

March 29, 2000

Mission to Dominican Republic, March 18-26, 2000

Staff:

Technical Communications: Norman Stewart

Physicians: Dr. Timothy Broderick, Dr. Jay Yelon, Dr. Hector Simosa,
Dr. Michel Aboutanos

Anesthesiologists: Michael Estes, Rick Frederick, Margaret Hallisey

Nurses: Donna Neatrou, Tina Tignor, Kelly McGowan

Peace Corps Volunteers: Luke Szymanski, Mathew Zunestein, Heather Stewart,
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Goal:

During this mission, our goal was to provide surgery and medical care at the Hospital of Samana, Dominican Republic. Test beds such as this allow us to fully assess the feasibility of sending live images over low-bandwidth connections with today's H.323 video conferencing applications like CuSeeMe, NetMeeting, etc. The team connected by a point-to-point method and multipoint server via the Internet. This enabled patients to be monitored from a remote clinic, (in this case VCU) for diagnosis of the patient. Once the data was collected from the patient to populate a database, a collaborating surgeon shared database tools and whiteboards during a live videoconference.

Saturday, March 18:

The team arrived at Puerto Plata Airport at about 2:30pm, Dominican Republic time. The team was able to get our equipment through customs without any resistance. At approximately 3:30pm, Dr. Payano, Mr. Santiago, and Maxwell greeted us just outside the terminal where our equipment was loaded into two pickup trucks. Dr. Hector Simosa accompanied the driver Santiago, while Micheal Estes rode with the other pickup truck driver. Dr.'s Timothy Broderick and Michel Aboutanos rode with Dr. Payano, and the rest of the team rode in a minivan driven by Maxwell. At about 7:00pm the team arrived at the Hospital of Samana, where I made a quick site survey to confirm Brett's earlier findings. After all the medical equipment was secured in a room adjacent to the OR, we went directly back to the hotel for a late dinner followed by a night's rest.



Sunday, March 19:

The team awoke at 6:30am; 5:30am eastern time, and I could really notice the difference! The team had breakfast and met the Peace Corps volunteers in the lobby of the hotel. They all loaded into the back of Santiago's truck and began our day at the hospital.

When the team arrived at the hospital, we were greeted with cheerful applause by the patients waiting for consults. We met several individuals from the Administration Department of the hospital along with members of the Rotary Club. They expressed how much they appreciated what we were doing. Michel translated our response to them.

We all knew what we had to do, and we split up as if it were rehearsed: the doctors did their consults with the patients, and the nurses prepared the supply room, while simultaneously setting up both operating rooms. The sterilization equipment was checked to make sure all the surgical tools could be properly sterilized after each operation.

The team of anesthesiologists went into action to set up their equipment and make sure they had appropriate ventilation. There was only one way of accessing the OR with the ventilation tube, and that was through a small opening at the bottom of the AC unit located in each OR. The opening had to accommodate not only their ventilation tube, but my cabling as well. This wasn't an easy task! One of the openings with the AC unit was located on the same side as the parking lot. This option was out of the question, as the Dominicans had never seen the satellite dish before. I was concerned that natural curiosity would draw observers close to the dish, causing harmful radiation exposure. There had to be a minimum of 10 feet in distance for individuals to be safe. This meant that the satellite dish could not be placed on the sidewalk or a table, allowing for someone to walk directly in front of the apparatus.

I decided to place the satellite on the roof of the hospital, and out of site to curious individuals. I inspected the site for a proper method for running the telephone wire from one end of the building to the other. I made sure that the wires could be routed in a fashion so that they wouldn't be disturbed. The only way to do this was out a window at the far end of the hospital, as Brett and I discussed back in Virginia. The cable would then have to run over the roof of the hospital and down the rear wall into a hole which, I believe, was about $\frac{3}{4}$ " of an inch. This hole was already accommodating the ventilation tube, and it also had to accommodate my cabling. I asked for a wire hanger to snake it through the opening, which wasn't an easy task. In the end, however, everything worked out. I could place the M-4 (satellite dish) on the roof of the hospital, leaving the cable snaked through the wall to save time. This left about 1 ½' ft of antenna cable inside the OR for the M-4 terminal, which meant that I had to get a high enough table to place the sat-phone on along with the R.D.T.U.

