National Centre for Radio Astrophysics

Internal Technical Report
GMRT/TGC/R305

Acceptance Testing Report on production version of

the Next Generation GMRT M&C System

- An exploratory Prototype for SKA-Telescope Manager

(The Next Gen GMRT M&C System is also referred as ***T****ango based* ***G****MRT* ***C****ontrol System****, TGC***)

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Objective: To provide report on User Acceptance Test on final delivered product by the TCS, Pune, as per the Work Order - **NCRA:WF084:LTD:2016/WO/CF/LO/P0072**

product - **Local Monitoring Control (LMC) version 3.7 , Oct 17, 2018**

Central Monitoring Control (CMC) version 3.3 , Oct 17, 2018

Revision	Date	Modification/ Change
Ver. 0	27 Nov 2018	Initial Version
Ver. 1	30 Nov 2018	Complete version, with executive summary

Test Report ID:	GMRT/OperGroup/28Nov2018		
Product ID / Name:	The Next Generation GMRT M&C System , now referred as TGC (Tango based GMRT Control System).		
Product Version or Build:	CMC 3.3, LMC 3.7 (Oct 17, 2018)		
Created On:	Compiled on Nov 28, 2018		
Review On:			
Review By:	Prof. Y. Gupta, and S. Nayak		
Review Comments:			
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Signing Off Authority:	**Name**	**Position**	**Signature, Date**

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Executive Summary

GMRT is a path-finder telescope for the SKA project to study SKA related technology and science. NCRA-TIFR is leading effort for design of the SKA **Telescope Manager** (TM) work-package. TM is responsible for developing all hardware and software necessary to control the telescope. The Next Generation Monitor & Control (M&C) System being developed for the GMRT up-gradation has significant synergy with the SKA-TM work package, hence it is identified as an Exploratory Prototype for the SKA Telescope Manager. Based on the TANGO evaluation report, and decision to avail the GMRT M&C System Production Version as an possible exploratory prototype for the SKA-TM, **Phase-1 Core M&C system** developed using the TANGO Framework. This Phase-1, three GMRT antennas M&C system delivered successfully by the vendor *TCS, pune* (NCRA:WF186:LTD:2014/WO138, Jan, 2016) .

To upgrade the GMRT M&C System it is inevitable to shift all business logics and applications to the new M&C system developed in Phase-1. Therefore, in **Phase-2 Business Logic and Auxiliary Applications with the core M&C functionality** , one of the main goals is to develop the TANGO based GMRT M&C system with a full capability to conduct the astronomical observations. The Phase-2 final product completed and delivered on Oct 17, 2018 by the TCS, Pune as per the work-order *NCRA: WFo84:LTD:2016/WO/CF/LO/Poo72*.

This User-Acceptance Test report consist of several software testing reports conducted on incremental deliverables given by the vendor while developing the Phase-2 final product. Integrated testing, Sanity testing (Bug reporting and its resolution testing), and regression testing done on the final product. As per the NCRA-TCS Minutes of Meeting (Sep 4, 2018), and based on this User-acceptance report, Phase-2 Product deliverables (Software versions : CMC 3.3, LMC 3.7, Oct 17, 2018) can be accepted along with the supportive material such as installation manual, software licenses to use etc.

This report briefly summarize various types of testings conducted on the Phase-2 deliverables, testing incidents, and the recommendations on the final product.

List of Abbreviation / Acronyms

Abbreviation	Expanded Form
AGN	Aggregation Node (Operational Array of the GMRT)
CMC	Central Monitoring & Control System
CPX	Central Processing Node
DS	Tango Device Server
FPS	Feed Positioning System
GAB	GMRT Analog Backend
GMRT	Giant Metrewave Radio Telescope
GSB	GMRT Software Backend
GTAC	GMRT Time Allocation committee
GWB	GMRT Wide-band Backend
HDB++	Historical Database Archiver
IO	I/O Device servers for the GMRT
IF	Intermediate Frequency System
LMC	Local Monitoring and Control System
LO	Local Oscillator System
M&C	Monitor & Control System
NCRA	National Centre For Radio Astrophysics
OFCSNT	Optical Fiber Communication and Sentinel System
ORB	Object Request Broad-cast Architecture
PANIC	Package for Alarms and Notification of Incidences from Controls
TANGO	Taco Next Generation Objects
TACO	Telescope and Accelerator Control System
TCS	Tata Cosultancy Services
TGC	Tango based GMRT Control System
TRDDC	Tata Research, Design and Development Centre
TIFR	Tata Institute of Fundamental Research
TM	Telescope Manager
SKA	Square Kilometer Array
ZMQ	Zero Message Queue

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1. INTRODUCTION :

GMRT is a path-finder telescope for the SKA project to study SKA related technology and science. NCRA-TIFR is leading effort for design of the SKA **Telescope Manager** (TM) work-package. TM is responsible for developing all hardware and software necessary to control the telescope. The Next Generation Monitor & Control (M&C) System being developed for the GMRT up-gradation has significant synergy with the SKA-TM work package, hence it is identified as an Exploratory Prototype for the SKA Telescope Manager. Since the TANGO[1] Open-Source framework chosen as the SKA M&C Common framework (*LMC standardization meeting, Mar 2015)*, evaluation of the TANGO framework carried out in collaboration with the SKA-TM, TRDDC[2] and GMRT-TCS team.
Based on the TANGO evaluation report, and decision to use the GMRT M&C System Production Version as an exploratory prototype for the SKA-TM, **Phase-1 Core M&C system** (NCRA:WF186:LTD:2014/WO138 , Jan, 2016) developed using the TANGO Framework. In Phase-1, three GMRT antennas M&C system delivered by the vendor *TCS, pune*, which was successfully accepted by the NCRA after testing. This core M&C system development is done using a generic and hierarchical Architecture which maps the functional modules of the SKA-1 TM as well.

The existing GMRT M&C System is being evolved over almost fifteen to twenty years. During this period, many business logics and applications have been developed for conducting astronomical observations ranging from the antenna tracking and corrections algorithms, new back-end controls, RF signal power-equalization, phasing for beam formation, generation of various engineering /observing-session report etc. Hence, to upgrade the GMRT M&C System it is inevitable to shift all these business logics and applications to the new M&C system developed in Phase-1. Therefore, in **Phase-2 Business Logic and Auxiliary Applications with the core M&C functionality** (NCRA: WFo84:LTD:2016/WO/CF/LO/Poo72, Nov 2016) , one of the main goals is to develop the TANGO based GMRT M&C system with a full capability to conduct the astronomical observations.

