



Re-usability Study on the GMRT M&C related Sub-systems : Space and Electrical requirements

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Objective: As a part of the new developmental process of Monitoring and Control system of GMRT, new micro-controller cards, computers and switches have to be installed at antenna base and in the CEB building. To keep maximum availability of these sub-systems, installing environmental conditions need to be preplanned like space, UPS and cooling systems. Also, during the upgrade process of control and monitoring system, existing sub-systems like telemetry, Antenna Base Receiver system at the base and subsystems in the Receiver Room (viz. telemetry, base band and OF) needs operational support. Therefore, in this report we estimate space, electrical and cooling requirements for the new M&C systems at antenna base and in CEB.

Revision	Date	Modification/ Change
Ver. 1	20 August 2013	Initial Version
Ver. 1.1	28 November 2013	Power consumption of individual sub-systems at antenna base noted. Ref. Shri. A.Diwane/R.V. Swamy
Ver 1.2	13 February 2014	As per the Plan meeting MoM send by Prof. Y. Gupta and Discussion inputs from group coordinators. Reference- Appendix-II
Ver 1.3	28 May 2014	Inrush current measurement at antenna C10 added.

Re-usability Study on the GMRT M&C related Sub-systems : Space and Electrical requirements

Jitendra Kodilkar, Arwind Diwane, S. Nayak and R.V. Swami \$ 28 May 2014, Version 1.3 \$

Abstract : As a part of the new developmental process of Monitoring and Control system of GMRT, new micro-controller cards, computers and switches have to be installed at antenna base and in the CEB building. To keep maximum availability of these sub-systems, installing environmental conditions need to be preplanned like space, UPS and cooling systems. Also, during the upgrade process of control and monitoring system, existing sub-systems like telemetry, Antenna Base Receiver system at the base and subsystems in the Receiver Room (viz. telemetry, base band and OF) needs operational support. Therefore, in this report we estimate space, electrical and cooling requirements for the new M&C systems at antenna base and in CEB. As per our study, proposed space, electrical power and cooling requirements are as follows :

- 1. To accommodate new sub-systems at antenna base, isolation transformer in common-rack need to be shift out of the rack. Also, 6U space available in the ABR rack can be reused. OR a new portable rack (~18 to 24 U size) can be placed at the antenna base.
To optimize space utilization, a common power supply shall be shared among two to three possible sub-systems.
In the CEB building, space is available in receiver room to install 24 U rack for new M&C systems hardware like application server, web-server, data base server and central switch etc.**
- 2. At antenna base, estimated total power load (either noted from sub-systems of power supply or inputs given by Lab personnel) is around 3.8 KVA whereas for only new systems estimated load is around ~ 2.4 KVA.
Practically measured load at the antenna base by electrical personnel is ~ 1.1 KVA for old and new systems. Total inrush current measurements show instantaneous power load of ~ 3.1 KVA.**
- 3. In operational condition, antenna base required cooling temperature range is from 19 to 22 degree Centigrade. In the Receiver Room, the required temperature range is 17 to 22 degree Centigrade.**

1. Introduction

The GMRT Monitoring & Control (M&C) System is under up-gradation process. To control new sub-systems at antenna base like Servo, Feed Positioning System, Front-end and Optical Fiber system, new M&C system hardware installation is planned. This hardware consists of micro-controller boards like the Rabbit RCM 4300 and PC 104. All these sub-systems at antenna base will communicate to the main Central Monitoring and Control (CMC) system through a network switch at antenna base and the Central switch at the CEB. In addition to this, there may be a separate M&C system application server, Data-Base server and Proxy Servers in CEB for intra-net and Internet users.

To keep maximum availability and reliability of the M&C system, environmental conditions in which systems are being installed like space, cooling and un-interruptible electrical supply plays vital role. Till the new M&C system installed, tested and released for operation, one major constraint is to support the existing system at least for next couple of years. In this internal technical report, we study about whether the existing resources like available space in existing racks, UPS availability at antenna base and in the central building can be re-utilize or alternate solutions are needed in order to support new and existing M&C system hardware. To account the stake of required resources for supporting the existing and new GMRT sub-systems, we discussed with Group Coordinator of each department (*Mr. Suresh Sabhapati- Servo, FPS; Mr. Ajith kumar – Analog/Digital Backend; Mr. R.V. Swami – Electrical; Mr. Suresh kumar – FE, OF system*). We received valuable inputs from them to estimate space, power and cooling requirements. A need of documenting the re-usability study on GMRT M&C related sub-systems also arose as a reference document required for the Hardware Requirement Specification (HRS) and Software Requirement Specification (SRS) work which is a part of the new M&C system up-gradation development process in a collaboration with the Tata Consultancy Services (TCS) company.