The M-4 had to be brought up to the roof everyday. With the aid of two Peace Corps Volunteers, I was able to position the M-4 with the satellite connection and lock it to the wall of the hospital. The satellite was also accompanied on the roof by the

Defcon1 motion sensor alarm detection unit to allow for security surveillance while I was inside of the OR.

After everything was connected, it was time to make the RDTU connections via sat-phone and POTS (Plain Old Telephone Service) with the hospital's new Internet account. Dr. Conception supplied me with the login information, and I was able to configure the R.D.T.U with the settings for their I.S.P. (Internet Service Provider, not to be confused with Inmarsat Service Provider, which uses the same acronym). During my first attempt, I didn't receive any dial tone, which meant I had to check all of the connections from the wall jack located at the opposite end of the hospital to the tip of our custom-made cables along the roof. It turned out that the problem resided in one of the couplers connected to the custom cables on the roof. On the second attempt, I was successful at 52kbps (remember, a 56k modem can theoretically receive data at a rate of 56k downstream but can only send at a maximum of 33.6). I then went to our contingency plan, which was to use the M-4. The first connections were a little troublesome, but were later successful. After confirming that I could get a voice call through, I focused on making a test connection to the Internet. I was able to browse several different websites and make a connection to our MeetingPoint server. At about 6:00pm, I packed up the R.D.T.U. and the M-4 and went back to the hotel.

Monday, March 20 (Surprise connection):

At about 7:45 am we arrived at the hospital. I did my usual routine of setting up the M-4 and getting dressed into scrubs. I asked Luke to take pictures of the surgeries while I was making the connections via POTS and SAT since he was so fascinated with how the digital camera worked. I made another successful connection via POTS and decided to test it with the Teamstation in Dr. Merrell's office. Once connected, I then called into Dr. Merrell's small conference room. I assumed that no one was there except for Ms. Doris D. Farquhar and made a successful connection to the Teamstation via IP. Dr. Broderick and Michel Aboutanos were ready for me to run my tests with the Laparoscopic equipment.

At approximately 8:30am, I made a phone call to Ms. Farquhar, and asked if she could assist me by going into the small conference room and verifying the images for me. Little did I know that what I thought was happening on Tuesday was happening today! Dr. Merrell greeted me, but the audio was garbled. He said that the image appeared to be black and white, which was also showing on my local monitor. I could only assume that it was either the actual dongle connection made between the S-VHS end on the adapter and the PCMCIA card, or that it was the female/female adapter for S-VHS cable causing the color to be lost. I called him up via sat-phone, since at that given time there wasn't any working phone in the OR. Dr. Yelon spoke with Dr. Merrell, who confirmed that part of the cystic duct could be identified although our video was pixilated.

However, I determined that there was too much information for the image to be processed quickly while the camera was moving rapidly over a standard phone line. I then lost the connection abruptly. I tried to reconnect, but I received a message from the phone company telling me that the number I dialed was incorrect and to please verify the phone number. I did so by using one of the hospital's phone extensions and dialing the

I.S.P number. After hearing the modem tones, I confirmed that I was in fact dialing the correct number. Troubleshooting the line took a larger portion of the day as I attempted to find another line out of the hospital and called Codetel.

At about 11:00am, Michel asked me to take a picture of an X-Ray off a light box and FTP it to our server. When I tried via satellite, the computer locked up frequently and I was unable to do so. I proceed on by asking the Peace Corps Volunteer to translate what I needed to say to Dr. Conception. I told him that he needed to get in contact with Codetel and ask them if they could straighten out the hospital line problem. I tried the line again to make sure that the line had not been repaired. Of course it hadn't been! I then asked the translator to confirm whether or not Codetel had been contacted, and Dr. Conception responded that a group of line technicians would arrive at about 3:00pm. I spoke with Dr. Merrell, explaining to him that I would be trying to reconnect, and that the phone line was dead. This left me no choice but to dial up via sat-phone.