1.1 Objective and Scope :

Objective of this document is to summaries the acceptance testing report on the M&C System deliverables given by the vendor (TCS, pune) , as a part of M&C System Phase-2 product mentioned in the work order NCRA:WFo84:LTD:2016/WO/CF/LO/Poo72, which are as follows -

- Installation procedure and manual
- Source code for M&C Software (for all deliverables)
- Acceptance Test-cases

1.2 Constraints :

(a) The TGC application tested for the GMRT Upgraded systems only, which consist of maximum 30 antennas, Upgraded FE-CB common Box, Servo system, GAB system, and GMRT Wide-band Backend (GWB) system, GMRT Software backend System (GSB) along with the beam-former of the GSB only (as control of GWB Beam is similar to that of the GSB).
Hence, Testing of the IF, LO, and FPS (Covered in Phase-1 testing) are not considered.

1 **TA**CO (Telescope Accelarator Controlled Object) **N**ext **G**eneration **O**bjects
2 Tata Research, Design and Development Centre, Pune, India – Institute involved in TM Consortium

(b) This test report do not cover testing of set of tools used to develop and build th **Phase applications** such as - *Tango 9.2.2 Framework, OmniORB 4.2.1, zmq 4.0.5, PyTango-8.1.5, taurus-3.4.0 and dependent packages.*

(c) This test report do not cover testing of the Use-cases which are mutually agreed to de-scope from the work as per the work-order amendments

Amendment-I : NCRA:WFo84:LTD:2016/WO/CF/LO/Poo72A
This amendment exclude following use-cases :
(i) Archiving – HDB++ ver 2.2 Data Logging and review need to be implemented by the SKA-TelMGT team .
NCRA will own the implementation and testing of -
(ii) Update & Install software (beyond 5 antennas)
(iii) Web-based thin clients for -
the PyDev environment for the Scripting
Fault-sheet generation
User-Administration – creating/deleting users from Kerberos
(iv) House-Keeping (Removing of logs/database, stale files and backups)

Amendment-II : NCRA:WFo84:LTD:2016/WO/CF/LO/Poo72B
Delivery-IV Tasks such as Create and Queue Task, this use-case was to automation of conducting series of observations. But as per the internal discussion (May 11, 2018) and final approval (May 15, 2018), it is concluded that to focus on project completion date with bug-free and more stable software, it is essential to de scope some use-cases from *Delivery-IV.*

(d) In addition to use the Phase-2 production version as a GMRT Observatory Upgraded control system, TGC (Tango based GMRT Control System) also act as an exploratory possible prototype for the SKA Telescope Manager software, hence multiple organization or teams, such as TRDDC, Pune and TCS-SKA team also playing a active role in the development. Therefore, some tasks, such as Domain Specific Engineering Configuration for the M&C system is being developed by the TRDDC, similarly Tango frame-work Archiving tools (HDB++) are being explored by the TCS-SKA team. Hence, these M&C System components testing is not covered in this report as it was not given in the work-order for development (*NCRA: WFo84:LTD:2016/WO/CF/LO/Poo72)*.

1.3 Applicable Reference Document for the testing

In Phase-2 of production version of the Next Generation GMRT M&C System-an exploratory prototype for the SKA Telescope Manager, following Baseline Documents are considered for the product-delivery.

(i) M&C_SRS_P-II_V1.04.xlsx – This consist of Software Requirements identified for the Phase-2 along with the agreed high level efforts partitioning between the NCRA, TRDDC and the TCS, Pune. This document is deduced after discussion with the TCS, TRDDC and going through the Software *Requirement Specification Document (Aug 2013, Ver 1.0)* joinlty.
(ii) Plan_2_estimate_v1.1_final.xls – This contains two excel sheets, one is use-case wise high level software product development and delivery planning along with the GUI IDs specific to each use-case. In second excel sheet, four main product delivery wise and use-case wise detail description given about the objectives to be achieved, effort estimation and tasks partitioning

between the GMRT, TRDDC and TCS team. *GUI design document (Nov 2014, Ver 1.1)* and *M&C_SRS_P-II_V1.04.xlsx* sheets can be referred for the detailed description.

2. Testing Summary and Assessment

For phase-2 Software deliverables, based on prioritized use-cases which need to be incrementally develop, and having dependencies, are grouped in four deliverables. For each use-case, a M&C system stake-holders are identified for the testing. Also, in the beginning of project, total 51 test-cases prepared based on use-cases **(see Appendix – I)** and given to the TCS for testing at the Lab-setup.

2.1 Testing Setup :

For every software delivery, incremental integration testing done by adding 5-6 antennas in the Central Monitoring & Control system, at the end of final delivery maximum 20 to 30 antennas were tested. The deliverables were integrated and the tested on GMRT upgraded setup (as shown in Figure-1) during the maintenance days (Every Tuesday, Thursday) and during white-slot time (non-allocated time for the GMRT Time Allocation schedule).

Testing Methodology –

Phase-2 Application developed incrementally based on prioritized use-case implementation, and deliverables which are made in 3 stages. **Table 1** gives a List of incremental deliveries given by the vendor, details of releases are available in the respective released documents.

Table 1 : Software Deliveries by the Vendor

Date	Version	Deliverables
17 April 2017	CMC 1.7.1	Use-case : M&C Utility, A&A
20 June 2017	CMC 2.0, LMC 2.4	All Phase-2 Delivery-1 Use cases (mentioned in Table 2)
21 July 2017	CMC 2.1, LMC 2.5	Phase-2 Delivery-1 , with critical/blocker bug fixes
10 August 2017	CMC 2.2 , LMC 2.6	Phase-2 Delivery-1 , with critical/blocker bug fixes
21 March 2018	CMC 2.6, LMC 3.0	All Phase 2 Delivery 2 use cases (mentioned in Table 2)
Till 12 Jun 2018	CMC 2.7 LMC 3.1 , CMC 2.8 LMC 3.2, CMC 2.9 LMC 3.3	Software release with few bug fixes and minor feature addition
26 Jun 2018	CMC 3.0, LMC 3.4	Phase-2, Delivery-2 and Delivery-3
18 July 2018	CMC3.1 , LMC 3.5	All Phase-2, Deliver-1, Delivery-2, Delivery-3
13 Aug 2018	CMC3.,2, LMC 3.6	All use cases with bug fixes
17 Oct 2018	CMC 3.3 , LMC 3.7	Final Delivery, with manual, documents, source etc.

To test the above deliverables, internal TGC system's stake-holder group formed. As per the internal weekly plan meeting, various issues associated with the M&C System development scheduling, tasks-assignment, testing responsibilities were discussed and assigned to individual TGC stake-holders (Several meetings between Dec 2017 to Jan 16th, 2018).

Following types of test-conducted manually for -- Interim Use-case wise incremental releases, Delivery-wise releases, release of stable deliveries after bug-fixing, and use-acceptance test on the Final product.

(a) Smoke Testing : For the use-case wise implementation interim releases , a *smoke testing* done whenever new use-case feature released to ensure first order it is working.

(b) Integration Testing : On the GMRT M&C setup (shown in Figure 1) it self, system integration testing done to ensure the entire application work as per the use-case wise requirements specified in the work-order. Critical business scenario tested throughly to check its error-free working such as tracking celestial source, astronomical data acquisition monitoring, configuring digital back-ends, power-equalization, and grid-pointing.

