

OnlineV2 - an introduction

(This introductory note is prepared by N.G.Kantharia on behalf of the team)

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Abstract

An upgraded control and monitor software **OnlineV2** for GMRT has been designed, developed and tested on 15 GMRT antennas with the new MCM card and using the ethernet link to antennas. This will allow faster and more reliable communication with the GMRT antennas in addition to providing a Python environment, graphical user interface and web-based monitoring utilities. A new Monitor and Control Module (MCM) based on a Rabbit processor was designed and developed by GMRT engineers in 2011. This software uses the fast ethernet link and implements communication with these new MCM cards. The work on OnlineV2 began in October 2012 and the software was successfully tested on 15 antennas in April 2015. All the modules developed for OnlineV2 are presented as separate technical reports in the series - this note only introduces these. Some of this note is taken from the paper by Kantharia et al. presented in the MWSky conference in December 2013 (reference 10).

A control and monitor system (CMS) consisting of hardware and software components is responsible for controlling the antennas and the electronics associated with it in addition to monitoring the parameters and the system performance. The CMS at GMRT (see Figure 1 for a schematic of the role of CMS) consisting of a monitor and control module (MCM; Ramakrishna, 1991 reference 11, Gadgil 1992 reference 12), an antenna base computer (ABC; Subramanya 1990 reference 8) and a communication handler (COMH) as the main hardware components and ONLINE as the software (Rao 1991, reference 6; Rao 1991, reference 9; Subramanya, 1990, reference 7) was developed by NCRA. This indigenously developed system has been successfully supporting GMRT observations since late 1990s.

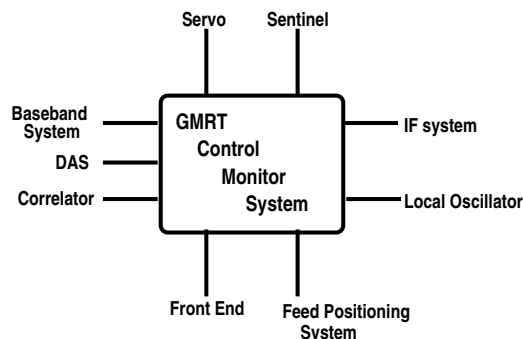


Figure 1: Schematic showing the central communications and coordination role played by a control and monitor system for GMRT

An expanded system using present day technology and supporting features of the GMRT upgrade is desirable and the hardware work for this was started a few years ago with the development of a new MCM (e.g. Kanade et al., reference 2; Balasubramanian et al., reference 3) using a Rabbit processor to replace the 8051

μ controller. An upgraded version of ONLINE is currently under development at NCRA and is referred to as OnlineV2. OnlineV2 is Linux-based and aims at speeding up command execution and reducing the radio frequency interference by using the power of the fast 1 Gbps Ethernet connection being enabled at GMRT for the 30 antennas and the in-built capabilities of the Rabbit processor on the MCM card. OnlineV2 does not require an antenna-base computer. OnlineV2 uses and expands the control algorithms developed for ONLINE on a different platform in a new framework. The shared memory format used in ONLINE is found to be optimal for OnlineV2 also. Web-based utilities and graphical user interfaces are introduced in OnlineV2. The following are the new features of OnlineV2 which are detailed in technical reports led by the different team members:

1. OnlineV2 - core software and testing done - Raj Uprade (R-265).
<http://ncralib1.ncra.tifr.res.in:8080/jspui/handle/2301/637>
2. OnlineV2 - New MCM and Qt/QML based Graphical User Interface - Naresh Sisodiya (R-266).
<http://ncralib1.ncra.tifr.res.in:8080/jspui/handle/2301/638>
3. OnlineV2 - Python based interactive command line + GUI environment and NOVAS astronomical library - Deepak Bhong (R-267).
<http://ncralib1.ncra.tifr.res.in:8080/jspui/handle/2301/639>
4. OnlineV2 - Enabling serial communication: Rabbit MCM to the FPS - Charu Kanade (R-268).
<http://ncralib1.ncra.tifr.res.in:8080/jspui/handle/2301/640>
5. OnlineV2 - Web-based monitoring tools and engineering interface - Santaaji Katore (R-269).
<http://ncralib1.ncra.tifr.res.in:8080/jspui/handle/2301/641>
6. Appendix: Listing of ONLINE commands and procedures as inputs to OnlineV2- Sachin Sherkar (R-270).
<http://ncralib1.ncra.tifr.res.in:8080/jspui/handle/2301/642>

