AMSAT Golf programs RT-IHU design. This phase will take advantage of the Golf hardware design, software, layout, and testing. The RT-IHU design is a 92mm x 92mm 1U cubesat circuit board with 2 TMS570LS processors and 2 AX5043 digital transceivers. Pacsat will modify that design by removing one of the TMS570 processors and adding between 1 and 3 AX5043 digital transceivers. The design will provide a single downlink and multiple ( up to 4 ) uplinks. There will be a single link for communications and control from the satellite IHU. The uplinks will be in the 2 meter amateur satellite band and the downlink will be in the 70 cm amateur satellite band.

The RT-IHU Mram will probably need to be expanded beyond the current 512 kilobyte capacity. This memory will probably incorporate a filesystem for message storage. Downlink power amplifier and filtering and uplink preamp, filtering, and signal splitting requirements need to be determined.

## 2.4 Phase 2 and Beyond

Phase 2 Pacsat payloads will explore advanced communications protocols, improving the operation and reliability of the BBS system.

## Reference Documents

1. PACSAT Data Specification Standards, <https://www.g0kla.com/pacsat/dataspec.txt>
2. PACSAT Protocol Suite - An overview, <https://www.g0kla.com/pacsat/intro.txt>
3. Pacsat File Header Definition, <https://www.g0kla.com/pacsat/head.txt>