Later that morning I proceeded on with the Internet connection via satellite. I made the connection to Brett's machine, where we did several tests that involved testing image and audio quality. While all this was taking place, I was transferring images taken by the Olympus to the R.D.T.U. The first attempt by the serial cable was too slow and resulted in an intolerably high use of system resources. I then used the Camedia floppy disk adapter, which seemed to achieve a higher rate of transfer while freeing up system resources. Brett did a couple of trace routes to me where I timed out on him.

Actual trace route: from Brett's desktop in Virginia.

1	128.172.120.254	0	
2	128.172.100.22	0	iridium.cns.vcu.edu
3	128.172.15.1	1	titanium.cns.vcu.edu
4	128.172.21.253	5	atlanta.cns.vcu.edu
5	192.70.138.193	16	sprint-7507.a1-0.1.networkvirginia.net
6	144.232.189.141	15	sl-gw9-rly-0-2.sprintlink.net
7	144.232.7.253	12	sl-bb12-rly-6-0.sprintlink.net
8	144.232.7.218	14	sl-bb3-rly-0-0-0.sprintlink.net
9	204.6.118.189	14	
10	38.1.10.5	17	se2.isc.us.psi.net
11	38.1.25.203	13	rc11.se.us.psi.net
12	38.1.45.228	21	
13	38.20.27.113	23	richmond8.va.isdn.psi.net
14	TIMED OUT		
15	38.30.130.115	977	ip115.richmond8.va.pub-ip.psi.net"

I then did a trace route to him. It was successful!

