Edge of Space Sciences *Promoting Science and Education through Amateur Radio and High Altitude Balloons*

Stratosphere

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Winter Edition

Where is it?

by Larry Cerney, NØSTZ

That's question most asked by the casual observer during a balloon flight. With the fine team of Fox hunters we have developed over the last few years, we know pretty well where the balloon and payload are during the flight. But to know the balloons location requires a great deal of equipment, expense and windshield time. Windshield time to spread out six to ten teams of Fox hunters around several counties to be able to triangulate bearings taken every 15 minutes. While I haven't heard any complaints, I thought I would make use of some of the newer technology available on Shuttle II to determine where the balloon is anytime, give or take 30 seconds, during the flight.

Early experiments with LORAN-C on Shuttle I allow us to receive telemetry from the payload that gave us the Lat/Long and range and bearing from launch. LORAN-C had some good days and some bad days. But during this time I was working out the bugs in my own portable packet receiving system. With the maiden flight of Shuttle II with GPS onboard, I started to get some good feelings about being able to know where the balloon was any time during the flight. I would read the telemetry and get the range and bearing, get my plotter and map, set the bearing on the plotter, locate the launch point again on the map, position the plotter to get the bearing correct, measure up the mile marker on the plotter to mark the range, put a dot on the map and read off the X/Y off the EOSS grid. Nothing to it, unless your traveling at near the legal limit on a two lane state road.

I thought "there has to be a better way". Mike, W5VSI, had mention that there was an easy way to convert the range and bearing from the launch site to an X/Y position using Trigonometry and Vector Mathematics. After blowing off the cobwebs in that portion of my mind, and my Trig text books I was able to work out the formulas necessary to do the conversation. Next I needed to automate the process somewhat. I wrote a program to run under Microsoft windows to do the conversion for me. All I needed to start the program was the grid position of the launch site. I would enter that known position as KX and KY in my program. From then on, all I needed was range and bearing data from the payload and I could convert to EOSS grid location in a matter of seconds.

I chose to write the program in "C++ for Windows" so I could run a packet program in another window and switch between them. I've included the complete C++ source code at the end of this article for anyone to use and improve. I'll outline what the program does using the pseudo code below.

1. Do while the known position is correct.
2. "Enter the known position in the form of X,Y."
3. Check to see if the position is correct, if it isn't go back to step 1.
4. If the known position is correct, drop to next loop.
5. Do while do_again is yes.
6. "Enter range and bearing from known position."
7. Calculate X using ***X = range * (COS((90-bearing)*pi/180))+ KX*** the known X.

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Nets

The weekly on the air net is held on the Colorado Repeater Association's 147.225/825 MHz Repeater each Tuesday evening at 8:00 PM.

Internet Home Page

http://www.usa.net/~rickvg/eoss.htm

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Send articles for publication to the editor of *Stratosphere*:

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The pi/180 converts degrees to radians that the computer uses to do math. If you are going to work this out on a calculator, drop the *pi/180 and make sure your calculator is in the degrees mode.

8. Calculate Y using ***Y=range*(SIN((90-bearing))*pi/180))+KY*** the known Y.
9. Print out the current EOSS grid position.
10. Print "Do again with same know position?
11. Yes loops back to step 5, no drops to next loop.

