A C-COM Satellite Systems Inc. White Paper

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iNetVu®: Earthquake-Proven

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Introduction

March 11, 2011, 2:46 pm – a 9.0 magnitude earthquake hits 100 km off the coast of Japan. Centered East-Northeast of Sendai, the underwater quake creates a tsunami 10 meters high which crashes into the shores of Northern Japan, blasting 140 km of the coastline and travelling as far as 10 km inland.

The devastation is beyond belief. The massive wave removes almost all evidence of civilization. What remains is a debris field resembling a war zone.

The most obvious and convenient communication tool for survivors is their cell phones. Given the magnitude of the earthquake, the ensuing tsunami, the electrical power interruptions, and the breakage in the copper and fiber communication lines connecting the remote sites, the cellular network was almost completely disabled throughout the affected area of northern Japan.

Telemann Communications Co. Ltd., located in Tokyo, is a Factory Authorized Reseller for C-COM Satellite Systems Inc. Telemann's client, Softbank Mobile Corp., the third largest cellular provider in Japan, is working feverishly to replace the area's disabled cellular network. Softbank, a corporate stalwart with a strong sense of civic duty, has embarked on the epic task of restoring the missing, destroyed and inoperable cell towers. The temporary structures they employ could provide continued communications coverage for the survivors of this monumental catastrophe.

Japan's Telecom Sector slowly recovering after the catastrophic earthquake

By Atul Roach 23/03/2011, 9:28 am PT

It was earlier reported that NTT DoCoMo had 2,130 of its mobile base stations still out of service, compared to 6,720 which were inoperative immediately after the quake. Likewise, KDDI had 1,500 non-functioning base stations, down from 3,800, while Softbank reduced its inoperative base stations from 3,786 to 1,157. It seems that Japan is recovering faster than expectations in the telecom sector which is important to keep people connected in such difficult times.

Problem Statement

Softbank developed a platform that consisted of a fixed satellite antenna, a cellular antenna, a cellular switch, and a power supply. This structure provided an excellent, quick-to-deploy solution to a very serious problem. Once the units are deployed, they can provide cellular service in a specific geographical area. The satellite antenna and attached satellite modem provided the necessary link to backhaul the calls to a wired network located elsewhere. Each unit took approximately 6 hours to deploy once the team arrived at a site. These platforms provided immediate relief to the people who had been left without communication for days after the earthquake and ensuing tsunami.

Mother Nature had another curve ball in her arsenal that would prove to be even more of a challenge for the Softbank team: aftershocks. Hundreds of aftershocks were generated in the days after the initial quake. Some of these aftershocks were stronger than "strong" earthquakes in other parts of the world.

The persistent aftershocks foiled this otherwise excellent solution. For the accurate operation of the link from these remotely located cellular stations, a fixed satellite antenna requires the pointing accuracy to be maintained at all times. With each aftershock, many of the platforms would inevitably stop working due to pointing issues. The efforts of the Softbank team to provide cellular service to the people who so desperately needed it were, unfortunately, being wasted.

Previous Options

The solution to the aftershocks was simple: send a team to re-point each failed system. The logistical nightmare created by this solution, though, is easy to understand: each re-point would take a minimum of two hours, and emergency teams would need to be constantly change gears from deployment into re-point mode. The teams would be taking one step forward, two steps backwards.

On April 7th, a 7.2-magnitude aftershock occurred, leaving 700 - 0.98m satellite antennas and 50 -1.2m antennas inoperable due to pointing issues. A visit by the Softbank team was needed to return the units to operational status. If one considers a minimum of two hours of work per site, the total time to correct this situation would be in excess of 1,500 hours, plus drive time. If we assume a drive time of one hour per site, the total time required to fix the antennas equals 2,250 hours of work, the equivalent of 94 days of round-the-clock work.

The C-COM Solution

Telemann Communications Co. Ltd. knew of the C-COM built iNetVu® mobile satellite antenna solutions, and thought this could provide the needed technological edge to deal with the aftershocks. Softbank already had a number of iNetVu® antennas deployed on vehicles used for temporary cellular sites at special events, and to backup a fixed site that was down for maintenance.

Softbank, having faith in the solution presented by Telemann Communications, ordered 110 iNetVu® systems: 55 iNetVu® 1200 systems and 55 iNetVu® 980 systems. Of course the need for the systems was beyond urgent – time was of the essence to bring vital communications back to the people in the affected areas. C-COM's normal delivery procedure includes the testing of each system on satellite before shipment. The time required to do these tests on 110 systems was deemed problematic, and so the decision was made to ship the units from C-COM's warehouse direct to Japan, and send two C-COM employees to test the units on-site prior to their deployment.

