OnlineV2 - an upgraded control and monitor software for GMRT

Design,development,testing

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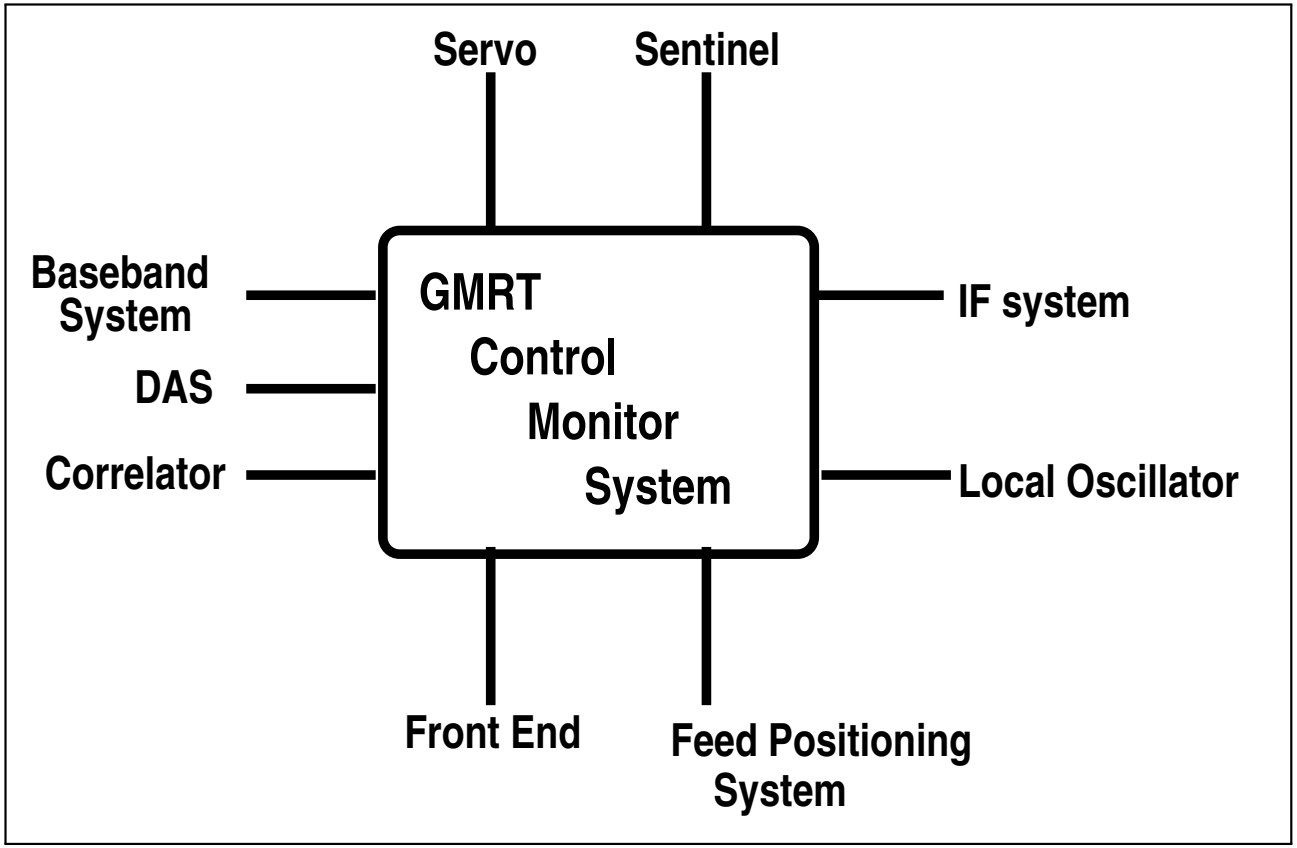
Outline

Control and monitor systems - role

- Controls, monitors and coordinates the operation of telescope
- GMRT - 30 antennas - coherent/subarray operations.
- Antenna control: sub-system operations e.g. FE, Servo, FPS, LO, IF, DAS, correlator: setting frequency, gain, antenna positioning, source tracking...
- Antenna monitor: response to control commands, control parameters, error logging...
- Science Observations: implementing command files, monitoring parameters.
- **All communication to the antennas subsystems is through the control and monitor system.**

CMS - role

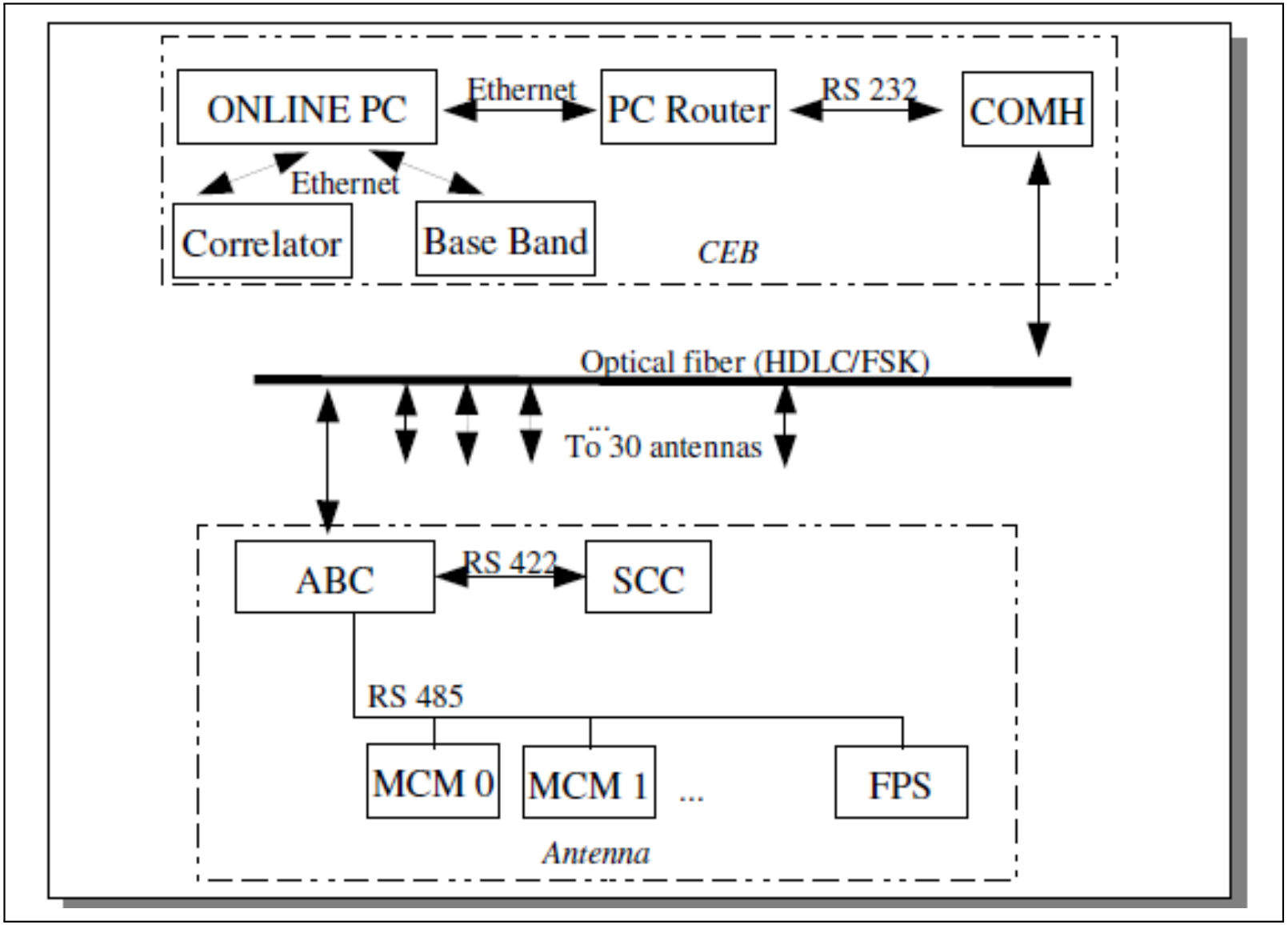


The role of a control and monitor system of a telescope.

CMS - Components

- Hardware and software components.
- Hardware components: Monitor and control modules (MCM) for each subsystem, communication-related hardware, transmission hardware, computers.
- Software components: higher level software, software on antenna-based computer/MCM, web software, communication protocols, shared memory.
- Central CMS communicates with subsystem or subsystem CMS. e.g. In current system:
  ONLINE $\rightarrow$ ABC $\rightarrow$ MCM $\rightarrow$ FE;
  ONLINE $\rightarrow$ DAS.

CMS-in-operation



Block diagram showing currently operational CMS (from L.Pommier)

CMS-in-operation

- Hardware: ABC (antenna base computer) using microprocessor 80C186
  MCM cards using the microcontroller 80C535, RS 485; SCC -RS 422
- ABC - communicates with MCM 0,2,5,10,14, servo μP. 9.6 kbps. CEB to ABC OF link: 250 kbps
- MCM - 16 control channels, EPROM, 1 MHz.
- Software: ONLINE (developed by Pramesh Rao, CR Subrahmanya and team), serial communication to antenna and with subsystems. Ethernet in CEB.
- ONLINE: runs on SPARC work station with Solaris OS. Several Fortran and C programmes - master user and normal users. Higher level interface: AIPS/POPS - allows for procedures.

Teleset and ABCcom

- Linux-based, serial communication C&M software in C++ and QT.
- Teleset - control room software; ABCcom - ABC software.
- Replaces the μP ABC by a personal computer.
- Transfer of more intelligence to the antenna-base computer.
- Multi-threaded software.
- Software developed by L.Pommier and Pramesh Rao in 2005.
- Successfully tested but not implemented.

Motivation for upgrading CMS

- ABC, MCM - ~ 20 years - upgrade to faster, better hardware.
- Avail of faster ethernet connection to antennas implemented by OF group.
- SPARC workstation with Solaris - outdated/not supported - upgrade to Linux.
- Provide GUI and web-based utilities to users.
- Provide full support for solar system objects (changing RA/Dec).
- More time to science observations - lower overheads. For example, currently ~ 20s required for any command sent to antenna. In new CMS, this should be less than a second.

Motivation for upgrading CMS

Example of observing file at GMRT

Overheads due to CMS ~ 4m every ~ 30m if pointing model loaded

subar 4 – *1 sec*

addlist '/odisk/gtac/cmd/snk/snk.list' – *1 sec*

gosacout – *1 sec*

gts'CDFS' – *1 sec*

sndsacsrc(1,12h) – **20 sec**

stabct – **20 sec**

$/(gotosrc)$ – *0 to 5min (depends on the target distance)*

strtndas – *2 sec*

time 5m – *1 sec*

stpndas – *2 sec*

Each command to antennas currently takes ~ 20s

Loading pointing offsets takes ~ 2m

Observing grid of 18 points for 1m each $\sim$ 30m

OnlineV2 $\rightarrow$ increased reliability; faster.

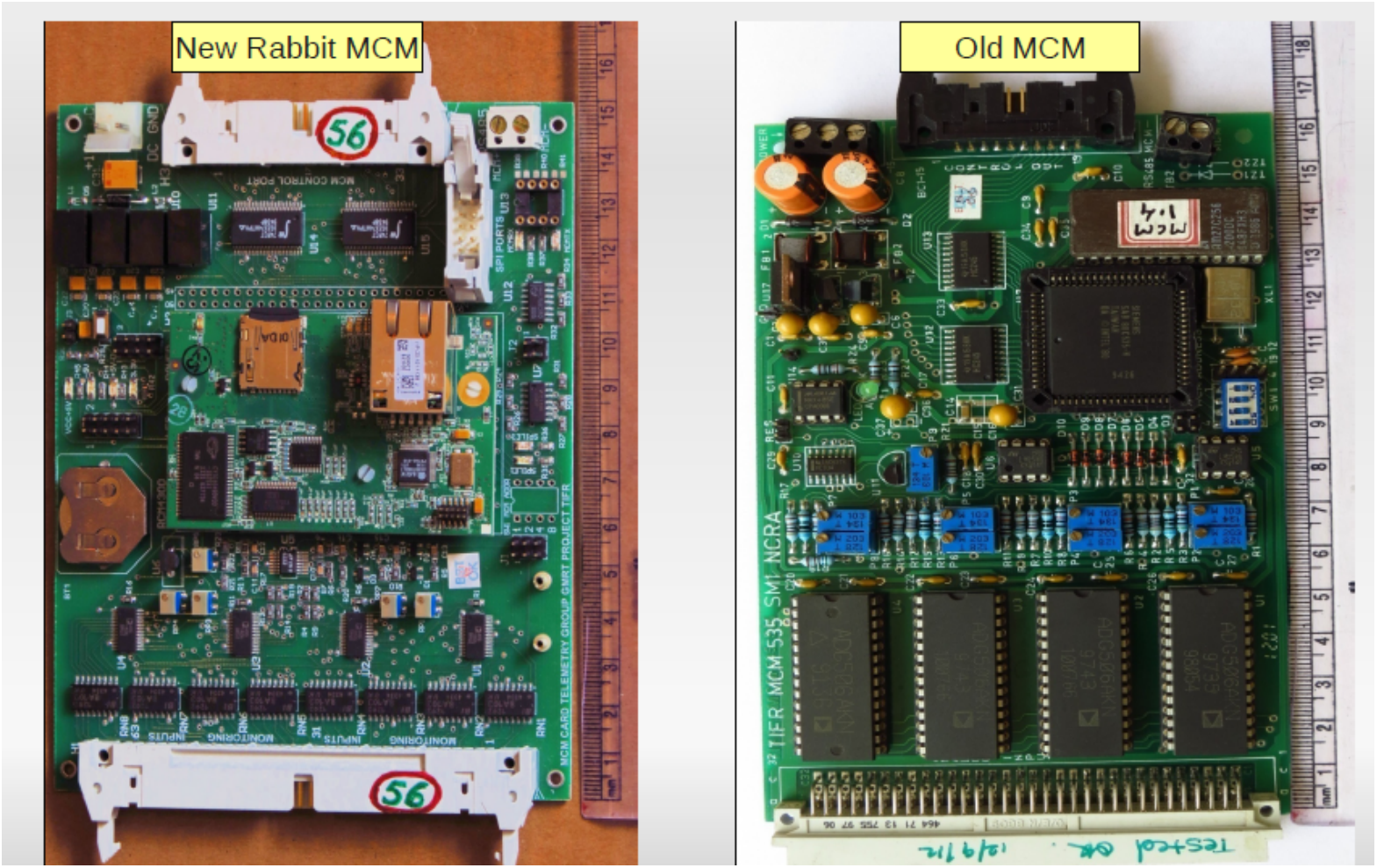
Short history of in-house CMS

- 2010-2011: Telemetry group upgraded hardware: Rabbit-based MCM.
- 2010-2011: Telemetry group installed Linux-based C&M (Teleset,ABCcom).
- 2010-2012: Dilemma about software upgrade for new C&M - inhouse / outsourced?
- 2012: In-house development at a stage where astronomer inputs useful.
- mid-2012: The decision to further develop the in-house version was made and I got involved at this stage.
- 2012-2013: Study of GMRT C&M software and on other telescopes - discussion on whether to use commercial SCADA systems or develop all in-house. The team agreed on the latter. Two years of work projected for the software.
- 2015: OnlineV2 successfully tested on 15 antennas.