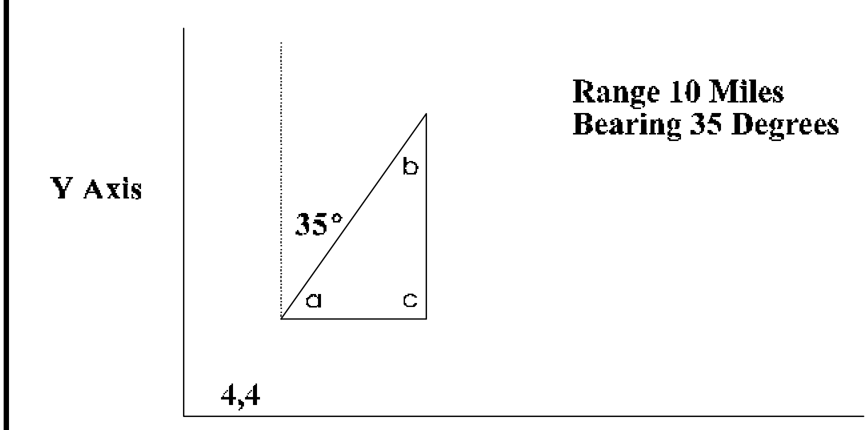

figure 1

12. Change known position?
13. While new_position is yes, loop to step 1. else quit program.

In the example figure 1, with a launch point of 4,4 and a range and bearing of 10 miles at 35 degrees, we can work through the formula to give us the X,Y coordinates. To find the X coordinate, we multiply the range of 10 miles by the cosine of the angle a plus the known X coordinate of the launch site. Here we would have X=10*(COS(90-35)+4 which equals 9.7. The Y coordinate would be Y=10*(SIN(90-35)+4 which is 12.2. So, with a range and bearing of 10 miles at 35 degrees from coordinates 4,4 would give us coordinates of 9.7,12.2 on the EOSS grid.

The reason for the 90- the bearing is, we need to determine angle "a" and the bearing is related to North. So, 90- the bearing gives angle "a" which is 55 degrees in this case. We use this angle "a" in conjunction with either the SIN function or the COS function as a multiplier to determine the X and Y coordinates.

The C++ program below (located on page 4) is not perfect. I'm not a programmer as any programmer who looks at the program can easily tell. I'm open to any improvements in the operation of the program. Feel free to modify the program for you use.

I hope this program will help share the ability to determine "Whereisit"?

A Quick Reference Guide for Interpreting NOSTS Status Reports

by Dan Feeback, KJ5MX and John Maca, AB5OX

(reprinted with permission from the CLARC Radio Amateur Gazette)

A firm launch date has been established for mid-February.	We hope to launch sometime before the end of August
Payload design and delivery schedules have been adversely impacted by unanticipated dificulties in acquisition of ancillary materials to support the payload engineering team.	We ran out of beer.
Power-up performance and payload integration testing was nominal.	Almost no smoke was observed.
An unexpected malfunction was observed during power-up of the 35mm camera subsystem.	The milliamp-level 3v camera circuitry was deep-fried when 12v was accidentally applied to it.
Launch site surface wind velocity is within the acceptible launch constraint window.	Winds at the launcch site are only slightly below level 2 on the hurricane intensity scale.
Contingency measures were implemented following premature hard surface contact and failure of the primary lift vehicle.	The backup balloon was inflated after the first one hit the ground and burst.
Real-time changes in upper air vector profiles have impacted the computer-projected flight path.	Get a boat and call the Coast Guard
Balloon and attached payloads are being tracked by experts from the CLARC payload recovery team using sophisticated state-of-the-art DF equipment.	KB5PGY is in the field with his HT.
Payload declination has far exceeded the computer-predicted ROD (Rate Of Descent).	The parachute failed to open.
GPS downlink telemetry is providing continuous two-dimention positional data.	We think the balloon is still somewhere over Texas.
Unforseen difficulties have been encountered in the location and retrieval of the payload at the targeted landing site.	We don't have even the slightest clue where it landed.
Payload search and recovery efforts were subcontracted to an organization more familiar with the projected landing area.	The Pearland hams found it by accident.
Inflight payload malfunctions are being reviewed by the postflight critical design review board.	We still haven't figured what went wrong.

Meetings

The monthly meeting of E.O.S.S is held at US WEST Facility at 700 West Mineral just west of Broadway.

Talk-in is on the 146.640/040 MHz repeater.

Meetings are scheduled for the second Tuesday of the month and they begin at 7:00 PM.

Wireless Cutdown Module

by Mike Manes W5VSI

Background:

FAR 101 requires a redundant, commandable balloon cutaway to terminate flights of all but exempt (under 12#) payloads. It's also desirable to cut the nozzle away after a small balloon bursts to prevent parachute fouling by the balloon's remains during descent.

In the past, EOSS has carried a hot-wire cutdown device at the parachute apex which melts the support line to the balloon. A long cable running down the shroud lines connected the cutdown relay to a Shuttle output port, while redundancy has been provided by a lawn watering timer driving a separate hot wire. Recently, EOSS added a load-sensing switch which initiated an immediate cutaway on burst to dump the nozzle.

The cable has proven problematic in that not only does it add weight, it must be slightly longer than the support and shroud line length. This challenge has proven daunting more than once. This prompted development of the Wireless Cutdown Module (WCM), where the cable is replaced by a VHF command receiver/decoder at the parachute apex. Cutdown commands are issued directly to the WCM from the ground station.