Softbank and Telemann had their staging areas located in Sendai, one the areas hardest hit by the tsunami. While this area was far from stable at the time of the shipment, it was judged to be the most effective and convenient location to begin the testing and deployment process.

The initial 15 systems were in the Softbank warehouse when the C-COM employees arrived, and the work began to prepare the systems for deployment.

Quiet Satellite

The first hurdle that needed to be addressed was related to the IPStar 3200 modem. This modem lacks the ability to communicate to an external device using any of the standard modem protocols. This modem is ideal for a fixed solution but would prove to be a challenge for a mobile implementation.

Most mobile platform controllers use DVB to locate the target satellite. The particular satellite IPStar was using, unfortunately, did not contain any DVB carriers. This meant that another method would be required to locate the target satellite.

The next choice would be to use a method called RF. In this method, the Controller talks to the modem to get the information to make a positive identification of the target satellite. As the IPStar 3200 modem does not have any native language interface, this method was also unavailable.

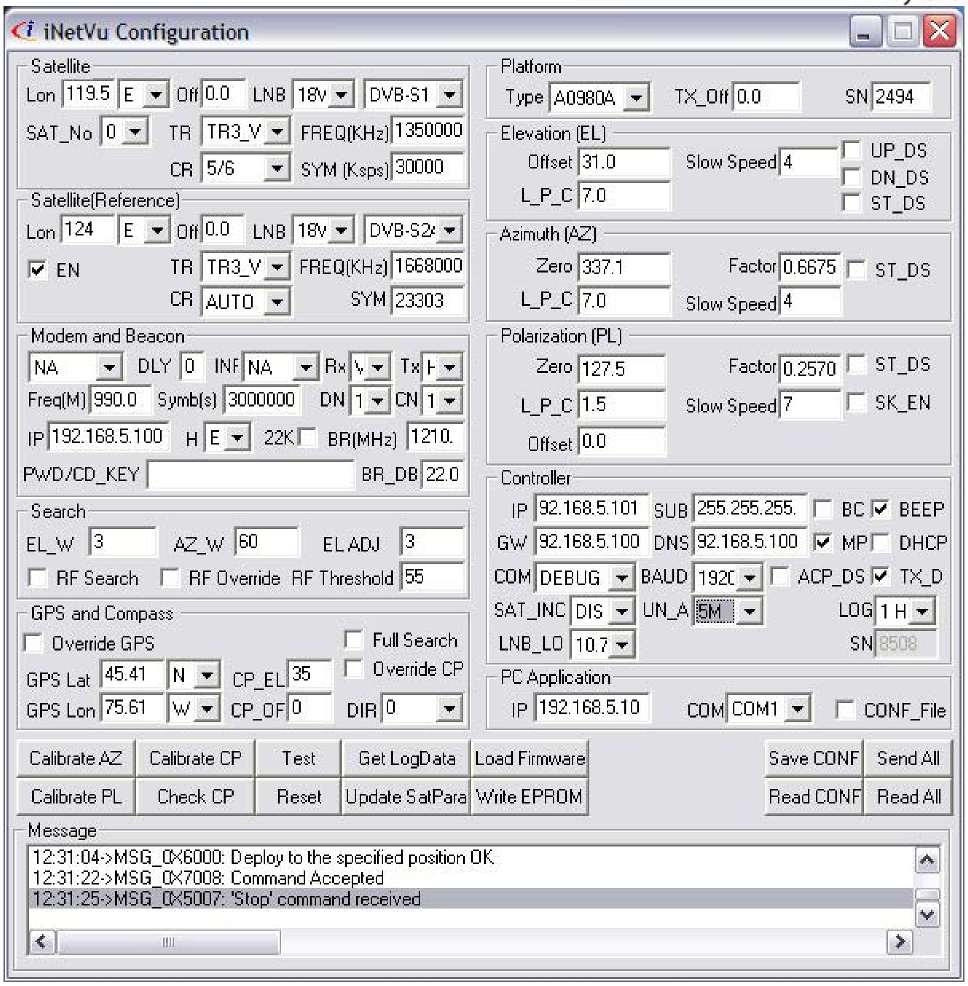
Another option for locating the satellite is to use the satellite Beacon signal. While this method would have worked quite well, it would have added thousands of dollars of expense to each unit deployed. In an effort to keep costs down, this method was considered only as a final solution.

The iNetVu® Controller offers another method of satellite acquisition: Reference Satellite. In this method, a reference satellite is found using DVB, RF or Beacon.

In the existing case, DVB was the selected method. This allows the platform to first locate and peak on the reference satellite, and then move to the target satellite, making the necessary three-axis adjustment. This method can be 'hit-or-miss' as the target satellite is pointed at blindly with no validation being available.