Upgraded CMS

- Hardware: 1. RCM4300 MCM 2. Ethernet connectivity 3. Network switches 4. Computers
- Software: OnlineV2
- Aims of OnlineV2:
  1. Support for ethernet communication
  2. Fast control and monitoring of system parameters
  3. Enhanced functionality, generalised framework to support expansion
  4. Web-based tools for astronomers, engineers
  5. Python-based high level environment
  6. Customised GUI for operators, engineers
  7. Two years for development foreseen - start $\sim$ October 2012.

MCM cards



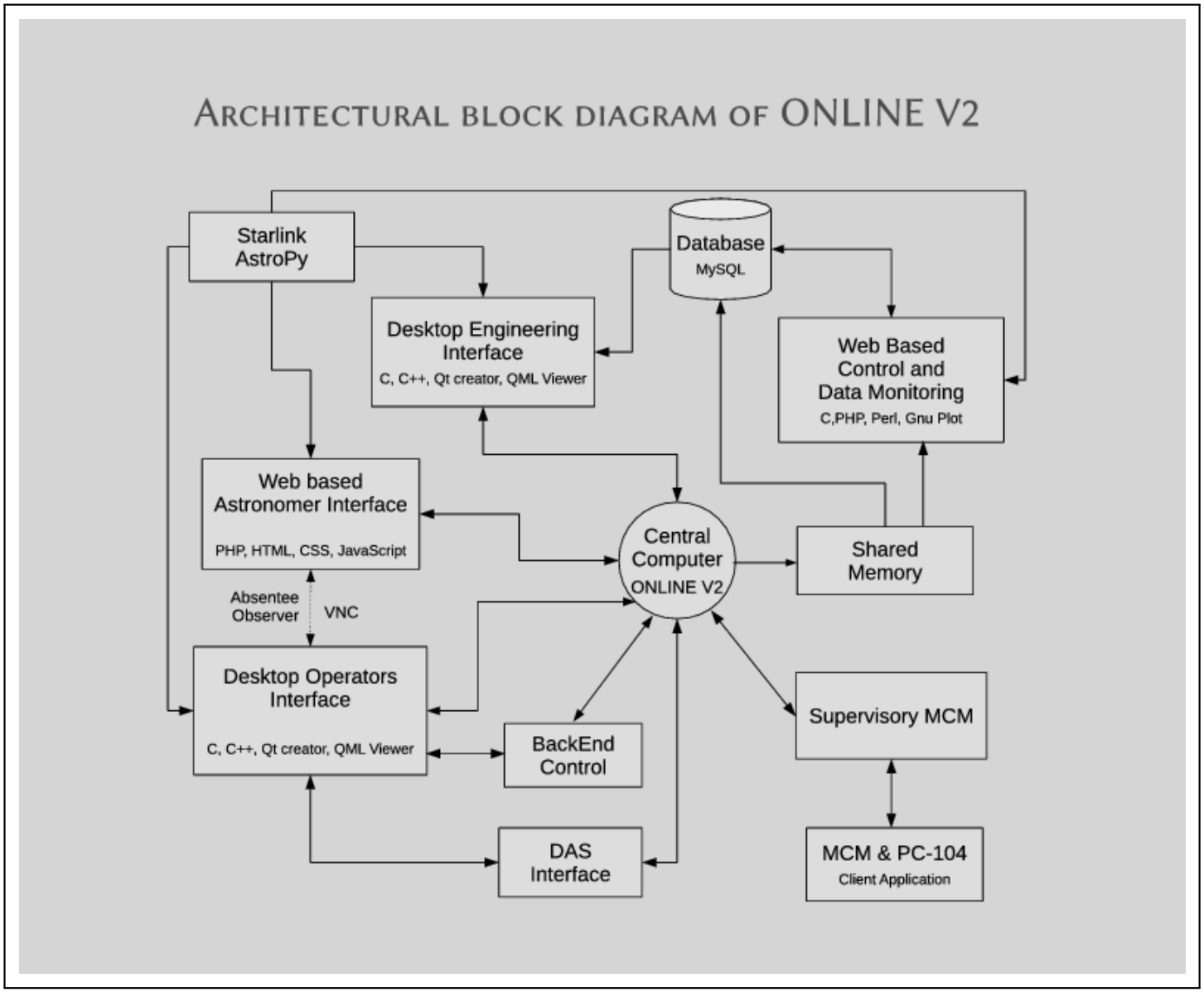
RCM4300 (Rabbit-4000 processor) card designed by R. Balasubramanian and telemetry group at GMRT in 2010-11. 160 new cards available at GMRT.

Old MCM and New MCM

1. MCM - 80C535 μC, 1 MHz μP, 64KB EPROM; ABC - 80C186 μP
2. MCM - 16 control channels, 2 monitor channels
3. MCM - Floating point operation not supported
4. MCM Serial communication - RS 485 link - 9.6kps

1. MCM - Rabbit-4000 μP - 30/60 MHz, dynamic C programmable, 512 kB RAM, 1 GB SD card – RCM4300
2. MCM - 32 control channels, 64 monitor, 5 serial ports
3. MCM - FLOPS supported
4. MCM ethernet communication - 100 Mpbs, ASCII commands; serial communication - RS 485 link - 115 kbps.

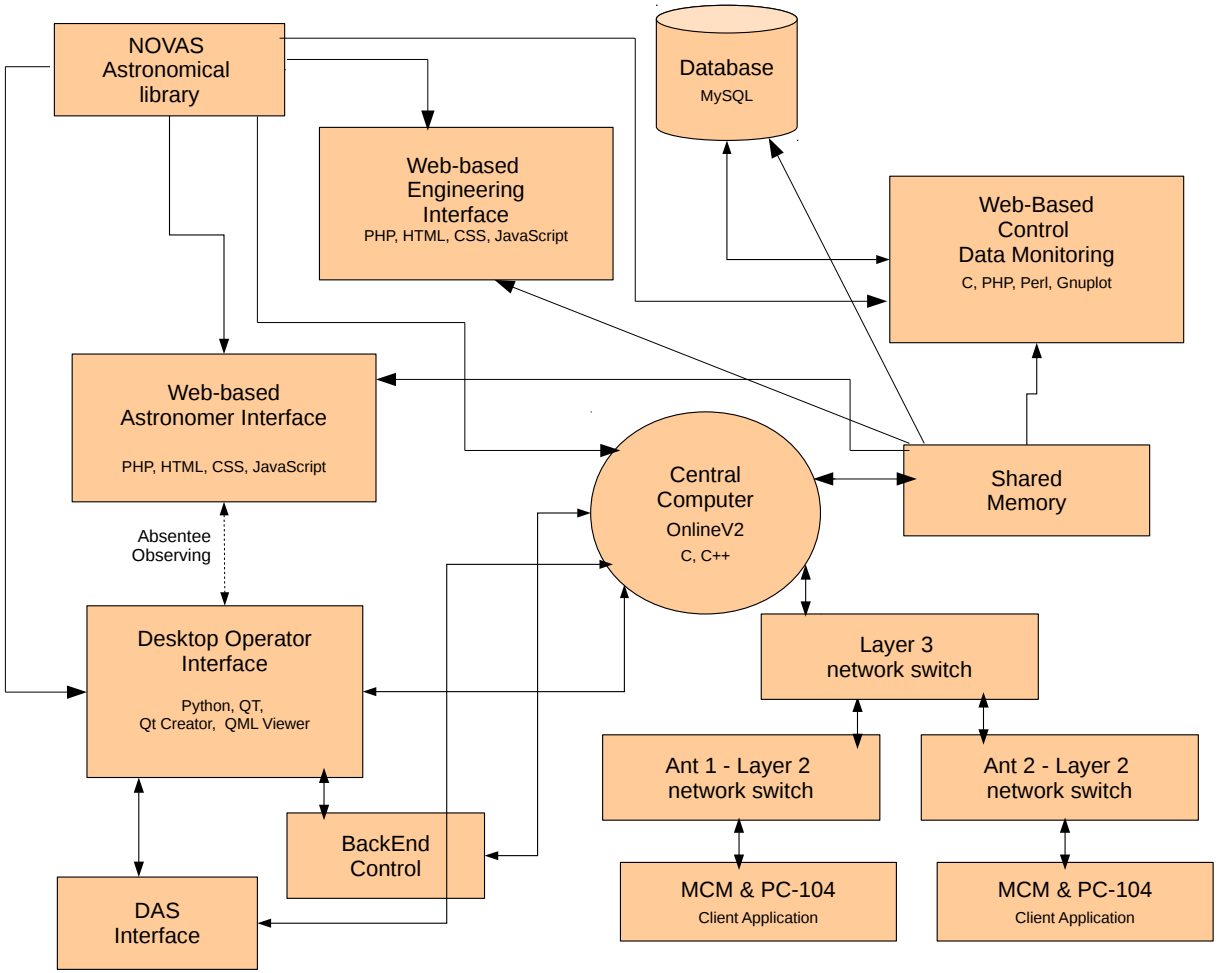
OnlineV2 - the design plan



Dec 2012; All ethernet linkages.

OnlineV2 - the realisation - 2015

Desktop-based control & monitor and web-based monitor



OnlineV2 - design and realisation

- 2012
- Separate supervisory hardware at antenna base

- 2015
- No separate supervisory hardware required at antenna base

Commands defined in ONLINE to control GMRT sub-systems are comprehensive - decision to retain those and hence the name OnlineV2.

OnlineV2 - design and realisation

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- Separate supervisory hardware at antenna base
- Higher level interface not decided

- 2015
- No separate supervisory hardware required at antenna base
- Python as the higher level interface

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- Starlink and AstroPy considered

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- Desktop and web-based engineering interface

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OnlineV2 - design and realisation

- 2012
- Separate supervisory hardware at antenna base
- Higher level interface not decided
- Starlink and AstroPy considered
- Desktop engineering interface
- VNC for basic web-based control by user

- 2015
- No separate supervisory hardware required at antenna base
- Python as the higher level interface
- NOVAS astronomical library used
- Desktop and web-based engineering interface
- Only web-based monitoring enabled

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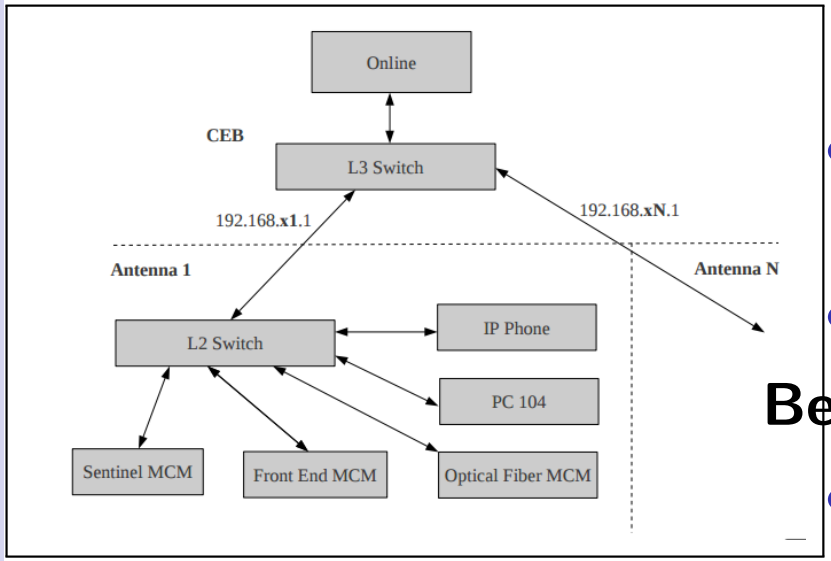
OnlineV2 to antenna



No ABC required because

- New MCM more powerful than existing ABC; no role for a separate computer.
- 1Gbps OF link - fast CEB-antenna communication.
- Split intelligence between control computer in CEB and new MCM.
- MCM can play supervisory role.

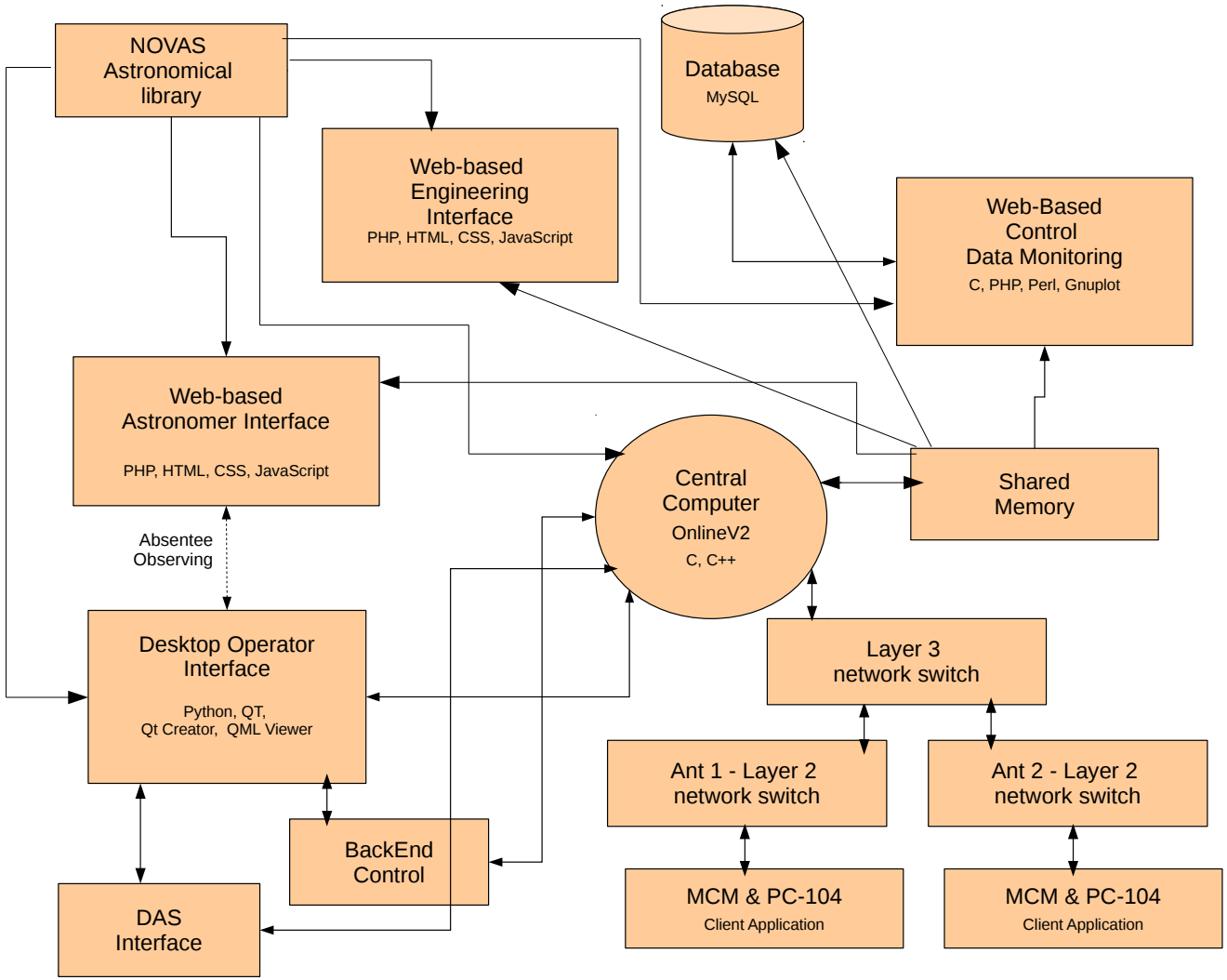
Benefits:

- Lower RFI footprint at antenna.
- Save money - 30 computers not required.
- Save time (also observing) and money on maintenance of an extra component in the system.