Technical Description:

The WCM comprises:

1. A recrystalled surplus Motorola Metrx VHF pager receiver. This unit is surprisingly sensitive and selective, and its range is enhanced via an external vertical dipole antenna. It is set to operate on the 144.34 command/telemetry narrowband FM channel used by the EOSS Shuttle to allow cutdown commanding not unlike the familiar Shuttle command process. With only minor retuning, the receiver produces decodable DTMF tones down to 1 uV at the antenna input. It operates from 1.5 Vdc at 2.8 mA, and cost $10 plus $9.50 for a crystal.

2. A controller based on the Parallax Basic Stamp computer. Received audio is processed through a 5 db gain bandpass amp for delivery to a Harris 22203 DTMF decoder chip. The data available signals from the '203 are lowpassed to 100 msec before delivery to the Stamp, along with 4-bit de-

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coded data. The Stamp also inputs the state of the load sensing switch to provide immediate cutaway, when armed, on balloon burst. Stamp outputs include a relay driver and piezo beeper. A 1.5 V regulator is included for the receiver. The receiver & controller draw about 13 ma from a 9V alkaline transistor radio battery.

The Stamp software is written in a form of BASIC and executes on powerup from a 256-byte serial EEPROM. The Stamp is the 2nd generation 14-pin SIP version. Software provides for remote arming and disarming the load-dump cutdown, as well as an immediate cutdown command. Each command is a unique four-key DTMF sequence following a minimum 2-second period of no detected tones. The piezo signals the end of the 2-sec idle period (4 beeps) and successful command delivery via a 1 to 3 beep burst. The relay is pulled in for a maximum of 10 seconds, except that relay activation is terminated upon sensing load release following an immediate command while loaded.

3. A relay which delivers about 4A from a 6V Li battery to a 1.5" length of nichrome wire wrapped around the nylon balloon load line. The beeper is provided for preflight checkout. Although the entire system could operate from 6V, the Li voltage pulls down to less than 4V when driving the wire, which would reset the Stamp. A power switch in the +9V line provides for simple preflight prep and disarming on recovery.

4. A load sensing switch, donated to EOSS by veteran ballooner Norm Kjome of U. Wy., is a rather stout 50-gram machined aluminum structure which is mounted in the support line between the balloon and the payload. Tension loads over 8 lbf compress an internal spring and releases the plunger on a microswitch. On load dump, the plunger is closed. A connectored harness delivers the NC switch contacts to the WCM electronics.

5. All components are except the cutdown wire and antenna are contained in a 4-inch cube foamcore housing. The housing is supported by the removable load sensing switch, accessible via a velco-secured door. The WCM door also provides access to the power switch and both batteries. The balloon and payload support lines are tied to each end of the load switch and exit through slots in the housing top and bottom. The balloon line carries the hot wire, which plugs into a connector on the end of a cable emerging from the housing.

Current Status:

As of this writing, the WCM is undergoing coldsoak testing in a freezer in preparation for its maiden flight, EOSS24, tomorrow AM. Except for used 9V battery dying after 3 hours, all appears to be working well. By the time you read this, some of the following procedural recommendations may have changed. Then again, we might get lucky!

WCM Preparation:

Before flight day, four steps should be taken:

1. Replace the 9V battery; it's cheap insurance
2. Perform a functional command check using an HT and a dummy load.
3. Replace the hotwire if it appears damaged or brittle; use #30 AWG nichrome, readily available from some discarded hairdryers.
4. Check the 6V Li battery. If it doesn't drop under 3.5V under a hotwire load, it has enough energy for another burn.

If deemed necessary, the command codes may be changed easily using the PC-based Basic Stamp development system. Be sure to test the new codes and list them for the ground station!

Preflight Operations:

After the cutdown switch and hot wire are past the rough & tumble of integration, the switch is inserted into the WCM and its connector mated, (or is the WCM wrapped around the cutdown switch?), and the hot wire is plugged in and secured with Kapton tape.

In the meantime, the rest of the WCM has undergone separate command testing from the ground station, both via the piezo response and verification of power delivery to the hot wire connector. Of course, the module is disarmed before connecting the hot wire, since the load dump will be sensed until the flight string is aloft. If this precaution is not observed, the burnt line can be replaced quickly, however. Disarming may be performed either via radio or by cycling the WCM power switch. The piezo will verify this action in either event, although the door must be open to hear it clearly. The door closure should be double-checked before launch, since it secures the WCM to the flight string. At this point, we're ready to fly.

