Alpine Monitoring System (AMS)

West Castle Resort; Crow's Nest Pass, Alberta

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INTRODUCTION

The AMS, is an alpine monitoring currently being used to collect meteorological data at Castle Mountain Resort (CMR) within the Crow's Nest Pass. The system is a collection of three meteorological (MET) stations, and one RF repeater station all of which are located on the mountain. A parent node station will reside within the (resort's) IT rack room, located on the bottom floor of the CMR lodge. This report is purposed to provide an overview of the current status of the AMS, as well as outline the tasks necessary to complete the project. We define *project completion* to be:

> *'A state in which all three MET stations are collecting, and sending the data via the RF telemetry system to the lodge parent node, where said data can be accessed from outside the LAN.'*

BASIC OVERVIEW

- ENTERPRISE
  - Parent node
    - Receives data from all MET stations
  - Network interface
    - I/O

- Three meteorological stations
  1. KIRA (Base)
     - Located in base of valley
     - PackBus Router
       - Routs KIRA, RYKER, SPOCK to ENTERPRISE
  2. RYKER
     - Located mid-mountain
  3. SPOCK
     - Located near North peak
       - Ham tower
- One radio repeater station
  1. T-REX
     - Mounted on T-REX
     - PackBus Router
       - Routes RYKER, and SPOCK to KIRA

TASKS TO BE COMPLETED

Currently, installation of ENTERPRISE has yet to begin, KIRA is not collecting data, however, RYKER and SPOCK are collecting data and storing locally. RM telemetry testing carried out on site, confirmed these sites were communicating with the use of the repeater station. Thus, little time will need to be allocated

to the telemetry network. KIRA will take one person a half day to complete sensor connections and adjustments as well as complete the 120VAC-12VDC mains connection. A substantial amount of time will be directed at ENTERPRISE installation; one day with two people for running wire and installation of equipment; one day, one person to make the IT connections and trouble shoot the WAN. Another day with two people will be necessary to install the connectors on the SPOCK enclosure, as well as make any necessary adjustments to sensors and turnbuckles on RYKER. The following will give a detailed explanation of the tasks and materials necessary for AMS completion.

ENTERPRISE - Full installation

Overview

The lodge receiver station aka 'Enterprise' is the root node designed to collect the data from the three remote met stations via RF401 telemetry. A PC running Loggernet receives data from the met stations by way of the RF401. The RF401 is connected to an inline lightning arrestor[1], connected to a yaggi antenna mounted on existing infrastructure on the lodge roof, directed toward the Base tower station (Kira). The PC also interfaces with the WAN, allowing the data to stream via SFTP a client PC residing at the University of Lethbridge. The data can then be processed and selectively displayed on a University hosted web site.

Installation Details

There are two methodologies available for the communication interface. The first provides little control over the flow and storage of data, and requires loggernet to be installed on the local host PC. The second, does not require this software, nor does a PC need to reside on site. Instead, a CR1000 configured as a *central router*, receives, organizes, stores, and performs operations on, the data sent by the three MET stations. An embedded or small form factor device acts as the interface between the datalogger and the WAN. The second implementation is ideal for several reasons; redundancy; efficiency; and portability are but a few. That being said, the MET station loggers will need to be reprogrammed, that is, additional code segments will need to be added, compiled, and sent to the CR1000. Time being the limiting factor, the first method will be implemented with future considerations for further development of the second

The RF401 is set to *PB aware*, with a PBA of 99 and is connected to the PC via a RS232-DB9 crossover cable. When loggernet is launched in command line mode, the server will initiate the *hello sequence* inherent to the PB protocol, creating a link between the MET station nodes. A small batch program will then be used to initiate data collection, and store each data set in the appropriate directory within the FTP directory. Once the ISP for CMR have assigned a static IP address to the PC, the University of Lethbridge IT department can add an exception to the university firewall. Thus, the data can then be requested from a host PC residing on campus through a secure port. This request and receive procedure can be handled using MySQL or BOA server SFTP/database support open source software. An interactive web interface can be implemented at a later date.

[11] NOTE: The LMR400 coaxial cable is terminated with an incompatible TNC connector, thus a TNC-N adapter will be used.

Materials

The following are the main materials required for installation. The lab currently owns these items and does not need to purchase them.