Development: OnlineV2 components

1. Core software
2. MCM programmes
3. Socket communication protocols
4. Python environment and interface
5. Serial communication to subsystems at antenna
6. Control data logging in database and web-replay
7. Astronomical Library
8. Graphical User Interfaces
9. Enabling absentee observing web-based tools*

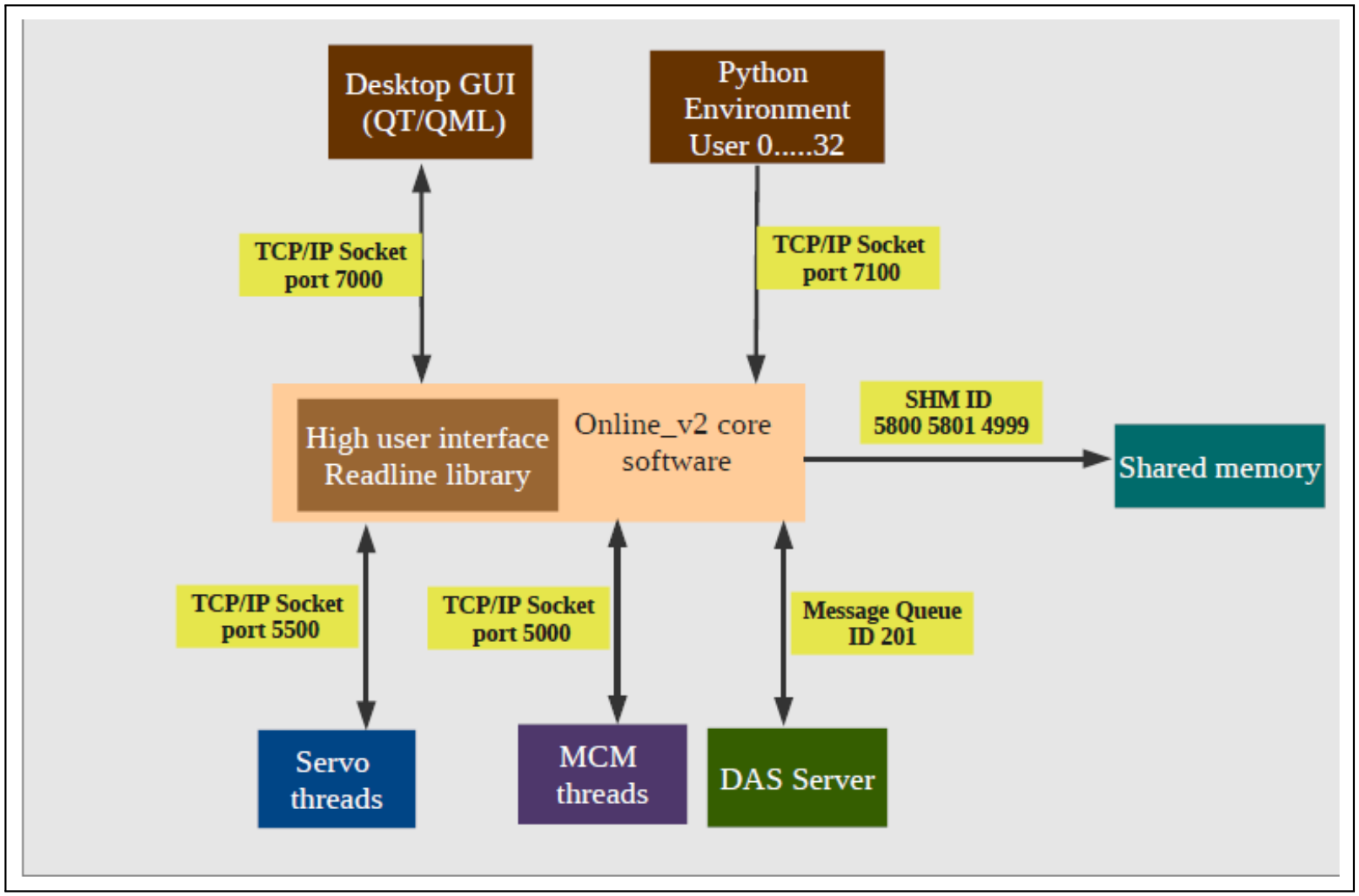
OnlineV2 components



OnlineV2 - 1. core software

- Central control software commanding sub-systems through/wo MCM. No antenna base computer (ABC).
- Client-server architecture; TCP/IP communication; fast communication: $\leq$ 1s
- Multi-threaded application
- Programmed in C - currently 18 programmes.
- Accessed through command line, GUI, Python interface
- C & M of wideband OF, sentinel, servo, FPS, GAB, DAS, FE.
- Syntax: antenna sub-system operation parameter argument e.g. C00 Sentinel init, C00 OF set rf_attn 10 10
- Antenna Operation: Init, Mon, set, reset. FPS, servo, DAS different.
- Complete listing of ONLINE commands and procedures prepared for porting.
- Alarm programme from ONLINE ported.

OnlineV2 - core software



OnlineV2 - core software

The server programme OnlineV2 initialises shared memory, several threads, connects to clients:

```
[teleset@tellab2 Online]$ ./online_v2
HIGHUSER thread CREATED=> 0
SERVO thread CREATED=> 0
GUI INTERFACE thread CREATED=> 0
PYTHON INTERFACE thread CREATED=> 0
MCM SYSTEM thread CREATED=> 0

msgget: Calling msgget(0xc9,01600)
msgget: msgget succeeded: msqid = 0
Sucessfully Created MESSAGE QUEUE ID=0
$$$ SERVER WANTING FOR PYTHON ENVIRONMENT CLIENT TO CONNECT $$$$

 >>  ACCEPTED CONNECTION FROM FPS MCM DEVICE 192.168.21.107
FPS thread opened succesfully=> 0
################ SERVER WANTING FOR CLIENT CONNECTION ######
```

OnlineV2 - 2. MCM programmes

- MCM programmes - client (MCM) $\rightarrow$ server (core)
- Support for both web and socket connection. Socket used.
- MCM programmes: control, monitor, summarize, poll socket for commands, serve webpage...
- Command Syntax: system name, operation, parameter, arguments. e.g. FE set band_sel 1420 1420, FE set slr_attn 0 0....
- ASCII command from OnlineV2 $\rightarrow$ 32-bit control pattern by MCM $\rightarrow$ subsystem
- Antenna base: 2 MCM: FE and sentinel, wideband OF, FPS, supervisory
- CEB: 40+ MCM for GAB control and monitor
- Each MCM has a unique IP address; web monitoring page
- MCM - downward compatible: serial, SPI ports
- Dynamic C coding

OnlineV2 - 3. Communication protocol

- Criterion: Optimise protocol size for fast communication. Typical packet size ~ 1.4 kB.
- Designed at GMRT - used experience from 15m protocol.
- ASCII characters in command structure
- OnlineV2 – MCM: Command: 1.6 kB, Response: 4.6 kB
- OnlineV2 – PC104: Command: 1.1 kB, Response: 2.1 kB
- e.g. OnlineV2 – MCM: Command and response

```
typedef struct
{
 int seq;                        // Unique Sequence
 char timestamp[64];             //  Timestamp of command
 char system_name[16];           // System Name for which command is
 char op_name[16];               // Operation to perform ( Init/Set/Mon/Reset )
 short int number_param;         // Number of parameter
 char parameter_name[32][16];    // Parameter Name
 char Argument_Ch1[32][16];      // Channel One argument
 char Argument_Ch2[32][16];      // Channel Two argument
} cmd;
```

```
typedef struct
{
 int response_type;              // Response type
 int seq;                        // Sequence number
 char timestamp[64];             // Time stamp
 char system_name[16];           // System name
 char Mon_raw[64][8];            // 64 channel raw data
 char Mon_sum[32][64];           // Monitoring summary prepared from 64 channel raw data
 short int num_resp_msg;         // Number of Response Message
 char response_message[32][64];  // Response message from MCM
} resp;
```

OnlineV2 - 4. Python environment and interface

- Interactive command line and basic Qt environment
- Higher level interface to core software for procedures
- Ipython - interactive command line shell
- User window $\rightarrow$ Hub $\rightarrow$ OnlineV2 core
- Totally 32 user interactive shells can communicate with OnlineV2 through TCP/IP protocol.
- Object-oriented design in Python as Application Programming Interface (API) - control (commands) and monitor (read shared memory) modules. General, easy expansion.
- Command syntax e.g. C00.servo.mvelev(10), C00.gab.set(), fps.initfps()....

OnlineV2 - Python environment and interface

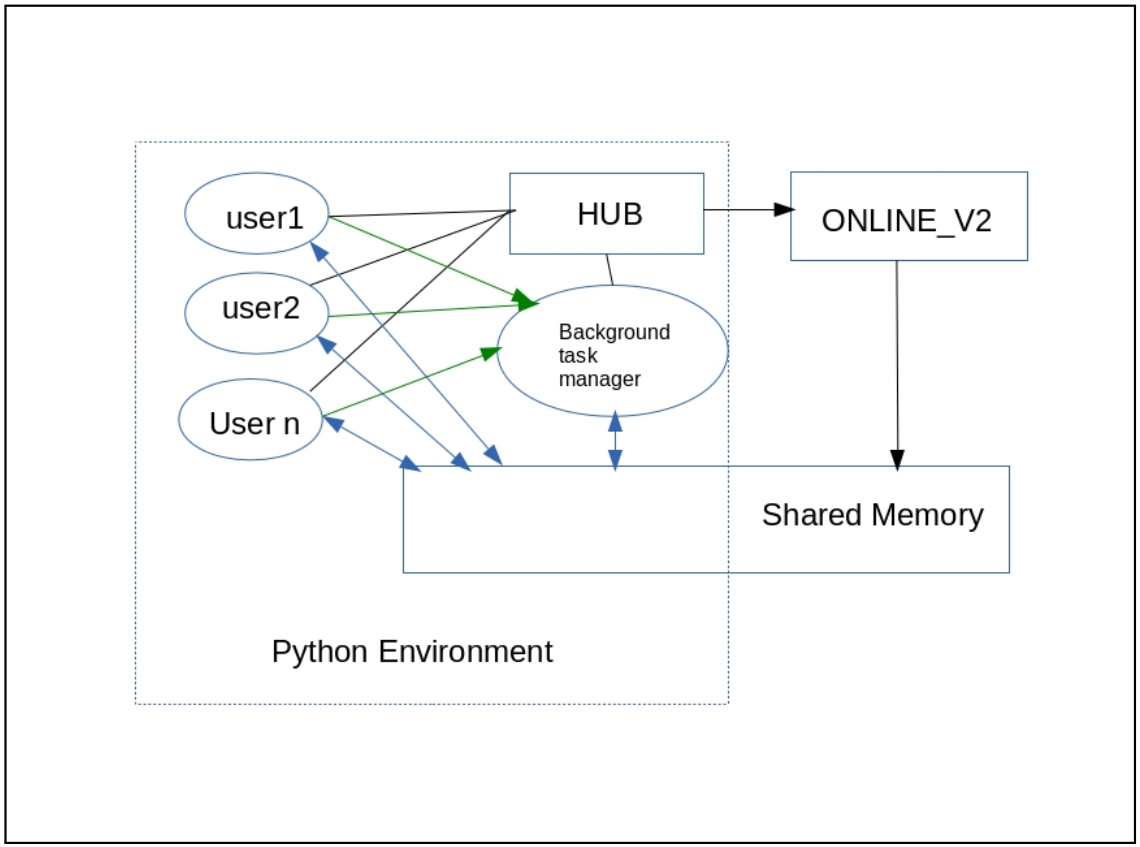
- More commands: of.set(rf_attn=(25,25)), defsub(2,[C01,C02,C03])
- Ipython User terminal opened.

```
File  Edit  View  Terminal  Tabs  Help
cms@incms:~/pyenv$ xterm &
[1] 26815
cms@incms:~/pyenv$ user5
GMRT ONLINE COMMAND LINE USER INTERFACE
Connecting as user: 5
user5@GMRT [1]: shlist
--------------> shlist()
0   vlacal.list
user5@GMRT [2]: addlist 'source.list'
--------------> addlist('source.list')
0   vlacal.list
1   source.list
user5@GMRT [3]: gts '3c147'
--------------> gts('3c147')
Source Not found in list:  vlacal.list
Source Found  in :  source.list
3C147        05h42m36.13s  +49d51'07.2"  2000.

source from source.list : 05h42m36.13s   +49d51'07.2"
Precessed RA(app):  5h43m46.04s Dec:  49d51'22.16"
rise : 7h56m25.11s transit: 13h39m34.62s set :19h22m44.12s
user5@GMRT [4]: fps.
fps.initfps         fps.read_version   fps.set_low_rpm    fps.set_min_angle
fps.mvfps           fps.run_to_preset  fps.set_max_angle
user5@GMRT [4]: fps.
```

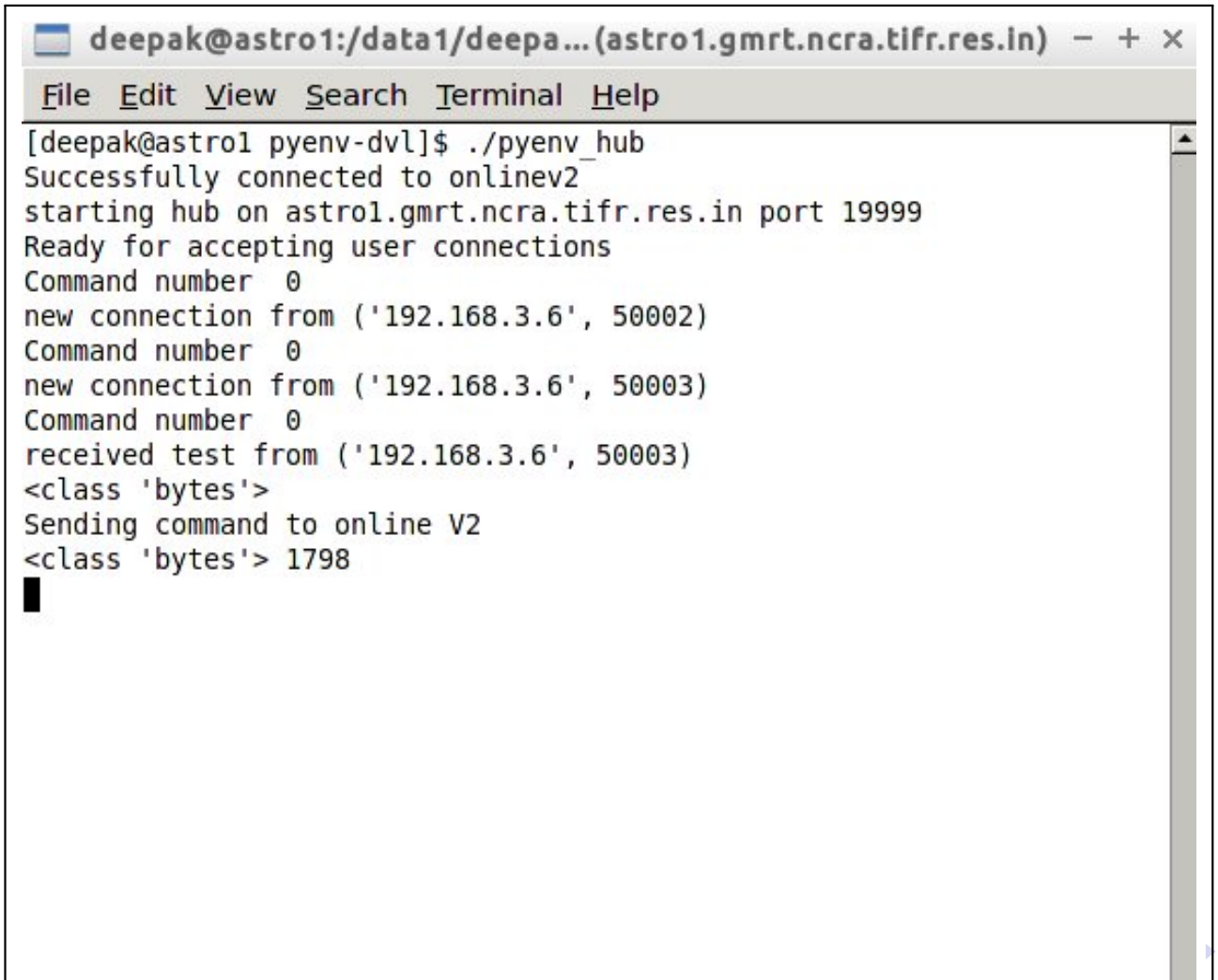
OnlineV2 - Python environment and interface

Design of interactive scripting environment



OnlineV2 - Python environment and interface

- Python hub - all users (clients) connect to hub (router) and hub connects to OnlineV2.