Actual trace routes: from the R.D.T.U

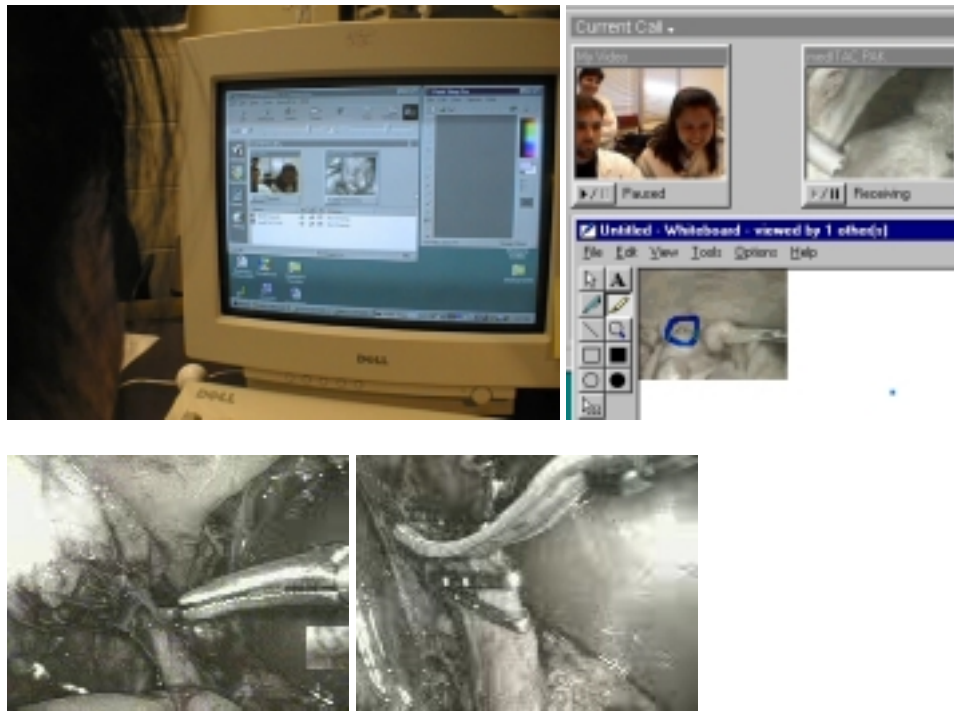
1,	38.1.1.1,919ms,	38default-gw.psi.net
2,	38.20.21.1,916ms,	None
3,	38.1.45.11,923ms,	rc11.se.us.psi.net
4,	38.1.25.193,931ms,	rc1.se.us.psi.net
5,	38.1.10.28,928ms,	None
6,	204.6.118.190,925ms,	None
7,	144.232.7.217,925ms,	sl-bb12-rly-0-3.sprintlink.net
8,	144.232.7.254,1178ms,	sl-gw9-rly-9-0.sprintlink.net
9,	144.232.189.142,970ms,	sl-vwan-3-0-0.sprintlink.net
10,	192.70.138.202,944ms,	vcu-router.networkvirginia.net
11,	128.172.21.254,940ms,	titanium.cns.vcu.edu
12,	128.172.16.2,1108ms,	palladium.cns.vcu.edu
13,	128.172.100.21,941ms,	platinum.cns.vcu.edu
14,	128.172.120.52,933ms,	None
1,	38.1.1.1,1019ms,	38-default-gw.psi.net
2,	38.20.21.1,894ms,	None
3,	38.1.45.11,902ms,	rc11.se.us.psi.net
4,	38.1.25.193,907ms,	rc1.se.us.psi.net
5,	38.1.10.28,932ms,	None
6,	204.6.118.190,948ms,	None
7,	144.232.7.217,970ms,	sl-bb12-rly-0-3.sprintlink.net
8,	144.232.7.254,906ms,	sl-gw9-rly-9-0.sprintlink.net
9,	144.232.189.142,1057ms,	sl-vwan-3-0-0.sprintlink.net
10,	192.70.138.202,929ms,	vcu-router.networkvirginia.net
11,	128.172.21.254,915ms,	titanium.cns.vcu.edu
12,	----,Timeout,n/a	
13,	128.172.100.21,1175ms,	platinum.cns.vcu.edu
14,	128.172.120.52,1456ms,	None

At about 3:45pm the Codetel technicians showed up. I explained to them my problem, and they diagnosed that the problem was at the switching office. The technician spoke to an employee at the capital where they could rectify the problem. The technician spoke to me and said the line would be up in about an hour. While I waited for the line to be tested, I continued to try to troubleshoot the black and white image shown over the local and remote monitor. I am unable to fully diagnose whether the problem resides in the adapter, the dongle connection, or the S-VHS video output on the laparoscopic machine.

Tuesday, March 21:

At 7:30 am we arrived at the hospital. I checked the telephone lines to make sure that they had not been tampered with throughout the night. I had to get a phone line from the other side of the hospital so that I could connect the phone from the supply room into the Lap OR. The normal setup of equipment took place. The OR was always up and running in about 15 minutes. Patients were escorted into the surgery room. While all this was taking place, I had my two volunteers, who were able to understand the reading on the sat-phone, to help me align the M-4 with the satellite. Once I had a reading of 57 dbhz and about 4 graphical bars displaying on the sat-phone's hand receiver, I was ready to get started. The first thing I did is check whether the phone line was working or not, and it was fine. At about 9:00am, Dr. Broderick was already into his first case. I told him to continue with the surgery and not to wait for me because I wanted everything to function as normal.

