The Installation of Satellite Modems on SEIS-UK Supported Remote Seismic Deployments

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Introduction

SEIS-UK, the NERC funded UK seismic equipment facility, supplies a full range of seismic equipment for short-term projects directed by UK-based academics, deploying anywhere in the world. The latest extension to the facility's capabilities is a venture into the satellite transmission of status information from remote sites. The aim is to improve station recording times by regularly monitoring the state-of-health information and by having the ability to remotely reset parameters if needed. This should reduce unnecessary service runs, allow for better scheduling of necessary trips and generally improve data recovery rates.

System Overview

Each field system will consist of:

- a digital sensor – CMG-3TD or CMG-40TD
- a Guralp CMG-DCM data recorder with integrated MiChroSat 2400 modem
- an external modem antenna and GPS antenna
- a power supply – usually batteries and solar panels

Back at SEIS-UK in Leicester there will be another MiChroSat modem permanently connected to a PC waiting to receive all transmissions and providing an access route to the remote units should any setup modifications be required.

Why the MiChroSat 2400?

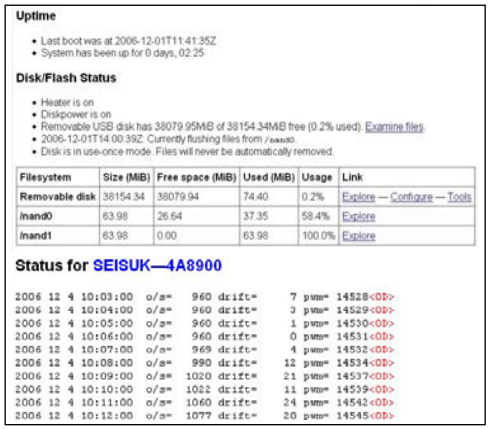
- The MiChroSat 2400 transmits using the Iridium Satellite Network – this is a Low Earth Orbit network of 66 satellites that gives total global coverage.
- Initial set-up is low-cost in comparison to the large dishes required for High Earth Orbit constellations such as VSAT.
- The power consumption is low due to the minimal hardware required – this is essential for remote solar-powered sites.
- Bandwidth is smaller than that for VSAT (which is generally used for data transmission) but for state-of-health communications it is ideal.
- The system is economical to run since air-time is on a pre-paid pay-as-you-go basis and by running a modem at SEIS-UK transmissions will be Iridium to Iridium thus avoiding the large fees for calling across networks.

Figure 3: The modem antenna for one of the new systems

Figure 1: A standard Guralp DCM module

CMG-DCM and Modem Configuration

- The system will use standard DCMs (see Fig. 1) but with the MiChroSat 2400 Modem installed internally - this saves space when shipping and provides a more secure system when deployed.
- The DCM is a low-powered linux-based data-logger with a removable USB/firewire storage disk (40Gb+).
- DCM units can be configured to record all data and status streams to the disk as well as to autonomously transmit the status information at a user-defined time interval.
- There will also be the capability to contact the unit from SEIS-UK to initialise changes to the setup and potentially download small event files.



Uptime

- Last boot was at 2006-12-01T11:41:35Z
- System has been up for 0 days, 02:25

Disk/Flash Status

- Heater is on
- Diskpower is on
- Removable USB disk has 38079.95MiB of 38154.34MiB free (0.2% used). Examine files
- 2006-12-01T14:00:39Z Currently flushing files from /nand0.
- Disk is in use-once mode. Files will never be automatically removed.

Filesystem	Size (MiB)	Free space (MiB)	Used (MiB)	Usage	Link
Removable disk	38154.34	38079.94	74.40	0.2%	Explore — Configure — Tools
/nand0	63.98	26.64	37.35	58.4%	Explore
/nand1	63.98	0.00	63.98	100.0%	Explore

Status for SEISUK—4A8900

```
2006 12 4 10:03:00  o/s=   960 drift=    7 pwm= 14528<OD>
2006 12 4 10:04:00  o/s=   960 drift=    3 pwm= 14529<OD>
2006 12 4 10:05:00  o/s=   960 drift=    1 pwm= 14530<OD>
2006 12 4 10:06:00  o/s=   960 drift=    0 pwm= 14531<OD>
2006 12 4 10:07:00  o/s=   969 drift=    4 pwm= 14532<OD>
2006 12 4 10:08:00  o/s=   990 drift=   12 pwm= 14534<OD>
2006 12 4 10:09:00  o/s=  1020 drift=   21 pwm= 14537<OD>
2006 12 4 10:10:00  o/s=  1022 drift=   11 pwm= 14539<OD>
2006 12 4 10:11:00  o/s=  1060 drift=   24 pwm= 14542<OD>
2006 12 4 10:12:00  o/s=  1077 drift=   20 pwm= 14545<OD>
```

Figure 4: status information as viewed over the DCM web interface.

Types of Status Message

The CMG-DCM records extensive log-files to its removable disk as it is running. These will not be transmitted in their entirety but will be condensed to provide us with an essential status check-list. This will include:

- the up-time of the instrument
- the time of the last re-boot
- the latest data files written to the disk
- the total disk usage
- the sensor mass positions
- the GPS state including offset and drift information

This will provide all the information required to ensure that the station is performing satisfactorily.

MiChroSat 2400 Specification

- The modems can operate at temperatures ranging from -30°C to +60 °C.
- Power consumption varies but the peak when initializing a transmission is around 11W (for a few microseconds) falling to bursts of around 4W during transmission. The power management will be controlled by the DCM unit.
- Transmission will be at 2400kbits per second.
- Transmission will be via the Iridium Satellite network.

Figure 2: The inside of a standalone MiChroSat 2400 Module. This will be integrated into the DCM housing.

First Deployment – Hudson Bay

The first deployment of these systems will be in the Northern Hudson Bay region as part of the HuBLE project (see Poster S41A-1312). The UK contribution to this project, headed by J-M Kendall at Bristol University, is funded by NERC and supported by SEIS-UK. The exact locations of the deployment sites are still to be determined but it is likely that there will be at least one modem site on Southampton Island and possibly two sites North of the Hudson Strait. With weather conditions as they are in this region these sites will need to run autonomously for most of the year so the modems will be the only link with the sites between annual service trips.

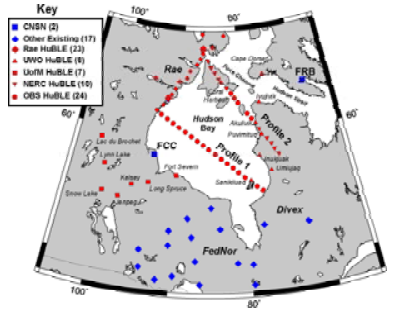


Figure 5: Map of the Hudson Bay region showing possible first deployment sites for the new systems.

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