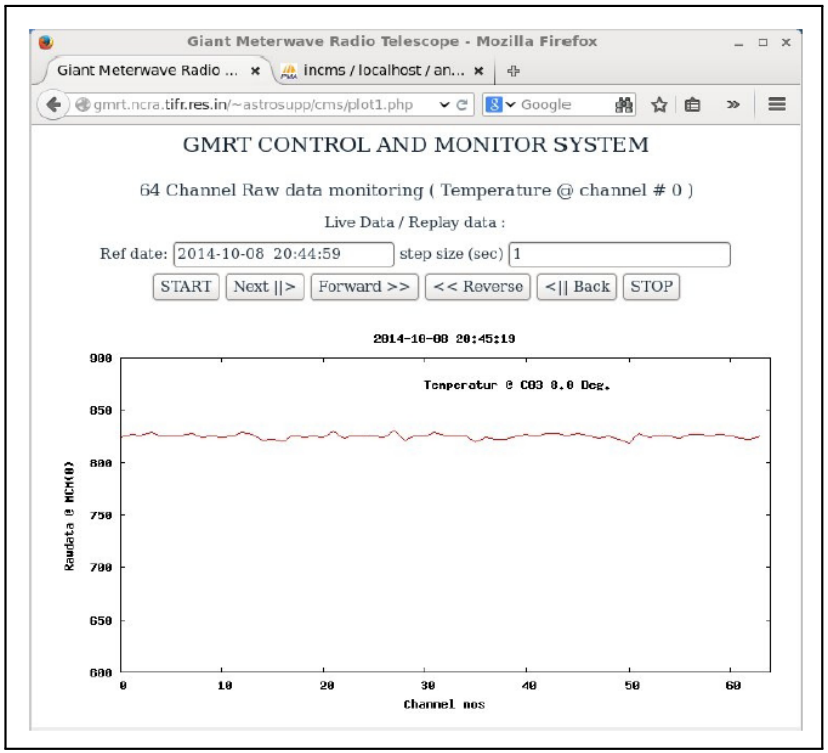
OnlineV2 - 5. Serial communication

- Old MCM, ONLINE - supports only serial communication
- New MCM, OnlineV2 - supports ethernet and serial
- Plan was to use ethernet communication for all subsystems
- IF+LO, Front End, Feed Positioning System at antenna still use old MCM $\rightarrow$ serial link
- Need to make OnlineV2 downward compatible to serial communicate with these
- OnlineV2 - successfully developed and used serial communication to FPS
- Serial for FE being developed, IF+LO ?
- Thus OnlineV2 can communicate with all antenna subsystems.

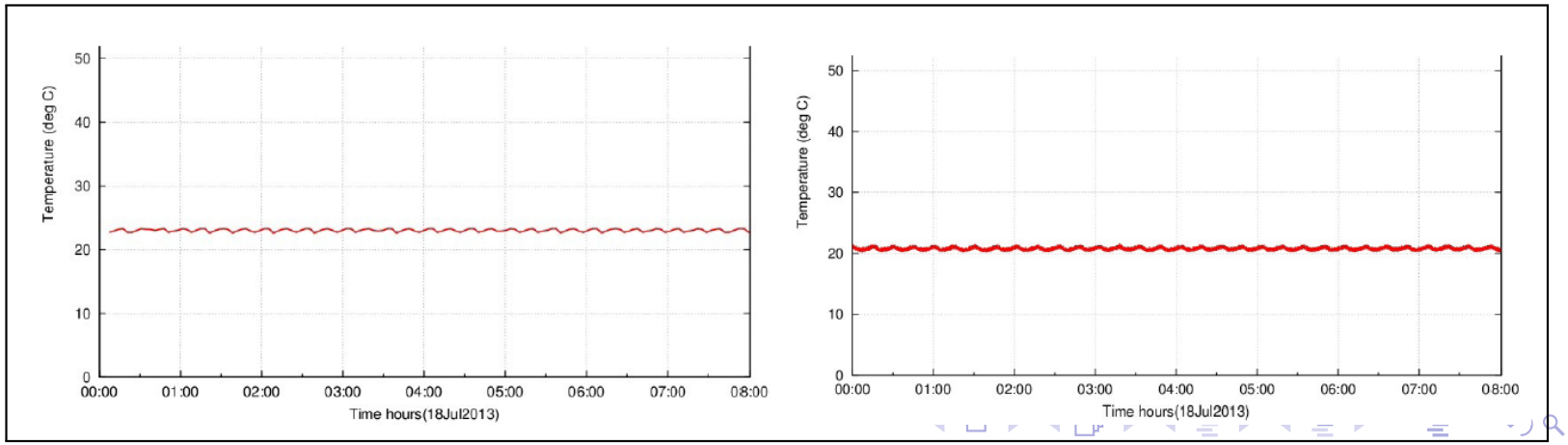
OnlineV2 - 6. Control data logging in database and web-replay

- The C&M data are logged in the shared memory of control computer. e.g. commands issued on python user terminals, command line or GUI, response from subsystem, process status etc.
- Data monitoring server collects shared memory data and uploads on MySQL database.
- Access to data through web-based utilities and desktop GUI.
- Plotting/tables provided, basic statistical parameters.
- Tested on shell temperature data from antenna C03.
- Monitoring data rates of 1 point/second for each antenna 2 MCM supported.
- Data volumes ~ 1 GB per day per MCM card.

OnlineV2 - Control data logging in database and web-replay



- Data of 64 monitoring channels of an MCM plotted from web-replay
- C03 temperature (left) ONLINE + old MCM monitoring
  (right) OnlineV2 + new MCM monitoring at 1 second rate.



OnlineV2 - web-based engineering interface

For Astronomers	For Engineers
User Documents	**Antenna Parameters**
GMRT Observer's Manual	Ondisplay Antenna Tracking Status
System Parameters and Current Status	Ondisplay History
Polarisation observations with GMRT	Feed position status
Dual band multi-pointing with GMRT	Pointing Offsets
GMRT Software Backend Documents	Wind Status
uGMRT upgrade status	Temperature Status
	Servo data
Before Observations	Electrical Power Status
GTAC Schedule [NCRA] [GMRT]	
White Slot Request[NCRA] [GMRT]	**IF Analog Signal Data**
Command file Creater and Observations Setup	Band Shapes, Deflection data
Line Observations Frequency Setup (tune)	Gray Plots
Source(s) Rise and Set Time	
Observing Time Calculator	**Digital Backend Data**
VLA Calibrator Search	Corr band shapes and Project State
Dual band multi-pointing coordinates	Fringe Status (rantsol amp-gain)
Proposal Submission System (NAPS)	Gain-amplitude and Phase (rantsol)
Online Archive (GOA)	Visibility - amplitude and phase (xtract)
	Correlator Room Temperature
During Observations	
Antenna Tracking Status	**Test Results, Callsheets and Schedules**
Corr band shapes and Project State *	Recent Callsheets
Quick Imaging Tool *	GMRT Upgrade Status
Gain-amplitude and Phase (rantsol)	Results of Weekly PMQC tests
Visibility - amplitude and phase (xtract)	GDDP, RFI status gray plots
Wind Status	Antenna Beam Width Plots
	Schedules and white slot request
After Observations	
LTA to FITS conversion:	**Contact**
AIPS help:	astrosupp@gmrt.ncra.tifr.res.in

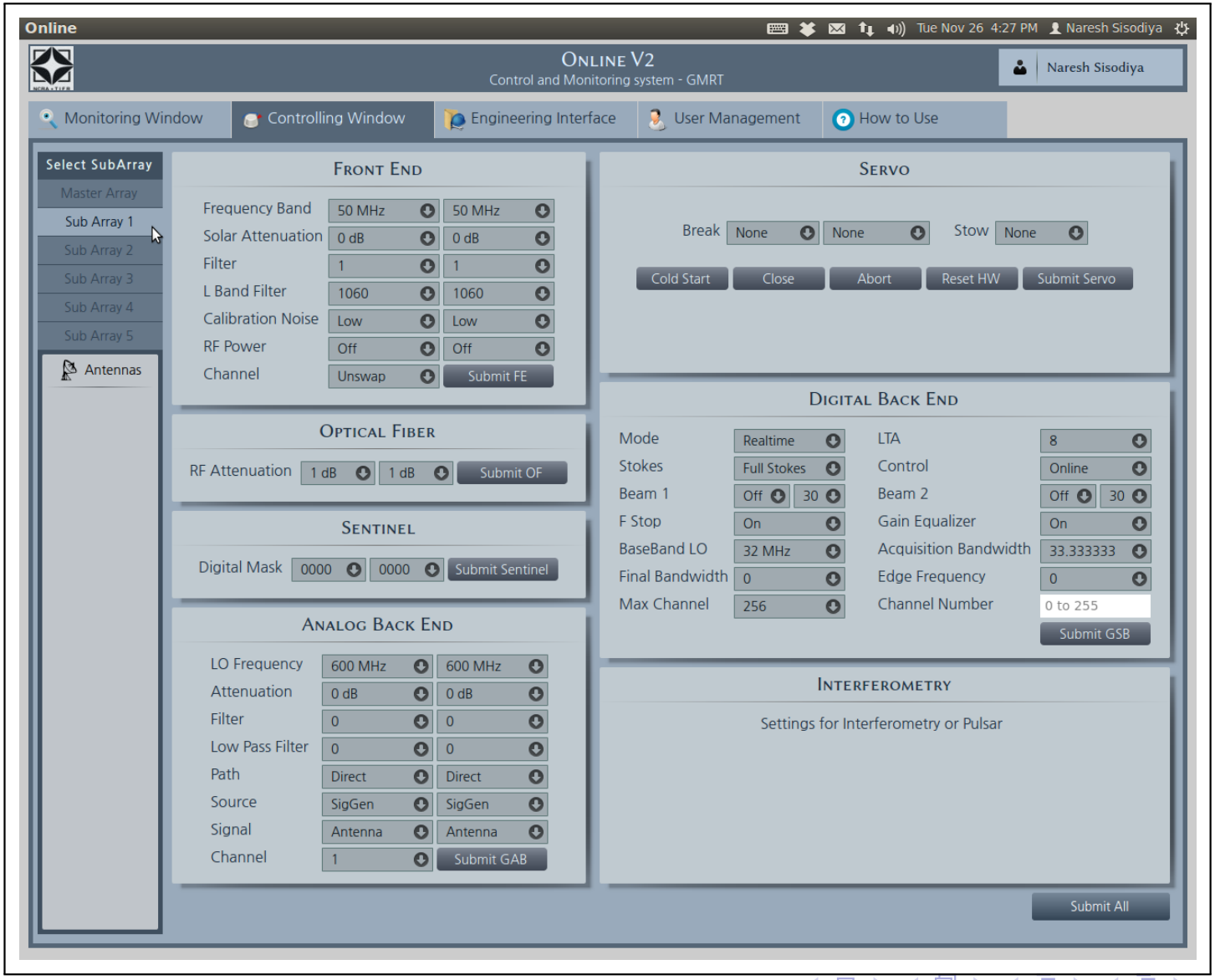
OnlineV2 - 7. Astronomical library

- Required for astronomical calculations - e.g. precession, time conversions...
- Starlink, AstroPy, IAU SOFA, NOVAS - examined
- Current ONLINE uses Starlink
- Naval Observatory Vector Astrometry Software (NOVAS) selected - ease of observing solar system objects
- Wrapper functions for accessing NOVAS library by C programmes, PHP, Perl and Python developed.
- Wrappers for solar system objects being developed.
- In ONLINE - user has to input the changing RA, Dec of solar system objects.
- In OnlineV2 - user will only have to specify the object like other celestial objects.
- OnlineV2, web-paged utilities will access the NOVAS functions.

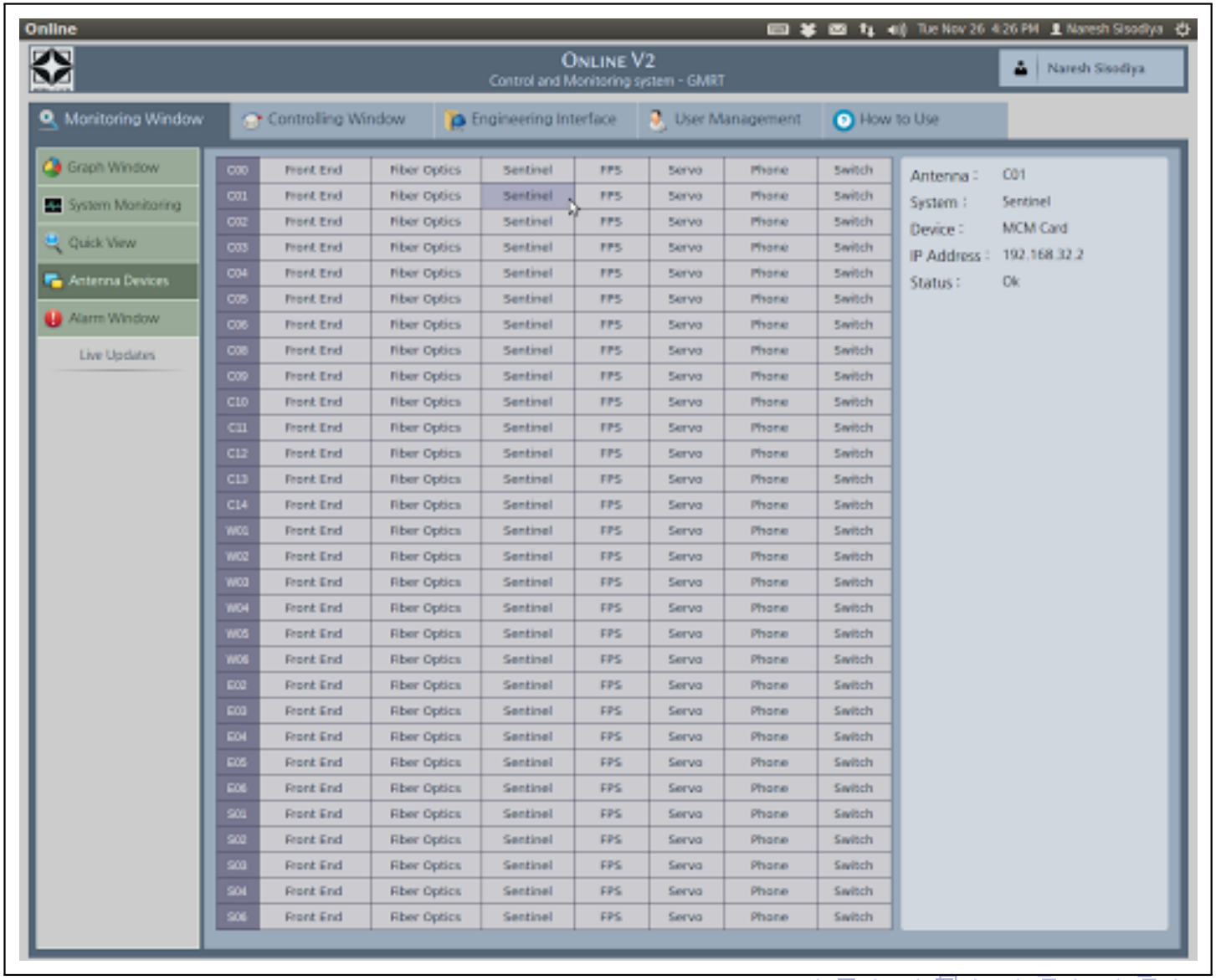
OnlineV2 - 8. Desktop Graphical User Interface

- Four interfaces available: Monitoring, Controlling, Engineering, User Management
- Communication between GUI and OnlineV2 core: XML file, socket and direct database access provided.
- Software used: C++, Javascript, Qt/QML
- Core software $\rightarrow$ GUI implemented; Python interface GUI to be done.
- Control of antenna-based sub-systems: FE, FPS, OF, sentinel
- Designed for portability and expansion.