Inflight:

Whether the WCM is armed for load-sense cutdown or direct cutdown depends on mission requirements. Typically, we like to go as high as possible, i.e., to burst, but if the balloon is rigid, or the upper-level winds appear to carrying the payload too far or into the mountains, an immediate cutdown command may be issued. In any event, it is prudent to delay arming until the flight is well aloft and above jet stream turbulence before arming the load sense release. The switch is sampled at 50 msec intervals, and once armed, even a transient load-dump indica-

Program File from "Where is It"

```
// GRIDLOC.CPP is a program to convert bearing and range from a known location
// and return an X,Y coordinate for using the EOSS grid.

#include <iostream.h>
#include <iomanip.h>
#include <math.h>

void main()
{
     const float pi=3.141592654;   // Constant PI
     float KX=0;     // Known X coordinate
     float KY=0;                    // Known Y coordinate
     float x=0;               // Calculated x coordinate
     float y=0;        // Calculated y coordinate
     float range=0;  // Range from Known position
     float bearing=0;       // Bearing from Known position
     char kpos_ok;  // Known position O.K.
     char do_again = 'n';       // Another way to define "n"
     char new_pos = 110;       // 110 is ASCII "n".

    do {
          do {
               cout << "Enter the known position in the form of X Y.\n";
               cin >> KX >> KY; // input known position in the form of X Y.
               cout << "\nThe position you entered is " << KX << "," << KY;
               cout << " is this correct? y or n\n";
               cin >> kpos_ok; // input y for yes or anything else for no.
          }while (kpos_ok != 'y'); // enter y to fall through loop.
          do {
               cout <<"Enter range and bearing from the known position. \n";
               cin >> range >> bearing; // input range and bearing
               x=range * (cos((90-bearing) * pi/180)) + KX;
               y=range * (sin((90-bearing) * pi/180)) + KY;
               cout.precision (2); // set output to two numbers. ie: 6.3 or 38.
               cout << "\nThe grid location is "  << x << ", " << y; // EOSS grid location
               cout << "\nDo again with same know position?    ";
               cin >> do_again; // input y or Y for yes or anything else for no.
          }while (do_again == 'y' || do_again == 'Y'); // enter y to go through again.
               cout << "\nChange known position?  ";
               cin >> new_pos;     // input y or Y for yes or anything else for no.
     } while (new_pos == 'y' || new_pos == 'Y'); // a y takes you back to start. Else quit.
     cout << "\nProgram Ended.........";
 }
```

tion will initiate a cutdown. As a rule, load dump shouldn't be armed until we've achieved at least the minimum desired altitude.

Past experience indicates that balloon release occurs within two seconds of command acknowledgment by the Shuttle, and these commands close the relay for 10 seconds. Keeping the wire hot for any longer simply burdens the Li battery unnecessarily and risks its overheating and damaging the controller. So we've maintained the 10-second limit.

If the WCM is armed, when load dump is detected, a 10-sec burn will ensue, and the unit is then disarmed to prevent repetitive burns. If an arm command is inadvertently issued, the WCM may be disarmed via ground command. Arming is not required for execution of an immediate cutdown command, however.

However, when an immediate command is issued, and a load is still sensed, then wire power is applied in one-second intervals until the load is dumped, for a maximum of 10 seconds. If the load already appears dumped on receipt of an immediate command, a full 10-sec burn is delivered, since load release is no longer detectable. This may be used to overcome a load switch fault or to deliver a longer burn, if necessary.

Postflight:

Upon recovery by the daunted EOSS Lost & Found Dept., the WCM is easily disabled by peeling the velco, opening the door and turning off the power switch. At this point, the WCM may be removed from the flight string by disconnecting the hot wire from its connector and removing the cutdown switch along with both support lines.

Postscript - 12/5/95

The WCM did fly on EOSS-24 in conjunction with the Central States VHF Conference this summer. We decided to arm the Load Dump cutdown mode rather than to command the cutdown. This would maximize altitude. Further, the ATV antenna fell away at about 45,000 ft in ascent, so we couldn't get immediate visual confirmation of a commanded separation.