- 2 x Cat5/6
- RS232 cable/DB9 crossover
    - 5’ from exterior access hole to PC shelf
        - NOTE: RS232 lengths cannot exceed 50’
- 1 full length of LMR400 coax from yagi to adapter (which connects to lightning arrest)
        - NOTE: LMR400 cables come in 33’ lengths aprox. 10 m
- 2 lengths of LMR200 cable = 20’ aprox. 6.096 m
        - NOTE: two connected together
- LMR200 (short length)
    - Go from RF401 to lightning arrest
- PC with loggernet
    - The ARTeMIS lab Toughbook
- Rf401
    - Mounts inside enclosure
    - 120VAC-12VDC power supply
- 5 m 14/3 weather proof
- Yagi antenna
    - Antenna mount with 2-1/4” UBOLT
- Lightning arrest
    - 4 X 1” laminating or decking screws
- Small CS enclosure
    - 2 x 2-1/4” UBolt
- 12 x Wire staples
- Power bar for spikes and brown outs

Materials to purchase

- UPS battery backup.
    - Alternatively we can use a charge controller, and battery to build our own UPS
- Female TNC to Male N adapter

KIRA

All sensors are installed, with the exception of the HMP45 and shield. Sensor wires were not labeled and thus must be traced before 32 pin connector insertion, and logger connections can be made. Several of the sensor wires, as well as the RF cable will need to be extended. The logger power wire will connect to a charge controller, which connects to a battery and an AC/DC adapter plugged into the mains power located within the adjacent shack. The solar panel can then be removed and returned to the lab. The RM-young propeller has been located and must be re-attached.

Materials

- 30 m 22/2
    - Sensor wire

        - 2 x CMP3 (2 wire + gnd)
        - 1 x NRlite (2 wire + gnd)
        - 1 x tipping bucket (2 wire + gnd)
- 10 m 18/3 weather proof
    - Power wire
- 20 m 22/4
    - Sensor wire
        - 1 x RM-young (3 wire + gnd)
- 30 pin Connector
- Prop for RM young
- HMP45
- HMP45 housing
- Lightning arrest
- 1 x LMR200 (short length)
    - Go from RF401 to lightning arrest
- 1 x LMR400
    - From LMR200 antenna connection to lightning arrest
- Female TNC to Male N adapter
- RM-YOUNG prop
- AC/DC adapter min 12-15VDC @ > 1 amp

RYKER

- Install Lightning arrest
- Collect data
    - Analyze to ensure correctness
- Check and adjust sensors
- Tighten turnbuckles

Materials

- 1 x LMR400
    - From antenna connection to lightning arrest

Materials to purchase

- Female TNC to Male N adapter

SPOCK

The sensors for SPOCK have been mounted to the ham tower. The MET station is collecting data but sensors are not in an optimal location. Further discussion surrounding the installation of a new tripod in a more suitable location along with the relocation of the MET sensors. Due to the human resources and financial logistics of this endeavor, this task may have to be completed in the summer of 2015.

T-REX

- Adjust solar panel orientation
- Ensure enclosure is secure

Materials

- Lightning arrest
- LMR200
    - Short length
        - Go from antenna to arrest
            - Both are N-type female

General Materials to Purchase

The following are materials are required for the installation but have yet to have been purchased. The RF401 uses a reverse polarity SMA, an obscure connection, further the lab owns LMR200/400 coaxial RF cable, terminated with N and TNC connectors. Thus the two components are incompatible and an adapter must be purchased. The most cost effective solution is to use a TCC N MALE to TNC FEMALE RF ADAPTER. One will be needed for each MET station, T-REX, and ENTERPRISE. Additional heat shrink is required in order to protect the sensor wire extensions on KIRA. The left over materials will also have use on future projects.

- 1 X 1 m 4:1 heat shrink 1”
- 1 X 1 m 4:1 heat shrink ½”
- 5 X 1133-TGN; TCC N MALE to TNC FEMALE RF ADAPTER
- 128 x Amphenol connector pins

TIME ALLOTMENT

Station Name	Task	Workers	Time
ENTERPRISE	• Run RF cable • Install antenna • Install enclosure • Wire rough-in	2	10 hours
ENTERPRISE	• Tie ins & connections • Connect to WAN • Test • Troubleshoot	2	10 hours
KIRA	• Power • Trace • Solder pins/connectors • Extensions	1	6 hours
RYKER	• Travel time • Depends on ride	2	15 mins-1 hours
RYKER	• Adjustments • Data collection	2	2 hours
SPOCK	• Travel time • Depends on Ride	2	20 mins-2.5 hours
SPOCK	• Collect data	2	20 mins

	RETURN TO VALLEY	2	1.5 hours - 20mins

Approx. 2.5 days for one person and 22 hours for the other. This does not include travel time.