The design of OnlineV2 is shown in the flowchart of Figure 2. The main motivation of upgrading the control and monitor software was the availability of the fast ethernet link to the antennas so that communication can be faster compared to the existing serial communication; the decreasing support to Solaris systems on which the current ONLINE runs; lower communication overheads for science observations meaning more telescope time for actual observations. The other motivating factors were making available desktop GUIs and web-based monitoring utilities.

A short history of the newly available CMS for GMRT (ie new MCM cards + OnlineV2) is as follows:

- 2010-2011: Telemetry group designed and developed a Rabbit processor-based MCM.
- 2010-2011: Telemetry group tested new MCM communication over serial port using the Teleset - ABCcom (Pommier - references 4,5) software running on a Linux machine. An in-house development approach for the new CMS.
- 2010-2012: Dilemma about full in-house software upgrade.
- mid-2012: Work on OnlineV2 started.

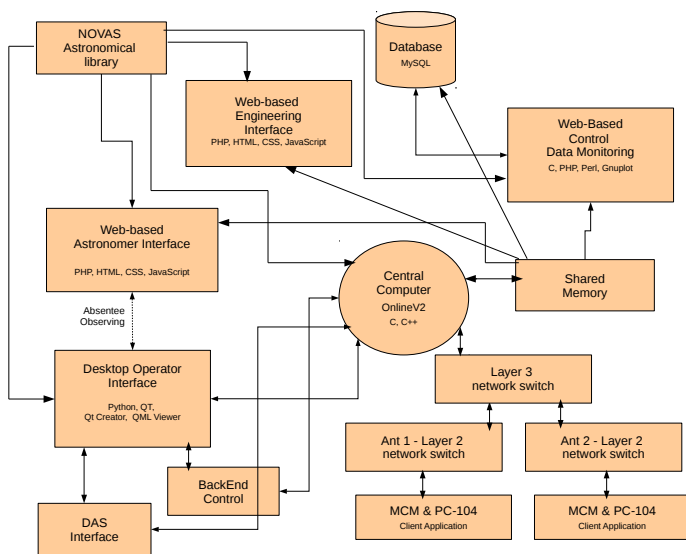


Figure 2: Architectural flowchart showing the design of the upgraded control and monitor software, OnlineV2.

Table 1: Table enumerating differences between ONLINE/old CMS and OnlineV2/new CMS

1	ABC	80C186 μ P	No ABC
2	MCM	80C535 μ C, 1 MHz, EPROM, 16kB/64KB disk, 16 control, floating pt operations not supported	Rabbit-4000 P, 30 MHz, 512 kB RAM, 2GB SD card, dynamic C, 32 control, 64 monitor, 5 serial ports, Floating pt operations supported
3	CEB \rightarrow Antenna	Serial-250kbps	Ethernet-1Gbps, ASCII comm
4	Communication to MCM	Serial from ABC to MCM, SCC	Ethernet from switch to MCM
5	Operating System	Solaris	Linux
6	Operator environment	POPS-based	Python-based
7	Astronomical library	Starlink	NOVAS
8	Solar system objects	Basic support	Full support
9	Programming	Fortran & C	C, Qt/QML, Apache, MySQL, javascript, PHP, Perl, Python
10	Graphical User interface	None	Available
11	Web-based monitoring	None	Available

- early-2015: OnlineV2 successfully tested on 15 antennas.