Unfortunately, the WCM failed to cut the balloon away. A postmortem revealed that the Kapton "space tape" used to secure the hot wire to the nylon support line had lost it's grip, and one end of the wire had broken away from the connector. The nylon under the wire appeared slightly scorched, however. Whether the post-burst turbulence did its work before the WCM could do its job is still unknown. So we tossed this into the "unconfirmed failure" category.

Incidentally, the same outdated, surplus Kapton tape was used to "secure" the ATV antenna. A valuable lesson was thus learned, and EOSS has since invested in a nice, fresh roll.

The next test flight comes up this month, with EOSS-25 riding along on another USAFA 250K balloon. The Academy has its own cutdown, but we'll carry the WCM sans hotwire along just for test anyway. The software has been modified to add a new command-counting mode. Every time a valid command is received, a counter in the Stamp's non-volatile EEPROM is incremented, and that count is read out as a series of beeps on power-up. The beep count equals the command count plus one. This counter may be reset to zero (one beep) by a new, 4th command.

By the time this Strat goes to press, we may have a report on how the WCM fared on EOSS-25.

President's Corner

By Merle McCaslin

Talk about time going by in a hurry. We realized at the November meeting that our group is five years old with the first flight in November of 1990 with the local Amateur Television Group. That first launch was very smooth with no wind. The balloon went straight up like a flag pole and made this balloon thing seem easy, but we had a lot to learn. We have had 24 flights, some of them twice, and tried very hard to get number 25 up in December; working with Gil Moore and his Air Force Cadets at the academy, but it was not to be. This flight is now scheduled for February third 1996.

This year we got four flights off the ground and one of those was a piggy back ride with the Air Force Academy on a 250 thousand cubic foot balloon. This was a new experience. The balloon floated at 110,000 feet for several hours. We had a crossband repeater in the flight train and got good reports from neighboring states. The same day we launched a 19 thousand cubic foot balloon with a experiment from Colorado University Colorado Spring on board. The other two flights were with our normal 1200 gram weather balloons. One was launched from Jim White's place 10 miles east of Parker, CO, and the other was for the Central States VHF society launch from NAVSYS Corp site south of Monument CO. Every flight is still a new learning experience of some kind.

EOSS HAS CONTACTS IN FAR AWAY PLACES I have received several interesting letters and e-mail the last quarter. I am amazed at the distance some of our correspondence travels. One letter is from John Coppens 0N6JC/LU from Casilla de Correo, Argentina. John was invited to give a short talk on the subject of balloons and experiments in the southern most city of the world, Ushuaia some 3000 km south of his home QTH. I also received e-mail that the Subj. was Greeting from the arctic. Rainer Liliskhkis is the station manager for the German arctic research station in Ny-Aalesund, Spitsbergen. which is the northern most permanent settlement in the world.

The following is some of John's letter written in Sept.

"A few weeks ago, we (almost) miraculously recovered a payload, launched in March this year, which disappeared after the parachute broke off at 8000 meters during the fall. Thought the recovery team was waiting on the right spot, the load come down too fast 120 km/h) and stopped transmitting when it hit the ground. Anyway, we did recover everything and the electronics seem to be ready for another trip. But most important, we recovered the camera, and its film, and the results were quite spectacular, especially taking into account the quality and price of the equipment. (About $25. The camera had a motor to advance the film, and we added a home brew electronic shutter) I include an example of a photograph taken from a height of 18000 ft of the end of a highway surrounding the city of Cordoba. In total 18 pictures came out well. probably the rest of the film was black because of radiation higher up."

John also joined EOSS and ordered our handbook. He is the second EOSS member from Argentina. Gustova Carpignano is the other member, Gustova was in USA this summer and came to Littleton and a group of us had dinner with him. It was great to meet him after exchanging e-mail with him for sometime. Gustova said that they never recover their payloads. They have a wide river near them and the payloads always land in the river.

Here are some parts of Rainer's letter from the arctic.

"Subject: Greetings from the arctic!

Hi Merle!