The first connection was made to Brett at about 9:00am Eastern Time via M-4. Brett informed me that the audio was a little garbled. Further, he was still getting gray images from the S-VHS adapter. When I switched to the local camera, the images appear in color. The problem didn't seem to be the drivers installed on the system or the PCMCIA card. Still I proceeded on with the test. Brett asked me to change my audio codecs. When we switched to Learnout & Hauspie 5kbps, the audio was better. The computer locked up before I could proceed on with the testing. I immediately restarted the machine. Once the computer was fully booted, I tried to dial out via POTS. Of course no luck! The phone lines were not operational. I received the same phone message as before explaining to me that the number did not exist. I then reconnected via the satellite. When the video was enabled, the system seemed to slow down. One possible explanation involves the particular Internet connection that I had, and what routers the connection was going through. At about 11:00 am, after some reconnections, the call seemed to be stable. Dr. Broderick and I were able to connect with Brett and Dr. Giselle Hamad back at VCU (Virginia Commonwealth University). Dr. Hamad was able to identify the cystic duct. I was able to paste an image into the whiteboard and make annotations. But the images were still in grayscale. The power went out a couple of times, but I was able to stay connected with the auxiliary batteries in both the M-4 and R.D.T.U. Within 15 minutes the hospital was running off a generator. Between patients I again tried to send the x-ray through FTP and was unsuccessful. When I reconnected with Brett, he ran a successful trace to me. Sometimes I did timeout, possibly due to the latency of the satellite link.



Numerous image pairs were captured (locally and remotely) and are being used for evaluations purposes for a manuscript on visual fidelity.

I was able to trace route Brett easily. However, I was unable to paste my result from the clipboard at times. Brett asked me to take local pictures of the lap chole for comparison with local versus remote quality. We also were able to connect to the MeetingPoint Server with CuSeeMe and the connection with audio was reasonable. It was a little choppy on my end when there was another participant added to the conference room. After trying, without success, to FTP via Internet Explorer, Netscape, and WSFTP LE, we decided that I would contact Brett the following day to try the same test over POTS (providing the service was restored). I tried to boot up the desktop that was meant for collaborating with the Dominicans.

Wednesday, March 22, 2000:

In the morning, Dr. Broderick was operating at 8:00am as scheduled. I was still transferring images from the Olympus C-2000 to the R.D.T.U. From the R.D.T.U. I could send images via satellite back to VCU. Once back at VCU they could be observed by surgeons. Most of the day was spent trying to get a working phone line. When attempting to transfer the database via sat-phone, the transmission timed out. When connected to VCU from the Dominican Republic, Brett had Dr. Blumfield in his office with him. He was able to identify the structures of a lap chole. The image appearing in Brett's location became pixilated if the laparoscopic camera moved too rapidly.

After the surgery I continued to try to transfer the database via sat-phone. I decided to go to Codetel, where I used the phone line to transfer the database. I was there

for approximately 50 minutes, and the cost was 2 pesos per minute. Luke was able to speak to Jose Garcia, Executive Account's Manager. He translated my needs to Mr. Garcia, who said he would have the line up by the evening. I called Brett back to confirm that he had received the database.

After speaking with one of the locals in the town in which we were working, I learned that he hadn't been able to dial across the street for approximately three weeks.

Thursday, March 23, 2000

In the morning I immediately tested the phone line. I called the hospital's I.S.P., where I had a connection of approximately 33.6kbps for uploading and a download speed of 50 kbps. Once connected with Brett, I was able to run several tests. He pinged me several times, and was able to get between 18 and 19 hops back to the Internet Service Provider in the Dominican Republic. Audio and video were reasonable (all audio was backed up by a phone line in the OR). There were several power outages that I believe resulted from the medical equipment being hooked up to one breaker. We were able to open the whiteboard and make annotations. When I pasted an image into the whiteboard, it took about two minutes for the image to show up at VCU.

Later that afternoon Brett configured the Compaq desktop back at VCU so that I could attempt dialing directly into the computer using peer-to-peer (H.324) protocol. I was unable to due to the Dominican Republic's phone system. I then tried to use the fax modem interface on the sat-phone and establish a 33.6kbs using the asynchronous setting from the M4. After negotiating various settings we were able to connect however the throughput was too low (<1kbps) to facilitate videoconferencing. The lower band asynchronous connection combined with the latency of a 46,000-mile trip will not support videoconferencing. The 64kbps connection must be used for real-time telemedicine.