(c) Sanity Testing : For every deliverable, after integration testing, software bugs and application crashes which were reported are ensured to resolved in the sanity testing.

(d) Regression Testing : After release of Final deliverables, CMC 3.3 , LMC 3.7 , a regression testing done with prioritized test-cases, and testing-reported in a four short brief reports over email.

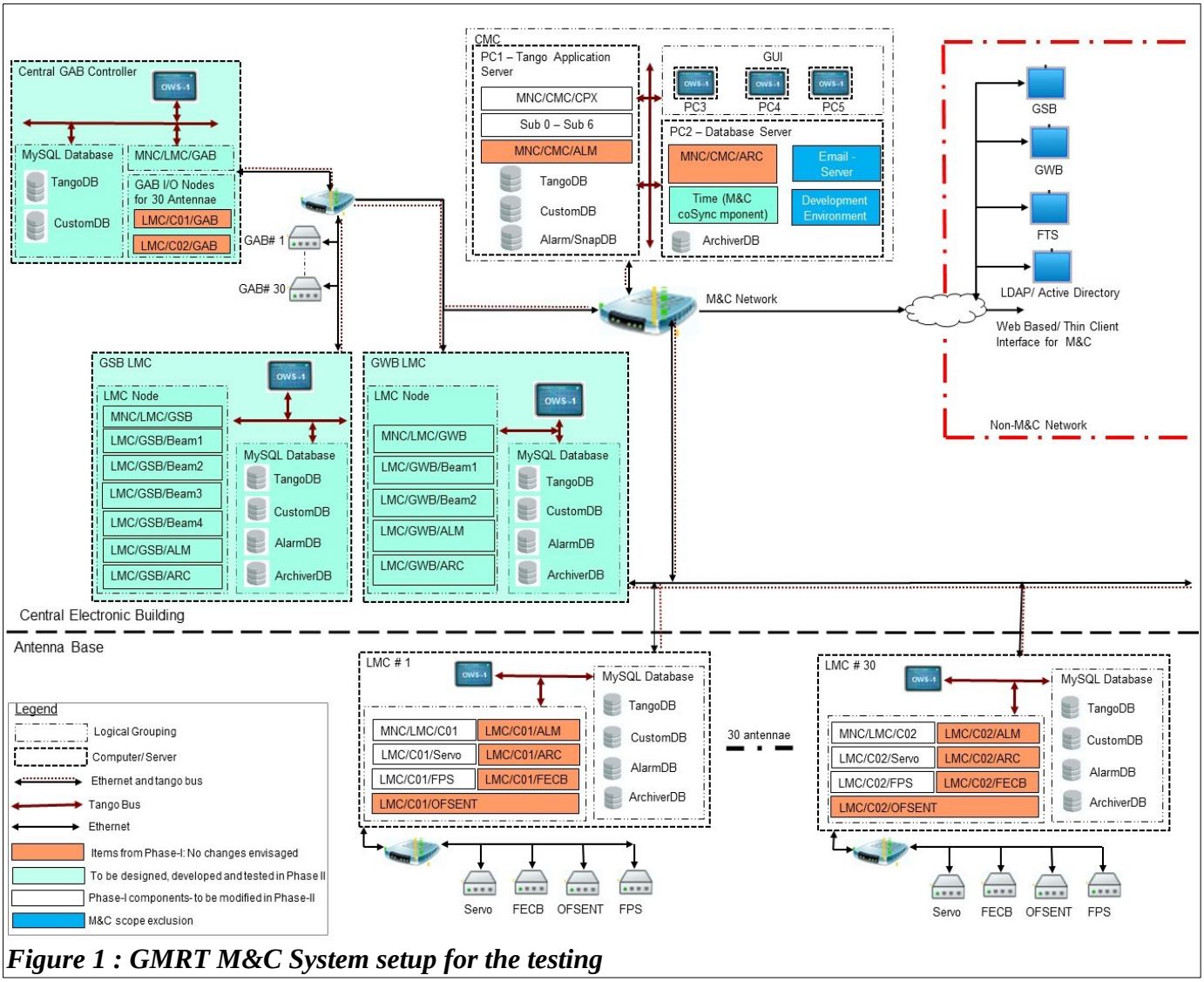

Figure 1 : GMRT M&C System setup for the testing

2.2 Smoke testing and System Integration testing :

Table 2 shows a delivery-wise list of Use-cases and it's completion (till Nov 28, 2018) status along with stake-holders.

Use-cases	Short description, GUI (GUI design document - Ver 1.1, Nov 2014) /Script Interfaces for functional testing.	Completion Status	Stake-holders , and Comment
Deliverable – I : Test Setup – Minimum 6 to 10 antennas			
M&C Utility	Source Catalog management, python interface for source coordination conversion, source trajectory. GUI - ManageCatalog_044, Skyplot_003 (Source positions real-time update)	**Completed**	Deepak, SNK
Define Sub-array	Per AGN/OPER station, creation of multiple sub-arrays broad-casting command, scripting interface for subarray allocation/de-alloaction. GUI – Manage_array_036, Skyplot (Polar Plot, Array status)	**Completed**	JPK
Antenna Position & Control	C++, Python interfaces for the antenna tracking, scanning, Satellite calculation to horizontal coordinate system, tracking error calculation and alarm raising for the individual antenans	**Completed**	Deepak, JPK, SNK
Data logging & View logs	Data archiving using HDB++, view log	**In progress**	Navnath + TM-SKA team
Log-on and Log-off (A&A)	User-role based login authentication, command authorization GUI – login_002, logout_071, scenario – M&C_004 from use-case	**Completed**	JPK
View Dashboard	AGN Level Status at higher level and LMCs configuration (Quick_access windows)	**Completed**	JPK
Time Synchronization M&C_SC_009	Configuring the Time-server, ALL – CMC Machine accessing the GPS time and locking condition checking	**Completed**	Rajsingh
M&C_SC_001, 002, 003 Electrical Power down	In case of Device reset, LMC reset and CMC. Setting shall be restored to previous if started after Halt-emergency.	**Completed**	Rajsingh
Configuration	Prepare SD/MDE Environment development, test and deployment schedule in alignment with the GMRT production version Phase-2 work	**In Progress**	TRDDC + GMRT (Rajsingh and team)
Non functional Requirements	(i) Normal User shall not allow to change the PANIC Alarm rule.(ii) GUI shall be released with tool-tips and help, (iii) Testing of antenna allocation-deallocation using the script (iv) M&C Software shall be easily installable.	**Completed**	JPK, Deepak
Deliverable – II : Minimum 10 to 15 antennas, GSB, GWB backends			
Correlator Setup-I	LMC and IO configuration of the correlator (Command, parameters, monitoring) GUI – BackendCorrelatorControl_028, Skyplot_003_Array-status, Data acquisition	**Completed***	JPK, SNK das-console part implementation (low priority