Open software is used in the development of OnlineV2 and the development is targeted towards GMRT antennas and subsystems. The differences between ONLINE and OnlineV2 are listed in Table 1.

Some of the hardware of the CMS system which were an outcome of the development of OnlineV2 are:

- Recognizing that an antenna base computer (ABC) is no longer required in the CMS chain at GMRT as detailed in the study by Kanade, Upgrade, Sisodiya in reference 1.
- Recognising that a Layer 2 switch at the antenna base and Layer 3 switch in the receiver room are required by CMS.
- Identifying the need for extra 40 Rabbit MCM cards to enable downward compatibility which might be required at antenna base to allow for time delay in upgrade of all subsystems (e.g. for serial communication to FPS) and also ensuring sufficient backup cards.
- Two server class computers with Linux.

OnlineV2 has a desktop control and monitor software module and a web-based monitor software module as shown in Figure 3. While some development is still going on as detailed in the technical reports, the modules have been tested.

OnlineV2 is a viable option as the upgraded control and monitor software for coordinating GMRT operations using the upgraded MCM cards and ethernet link and is installation-ready. OnlineV2 has been successfully running on a 8-MCM test setup in the telemetry lab for more than an year. Command-response times are less than 0.5 seconds and tests show that under ideal conditions these can be as small as 100 ms. Continuous monitoring at 1s intervals for 15 antenna single-MCM system has been tested for more than four days. OnlineV2 core, python environment, desktop GUI has simultaneously controlled 15 antennas single MCM system in April 2015. Downward compatibility in terms of serial communication has been provided and tested for the FPS system. Rest of the sub-systems have either been tested

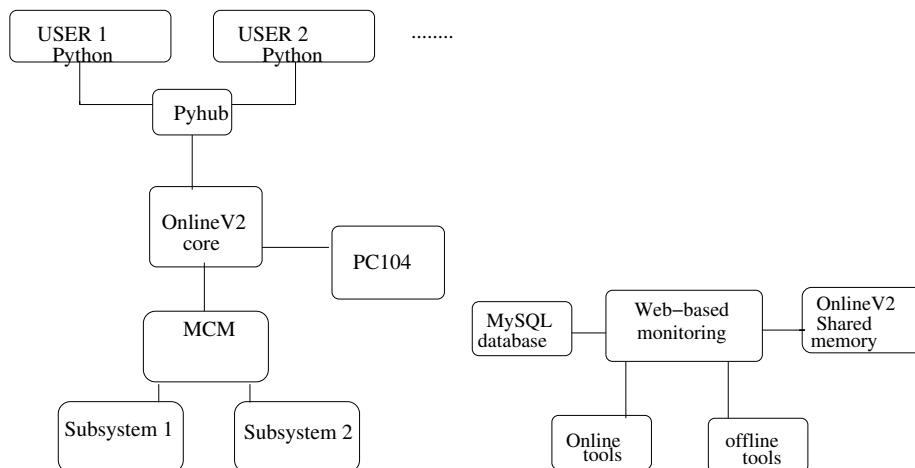


Figure 3: (left) Desktop OnlineV2 (control and monitor) and (right) web-based OnlineV2 (monitor)

at antenna or in the relevant laboratory and whatever problems encountered have been understood and resolved thus making OnlineV2 a reliable option. However the following are the requirements which need to be met before OnlineV2 can be installed:

1. Two dedicated server-level computers - one for the core software and other for web-based monitoring tools (and absentee observing tools) outside the firewall.
2. Ethernet link to all 30 antennas to be operational.
3. RF signal from all 30 antennas to be brought to the CEB instead of the IF signal.
4. Installing new MCM cards on all antennas.
5. Rigorous testing of OnlineV2 after above is available.
6. If Observatory decides to install OnlineV2 then the shift can be implemented in \sim a month.

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