National Centre for Radio Astrophysics

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OnlineV2 Monitoring Tools

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Part 1. *Monitoring tools*
Part 2. *Engineering tools*

Part 1. Monitoring tools

Online V2 design plan:

As per the design plan, the central server for OnlineV2 sitting inside the central building will communicate with clients. There are three types of clients. First one are the User Interface clients which are the terminals located inside the control room i.e. operator terminals. The second one are the System Control clients i.e. the MCM cards and PCs. MCM cards control the antenna base systems and the systems inside the central building. PCs sitting inside the central building controls the digital back end system. The third client is the data monitoring server sitting inside the central building which collects the monitoring data from the central server and acts as a web server. Control room staff will issue the commands through the user terminals to control the telescope systems. These commands will be received by the OnlineV2 central server and then sent to system control MCM cards or PCs for execution. After the command execution, the return response from the various systems received by the system control clients will be sent back to the central server. This response finally will be sent back to user terminal inside the control room as acknowledgment message. This communication between the clients through the central server and the task status will be written in to the shared memory on the central server for all the time. The data monitoring server will collect updated shared memory data from central server. Fig. 1. shows the block diagram of OnlineV2. Users will accesses this data through internet or intranet. This report describes the design and development of the data monitoring client.

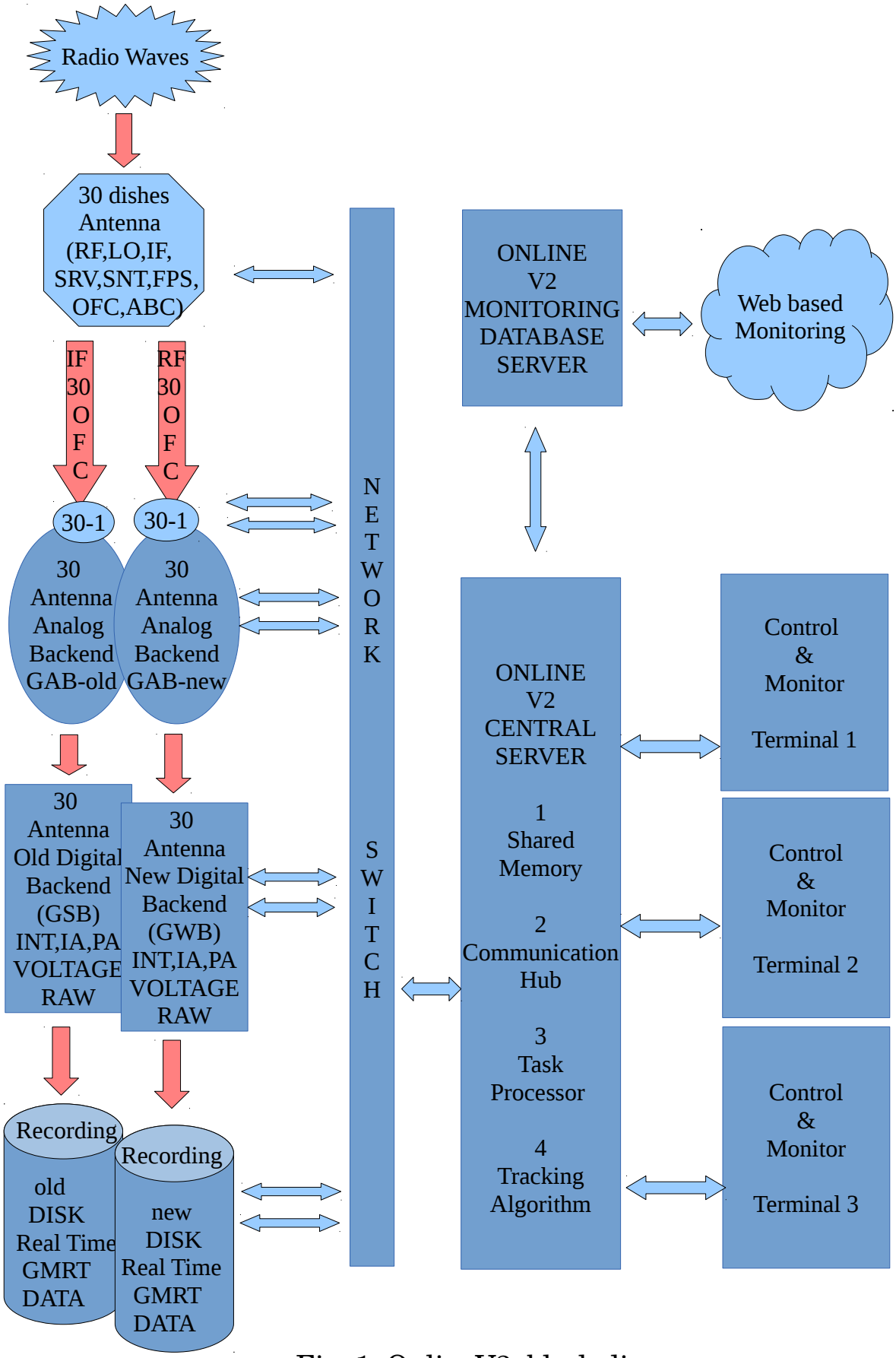

Fig. 1. OnlineV2 block diagram

User Interface Clients:

Desktop User interface (command line and GUI)

These are the User Interface terminals (command line) developed in the Python environment for telescope operations. One can open maximum 32 user terminals to form multiple sub arrays or multiple tasks. Along with command line interface there is GUI interface which is developed in Qt/QML. These clients connect to the central server through the computers inside the control room. Two to four general purpose computers are kept inside the control room for the smooth telescope operations. (see the reports on Python environment based commands and Qt/QML based Graphical User Interface for more details).

System Control Clients:

a) Antenna base clients(Rabbit MCM and PC104)

Each antenna has subsystems like FE, LO, IF, SRV, OFC, FPS, SNT etc. Each subsystem at the antenna base is controlled by the MCM card. Servo system is controlled by the PC104 card. All these cards (clients) from each antenna directly communicate with the central server via ether-net link.

b) Central building clients(Rabbit MCM & back end control PCs)

For each antenna a MCM card is provided to control the analog backed system. These cards are sitting inside the central building (receiver room). To control the digital backend system, a dedicated computer called backend control PC, is provided inside the digital backend lab (corr room). Central server communicates with all these MCM cards and PCs (clients) via ether-net link inside the central building.