Nice to get some feedback to my message, I hope it has been good for you. Yes, I do fly balloons. It is one of my jobs. I work as the station manager for the German arctic research station, here in Ny-Aalesund, Spitsbergen. One of my daily routines is to launch a weather balloon. Now as it becomes winter we are getting more and more into atmospheric physics and chemistry again. Our main focus is on ozone-depletion. Next to balloon-soundings (again) we run a couple of other instruments to remote sense almost the whole variety of all trace gases connected to ozone depletion including stratospheric aerosols that make catalytic surfaces. We are carrying out test-flights for different developing teams in Japan and in the US. Mainly ozonsondes again, but with different balloons. The routine balloons are TOTEX TA1200 rubber balloons whereas *the test-flights are normally carried by RAVEN plastic-film balloons. Last year we had the luck to perform the highest ever balloon-flight for the arctic when a 5000m3 plastic balloon carried the payload as high as 43.7 km. (And than it kept traveling instead of bursting until the batteries went weak.) Yes, that is in short, what I am doing with balloons. For the moment I try to establish an amateur radio station here as well. But that seems not too easy, we have a lot of equipment that interferes and, we have a lot of aurora. So, if you are curious to get to know a bit more about the station, there is a www-page about it: http://WWW.AWI-Bremerhaven.DE/AboutAWI/Koldewey.html it is not too nice, but it contains at least two pictures, one of the town, which is the northern most permanent settlement in the world, and one of the main station building.*

with arctic greetings yours
Krainer
e-mail: lili@awi-koldewey.no

That is an example of a couple of piece's of traffic we received as well as e-mail from Oliver Welp in Germany who was getting ready for their third launch. He stated anyone from EOSS who visited Germany would be more than welcome to visit him and his group. Several others individuals and clubs around the USA and Canada contacted us for information and membership.

EOSS election will be held at our regular meeting on February 13th.

Helium Not Something to Fool With

By Merle McCaslin, KØYUK

The following article was in an Ann Landers column a few weeks ago. I don't usually read her column but when I saw the above headline it caught my attention. The following is part of an article written by a 15 year old in answer to a question someone else wrote about the safety of helium in party balloons for her children.

I read in the paper that a guy died from inflating helium balloons in the back room of a restaurant. This 20-year-old was showing a 17 -year old girl how to fill the balloons with helium for her birthday party. They began to horse around, taking "hits" from the tank. After only the second hit, the guy fell to his knees and passed out. He died a few minutes later "massive pulmonary hemorrhaging."

I realize that people of all ages operate these tanks. I have seen kids my own age working in stores using them to inflate balloons. The common perception is that helium is fun and relatively safe. The compressed gas in the tanks can be deadly.

A local medical examiner reported that the 20-year-old guy literally "blew his lungs out." Everyone in my town was shocked by the tragedy. I hope people who use these machines at work and for parties will realize how dangerous they can be. — S.C., Newburyport, Mass."

A "Rocky Mountain High" Balloon Launch

by Joe Lynch, N6CL

(Ed note:This article appeared in the October, 1995 issue of CQ Magazine and we reprint it with the permission of CQ and the Author, thanks!)

As part of the 29th annual Central States VHF Society Conference, the Edge of Space Sciences, Inc. organization planned to launch its 24th balloon, EOSS 24, at 9:00 AM on the Sunday morning of the conference.

Founded in 1990, EOSS, the Colorado based organization, now has around 75 members who have enthusiastically launched and chased balloons across parts of Colorado, Wyoming, Nebraska, Kansas and Oklahoma. Most of these launches are designed to get people interested in amateur radio. Often the launches take place on public school grounds and involve the faculty and students in on-board experiments. However, a few of the launches were made with the cooperation of the Air Force Academy.

Because of funding cuts, the academy has had to restrict some of the cadet-based experiments that would have been flown on board aircraft. Having the training from EOSS and the balloons as an alternative has enabled the cadets to continue to fly their experiments.

It was about 8 AM local time in Monument, Colorado on that Sunday, when your editor arrived at the launch site. The sky was partly cloudy and a very slight breeze was blowing - conditions just right for a balloon launch. Members of the launch team had been at the site since before dawn. Now, less than an hour before launch, these team members were busy scurrying around making last-minute preparations for the launch.

Launch Director Nathan Roskop, W0WPG was busily checking every aspect of the launch, making sure everything was ready for it. Barely 20 years old, Nathan has been licensed as an amateur for just over two years. He has been a part of five other balloon missions. Having volunteered to be launch director (the prime consideration) and having been determined by his peers as qualified for the responsibilities of the position, Nathan was appointed to direct this, his first launch.