			feature) is in progress , completed by the TCS but pending from the GMRT.
Power-equalization	GAB-Detector, OPF-detector, GAB-atten, OPF_atten – power equalize python script need to develop at the CMC & SUBARR NODES. TuneReceiverPE_026 – GUI	**Completed**	Sachin
Antenna Parking + M&C_SC_005	1) Receive & test servo high wind event. And rise the alarm for high wind algorithm. Implement custom algorithm in panic (via program/script). (2) Load & maint stow position. Test the parking script for all antenna.	**Completed***	JPK (Only once tested successfully, real-time wind scenario need to re-check).
Monitor Alarm & Warning + M&C_SC006	Alarm Management (Shelving, disabling etc.), Sub-array Alarm (Based on dynamic antenna configuration), Alarm Notification in B1 section.	**Completed***	JPK - For testing only few Alarms , configured, all-alarm need to configure and test.
Setup Telescope	Overall Telescope Operation – Such as functionality of antenna tracking, tune-receiver settings using the GUI. And through batch-functionality as well. GUI - OperationControl_027 + SubsystemSubsytems_032, CommonCommandEnviornment_033, ExpertConsole_034 (Changes for LMCsys, NodeSys, CMCSys commands)	**Completed**	JPK, Deepak
Tune Receiver-I	GUI & Functionality – Tune Receiver BandCentre_025, Setup_024, get_current_settings	**Completed***	SNK - GTAC_ID related remain (Dependencies on Thin-client application).
Basic Diagnostic	MessageConsole_039, Introspect_040, Filter_052, Maintenance Mode pre-condition	**Completed**	JPK
System Shutdown	M&C System Halt-emergency, and Halt-normal functionality execution correctness. Script execution, individual LMC/AGN Start/stop execution	**Completed**	Rajsingh
M&C_SC_007 Batch/Script Execution	The validation of python_script for M&C System commands and Python syntax. Status of Script running, stop, abort etc. Scripting APIs. Scripting DS per Tango Node	**Completed**	Deepak
Deliverable – III : Minimum 20 to 25 antennas, GSB, GWB, GAB back-ends			
Correlator Setup-II	Pulsar Das-chain testing GUI – BackendBeamControl_029 + PulsarMonitor_021, I/O Configurations	**Completed***	JPK/Nilesh Pulsar Monitoring need to externalize by giving monitoring hook.

Antenna Phasing	BackendPhasing_030_GUI, Data Plotting, Conversion of Phase.pl script to Phase.py (python script)	**Completed***	SNK - From GMRT side, implementation remain. (Mock/Simulated testing done).
Antenna Pointing	GUI - Pointing_031 , Antenna Offsets with antenna selection for execution through GUI, Batch - execution of pointing program. Scan_command implementation	**Completed**	SNK/Deepak
Tune Receiver II	Local Control of GAB of LMC from the CMC (in case of Antenna disconnect then individual GAB_<ANT> IO can be set	**Completed**	JPK

2.3 Sanity Testing (Bug Reporting/Testing) :

There were total 12 software deliveries provided by the vendor, every time re-testing, bug verification and resolution testing done, if bugs are not resolved, those again reported. There were many cases where bugs were not testable at the Lab, but on the GMRT site it were re-producible. Also, some-times, due to mis-communication, a few bugs were invalid which were raised by the GMRT stake-holders.

Table 3 shows statistics on Bugs which were reported during the phase-2 development, and its present resolved status for the latest release of LMC 3.7 and CMC 3.3 version of the software (Oct 17, 2018).

Total 153 Bugs reported during the Phase-2 testing, most of the bugs were resolved. Out of 153, total 135 bugs are resolved. In non-resolved 17 bugs, 6 bugs are related to the frame-work, 4 bugs were invalid, 5 bugs are either having work-around or occasionally occurring. And 2 bugs are suggestion and future enhancement. See Appendix-II for detailed bugzilla-report summary.

Table 3 : Bug Statistics during the Phase-2 testing

Bug Type	Total Number	Fixed	Open/ Won't Fix /Work-around/- Invalid	Remark
Blocker	23	19	4	***Bug-78, 199, 228*** Frame-work related. ***Bug-231*** (occasionally occurring to the LMC only, not affecting overall application, hence not blocker)
Critical	48	43	5	***Bug 85, 210*** – Tango frame-work related. ***Bug 167*** – CMC need to start LMC manually after switching ON (only once). ***Bug 212*** – Open, mysql connection pool related problem, occasionally occur but need to re-tune. (solution – restart mysqld), ***Bug 222*** – Same project code for both correlator – not possible at present, can use different project-code.
Major	40	39	1	***Bug 166*** – Consuming more CPU?, alternative way (browser) to check Satellite interference exist at present, need future enhancement.
Normal	12	10	2	***Bug 79, 90*** – Invalid bugs
Minor, Suggestion, enhancement	22	18	4	***Bug 89, 93 –*** Invalid bugs ***Bug 158*** – Frame-work related ***Bug 214*** – Wish list (suggestion)
Duplicate Bugs	8	8	0	
TOTAL Number of Bugs	**153**	**135**	**17**	**Refer Section Testing incident for frame-work related bugs.**

2.4 Regression Testing :

On every delivery (1 to 3) releases, a regression testing done while accepting at the mile-stones, problem reported over bugzilla[1].
In this section, regression testing reported using the final release of product (CMC 3.3, LMC 3.7) based on prioritized use-cases. The entire application tested for a period of one month with various testing aims. It is ensured that all bugs are fixed, if problem noticed, on urgent basis the problem asked to re-fix, and re-tested during the test-time.

Following table gives the short details of tests which were reported in a series ***over email from Oct 17th to Nov 28th, 2018***. *Note that test conducted only on available times during either maintenance days or on a free time allocated with the GTAC observation schedule.*

1 http://hasta.gmrt.ncra.tifr.res.in/bugzilla

Regression Test[2]	GMRT Test setup	Test conducted by	Remark
Oct 18, 2018 , duration : 9 hrs	27 Antennas GSB, GWB, GAB RF Band : 470 MHz	Jitendra, Deepak	23 antennas were tracking without any problem, GWB and GSB both correlator showed fringe on 3C48 sources. Continuous data acquired successfully. Power-equalization re-tested on GWB using GAB attenuation successfully. * Problem relating to scripting, GSB, and beam -control related reported.
Oct 24th, 2018, duration : 8 hrs	25 Antennas, GSB, GWB, GAB RF Band : 1420 MHz	Deepak, Jitendra, Shinde	17 antennas were fringing, track on-off source on 3C48 source through script file tested successfully . * scripting problem resolved during this time (root user permission problem, jive variables) * Problem of GSB start-scan some times reported. , AGN hang noticed 2-3 times.
Nov 14th, 2018 duration : ~ 4 hrs	30 Antennas, GSB , GWB, GAB RF Band : 725 MHz	Jitendra, Navnath	(i) 25 antennas were fringing, source on-off through script ran successfully. (ii) GSB/GWB data acquisition scan start-stop ran successfully. (iii) Command turn-around time for each system measured. * Pointing use case : 'grid-pointing.py' procedure problem reported.
Nov 27th, 2018	21 Antennas, GSB, GWB, GAB RF Band : 1420 MHz	Jitendra, SNK, Deepak, Rajsingh	'grid-pointing.py' script tested successfully. (Minor problem of catalog addition in the scripting faced)

2.4.1 Nonfunctional Requirement Testing – Performance :

Nonfunctional Requirement Testing were covered in this section mainly are related to the performance, such as command turn-around time, GUI responses, long-term execution of telescope functionality such as a tracking. Over several deliverables, it has been observed that LMC uptime is sustainable at least one month, CMC application uptime is sustainable or running time is at least one week.