OnlineV2 GUI - operator control window



OnlineV2 GUI - operator monitor window



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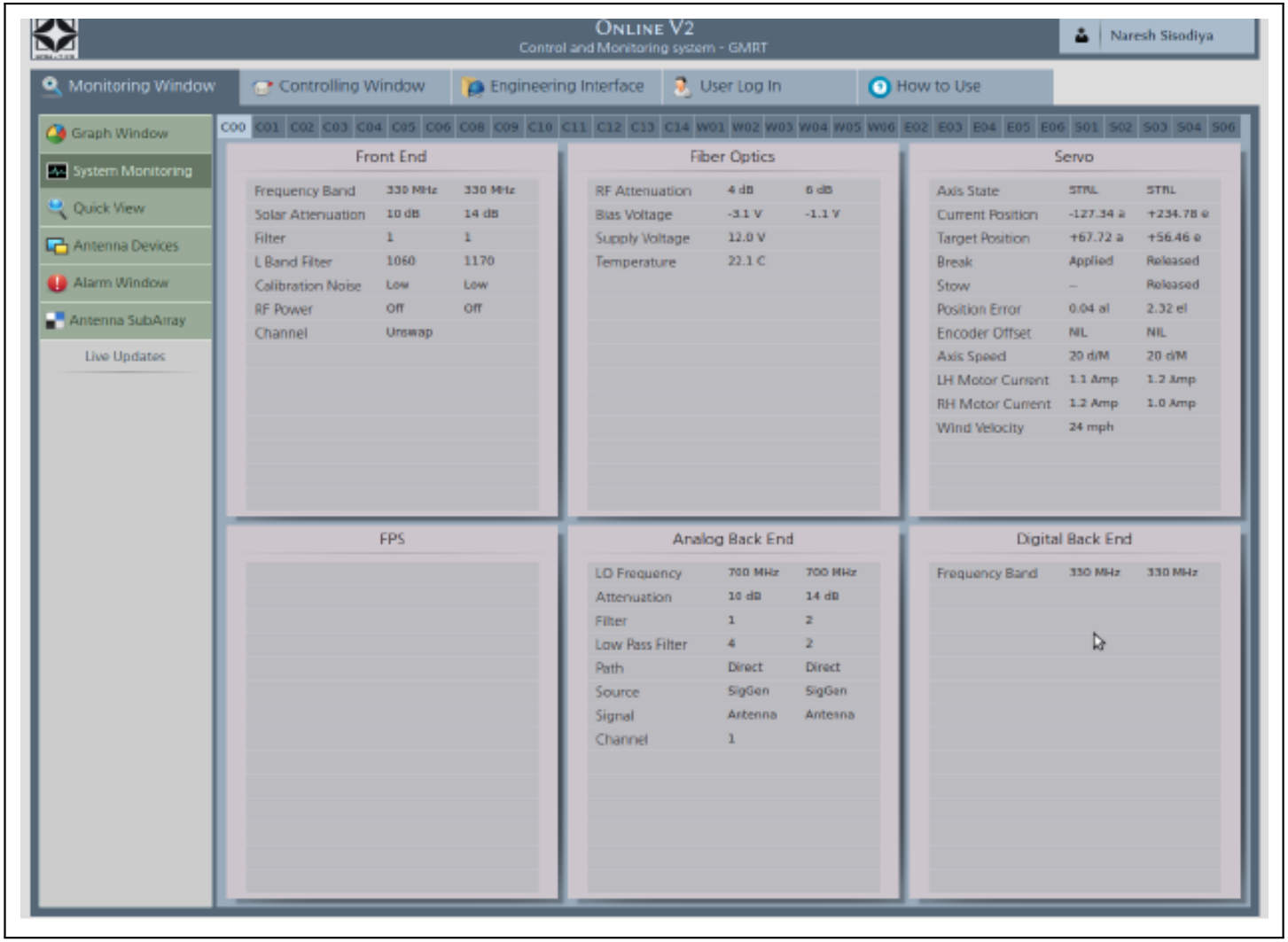
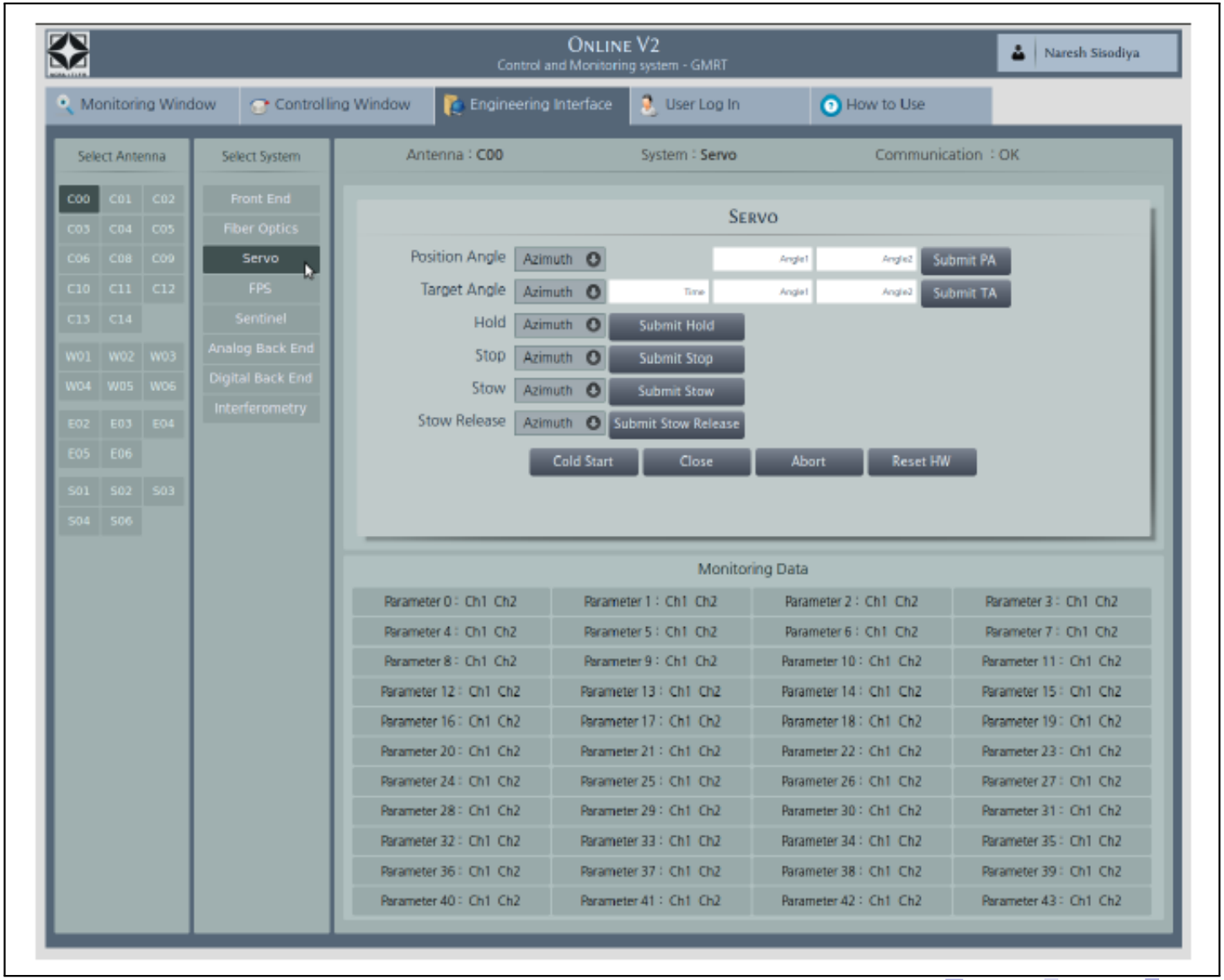


OnlineV2 GUI - engineering window



Web-based tools for Absentee observing

WUGH - Web-based User of GMRT Hub: absentee observing tools and more Available at www.gmrt.ncra.tifr.res.in/

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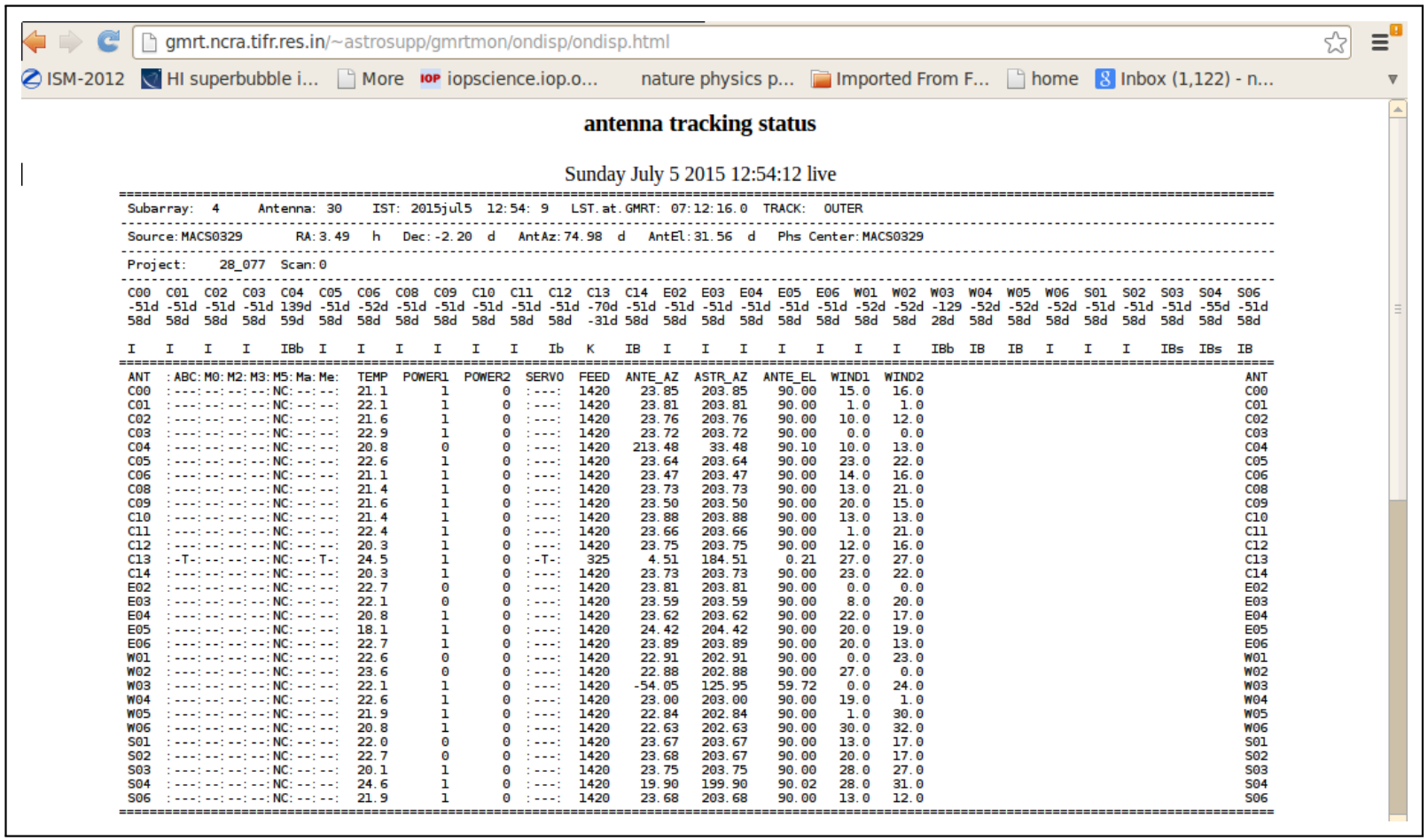
RFI Plots:	
GDDP summary:	
Contact	
* gmrtoperations@ncra.tifr.res.in	

a. Web-based antenna status



gmrt.ncra.tifr.res.in/~astrosupp/gmrtmon/ondisp/ondisp.html

ISM-2012 | HI superbubble i... | More | iopscience.iop.o... | nature physics p... | Imported From F... | home | Inbox (1,122) - n...

antenna tracking status

Sunday July 5 2015 12:54:12 live

Subarray: 4 Antenna: 30 IST: 2015jul5 12:54: 9 LST.at.GMRT: 07:12:16.0 TRACK: OUTER

Source: MACS0329 RA: 3.49 h Dec: -2.20 d AntAz: 74.98 d AntEl: 31.56 d Phs Center: MACS0329