Next, Section-2 briefs constraints or assumptions while evaluating re-usability requirements for M&C system. Space, electrical power and cooling requirements and resource estimates are organized for antenna base in Section-3 and for the Central Electronics Building (CEB) separately in Section-4. In last Section-5, re-usability study summarized and proposed requirements are mentioned.

2. Constraints and Assumptions :

After discussing with each Group Coordinator on required operational support to the existing GMRT sub-systems and time estimates for new sub-systems installation, following assumptions and constraints are made to evaluate re-usability requirements :

- (1) At antenna base, Antenna Base Receiver (ABR) sub-systems and the Feed Positioning System (FPS) will be operational and support is needed for at least next two to three years. Similarly, the existing Fiber Optic System Racks and two Telemetry System Racks in the Receiver Room need to keep in operation for at least next two to three years.
- (2) The installation of a new FPS components/sub-systems will replace the old components/sub-systems at Antenna Base. Hence, support for both the existing and new FPS control sub-systems at Antenna Base is not desired.
- (3) Space utilized by the three racks of Servo sub-system at Antenna Base kept unchanged as it is supposed to be occupied by the new upgraded Servo system. Existing three servo racks (each of around 44 U and ~24 X 24 sq. inch size) plan to be replace by only two servo racks (each of ~40 U and 31 x 31 square inch in size) .
- (4) For space re-utilization at antenna base, total shell area considered is around ~128 sq. feet (this exclude C04, C08 and C12 antenna which are unlike other antenna base shells).
- (5) Servo system needs UPS support only for the electronic systems (PC104 and associated cct.) i.e. UPS support is not desirable for the electro-mechanical systems viz. Servo motors.
- (6) While estimating load capacity of the Uninterrupted Power Supply (UPS) for Antenna Base and Receiver Room, the AC line voltage supplying power to UPS and systems is assumed to be 230 Volts. Approximate load of sub-systems and M&C h/w components are mentioned in maximum amperage.
- (7) All values quoted for given parameters in this requirement study of re-usability are not absolute but approximately estimated using the available inputs and discussion with each department personnel.

3. Antenna Base Requirements :

Antenna base re-usability requirements are studied mainly for required space and electrical power for the existing sub-systems and planned new sub-systems under the up-gradation.

3.1 Space Utilization :

At antenna base, there are two racks : (i) The **Antenna Base Receiver (ABR) rack** in which PIUs (Plug In Units) of Analog sub-systems like Intermediate Frequency (IF) and Local Oscillator subsystem are installed. (ii) **Common Rack** contains Fiber Optic systems' (existing and new) PIUs, telemetry system's PIUs, sub-systems that control the Feed Positioning System and the Isolation Transformer placed at the bottom. Each Rack is about 42 U and ~ 25 X 25 inch size. **Figure 1** shows Front-view of both the racks and **Figure 2** shows Top-view of Receiver systems and Common Rack along with a available space at antenna base. Dimension of the planned new UPS is around ~ 400 X 600 X 900 mm (Ador Power AC - RFI Team has approved two models, Ref. Shri. R.V. Swamy). In **Table 1**, space requirements of the existing and new sub-systems under up-gradation have been given.

- From Table 1, Figures 1 and 2, proposed space requirements to support the upgraded sub-systems and existing sub-systems at antenna base are as follows :

- (1) (a) Place new sub-systems in Common Rack. To accommodate new sub-systems in Common-Rack, move isolation transformer, AC distribution panel and contractor circuit to other separate place.
- (b) Utilize 6U space available in ABR rack for new telemetry/M&C sub-systems mainly CPU.
- (c) To make a space for new MCM Rabbit cards (if more than three Rabbit cards), move existing Telemetry PIUs to ABR Rack and utilize the space for new Rabbit cards.

OR

Place a new mountable rack at the antenna base for installing M&C Hardware components which includes PC, Screen, Keyboard and network switch which can fit into 18 to 24 U Rack.

(2) Place a new UPS near the ABR rack. Available entrance space after placing the new UPS near ABR rack is around ~ 1.6 to 2.3 Feet (Refer Figure 2).

(3) To make provision of space for future expansion of subsystems, instead of individual power supply for each sub-system share a common power supply among two to three possible sub-systems.