Here, we are summarizing testing measurement noted during either bug closure time or while regression testing done on final deliverables. See APPENDIX – D, for details of the command-turn around timings.

(a) Command turn Around time :

i. LMC 2.4 (Jun 30th, 2018) , Bug Ref 92 Command turn around time is 8 to 14 second from the LMC to every GMRT-subsystem under control.

ii. CMC 3.2 and LMC 3.6 version (Aug 24th, 2018) , ref- bug-225 resolving report Command turn around time is reasonable - 8 to 15 sec for any sub-systems.

2 Detailed reports were circulated over email on respective dates.

iii. CMC 3.3 and LMC 3.7 version (Oct 18, 2018) , ***refer APPENDIX-III*** For all 30 antennas, average command turn-around time is 17 sec. Occasionally it takes 9 sec and maximum 30 sec

iv. CMC 3.3 and LMC 3.7 version (Nov 14, 2018) , ***refer APPENDIX-III***

- For all 30 antennas, average command turn-around time for any sub-system is ~ 10 seconds (this include GAB system also), but if any one of the antenna doesn't respond (due to system problem), then command wait till the aggregation response time-out which is of 30 second.
- CMC to GAB-LMC for 30 system takes – 18 to 30 seconds
- CMC to GWB/GSB backend subsystems take 10 to 20 seconds (Except setphase source command which some times take 30 second).
- Note – Monitoring for all-subsystem is working smoothly with updating all the parameters of LMC per 2 second.

(b) Sub-sequent Track command after long duration (Bug 129, CMC 3.2) :
CMC was able to execute track-command successfully to the array, if previous track for the array ran for longer time (more than 2 hrs).
This issues is sorted out and tested on April 25, 2018, Aug 31st on CMC Ver 3.2.

(c) GUI Opening time (Bug 99, tested on CMC 3.2 Version, Aug 24, 2018) :
From GUI Client machine (ctrlterm1) : Time takes 7 sec (period after login entered).
From CMC Application server (cmsserver) : Time takes 4-5 sec (period after login entered).

2.5 Testing Incidents

This section briefly review a few problems or defects that were unexpected results and came to the surface during the testing time only i.e. it were not envisaged during the small-scale prototyping on Tango based device controls, and while design/architecting process based on Tango-framework.

Following problems need a review/inspection, and action plans to resolve it. These problems already have work around, hence are not critical/blocker problems to the application usage at present.

(1) **Aggregation Node Hangs (Bug 199), CMC GUI Freeze (Bug 85), GUI Hangs (Bug 228**) : Refer TCS Report on Details of ***Framework Specific Issues by the TCS, September 2018, version 1.0***

(a) AGN Hang problem : This problem coming while child Tango Device Server (DS) is alive and Parent Tango Device Server (DS) has subscribed the attributes. Suddenly due to some reasons, if child DS goes down (network problem, power down, or software problem etc.) then Parent device hangs.

Report by the TCS clarifies that -

(i) Unsubscribed of attributes is unsuccessful. TANGO DS at higher level expects the child device to be available even while un-subscribing to it.

(ii) On Tango Community forum it was suggested that either keep DS alive or check other resources such as memory, file-descriptor etc. Also, it is mentioned that probable reason of this problem is -

Yes, there is a possibility of having more than 30+ TANGO DS running on 30+ TANGO Facility. The TANGO DS on the host of interest (where we get resource limit reached error) tries to reach to these 30+ DS(s) which may or may not be alive.
This it typically something you want to avoid. It is really preferable to have TANGO devices always running, maybe just sitting idle, rather than starting and stopping services, since clients hitting non-running devices create a unwanted load on the database server, which depending on how much unfair the client is, can turn out in a heavy load.

(b) Occasional GUI Hang/Freeze problem - This is as per the report due to problems, one is tango synchronous call are used to create attribute-proxy, and other is due to Server device server push-heart beat and polling mechanism related issue.

Work-around – Restart the particular AGN which has hang, and restart the GUI. Both operation takes less than ~30 seconds

(2) **CMC GUI crashed some time (Bug 158) :**
As per Mr. Reynald from Tango forum, this will be fixed after replacing Tango 9.2.2 with Tango 9.2.5a. We are in progress to replace Tango version and after testing at TCS setup we will replace it at GMRT setup (Refer Bugzilla for the details)
This has been seen very rarely (if occur may be once in two week?), work-around is restart the GUI

(3) **HDB++ take larger data size for archive (Bug 78) :**
As per the MoM 4 sep 2018, the TCS-SKA team is handling this problem, but work around is dis-card unnecessary attributes for the archiving, also tune the polling time for longer period or only on change event. (for e.g. software version, system version, network speed etc. are not required at very faster rate).

(4) **After Normal shutdown, LMC not starting (Bug 167)**
Using the GUI, select all LMC and give 'start LMC' command. This need to do only once after starting of the CMC application

3. Recommendation

There were two product review meetings of the NCRA with the vendor TCS, pune at the final stage (24 Aug 2018, 4 Sep 2018), in which non-resolving bugs, work-around to resolve the problem discussed. As per the MoM, the Final product delivered by the vendor (TCS, Pune) CMC 3.3 and LMC 3.7 version can be accepted given that at actual deliverables (DVD, manuals etc) are matching with declared final product.

Hence, acceptable deliverables are :

(1) DVD/USB pen-drive containing CMC 3.3, LMC 3.7 version software along with the source code having industry standard comments.

(2) Installation Manuals for the Central Node Application Ver 1.01 July 2018
Installation Manuals for the Control Node Application Ver 1.01 July 2018

(3) Any Other administrative needs such as completion certificate etc.

After extensive testing of the final product, TGC team recommendations are as follow -

1. Non-functional Requirement – Command turn-around time :

This is a trade-off between the desired requirements and practical achievable time, considering the fulfilling the requirements like command authorization, validations for the command argument, checking of whether command allowed in particular state of device, and user-authorization etc. takes some time. Also, command transaction table updates in a hierarchy (from IO device to LMC, and LMC to AGN-CPX) takes some time. However, comparative to the existing Control & Monitoring System (ONLINE system), current command request response time for all 30 antennas at present seems to be reasonable 6 to 15 sec.