On board, or rather attached to EOSS 24, would be a 70 cm in, 2 meter out 300 mw repeater, an ATV (amateur television) transmitter (operating on 426.250 MHz), and a 1 watt packet station to retransmit GPS (global positioning system) coordinates received by the on-board GPS receiver and other telemetry. Additional equipment on board would be a 35 mm still camera set to shoot a picture every five minutes, and an experiment. The experiment was designed to see if a quick cut-down of the payload from the balloon could be achieved by sending a signal to an on-board receiver. All of this equipment would weigh in at just less than 6 pounds in order to qualify for the FAA (Federal Aviation Administration) exemption from regulatory control.

The balloon would travel to a maximum altitude of approximately 100,000 feet, where its expansion would cause it to burst, thereby causing its descent. The descent would be slowed by the parachute attached just below the balloon andy above the payload.

With excellent weather conditions, and the FAA and the control towers at Colorado Springs, Denver International and the Air Force Academy airports notified of the balloon launch, everything was set for its take-off.

The balloon was slowly inflated with helium to its proper lift weight. Again Nathan checked every aspect to make sure that the balloon was ready. The last items checked were the on-board transmitters and repeater, and that was done by on-air confirmation that the equipment was indeed working.

Finally, at 08:58:16 AM Nathan gave the word to release the balloon. As the balloon went soaring into the sky, the transmitters on board continued their missions of repeating signals, and providing telemetry and visual indications. A net control was set up to operate through the on-board repeater. As stations started checking in, the net control station operator started coordinating these check-ins, giving priority to stations that were at some distance from the balloon. In addition to the balloon repeater, a 2 meter, 70 cm repeater was linked to the balloon repeater input frequency so those who did not have access to 70 cm would still be able to work through the balloon repeater.

About 15 minutes into the launch the ATV signal was lost. It would remain to the recovery of the payload to solve the mystery of why it was lost.

At the same time operators who were tracking the balloon began chasing it northward on a crisscross pattern that generally stayed close to Interstate 25. Your editor was with Jerome and Bobette Doerrie (K5IS and N5JDH respectively) and their two daughters, Jennifer, KA5WMH, and Elena, KB5DAK. We decided to follow Jack Crabtree, AA0P, who was tracking the balloon's progress by using its GPS data along with data from a GPS receiver in the car and his laptop computer. Also with us in their own car were Charlie and Wanda Chennault (WA5YOU and WB5NIF) and their son and daughter, Nathan and Jamie.

As one of the founders (along with Dave Clingerman, W6OAL) of the EOSS organization, Jack has been on most of the 23 other balloon launches. Before we started, he pointed out to us that to this point they had a 100 percent payload recovery after each launch. He wasn't about to let this one get away and spoil the record. So off we went to help Jack and EOSS preserve it!

Beginning our trek up I-25, we followed the zig-zagged route of the balloon. Along the way we each made contacts through its repeater, I with fellow section manager, Joe Knight, W5PDY, who was in Albuquerque, New Mexico. Because of the extended altitude, so extensive was the range of the repeater that stations from New Mexico to Wyoming were now checking in and making contact with each other.

At one point we stopped to see if we had a visual contact with the balloon as it reached its maximum altitude. Now nearly 40 feet in diameter, it was barely visible to the naked eye at its height of over 97,000 feet. Shortly after this visual contact, the balloon burst and the payload began its descent.

Knowing that the descent would be much quicker than the ascent, our pace quickened. Stops became more frequent as we determined our location in reference to the rapidly falling payload. From burst to landing, we had 15 minutes to predict its touchdown point and get to it.

Arriving southeast of Castlerock, we spotted the bright-red parachute against the clouds in the sky. After we moved closer to where Jack had predicted touchdown, we stopped the cars, jumped out, and ran in the direction of where we spotted the parachute. Wanda set up her tripod with her very powerful long-range lens in order to take pictures of the parachute's descent, and I ran up a road to watch the descent. Spotting a grove of trees about two miles in front of me, I watch as the parachute finally disappeared behind the grove. I made a mental note of approximately where in the grove I had last seen the parachute.

Nearly four hours later, at approximately 11:55 AM, the payload was on the ground. After following a crisscrossed path northward, it landed approximately 23 miles from its launch site. Because the packet transmitter was still functioning, we could still get a fix on the position of the payload based on the GPS coordinates the packet station was retransmitting.

Back in the cars we drove south along a small hill range. Finally getting in close proximity to the balloon's position, we found that we would have to hike in to the landing location. And, hike we did, over two hills!

