May 14, 2008
Volume 1, Issue 1

NAMASTE NEWS

An engineering project for AMSAT serving the Advanced Communications Package on Eagle and Intelsat ride-share.
http://www.amsat.org/namaste *comments: namaste-dev@amsat.org*

Getting Started

By Team Namaste

Namaste is a satellite ground station project supporting the advanced communications package (ACP) on Eagle and Intelsat. It's an all-digital microwave band transceiver that will allow for many flexible and fun communications features. The uplink is 5.6 GHz and the downlink is 3.4 GHz.

Eagle is AMSAT's high-earth-orbit satellite. The Intelsat project is a ride-along opportunity. This means that Intelsat carries our amateur radio payload into geosynchronous orbit, and would therefore handle the stationkeeping and other overhead tasks. In other words, AMSAT would be responsible for the communications package, and Intelsat would handle the rest.

Namaste is the effort to develop an earth station attainable by the average ham so that users can immediately take advantage of the audio, digital messaging, and video services that these satellite opportunities provide. Previous AMSAT launches have been mostly low-earth-orbit, which requires the ability to track the satellite as it crosses the sky in a relatively quick 10 minutes. A geosynchronous orbit, while much higher and therefore incurring larger path losses, does not require tracking. This makes setting up a ground station much simpler, which is an advantage in portable and emergency applications. There are many challenges to be met in the course of the project. This newsletter will outline some of them, including but not limited to financial, recruiting, and technical. Welcome to Namaste!

INSIDE THIS ISSUE

The Financial Challenge

By W5NYV

The commercialization of space changes things for the amateur satellite service. Free launches seem to be a thing of the past. When space launches are driven by business cases rather than run by the government or the military, the amateur satellite service must adapt.

This means that the price of launching a satellite can soar into the millions. Commercially, launches are priced per the kilogram put into orbit, with various orbits offered.

Currently, there are several major amateur satellite projects in the development and construction phase. They are Phase 3E (based in Germany), Project Eagle, and the Intelsat ride-along (both based in the United States). Project Eagle and the Intelsat ride-along are projected to cost many millions of dollars to launch.

Two areas of interest to various funding sources are education and emergency communications. Educational opportunities include being able to

Please see *The Financial Challenge* on page 3

Technical Challenge: MPE

By Team Namaste

One of the technical challenges addressed by the team is an RF safety evaluation. The FCC limits the amount of RF exposure that operators and members of the general public can legally receive. It is important to know how much RF energy is being emitted by a transmitter because the operator is responsible for safe operation.

In the case of Namaste, the baseline antenna is a half-meter dish. This antenna is the same type and size that many people use for satellite television, such as DirecTV.

Calculations show that MPE is exceeded in the transmitted beam produced by this type of dish.

With a transmit power of 10 watts and using an uplink frequency of 5660 MHz, the station will exceed MPE. In order to comply with FCC regulations, the operator must ensure safe operation of the dish by not pointing it at other people or deploying it in a way that people can wander in front of it. The RF safety evaluation document can be found on our website:

http://www.delmarnorth.com/namaste/Namaste_Bulletin_65_Worksheet.pdf

Technical Challenge: Link Budget

By Team Namaste

"It's all about the link budget."

A link budget is very similar to a financial budget. You add up all the gains. You subtract all the losses. If you are in "the black", then you have enough power to make contact. If you are "in the red" then you need more power, more gain, or less loss.

The link budget for communicating with a satellite has one really large item in the losses column, and that is something called path loss. This is the loss of signal that is due entirely to the distance that the signal has to travel. Path losses for Namaste are 195-200 dB!

How do you account for these losses? Well, it's a challenge, especially since the antenna and the power amplifiers for the spacecraft might be limited, and if you want to have a ground station that blends in with the modern reality of CC&Rs and antenna restrictions, then you have a limit when it comes to the antenna gain.

Please see *Link Budget* on page 5

"Halving the system noise temperature at the receiving ground station doubles the data rate."

A Station for Everyone

By Team Namaste

Who will use this ground station? We hope to delight two major audiences in the course of designing this ground station.

First, we want to excite amateur radio operators who want to have fun using microwave bands to talk through a satellite employing digital communications techniques.

Second, we want to serve emergency communications operators, who need a reliable, infrastructure-independent communications backup system in order to get their job done.