Data Monitoring Client (web server):

Web server (*collect and serve the monitoring data*)

This is a server machine sitting inside the central building which acts as client for central server and also acts as web server for web users. One can call it as a data monitoring web server. It stores communication, monitoring and task data in to the MySQL database. Apache server is hosted as web server.

Central Server:

The central server coordinates the control and monitoring activities. All the clients communicates with this central server via ether-net link. The important functions of the central server are as follows.

1) handles all the communication between various clients.
2) handles the tasks and sub-tasks (task processor).
3) handles the tracking process of all individual antennas.
4) handles shared memory for tasks and communication.

Data Monitoring :

All the data from each user interface client and system control client is written in to the shared memory of central server. All these data parameters are listed here.

a) *System parameters of 30 antennas*
System wise parameters for each antenna i.e. command, response, asynchronous message, MCM raw data etc. are written in to the shared memory. The systems are Front End, Intermediate Frequency, Local Oscillator, Feed Position, Sentinel, Servo, Optical Fiber, Analog Back End and Digital Back End. Few of the important parameters that are recorded are wind speed, temperature, encoder readings, feed position, tracking status, local oscillator frequency lock, digital back end status, antenna setup, 30 to 1 status etc.

b) *Task Status of n sub arrays/projects*
Here task is the process running on the central server and it is handled by the task processor or sub array controller. Task may be the setup for complicated science observation or may be a simple task like parking the antenna. Few important task parameters are task no., user name, project title, project code, source name, source ordinates, command file, source list, setup file, back end status, record files (.lta) files, disk space, scan status, antenna tracking status etc.

c) *Astronomical data monitoring (back end data)*

It is a huge amount of data and normally monitored on back end machine itself. But as a remote user one should be able to access this astronomical data on the web along with the project status. Hence we plan to collect small amount of this data on the data monitoring server so that user can monitor it on the web during his/her observations. Few important data sets are visibility matrix, self power plots, time series plots of visibility amplitudes and phases etc.

d) *System health monitoring (test results)*

To maintain various systems, routine tests have to be conducted over regular intervals. The results from these tests are used for calibration or system debug purpose. We store these test results for a long term study of various parameters which helps to improve the sensitivity and life of this instrument. Few important test are pointing test, deflection test, fringe test, swap test, polarization test, etc.