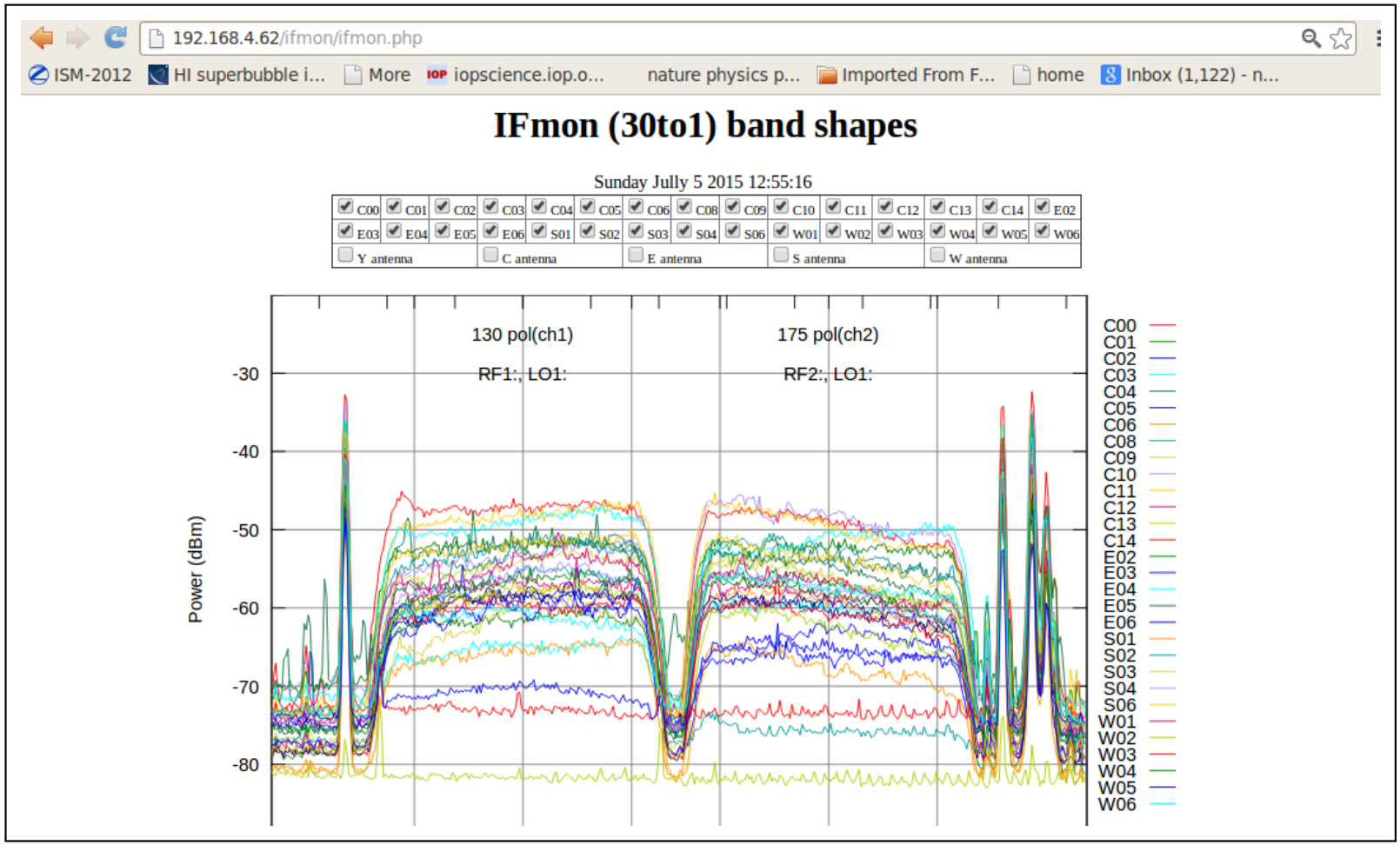
Project: 28_077 Scan: 0

C00	C01	C02	C03	C04	C05	C06	C08	C09	C10	C11	C12	C13	C14	E02	E03	E04	E05	E06	W01	W02	W03	W04	W05	W06	S01	S02	S03	S04	S06
-51d	-51d	-51d	-51d	139d	-51d	-52d	-51d	-51d	-51d	-51d	-51d	-70d	-51d	-51d	-51d	-51d	-51d	-51d	-52d	-52d	-129	-52d	-52d	-52d	-51d	-51d	-51d	-55d	-51d
58d	58d	58d	58d	59d	58d	58d	58d	58d	58d	58d	58d	-31d	58d	58d	58d	58d	58d	58d	58d	58d	28d	58d	58d	58d	58d	58d	58d	58d	58d

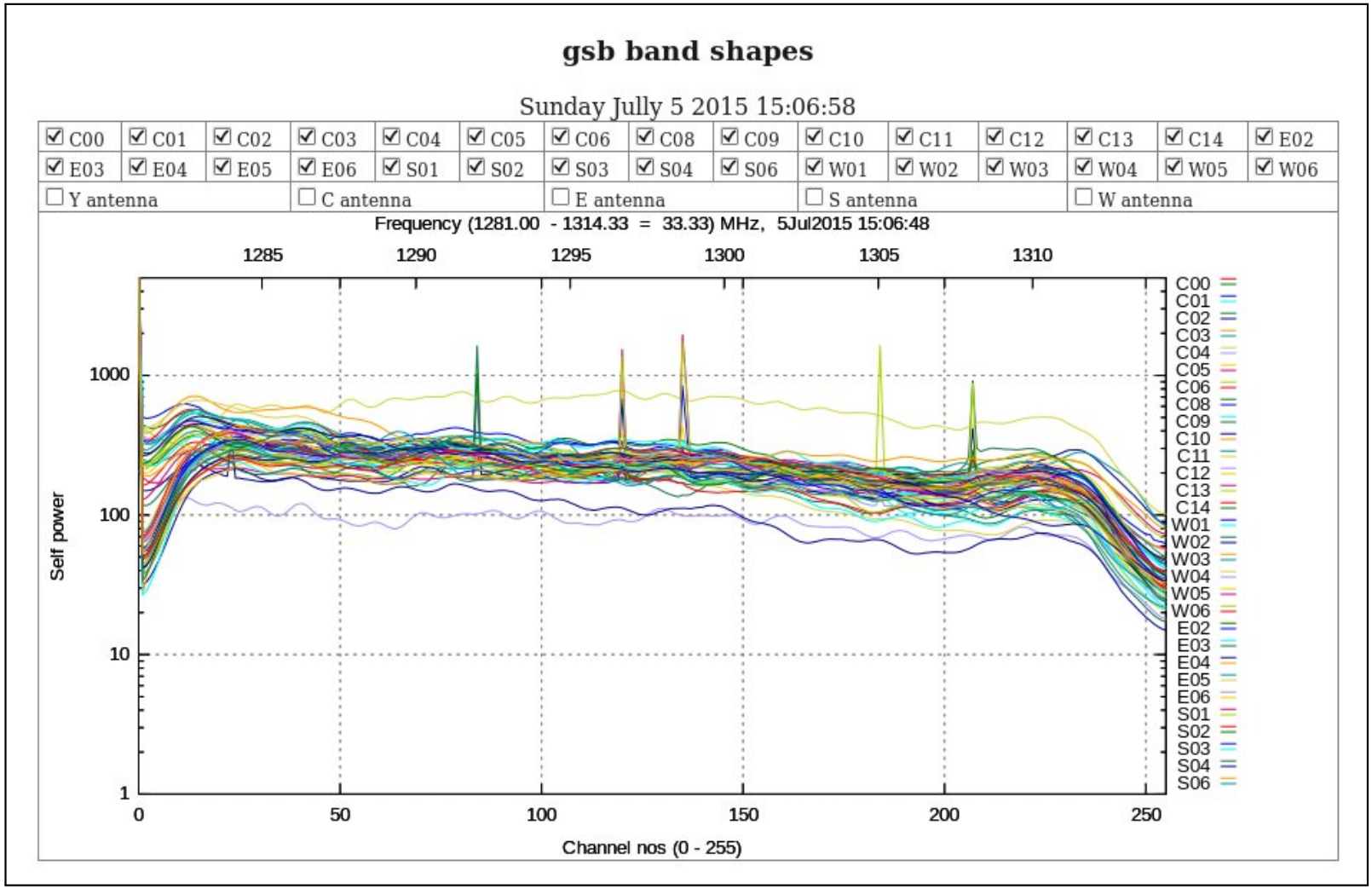
I	I	I	I	IBb	I	I	I	I	I	I	Ib	K	IB	I	I	I	I	I	I	I	IBb	IB	IB	I	I	I	IBs	IBs	IB

ANT	ABC:	M0:	M2:	M3:	M5:	Ma:	Me:	TEMP	POWER1	POWER2	SERVO	FEED	ANTE_AZ	ASTR_AZ	ANTE_EL	WIND1	WIND2		ANT
C00	---	--	--	--	NC:	--	--	21.1	1	0	---	1420	23.85	203.85	90.00	15.0	16.0		C00
C01	---	--	--	--	NC:	--	--	22.1	1	0	---	1420	23.81	203.81	90.00	1.0	1.0		C01
C02	---	--	--	--	NC:	--	--	21.6	1	0	---	1420	23.76	203.76	90.00	10.0	12.0		C02
C03	---	--	--	--	NC:	--	--	22.9	1	0	---	1420	23.72	203.72	90.00	0.0	0.0		C03
C04	---	--	--	--	NC:	--	--	20.8	0	0	---	1420	213.48	33.48	90.10	10.0	13.0		C04
C05	---	--	--	--	NC:	--	--	22.6	1	0	---	1420	23.64	203.64	90.00	23.0	22.0		C05
C06	---	--	--	--	NC:	--	--	21.1	1	0	---	1420	23.47	203.47	90.00	14.0	16.0		C06
C08	---	--	--	--	NC:	--	--	21.4	1	0	---	1420	23.73	203.73	90.00	13.0	21.0		C08
C09	---	--	--	--	NC:	--	--	21.6	1	0	---	1420	23.50	203.50	90.00	20.0	15.0		C09
C10	---	--	--	--	NC:	--	--	21.4	1	0	---	1420	23.88	203.88	90.00	13.0	13.0		C10
C11	---	--	--	--	NC:	--	--	22.4	1	0	---	1420	23.66	203.66	90.00	1.0	21.0		C11
C12	---	--	--	--	NC:	--	--	20.3	1	0	---	1420	23.75	203.75	90.00	12.0	16.0		C12
C13	-T-	--	--	--	NC:	--	T-	24.5	1	0	-T-	325	4.51	184.51	0.21	27.0	27.0		C13
C14	---	--	--	--	NC:	--	--	20.3	1	0	---	1420	23.73	203.73	90.00	23.0	22.0		C14
E02	---	--	--	--	NC:	--	--	22.7	0	0	---	1420	23.81	203.81	90.00	0.0	0.0		E02
E03	---	--	--	--	NC:	--	--	22.1	0	0	---	1420	23.59	203.59	90.00	8.0	20.0		E03
E04	---	--	--	--	NC:	--	--	20.8	1	0	---	1420	23.62	203.62	90.00	22.0	17.0		E04
E05	---	--	--	--	NC:	--	--	18.1	1	0	---	1420	24.42	204.42	90.00	20.0	19.0		E05
E06	---	--	--	--	NC:	--	--	22.7	1	0	---	1420	23.89	203.89	90.00	20.0	13.0		E06
W01	---	--	--	--	NC:	--	--	22.6	0	0	---	1420	22.91	202.91	90.00	0.0	23.0		W01
W02	---	--	--	--	NC:	--	--	23.6	0	0	---	1420	22.88	202.88	90.00	27.0	0.0		W02
W03	---	--	--	--	NC:	--	--	22.1	1	0	---	1420	-54.05	125.95	59.72	0.0	24.0		W03
W04	---	--	--	--	NC:	--	--	22.6	1	0	---	1420	23.00	203.00	90.00	19.0	1.0		W04
W05	---	--	--	--	NC:	--	--	21.9	1	0	---	1420	22.84	202.84	90.00	1.0	30.0		W05
W06	---	--	--	--	NC:	--	--	20.8	1	0	---	1420	22.63	202.63	90.00	30.0	32.0		W06
S01	---	--	--	--	NC:	--	--	22.0	0	0	---	1420	23.67	203.67	90.00	13.0	17.0		S01
S02	---	--	--	--	NC:	--	--	22.7	0	0	---	1420	23.68	203.67	90.00	20.0	17.0		S02
S03	---	--	--	--	NC:	--	--	20.1	1	0	---	1420	23.75	203.75	90.00	28.0	27.0		S03
S04	---	--	--	--	NC:	--	--	24.6	1	0	---	1420	19.90	199.90	90.02	28.0	31.0		S04
S06	---	--	--	--	NC:	--	--	21.9	1	0	---	1420	23.68	203.68	90.00	13.0	12.0		S06