In near feature, re-tuning the Tango attributes polling mechanism, by-passing unnecessary multiple authorization & authentication may improvised the situation i.e. reducing the command turn-around time.

2. Changing some implementation policy :

In some of the command-control flow improvements are needed.

(a) Digital Backend Control (GWB and GSB) :

- Command relating to set-phase center source takes more time, hence no catalog entry required.
- Dynamic tango attribute for the project creation do not delete (Tango problem)
- same project code for both the corrector

(b) DS Node code optimization for the performance is needed, such as handling Java threads, mysql
connections and using of separate tango threads for the IO device level monitoring.

3. Up-gradation to Ubuntu 18.0 version

CMC and LMC shall able to port on Ubuntu 18.0 version for easy future maintenance.

4. APPENDIX

APPENDIX – I : TEST CASES

S.No	Sheet Name	Use-Case	GMRT Stakeholder
1	TC001_DashboardLMCStatus_004	View Dashboard	JPK
2	TC002_LMCIntrospect_005	View Dashboard	Rajsingh
3	TC003_C01SystemStatus_006	View Dashboard	Rajsingh
4	TC004_C01Introspect_007	View Dashboard	Rajsingh
5	TC005_C01ServoMonitor_008	View Dashboard	Deepak
6	TC006_C01ServoIntrospect_009	View Dashboard	Deepak
7	TC007_DashboardSystemStatus_010	View Dashboard	JPK
8	TC008_ServoMonitorCMC_011	View Dashboard	Deepak
9	TC009_ServoMonitorCMCIntrospect	View Dashboard	Deepak
10	TC010_DashboardQuickAccess_016	View Dashboard	Deepak
11	TC011_DashboardResourceAllocatn	View Dashboard	JPK
12	TC012_DashboardQuickAccessTemp	View Dashboard	JPK
13	TC013_TuneReceiverSetup_024	Tune Receiver	SNK
14	TC014_Subsytems_032	SetupTelescope	Deepak
15	TC015_CommonCommandEnvironment	SetupTelescope	Deepak/JPK
16	TC016_ExpertConsole_034	SetupTelescope	Deepak/JPK
17	TC017_MainAppWindow	"–"	JPK/SNK
18	TC018_ObservationProgram_035	M&C_SC_007 Execution of Batch Process	Deepak
19	TC019_SystemVariables_037	SetupTelescope	SNK
20	TC022_Introspect_040	View Dashboard	Rajsingh
21	TC023_Filter_051	"–"	JPK
22	TC024_LMCMasterControl_058	NonFunctional Requirement	JPK
23	TC025_ManageArray_055	Define Subarray	JPK
24	TC026_MasterControl_056	NonFunctional Requirement	Rajsingh/JPK
25	TC029_ConnectRemoteHardware_069	???	Abondoned, Check MoM of TCS
26	TC030_Subsystem_Power_On	NonFunctional Requirement	Rajsingh
41	TC031_Alarms	Alarms	JPK
42	TC032_LMC_Power_On	NonFunctional Requirement	Rajsingh
43	TC033_CMC_Power_On	NonFunctional Requirement	Rajsingh
15	TC034_CMC_Introspect	NonFunctional Requirement	Rajsingh
44	TC035_Performance	NonFunctional Requirement	Rajsingh/JPK/Deepak
45	TC036_M&C_Requirements	NonFunctional Requirement	JPK
6	TC037_Expert_Console	SetupTelescope	Deepak
7	TC038_Manage_Array	Defnie Subaray	JPK- Project association/ownership of GSB-GWB
8	TC039_User_Logon_and_Logoff	A & A	Rajsingh
9	TC040_M&C_Utility	M&C Utility	Deepak/SNK
10	TC041_LMC_Operation_Control	Antenanna Position & Control	Deepak/SNK
11	TC042_Operation_Control	Antenanna Position & Control	Deepak/JPK
12	TC043_Script_Status	M&C_SC_007 Execution of Batch Process	Deepak
13	TC044_Dashboard_CMC_Status	View Dashboard	Rajsingh
46	TC045_Data_Logging	Data Archive	Navanath
47	TC046_Power_Equalisation	Power Equalization	Sachin/Deepak
48	TC047_Corelator_Control	Correlator Control	JPK
49	TC048_Antenna_Mask_Generator	Correlator Control	JPK
50	TC049_Skyplot	SkyPlot	SNK

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Appendix-II : Bugzilla Report Summary for the Phase-2 Testing.

Reference : http://hasta.gmrt.ncra.tifr.res.in/bugzilla

Bug ID	Component	Status	Resolution	Summary
76	Functional	RESOLVED	FIXED	LMC restart or start on LMC status not updating
77	Functional	RESOLVED	DUPLICATE	LMC restart or start on LMC status not updating
78	NON-FUNC	RESOLVED	WONTFIX	hdbpp takes archive datasize is larger
79	Functional	CLOSED	INVALID	Date, LST, IST not coming on login GUI
80	Installation	CLOSED	FIXED	keep bash source + MnC source file separately.
81	Functional	CLOSED	FIXED	about, contactus
82	Installation	CLOSED	FIXED	tango.sql have many c02/C02 and C06/c06 unwanted fields
83	NON-FUNC	RESOLVED	FIXED	Multiple starter process running
84	Component/Engine	RESOLVED	WORKSFORME	local mode not working
85	Functional	IN_PROGRESS	---	CMC freeze
86	Functional	RESOLVED	REOPEN	LMC_Operational_Control window
87	Functional	CLOSED	FIXED	track command failed at C08
88	Functional	RESOLVED	FIXED	Command history execution
89	Functional	RESOLVED	INVALID	Command not executing
90	Functional	RESOLVED	INVALID	LMC can not set in Local mode from the LMC GUI
91	Functional	RESOLVED	FIXED	Command fails for C06
92	Functional	RESOLVED	FIXED	Request-Response time
93	Functional	CLOSED	INVALID	Connect to device not working
94	Functional	RESOLVED	FIXED	Unable to execute script from Operator stations other than 0
95	Functional	CLOSED	FIXED	Alarm service NOT OK