OnlineV2 Data Collection and Monitoring

a) Data collection on the data server:

A 'c' program is running on the central server which continuously reads the shared memory and sends the data to the data monitoring server. MySQL database has been setup to store this data on the data monitoring server. For every fresh update, the data base is getting updated with the new parameter value with time stamp. At present an update is restricted to one second. However this time can be reduced to 0.25 second if required. The update interval has been successfully tested for 0.25 second. The test setup of 8 MCM cards was used for testing the control and monitoring data. No system was connected to the MCM cards and the raw data from 64 channels was recorded to check the dropouts or other problems. We recorded this data over a few days, the total size of the data is around 1 GB per day per MCM card.

b) Data Display on Web:

An Apache web server is running on the monitoring server for giving web access of data to the users. We used JavaScript on the client side and PHP script on the server side. A simple web interface is developed for monitoring the raw data for testing purpose. In this tool, one can select the any MCM card and monitor the real time raw data from all the channels from that MCM card. It is like a player, one can go forwards, backwards or jump to any time stamp. The JavaScript sends Ajax call to the PHP script, which executes the query on MySQL server and finally the desired data is displayed on the web page. On the server side, Perl script calls Gnuplot for data plotting. To access this page click on the link below.

http://gmrt.ncra.tifr.res.in/~astrosupp/cms/plot1.php

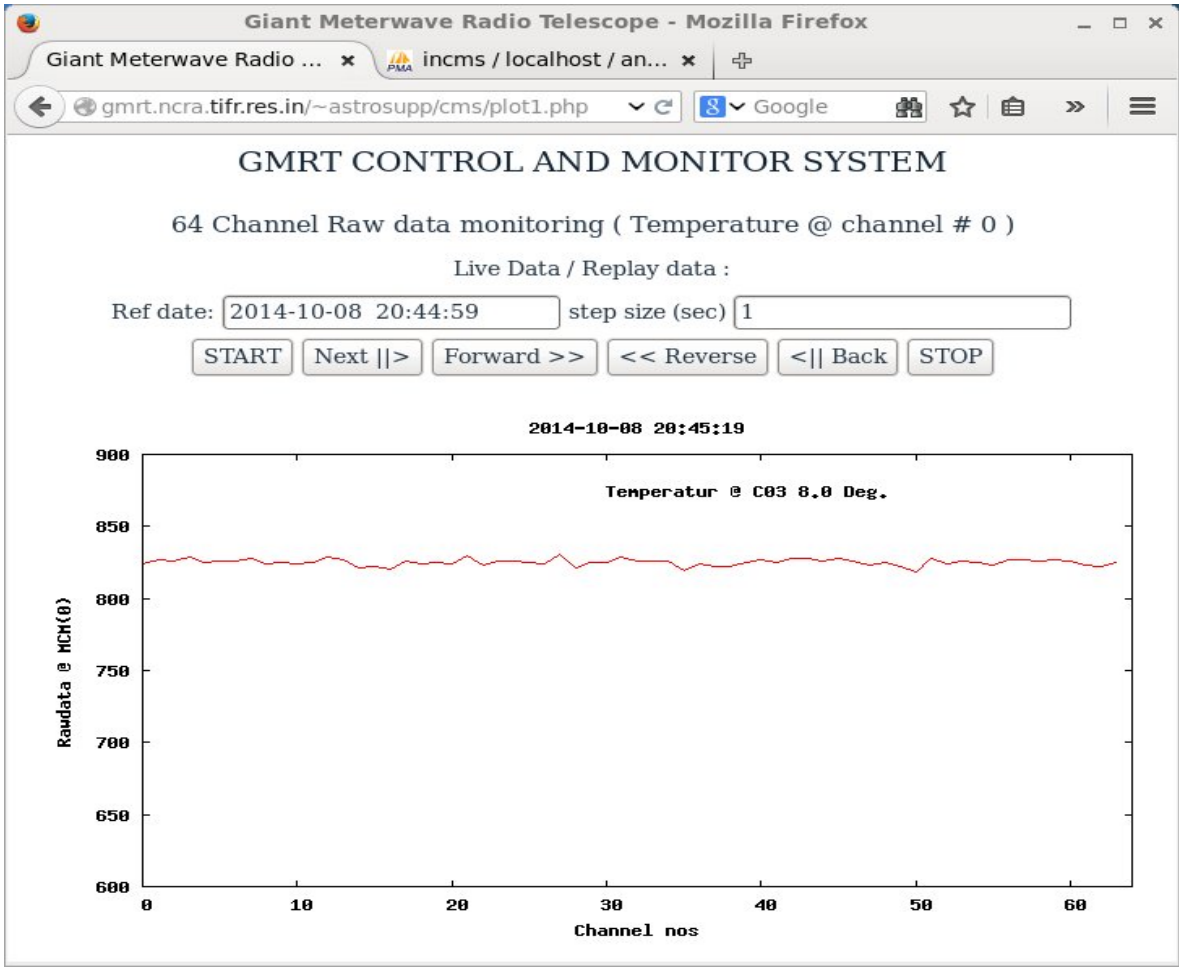

Fig. 2. Web interface for raw data sent by rabbit MCM over 64 channels.

Below is the description of MySQL data table for raw data collection.

Field	Type	Null	Key	Default	Extra
seq	bigint(20)	NO	PRI	NULL	auto_increment
time	timestamp	NO		CURRENT_TIMESTAMP	
ant	varchar(11)	NO		NULL	
sys	varchar(11)	NO		NULL	
c0	int(11)	NO		NULL	
c1	int(11)	NO		NULL	
c2	int(11)	NO		NULL	

c) Temperature monitor test at antenna base:

This testing was done at the C03 antenna. A new temperature monitoring unit was connect to the rabbit MCM card. As with the lab setup, the 64 channels data was monitored with the first channel giving the antenna shell temperature as shown in the Fig. 3. The existing Online temperature monitoring is shown in the Fig. 4. Due to the different locations of the two temperature sensors connected to the new MCM and existing MCM, the mean values differ by a degree of so. The data behavior of the temperature data was similar with the existing Online system. The recording time resolution of existing Online is 3 minutes while for OnlineV2 it is one second.