b. Web-based IF bandshapes



c. Web-based GSB bandshapes

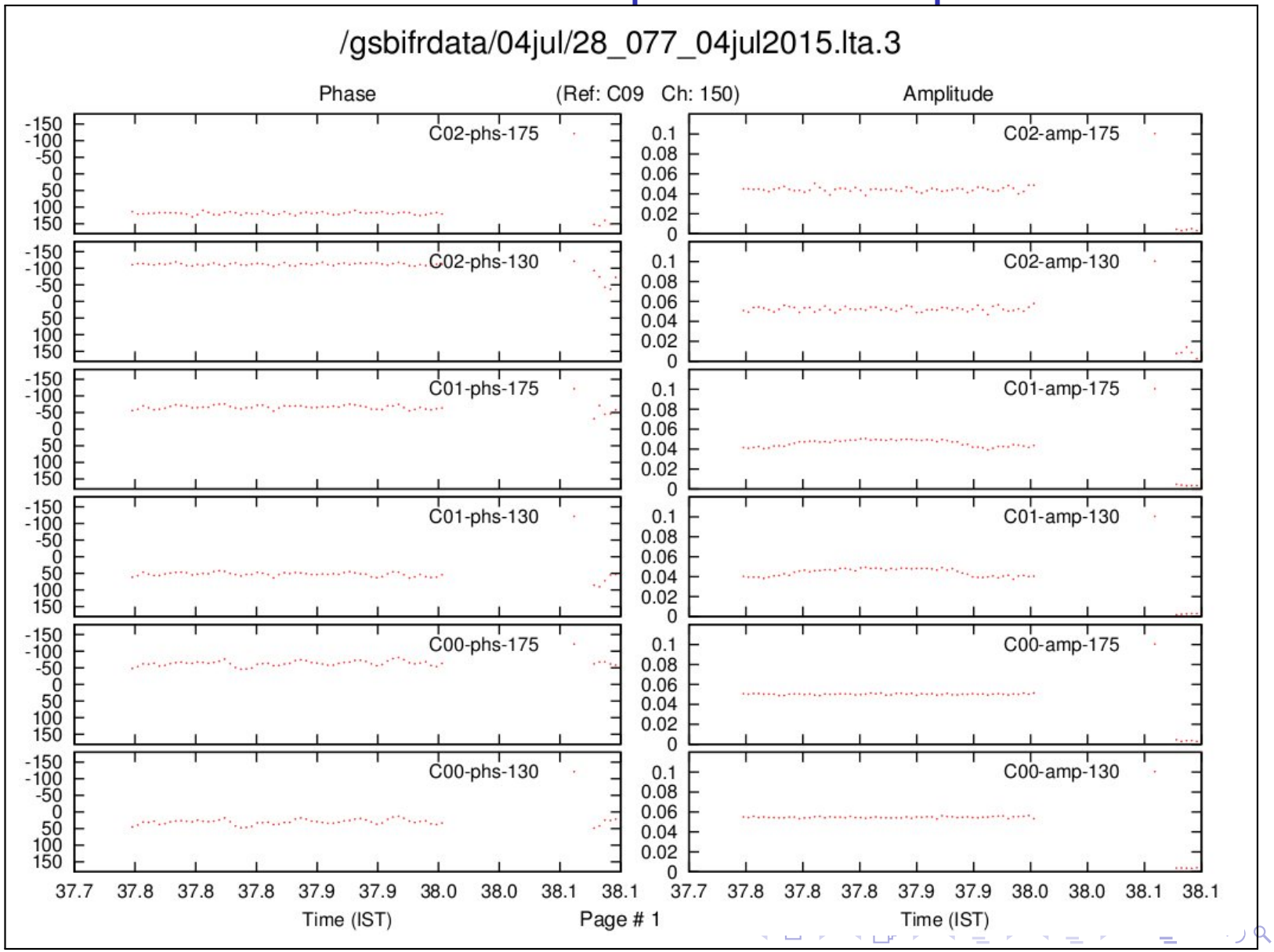


d. Web-based Scan listing

scan list

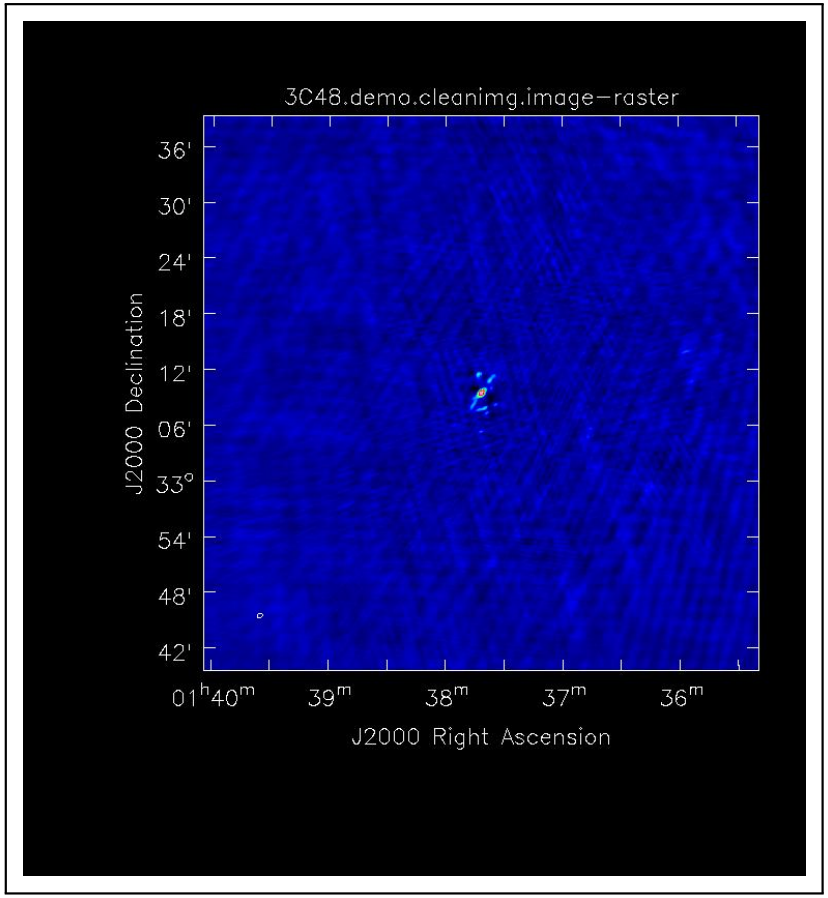
	Date Time (IST)	State	Project	Source	RA	Dec	AntAZ	AstroAZ	EL	RF(1)	RF(2)	LO1(1)	LO1(2)	BW	CHN
	05Jul2015 14:55:48	4 scn 1	28_077	A3444	10.40	-27.26	-20.68	159.32	40.53	1281.00	1281.00	1230.00	1230.00	33.33	256
	05Jul2015 14:52:43	4 src 0		A3444	10.40	-27.26	-21.52	158.48	40.27						
	05Jul2015 14:52:37	4 scn 0		0921-263	9.36	-26.31	-3.50	176.50	44.44						
	05Jul2015 14:47:33	4 scn 1	28_077	0921-263	9.36	-26.31	-5.09	174.91	44.35	1281.00	1281.00	1230.00	1230.00	33.33	256
	05Jul2015 14:46:37	4 src 0		0921-263	9.36	-26.31	-5.38	174.62	44.33						
	05Jul2015 14:46:28	4 scn 0		A3444	10.40	-27.26	-23.17	156.83	39.71						
	05Jul2015 14:15:47	4 scn 1	28_077	A3444	10.40	-27.26	-30.77	149.23	36.40	1281.00	1281.00	1230.00	1230.00	33.33	256
	05Jul2015 14:12:18	4 src 0		A3444	10.40	-27.26	-31.58	148.42	35.98						
	05Jul2015 14:12:12	4 scn 0		0921-263	9.36	-26.31	-15.85	164.15	42.82						
	05Jul2015 14:07:09	4 scn 1	28_077	0921-263	9.36	-26.31	-17.32	162.68	42.48	1281.00	1281.00	1230.00	1230.00	33.33	256
	05Jul2015 14:00:40	4 src 0		0921-263	9.36	-26.31	-19.17	160.83	42.00						
	05Jul2015 14:00:27	4 scn 0		3C147	5.71	49.85	144.13	324.13	46.50						

e. Web-based xtract - visibility amplitude and phase



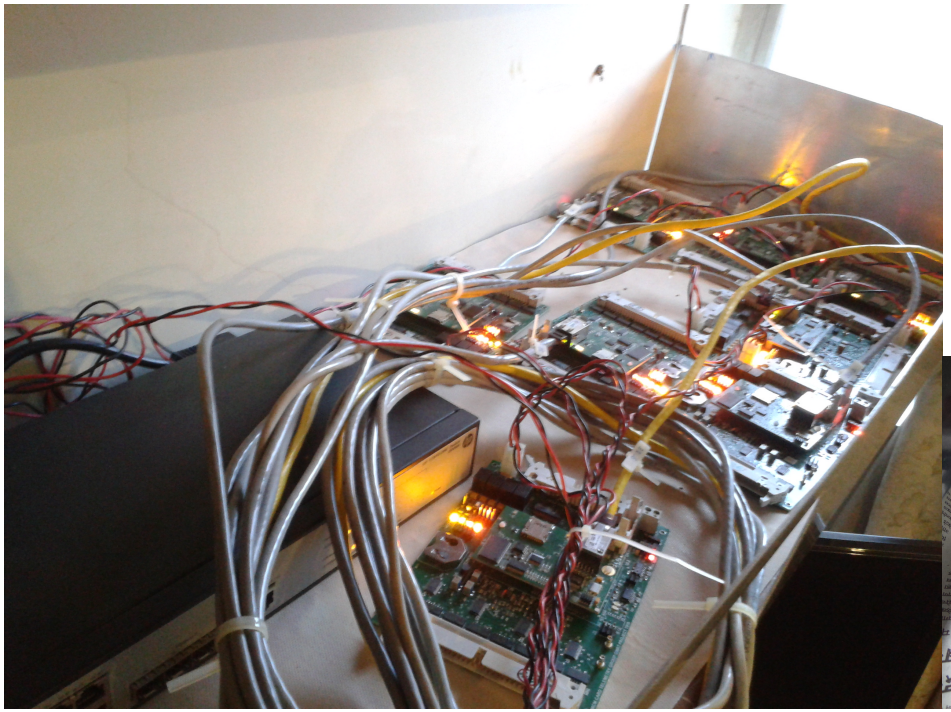
f. Web-based Quick imaging tool

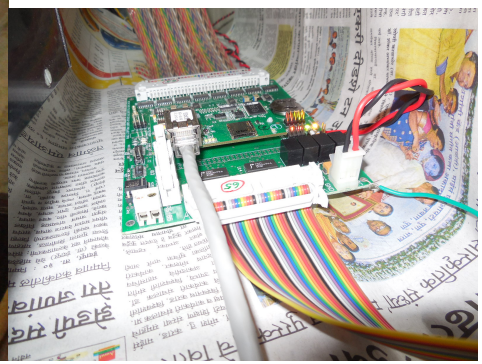
- CasaPy script
- Operates on current observations.
- User inputs: lta filename, calibrators
- Currently hardwired: channel 150, reference antenna C11.
- No RFI excision, no self-cal.
- Next steps: channel, reference ant, bad antennas - user inputs.
- 150 MHz image from 30 June 2015.



OnlineV2 Testing

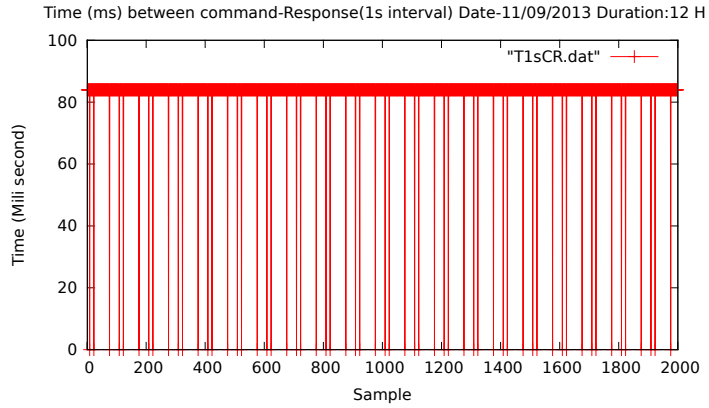
- Several tests on communication reliability, response times, subsystems.
- 8 MCM card lab setup connected to OnlineV2 computer.

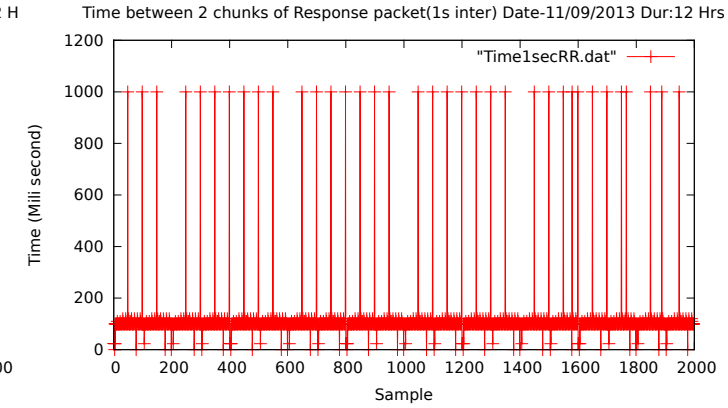


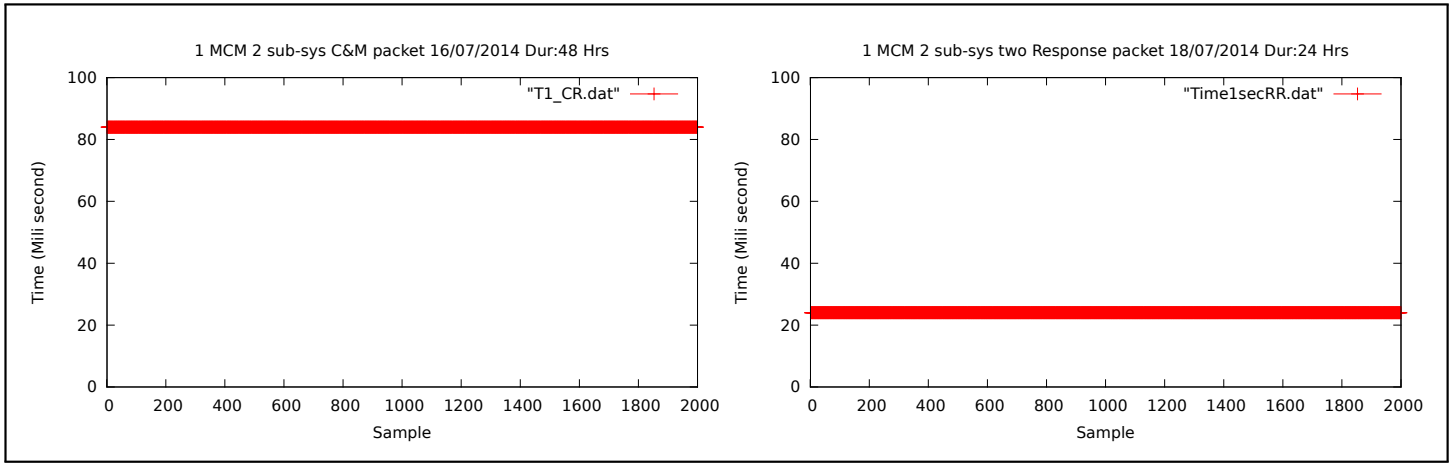


OnlineV2 Testing

Communication checks - roundtrip times and dropouts. Dropouts noted for 1s and 2s command intervals. LAN isolated. Command-response interval and interval between two response packets.







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OnlineV2 succesfully C&M of two Rabbit MCM connected to OF and sentinel at one antenna

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OnlineV2 Testing: Sep-Oct 2014

- Lab FE setup, GAB, 3 antenna+2 subsystem tests successful
- Lab testing: Rabbit MCM $\rightarrow$ Front End system hardware $\rightarrow$ spectrum analyser. e.g. solar attenuation, setting frequency band.

C&M of three antenna (C01, C04, C06) -two subsystem on two Rabbit MCM through OnlineV2 successful. C&M of GAB and lab FE setup through OnlineV2 succesful.

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OnlineV2 Testing: December 2014

- Lab setup of Servo: OnlineV2 $\rightarrow$ PC104.

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Commands such as hold, track successfully sent and interpreted

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OnlineV2 Testing: Mar-Apr 2015