Bug ID	Component	Status	Resolution	Summary
96	Functional	RESOLVED	FIXED	expert console on LMC + CMC hangs
97	Functional	RESOLVED	FIXED	Usability Issues
98	Functional	RESOLVED	FIXED	Unit values format on expert console or on Input Fields.
99	NON-FUNC	RESOLVED	FIXED	CMC GUI Opening takes ~ 1 minute
100	Functional	RESOLVED	FIXED	CMC, LMC archiver status OK but message history /message_console is empty
101	Functional	RESOLVED	FIXED	notifications are not coming
102	Functional	CLOSED	FIXED	screen lock indication
103	Functional	RESOLVED	FIXED	dashboard->systemstatus
104	Functional	CLOSED	FIXED	nomenclature change SUB to AGN/OPER
105	Functional	CLOSED	FIXED	Subsystem DS can not start stop from the CMC
106	Functional	CLOSED	FIXED	source rise set AZ EL value doesn't come
107	Component/Engine	IN_PROGRESS	---	Servo IO behavior noticed
108	Functional	RESOLVED	FIXED	halt-normal, halt emergency not working
109	Functional	RESOLVED	FIXED	use catalog button
110	Functional	RESOLVED	FIXED	manage Subarray
111	Functional	RESOLVED	FIXED	Catalog adding problem
112	Functional	RESOLVED	FIXED	Operation Control window usability
113	Functional	RESOLVED	FIXED	track command failed + Catalog field precision values not taken for RA-DEC
114	Functional	RESOLVED	FIXED	save catalog button
115	Functional	CLOSED	FIXED	track command failed from the CMC
116	Installation	RESOLVED	FIXED	Hardcoded variables and path
117	Functional	RESOLVED	FIXED	C06 authorisation failed
118	Functional	RESOLVED	FIXED	operation_control Usability GUI
119	Functional	RESOLVED	FIXED	workspace/center stage area in GUI

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Bug ID	Component	Status	Resolution	Summary
120	Functional	RESOLVED	FIXED	AGN Command failed -- problems
121	Functional	RESOLVED	DUPLICATE	Antenna allocation for sub-array is not working
122	Functional	RESOLVED	FIXED	master control GUI do not update
123	Functional	RESOLVED	DUPLICATE	master control GUI do not update
124	Functional	RESOLVED	DUPLICATE	master control GUI do not update
125	Functional	RESOLVED	FIXED	time-format : argument not taken problem
126	Functional	RESOLVED	DUPLICATE	agn node starting issue
127	Functional	RESOLVED	FIXED	AGN Status
128	Functional	RESOLVED	FIXED	sub-array antenna allocation remain
129	Functional	RESOLVED	FIXED	sub-subsequent tracking failed
130	Component/Engine	RESOLVED	FIXED	track pre-processing script
131	NON-FUNC	RESOLVED	FIXED	event messages appearing three times
147	Functional	RESOLVED	FIXED	agn status ok but alarm,gmrt,archiver status not avaialable
148	Functional	RESOLVED	FIXED	response timeout 30 sec
149	Functional	RESOLVED	FIXED	filter selection in the GUI
150	Functional	RESOLVED	FIXED	CMC doesn't forward commands to LMC, goes into Hang state
151	Functional	RESOLVED	FIXED	Message shows AGN0 Authorization failed.
152	Functional	RESOLVED	FIXED	Authorization failed for S01 and C13 antenna from CMC. Commands are working in local mode of LMC. For W01 and E02 command works without error.
153	Functional	RESOLVED	FIXED	Java is taking 170% CPU on CMC machiine
154	NON-FUNC	RESOLVED	FIXED	continuous logout messages, and unable to get child token
155	Functional	RESOLVED	FIXED	Dynamic attributes do not update
156	Component/Engine	RESOLVED	FIXED	In batch mode, if script validation fails it should give details about the failure.
157	Functional	RESOLVED	FIXED	CMC not coming UP properly.

Bug ID	Component	Status	Resolution	Summary
158	Functional	IN_PROGRESS	---	CMC GUI killed due to segmentation fault.
159	Functional	RESOLVED	FIXED	CMC GUI not coming Up due to mysql query
160	Functional	RESOLVED	FIXED	Same message being thrown so many time at activity window of CMC
161	Functional	RESOLVED	FIXED	While sending track command messages in red color throws up.
162	Functional	RESOLVED	FIXED	Performance issues
163	Functional	RESOLVED	FIXED	LMC GUI doesn't come up properly
164	Functional	RESOLVED	DUPLICATE	AGN0 and other AGN nodes are not coming up after CMC restart
165	Functional	RESOLVED	DUPLICATE	LMCs not starting
166	NON-FUNC	RESOLVED	WONTFIX	satellite interference component
167	Functional	IN_PROGRESS	---	CMC Start after normal shutdown, LMCs are not comings
168	NON-FUNC	RESOLVED	FIXED	GAB LMCs not stopping process after ds_stop
169	Functional	RESOLVED	FIXED	CMC 2.6 : ANAMALOUS BEHAVIOUR OF GUIs and BLOCKING ISSUES
170	Functional	IN_PROGRESS	---	GSBLMC not working from the CMC
171	Functional	RESOLVED	FIXED	open_mdi - GUI Popup error
172	NON-FUNC	RESOLVED	FIXED	AGN Restart - Not all components are being restarted
173	Functional	RESOLVED	FIXED	CMC 2.6 Usability
174	Functional	RESOLVED	FIXED	trackoff_AZ/EL or trackoff_RA/DEC command failed.
175	Functional	RESOLVED	FIXED	script invalid path
176	Functional	RESOLVED	FIXED	archive r can not started
177	Functional	RESOLVED	FIXED	LST on CMC GUI is not correct. But on LMC GUI it is correct
178	Functional	RESOLVED	FIXED	servo introspect parameters not appearing
179	Installation	RESOLVED	FIXED	when upload button is pressed in catalogs window, it gives error "No hostkey for host 10.29.135.26 found."
180	Functional	RESOLVED	FIXED	track_local command not working from MNCScriptManager on LMC (S01 antenna)
181	Functional	RESOLVED	FIXED	In manager pool window, antenna selection get refreshed after few seconds.

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Bug ID	Component	Status	Resolution	Summary
182	Functional	RESOLVED	FIXED	Subsystem Device server gets killed while we start deviceClient program.
183	Functional	RESOLVED	FIXED	add catalog not working from CMC
184	Functional	RESOLVED	FIXED	LMC is disconnected. Unable to forward command. But in Dashboard LMC status is ok.
185	Functional	RESOLVED	FIXED	add_catalog_entity not working from GUI
186	Functional	RESOLVED	FIXED	batch-command status
187	Functional	RESOLVED	FIXED	set lmc in local or auto mode
188	Functional	RESOLVED	FIXED	GSB Corrctl1 command goes to corrctl2
189	Functional	RESOLVED	FIXED	AGN0 failed to start
190	Functional	RESOLVED	FIXED	Unable to change mode Local/Remote of LMC from CMC
191	Functional	RESOLVED	FIXED	DASHBOARD shows system disconnected
192	Functional	RESOLVED	FIXED	c01 lmc not starting
193	Functional	RESOLVED	FIXED	project 'delete forcefully' command failed.
194	Functional	RESOLVED	FIXED	agn4 do not show any agnsys command
195	Functional	RESOLVED	FIXED	monitor->Message Console shall have 'detailed resp. button'
196	Functional	RESOLVED	FIXED	skyplot sources
197	Functional	RESOLVED	FIXED	getpsource command failed.
198	Functional	RESOLVED	FIXED	subsystem window shows one antenna less for the GAB
199	Functional	UNCONFIRMED	---	agn hang
200	Functional	RESOLVED	FIXED	sky-plot do not show correct source name
201	Functional	RESOLVED	FIXED	Use of latitude and longitude of antennas in calculation of azimuth and elevation.
202	Functional	RESOLVED	FIXED	startproj, stopproj, setfreq command do not work from operation control
203	Functional	RESOLVED	FIXED	bandplot cross visibility are not coming
204	NON-FUNC	RESOLVED	FIXED	starter AGN log give messages