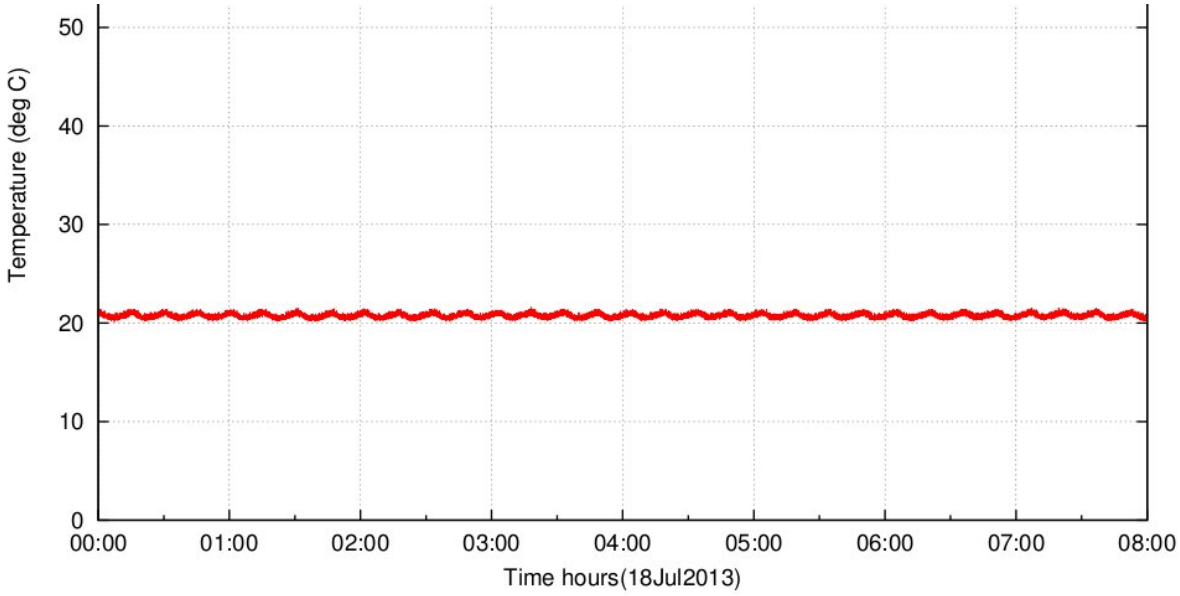

Fig. 3. Temperature monitoring at C03 antenna (OnlineV2)

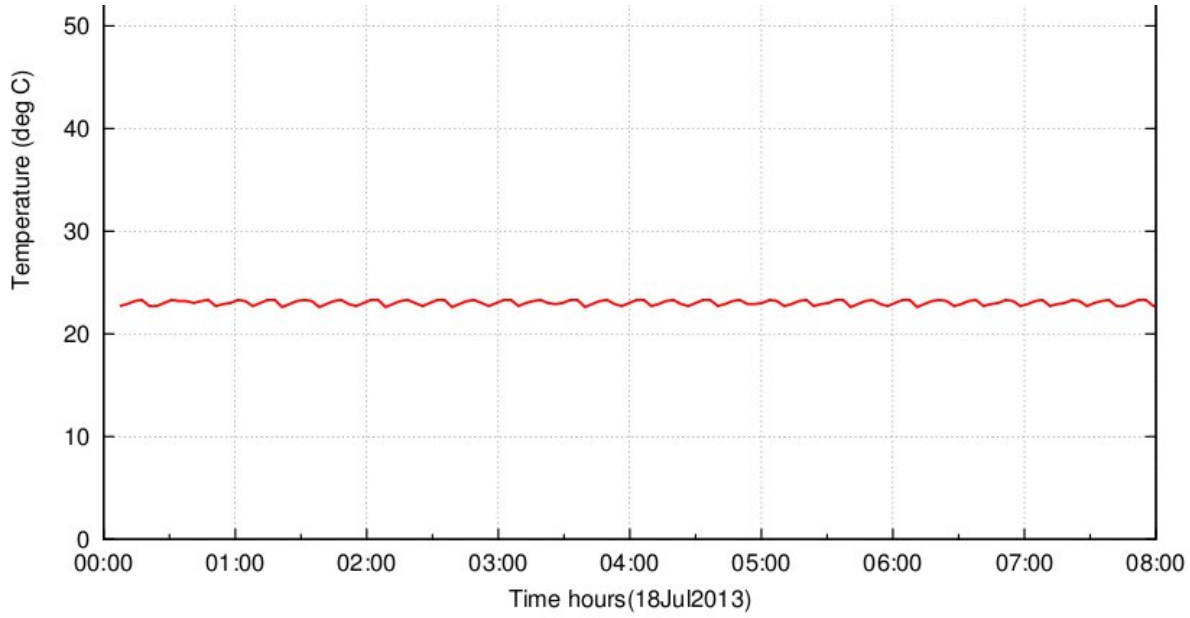

Fig. 4. Temperature monitoring at C03 antenna (existing Online)

d) Raw data recording test:

The raw data from the 64 monitoring channels of the new rabbit MCM cards was recorded over a few days to check the stability and presence of any dropouts. In Fig. 5. raw data recorded by the three channels 20, 40 and 60 of the total 64 monitoring channels of the MCM card are shown. Here three different plots indicates three channels 20, 40 and 60. Offsets are purposely added to avoid overlap between the traces. As seen in the Fig. 5. the monitoring done at a rate of a 1 second per data point is stable and no dropouts were recorded in the data acquired from 12, October 2014 to 15, October 2014. This test was conducted on 8 MCM setup in the telemetry lab.