As this technique made the best price/performance choice, the C-COM software engineers would need to make some modifications to the algorithm used to ensure absolute accuracy. To prove this method was stable, hundreds of deployments were done over multiple days, and the ES/NO values were recorded. In all but one case, the value was within a very high range that was considered acceptable.

The acceptable range selected was a value of 11, and the absolute highest value seen was 13.6. In the one failed case, the value seen was 3.4, and at that level the system did an automatic re-point due to a connection failure.



Aftershock

During the two weeks that C-COM employees were on-site, more than 40 aftershocks were felt, some large (7.6 Magnitude) and some small (4.0 Magnitude). It was obvious that a failsafe method needed to be developed that would put the antenna into automatic re-point mode if the aftershock knocked it off the satellite.

This Table represents the earthquakes recorded in the area
during C-COM's Employees visit

3	Apr	5.1	Mb
4	Apr	5	Mb
4	Apr	5.1	Mb
4	Apr	5.4	Mb

9	Apr	5.4	Mb
10	Apr	5.2	Mb
11	Apr	6.4	Mw
11	Apr	5.2	Mb

13	Apr	5.2	Mb
13	Apr	5.7	Mb
13	Apr	6.1	Mw
13	Apr	5.2	Mb

5	Apr	5	Mb
5	Apr	5	Mb
5	Apr	5.1	Mb
6	Apr	5.5	Mb
6	Apr	5	Mb
7	Apr	5.2	Mb
7	Apr	7.1	Mw
9	Apr	6.1	Mw
9	Apr	5.4	Mb

11	Apr	5.4	Mw
11	Apr	5.6	Mw
11	Apr	5	Mb
11	Apr	5.2	Mb
11	Apr	6.6	Mw
11	Apr	5	Mb
12	Apr	5.2	Mb
12	Apr	5.8	Mw
12	Apr	6	Mw

14	Apr	5.1	Mb
14	Apr	5	Mb
14	Apr	5.7	Mw
14	Apr	5.4	Mb
15	Apr	5	Mb
15	Apr	5	Mb
15	Apr	5	Mb

In a normal situation the iNetVu® Controller already contained an algorithm to keep the antenna pointed correctly, if selected by the user. As mentioned, the IPStar 3200 modem does not have a native language embedded, and so communication with it was not possible. As the Target Satellite has no DVB signals available, the re-peak algorithm with that option was not possible.

On-site C-COM's personnel turned their software engineers and requested a special new algorithm that would address the issue at hand. New software was written overnight, sent from C-COM's Ottawa offices, and field-tested more than 50 times.

This new software allowed the antenna to automatically perform a re-peak if it detected that the target satellite was no longer being pointed to within an acceptable degree of accuracy. The success of this new algorithm provided Softbank with the confidence that the units would not require a re-point each time a major aftershock occurred.

Power Outage

C-COM field personnel conceived another situation that could cause the system to become inoperative. What if a power outage was to occur, followed by an aftershock which knocked the unit off satellite? When the controller repowered it would be unable to detect any problems, given the way the satellite was located, and would not know to initiate a re-point sequence. This situation was not improbable since many of the systems are powered by gasoline generators.

Doing a re-point at all power-on situations was a possible solution, but this could create a different set of problems. As the systems are being used to backhaul a cellular network, if they are automatically put into re-point mode during repowering, this would cause all 'calls-in–progress' to be dropped, and the system would be unavailable for some minutes. It is far better to only initiate a re-point when the units have actually lost their pointing accuracy on the target satellite.

A solution to this would need to be developed, and so C-COM software engineers were put to the test again with another request. An algorithm was developed within a few hours and new software was sent for field testing. The solution worked flawlessly, and was tested a number of times with different controllers and antennas.

Now even in a worst case scenario of a power outage and then a major aftershock, Softbank could be assured that the iNetVu® systems would perform their task with no human intervention.

Implementation

Initially, Softbank had been busy building additional trucks equipped with the iNetVu® 1200 mobile satellite antenna system. These vehicles were to be deployed to disaster areas to provide temporary cellular service to assist with the cleanup efforts. The deployment of the iNetVu® 980 units will occur on a case-by-case basis, as Softbank sees fit, based on the need to provide cellular coverage into additional areas affected by the disaster.

Additional orders have been placed to C-COM for more iNetVu® 1200 and iNetVu® 980 units.

Summary

The client had a definite need for mobile satellite communications, and the type of deployment required presented a number of unique challenges for the mobile satellite controller used. C-COM personnel have worked with many of their resellers around the world to solve these types of technical issues. The depth of C-COM engineer's skill sets, both in terms of mechanical, electrical, RF and software, allowed these types of unique requirements to be addressed in a timely and professional manner.

C-COM has shown a desire to make the necessary modifications to their existing products to specifically address the needs of clients and deliver solutions that are world class in design and reliability.