What do these two types of operators have in common? Both want the system to be easy to use. What do amateur radio operators want? They want it to be fun. What do emergency communications operators want? They want it to be easy and reliable.

The needs and wants of these two audiences supply the vision for the entire design process. This is a user-centered design, and we take user input seriously. That's why we need you to be part of the process.

Please participate by filling out the survey on page 4 in this newsletter and returning it to the AMSAT booth, or send your comments via email to w5nyv@yahoo.com.

We need your feedback, comments, and critique to make this project a success.

"Are you a member of AMSAT? Consider joining today!"

The Financial Challenge from page 1

demonstrate a real and accessible communications system over satellite.

Emergency communications support enabled by the ACP has gained some attention from various agencies in the United States. Funding sources are being pursued, but more are needed in order to finance the launch. A donation to AMSAT of any amount is greatly appreciated.

If you have ideas about how to finance the launches described in this newsletter, or contacts that can help with financing or give financial advice that you would like to share with AMSAT, please contact us and be a part of the next phase of the amateur satellite service!

How much do you think an all-digital microwave-band satellite ground station should cost?

What is your favorite operating mode?

What would be something about the ground station that would cause you to drop everything and run out and buy it?

If you were designing a ground station, what would be the most important features to include?

What should the ground station absolutely not ever do?

Have you ever contacted someone through a satellite link?

Should operating the station seem more like
(A) a telephone
(B) a 2-meter repeater
(C) working locals on HF
(D) working DX on HF
(E) chatting on the internet

Link Budget from page 2

So what does the link budget look like right now? Well, here is a simple conservative estimate.

K is Boltzmann's constant. Tsys is the system noise temperature. The noise power spectral density N0 = k x Tsys. This is the noise power per hertz of bandwidth.

Assuming 20W RF power at spacecraft, 18dB transmit gain at spacecraft, 195dB path loss for 3.4 GHz downlink frequency, and 22dB antenna gain at ground station, the RF flux received at the ground station is -142dB.

The proposed coding scheme is a rate ½ k=7 convolutional code, with a companion Reed Solomon (255, 223) on the "outside". This boils down to mean that the required energy per bit divided by the noise power spectral density is about 3dB.

The resulting downlink bit rate for a system noise temperature of 150K is approximately 1.5 Mbps. System capacity for this set of assumptions is approximately 100 simultaneous voice users.

With more power and lower system noise temperature, the data rates go up from there. Stay tuned for more results from the link budget analysis!

A link budget is the net result from adding up all the gains and all the losses in the system. Are you in the red or in the black? If you're in the red, you need more gain or less loss to make your budget and "close the link"!

The Components and Configuration

By Team Namaste

Every system can be divided up into parts. Namaste is no different. Here is a brief description of the parts and configurations currently envisioned for the ground station

Hardware. Consisting of an antenna, an outdoor unit that receives and downconverts the signals to baseband, an indoor unit that provides the baseband to the operator.

Software. All of the programming required to run the station. This includes software that the operator can build upon when writing his or her own applications.

Protocols. The rules of how the parts of the system communicate are called protocols. Namaste has many different protocols. Some should be very familiar, since they are the same sort of protocols that the internet uses to transfer data back and forth between computers. The main difference with Namaste is that the delay between ground station and satellite is so large. This means that the protocols might need to be adapted. Delay-tolerant network protocols are being researched and learned for this project.

Please see *Components* on page 6

"A protocol is the set of rules that allow parts of a network to communicate with each other. Agreeing on a protocol is a very important first step in systems being able to operate with each other. This is called interoperability, and is very important in emergency communications."

Project Namaste

www.amsat.org/namaste

E-Mail:

namaste-dev@amsat.org

Sit vis vobiscum!

Components from page 5

Bare-Bones. A configuration consisting of the indoor and outdoor units. Operator needs to supply the computer that will run the software.

Experimenter. A configuration consisting of the indoor and outdoor units as well as a processor and other peripherals designed to support programming and experimentation with the ground station.

Portable. A configuration designed to be portable. It's self-contained and easy to set up in the field.

Super-Portable. A configuration designed to be very lightweight and portable. It's self-contained and easy to use or drop into the field for emergency applications. This may be UHF/VHF and it may have to give up a large part of the feature set in order to be small.

Project Namaste

Future Volunteer
Street Address
City, ST ZIP Code