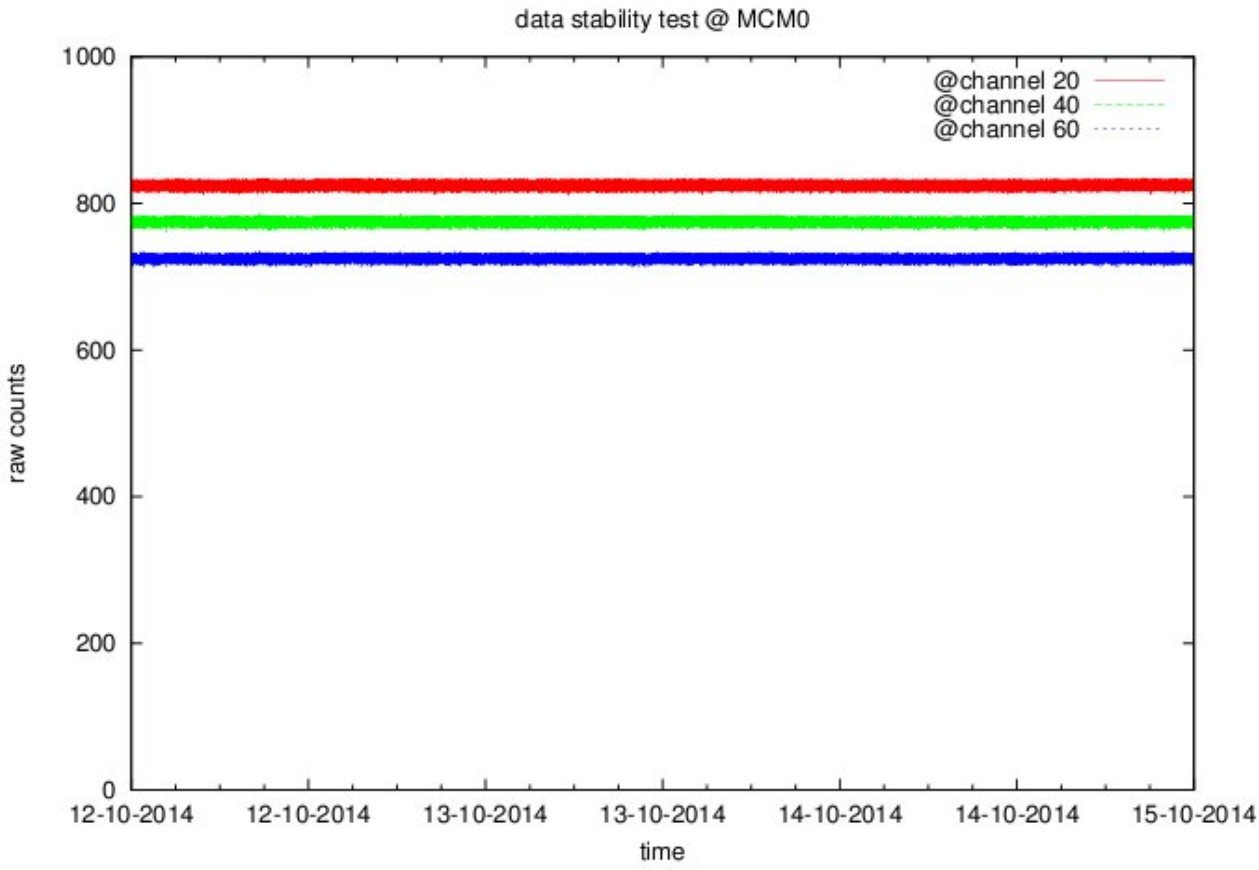

Fig. 5. Raw data recording test (stability test).

Summary:

As per the OnlineV2 design plan, we have successfully implemented and tested the data base for the 64 raw data monitoring channels of the rabbit MCM card. This data can be easily accessed through the web interface. Long period stability test is successfully conducted and shows no dropouts for a rate of 1 second. Physical data corresponding to the temperature in an antenna shell has been recorded through the MCM monitoring channel 1 has been found well match with the values recorded by the existing control and monitor system (ONLINE).