Bug ID	Component	Status	Resolution	Summary
205	NON-FUNC	RESOLVED	FIXED	expert console progress bar update late
206	Component/Engine	RESOLVED	FIXED	CPX got killed, but all AGNs were running.
207	Component/Engine	UNCONFIRMED	---	gotosrc scripting API not working properly.
208	Functional	RESOLVED	FIXED	back to back tracking commands not working. If we issue tracking command twice then it works.
209	Functional	RESOLVED	FIXED	backend actions are not reflected in the GUI
210	Functional	IN_PROGRESS	---	agn shows crashed
211	Functional	RESOLVED	FIXED	while tracking, Correlator command some times failed.
212	Functional	IN_PROGRESS	---	GSB/GWB LMC need to restart
213	Functional	RESOLVED	FIXED	quick status -> sub-array allocation is not correct
214	Functional	UNCONFIRMED	---	In command line mode, IPython prompt should be show operator station name.
215	Functional	RESOLVED	FIXED	use catalog command for system catalog
216	Functional	RESOLVED	FIXED	Scripting DS not working for the GWB-LMC
217	Functional	RESOLVED	DUPLICATE	CMC command gives timeout
218	Functional	UNCONFIRMED	---	servo position command should consider axis offset(static,dynamic and user) like tracking,
219	Component/Engine	RESOLVED	FIXED	command timeout
220	Functional	RESOLVED	FIXED	Antenna Selection gets de-selected
221	Component/Engine	RESOLVED	FIXED	stop-array command not working from cmc->'operational_control' window
222	Functional	UNCONFIRMED	---	Same project code for GSB and GWB to be assign to the Single Subarray
223	Functional	RESOLVED	FIXED	GSB and GWB project association functionality
224	Functional	RESOLVED	FIXED	stopproj command failed.
225	Functional	RESOLVED	FIXED	command response turn around time
226	Functional	RESOLVED	FIXED	All Antennae not accepting track command from CMC
227	Functional	RESOLVED	FIXED	Subsystem Device server getting killed automatically
228	Functional	UNCONFIRMED	---	GUI Hangs

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Bug ID	Component	Status	Resolution	Summary
229	Functional	RESOLVED	FIXED	correlator command authorization problem
230	Functional	RESOLVED	FIXED	project can not assign to subar-0
231	Functional	UNCONFIRMED	---	IO DS getting killed automatically
232	Component/Engine	RESOLVED	FIXED	some commands are going to antenna, even if it is not allocated to specific AGN. I am able send commands to all antenna from MNCScriptmanager(AGN4).
233	Component/Engine	RESOLVED	FIXED	if we add comment(# at begining) in configuration file 'scriptVariables.txt' file, MNCScriptmanger gives error. Same thing happens with servo IO conf file (antaconf.in)
234	Functional	RESOLVED	FIXED	For C02 and C03 antenna, tracking is not working from CMC as well as LMC
235	Functional	RESOLVED	FIXED	agn not able to detect LMC correct status
236	Functional	RESOLVED	FIXED	assign owner command need to execute twice.
237	Functional	RESOLVED	FIXED	Remote GUI showing mysql error
238	Functional	RESOLVED	FIXED	GAB Command not going through some antenna LMCs
239	Component/Engine	RESOLVED	FIXED	skyplot and polar plot target source /antenna coordinates show difference of 180 degree
240	Functional	RESOLVED	FIXED	GSB and GWB startproj can not work.
241	Functional	UNCONFIRMED	---	use pointing command not working from LMC. Also it is not available on CMC expert console.
242	Functional	RESOLVED	FIXED	skyplot shows wrong RA-DEC coordinate for the tracking.
243	Functional	RESOLVED	FIXED	GAB LMC not working properly.

APPENDIX – III Regression Test : TURN-AROUND time

 # Date 14 Nov 2018

 # Command Statistics for all ~30 antennas :

System	Command	Exec_Time	Resp_Time	Period (Sec)	
FE	seturfsys	18:28:03	18:28:36	30	# Failed at c01, e06, w02 *// command Timeout is 30 sec for aggregation*
FE	seturfsys	18:32:50	18:33:20	30	# Failed at W02
FE	seturfsys	18:33:47	18:33:57	10	## Successful (Excluded W02)

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 # GAB communicating to ALL 30 antenna systems

GAB	Set GABLO	18:27:04	18:27:24	20	# Failed at w02
GAB	Set GABLO	19:00:18	19:00:49	30	## Successful to all antenna
GAB	Set gabconf	18:30:18	18:30:50	32	## Successful to all
GAB	Set gabconf	18:31:01	18:31:34	33	## Successful to all

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 # GSB and GWB

GWB+GSB	corr_config	18:38:38	18:39:29	50	*
GWB+GSB	corr_config	18:39:47	18:40:09	22	18:40:02 GSB , 18:40:09 GWB
GWB+GSB	init	18:43:18	18:43:41	23	18:43:34,41 GSB-GWB

GSB	initprj	18:44:46	18:45:06	20
GWB	initprj	18:45:21	18:45:33	12
GSB	associate	18:46:16	18:46:26	20
GWB	associate	18:46:55	19:47:07	12
GSB	setpsource	18:48:14	18:48:53	29
GSB	setpsource	19:28:54	18:29:23	29
GWB	setpsource	18:56:12	18:56:41	29
GSB	setfreq	19:32:59	19:33:16	17
GWB	setfreq	18:56:51	18:57:45	44 * // two commands

 # Date 18 Oct 2018

System	Command	Exec_Time	Resp_Time	Period (Sec)
FE	set_fe	17:46:12	17:46:29	17
FE	set_fe	17:48:25	17:48:42	17
GAB	Set GABLO	17:56:53	17:57:23	30
GAB	Set gabconf	17:58:14	17:58:23	9

GABLMC	Set GABLO	18:31:20	18:31:38	18 (Only to C00)
GABLMC	Set GABLO	18:32:55	18:33:17	23 (Only to C00)
GAB	Set GABLO	18:00:20	18:00:50	30 // To all antenna Again
GAB	Set gabconf	18:10:00	18:10:09	9 // To all antenna Again

.....

GWB+GSB	corr_config	19:26:45	19:27:01	16
GWB+GSB	init	19:29:02	19:29:52	50
GWB/GSB	initprj	19:29:52	19:30:06	14
GWB	associate	19:31:52	19:32:06	14
GWB	setfreq	19:32:59	19:33:16	17
GWB	getpsrc	19:33:01	19:33:32	31
GWB	startscanprj	19:33:52	not noted	
GSB	asscociate	19:04:13	19:04:27	14
GSB	startscan	19:11:55	19:12:58	1 min? Command Failed.