About the time we arrived at our location Mike Musick, N0QBF, from Missouri, also arrived. Parking a bit farther south from us, Mike began his hike. Using his handheld receiver, he began to use direction-finding techniques to locate the signal still coming from the repeater. While I took off for my grove of trees, Jack spotted Mike and joined up with him.

After going over the two hills, I spied the trees. Using Boy Scout survival techniques I learned 35 years before ("Where am I and how do I get out of here?"), I positioned myself sough and to the west of the trees as I had seen them before on their north side. I began walking away from the grove all the while keeping my position relative to the grove.

I found myself walking up a valley toward a "V" in the terrain with the last hill that I had traversed continuing to be on my right (west) and another hill beginning on my left (east). About three-quarters of a mile in from the grove I spotted Mike and Jack on top of the west hill. They pointed down the hill toward a smaller grove of trees, indicating to me that they had spotted the parachute.

Trees in front of me obscured my view, but taking their cue, I continued to walk sough, in the same direction that I had been going. Coming across a dirt road, I followed it right to the rope connecting the parachute to the payload at about the same time that Mike and Jack arrived from the west side.

Mike won the prize for having first spotted the downed payload. However, I was a bit pleased with myself, that, with a little luck, it is possible to recover the payload without a radio signal, if it's necessary.

Knowing that a film crew from Grove, Oklahoma Channel 43, UHF TV station was behind us, we left everything intact. Finally, Tony Bickel, K5PJR, and his cameraman, Jean Bohannan arrived and shot their footage, which they had planned to make available for public televisions across the country.

Upon inspection of the ATV payload, we discovered why we had lost the ATV signal. The antenna was gone! Also gone was the coax connecting it to the ATV transmitter. Jack surmised that the extreme cold of the altitude (-50 degrees C) destroyed the connector or the antenna mounts, causing the antenna to fall off.

We also discovered that the cut-down experiment failed to work properly. When the signal was received, it would cause a circuit to be completed causing a voltage to be placed across a wire coiled around the rope connecting the balloon to the parachute. When the wire heated, it would burn the rope, thereby cutting it and releasing the parachute and the payload from the balloon.

While there was some burn discoloration of the rope where the wire was coiled around it, the rope was still intact. Initial conclusion of the probably cause of the failure was low battery voltage. Battery voltage in most batteries can drop to zero if exposed to the extreme cold of the altitude. It would remain until the payload was examined by the team several days after the launch to determine the exact cause of the failure of the experiment.

Finally, after everyone had taken all the required pictures, we disconnected the payload from the parachute, secured everything, and began our trek back to our cars. Arriving to what had now become a mini hamfest, we determined that we would have a postmortem lunch at a nearby restaurant, amateurs' usual perfect end to a fun outing.

What does it take to launch a balloon? Upwards of 10 to 15 people are necessary at the launch site. It takes four to six people to get the balloon inflated. Additionally, it takes a couple of others to keep the payload in line as the balloon is alighting. Depending on how many radios are on board, it takes an operator to man each of the ground based receivers.

Chase teams can be as many as are practical to follow this airborne fox hunt. For this EOSS launch approximately ten chase teams took off looking for the balloon. Accompanying several of the teams were spectators who were from the conference and wanted to see results of the launch.

If your organization is interested in ballooning, how would you go about putting together the necessary information to find the resources? Jerome and Bobette Doerrie have written an excellent introductory article, *"Ballooning 101,"* which was published in the *Proceedings* of the *ARRL 1995 National Educational Workshop*, which was held July 28, 1995 at the Manchester, New Hampshire hamfest. Copies of the *Proceedings* may be purchased from the League for $12.00 plus shipping (to: 225 Main street, Newington, CT 06111).

My thanks go to Jack Crabtree and Jerome and Bobette Doerrie for their assistance in preparing this topic in this month's column. For more information on Jerome and Bobette's article, contact them at Rt. 2 Box 72, Booker, TX 79005, or call them at 806-659-2264. For more info on EOSS, contact Jack crabtree at 4327 W. Bellewood Dr., Littleton, CO 80123, or call him at 303-795-7736.

Submissions to the *Stratosphere*

Stratosphere welcomes any and all articles pertaining to High Altitude Ballooning and Amateur Radio.

Submit your article in a computer readable format. We prefer text files be submitted in plain ASCII. Most formats of graphic files and gray scale photographic images are supported. If you are in doubt contact the Layout Editor.

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