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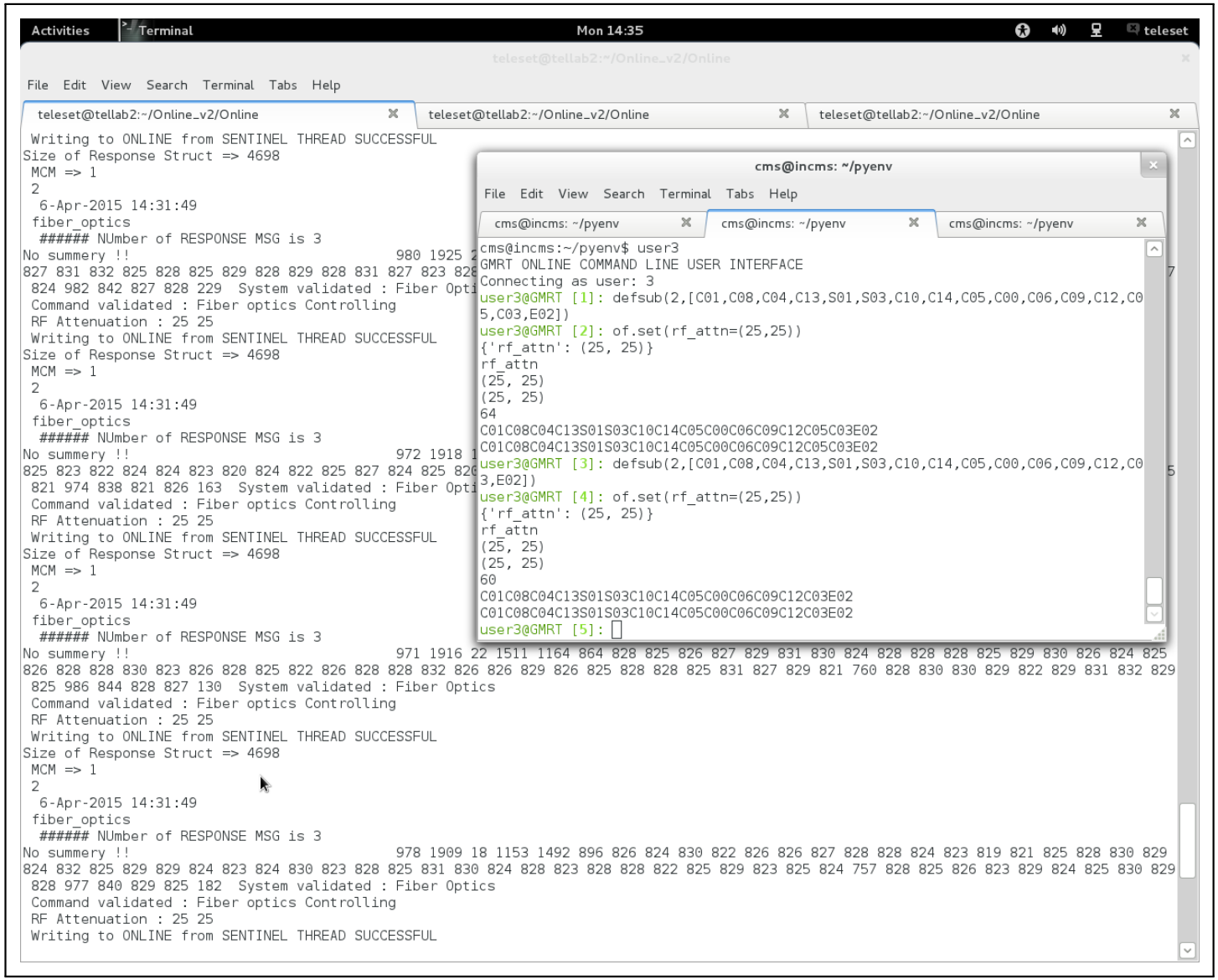
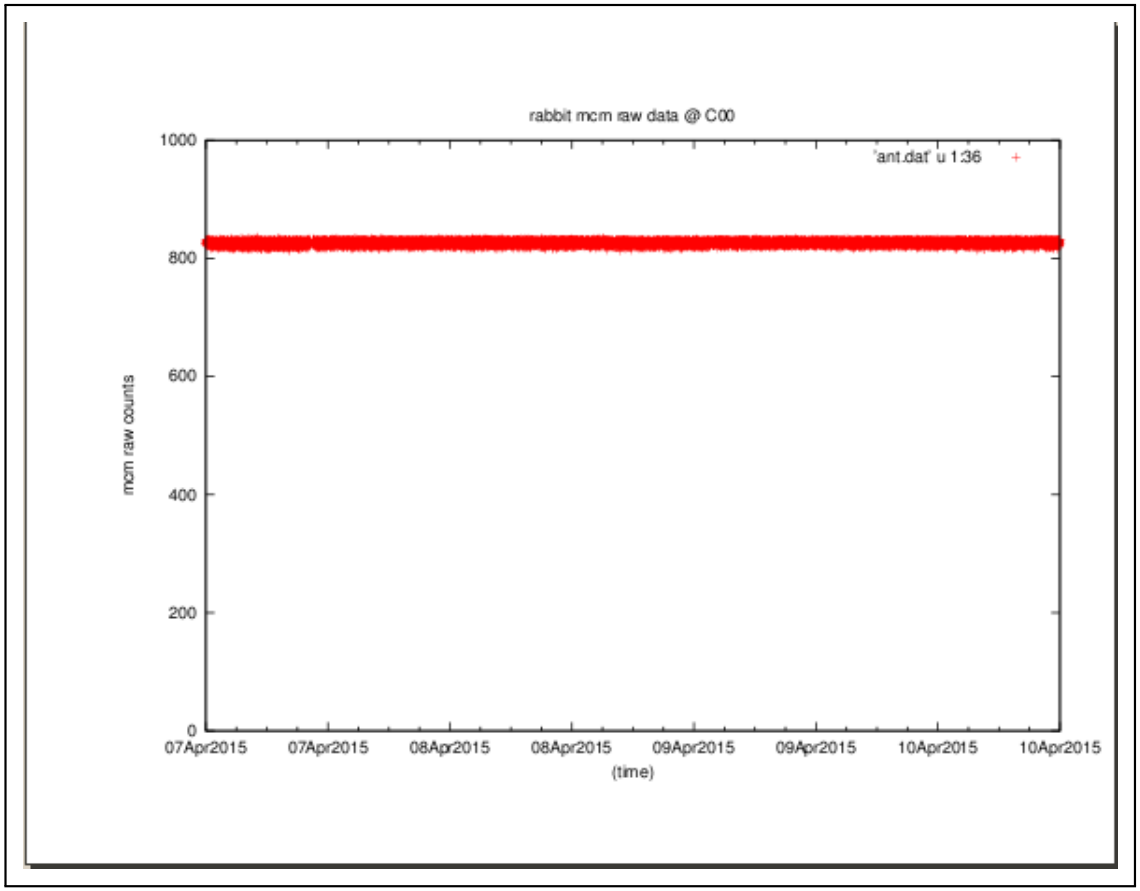


OnlineV2 terminal + Python terminal.

OnlineV2 Testing: Mar-Apr 2015



Web-based offline monitoring of shell temperature data recorded in MySQL database from 15 MCM on 15 antennas. 1s data rate - reliable communication over 4 days.

OnlineV2 ongoing work

- Downward compatibility to serial communication at antenna for FE, IF+LO
- Linking OnlineV2 core software to NOVAS library
- Finalising Shared memory structure
- Linking Python environment to desktop GUI
- Populating control data MySQL database;linking utilities to NOVAS
- Master user/normal user consoles
- Procuring computers for final setup: a Linux computer for core software, GUI, master control. A Linux computer for control data monitoring + astronomer use etc outside firewall.
- Tidying up software; adding commands and procedures; adding internal fixes to monitoring commands e.g. hold.

Is OnlineV2 a viable option for GMRT ?

YES!

- OnlineV2 is installation-ready.
- Tested wth new MCM on 15 antennas during MTAC break and a lab setup of 8 MCM has been functioning for more than a year without problems.
- OnlineV2 uses the fast ethernet link to communicate with antennas. Command-response times are < 0.5 seconds. Monitoring times tested at 1s.
- OnlineV2 designed for ethernet communication with all MCM. Downward compatibility to serial at antenna base provided.

Bottlenecks and timescales

- Dedicated computers for OnlineV2 required.
- Wideband RF from all 30 antennas to be brought to CEB.
- Ethernet link to all 30 antennas to be operational.
- New MCM cards to be installed.
- Extreme-condition testing of OnlineV2.
- Earliest OnlineV2 can be operational - depends on above. MTAC October 2015?

Summary

- OnlineV2 - an upgraded control and monitor software, developed for GMRT has successfully controlled 15 GMRT antennas using the upgraded MCM cards and ethernet connections (April 2015). Downward compatibility for serial communication successfully demonstrated. **It is a working and better alternative to the existing ONLINE.**

Summary

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- This CMS - the new MCM to the OnlineV2 software has been developed in-house by NCRA personnel. The development of ethernet OF link by the OF group is the crucial upgrade motivating OnlineV2 and making it the best available option.

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- OnlineV2 - an upgraded control and monitor software, developed for GMRT has successfully controlled 15 GMRT antennas using the upgraded MCM cards and ethernet connections (April 2015). Downward compatibility for serial communication successfully demonstrated. **It is a working and better alternative to the existing ONLINE.**
- This CMS - the new MCM to the OnlineV2 software has been developed in-house by NCRA personnel. The development of ethernet OF link by the OF group is the crucial upgrade motivating OnlineV2 and making it the best available option.
- Main reasons for upgrading software: fast ethernet communication, no need for ABC, Linux-based operations, generalised software with LAMP, GUIs, web-based utilities.

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- Benefits of OnlineV2 for an astronomer (1) Faster,reliable communication – more observing time on target (2) Web-based utilities (3) Procedures in Python.
- Recently learnt that SKA has changed specs and decided to use Python-based and multi-threading software which is being successfully used by OnlineV2.

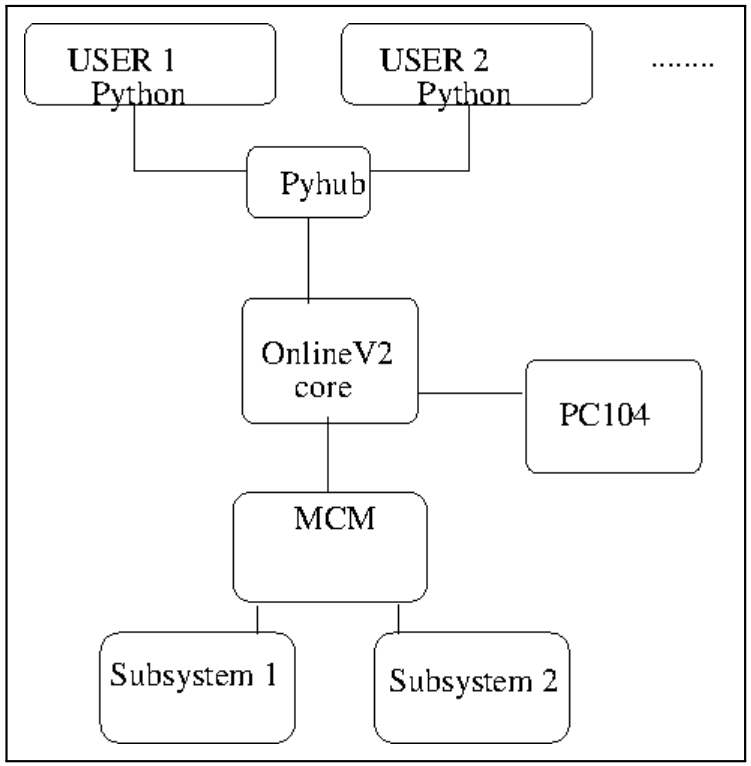
The Team

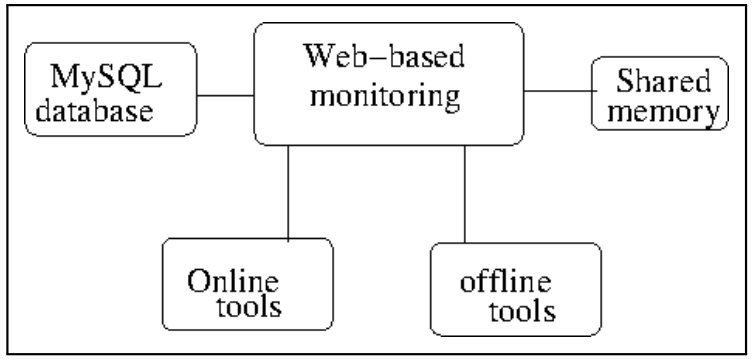
- Core OnlineV2 software - Raj Uprade
- MCM software + GUI - Naresh Sisodiya
- Communication protocols - Raj, Naresh, Deepak
- Python interface + astronomical libraries - Deepak Bhong
- Serial Communication + switches - Charu Kanade
- Web-based data monitoring and absentee observing tools - Santaji Katore
- Listing ONLINE commands/procedures and quick imaging tool - Sachin Sherkar
- OnlineV2 testing + hardware patches - Mahadev Misal
- MCM testing - C. Satheesh
- OnlineV2 antenna testing - all + Bharat Sethe, Anil Mule
- Group Coordinator - S. Nayak

Many thanks to: OF group, computer group, GAB group, Servo group, FPS group, FE group, correlator group

Questions/comments ?

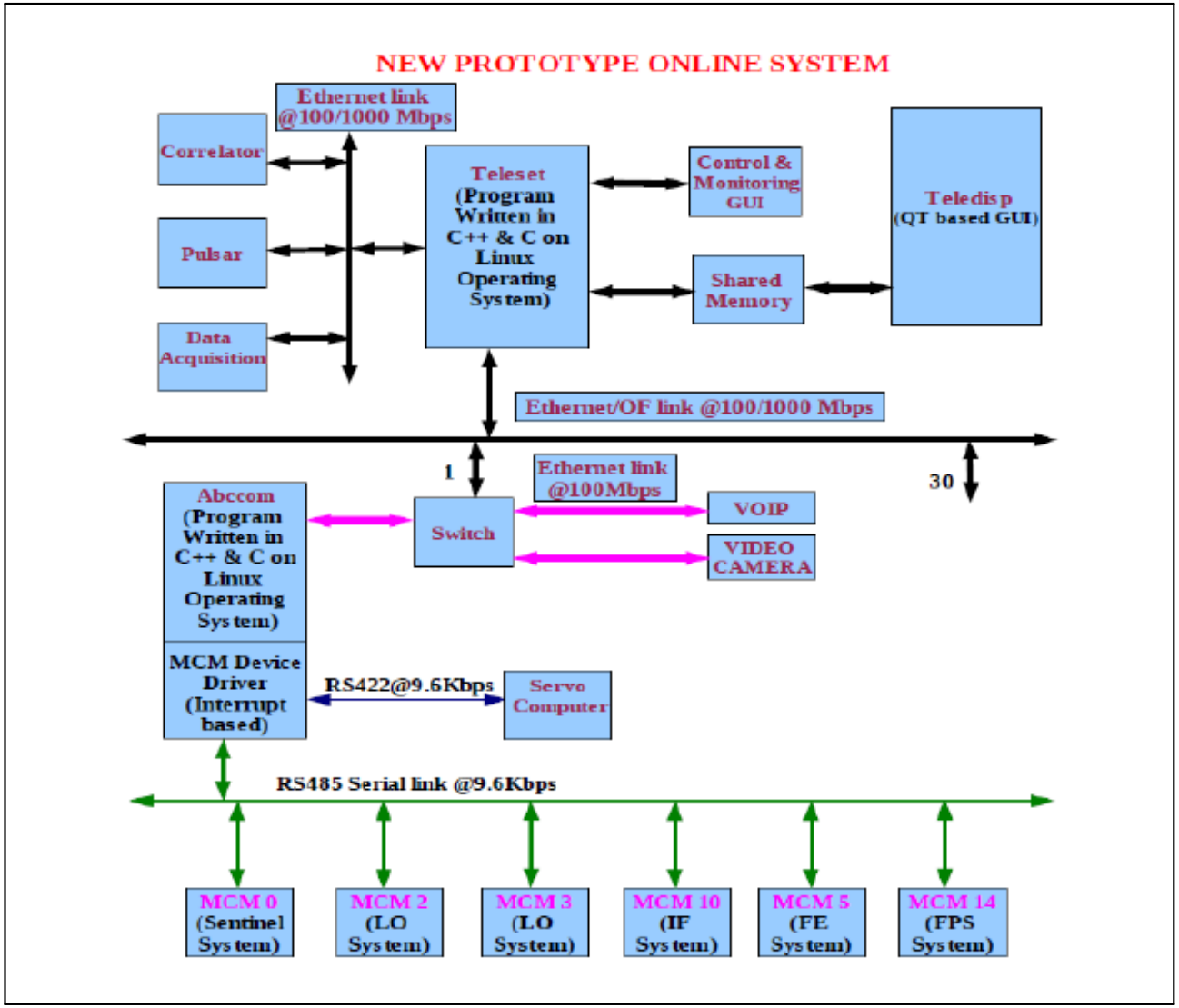
Summary





Desktop OnlineV2 (control and monitor) and web-based OnlineV2 (monitor)

In-house CMS - 2012



Block diagram of CMS in-house development by telemetry group (Slide from R Balasubramanian's talk in 2012). Modules successfully tested in lab and antennas.

GMRT C&M Softwares

- **ONLINE - late 1990s** Intelligence in control room Sparc work station and some on ABC. None in MCM. Serial communication. Fortran and C used. No GUI. No web-based utilities. Implemented.
- **Teleset, ABCcom - 2005** Intelligence in both control room Linux PC and ABC. None in MCM. Serial communication. C++ and Qt programming is used. No GUI. No web-based utilities. Not implemented.
- **OnlineV2 - 2015** Intelligence in both control room Linux PC and the new MCM card. No ABC required. Ethernet communication. C, Apache, MySQL, PHP, QT/QML, Python used. Web-based utilities provided. GUI. Inputs from above. An option to ONLINE.

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ONLINE and OnlineV2

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