Table 1: Space Requirements for existing and new subsystems at the Antenna base

#	Existing Systems	Space in U (1 U = 1.75 inch)		New GMRT subsystems	Required Space in U
		Rack-1 ~ 42 U	Rack-2 ~ 42 U		
1	ABR Power Supply	7		New Fiber Optic System	6
2	ABR PIUs	~28		Network switch	5
3	OF system Power Supply		3	Antenna Base Processor	5
4	Telemetry system + OF system PIUs		6	Two Rabbit Cards	6
5	FPS System + Power Supply		12	FPS + Power Supply	12
6	Isolation Transformer + AC distribution		10	PC Screen + Keyboard	8
7	New Fiber Optic System *		6	FE-OF Power supply	5 + 4 + 2
	Total Space	35 U	37 U		53 U
	Available Space	6 U	~ 5 U		

ROUGH SCHEMATIC :
 FRONT VIEW OF GMRT ANTENNA BASE
 RECEIVER SYSTEM AND COMMON RACKS
 VERSION 0.9 1 JULY 2013 JPK

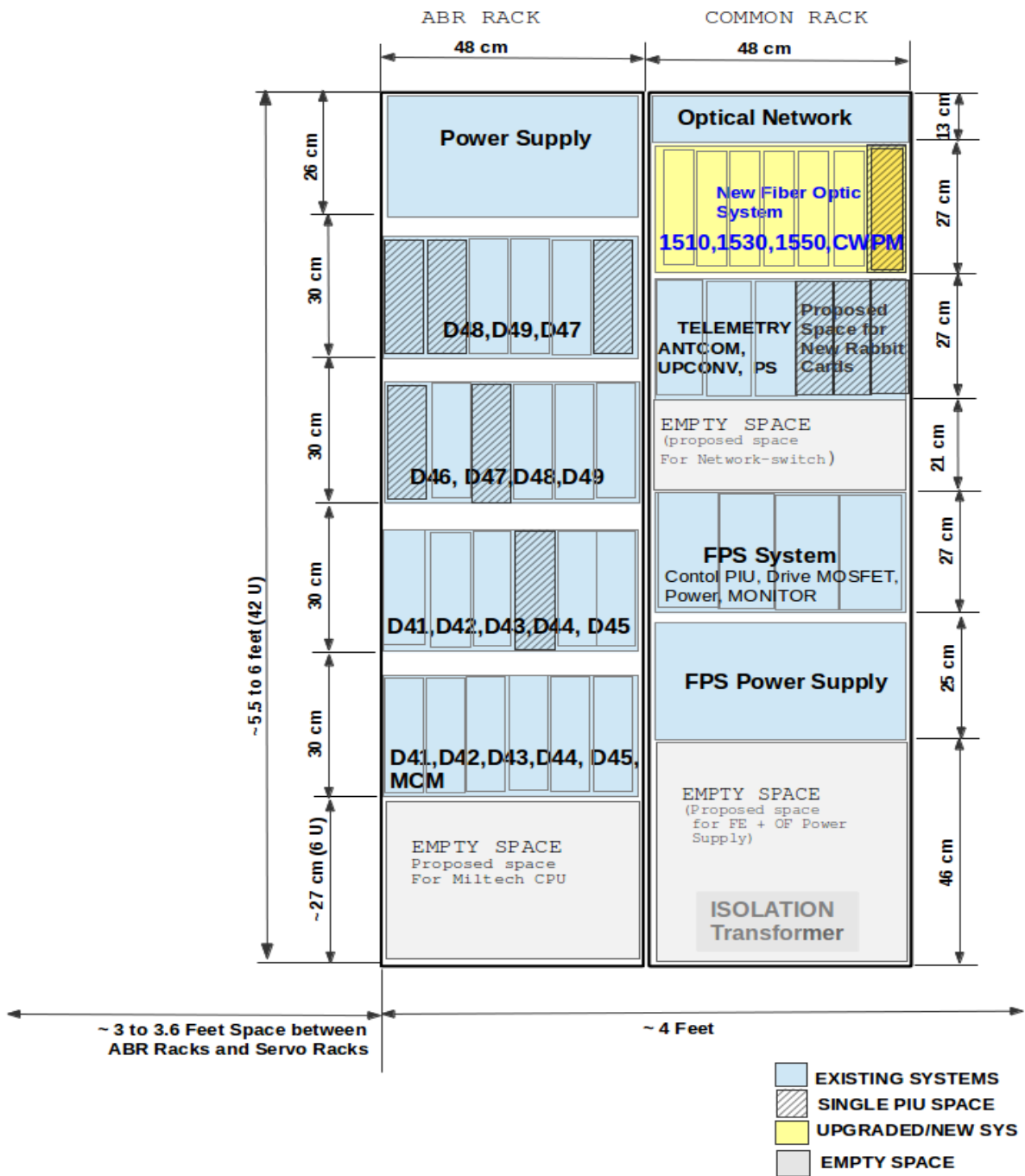


Figure 1: Front view of ABR and Common Racks at the GMRT Antenna base

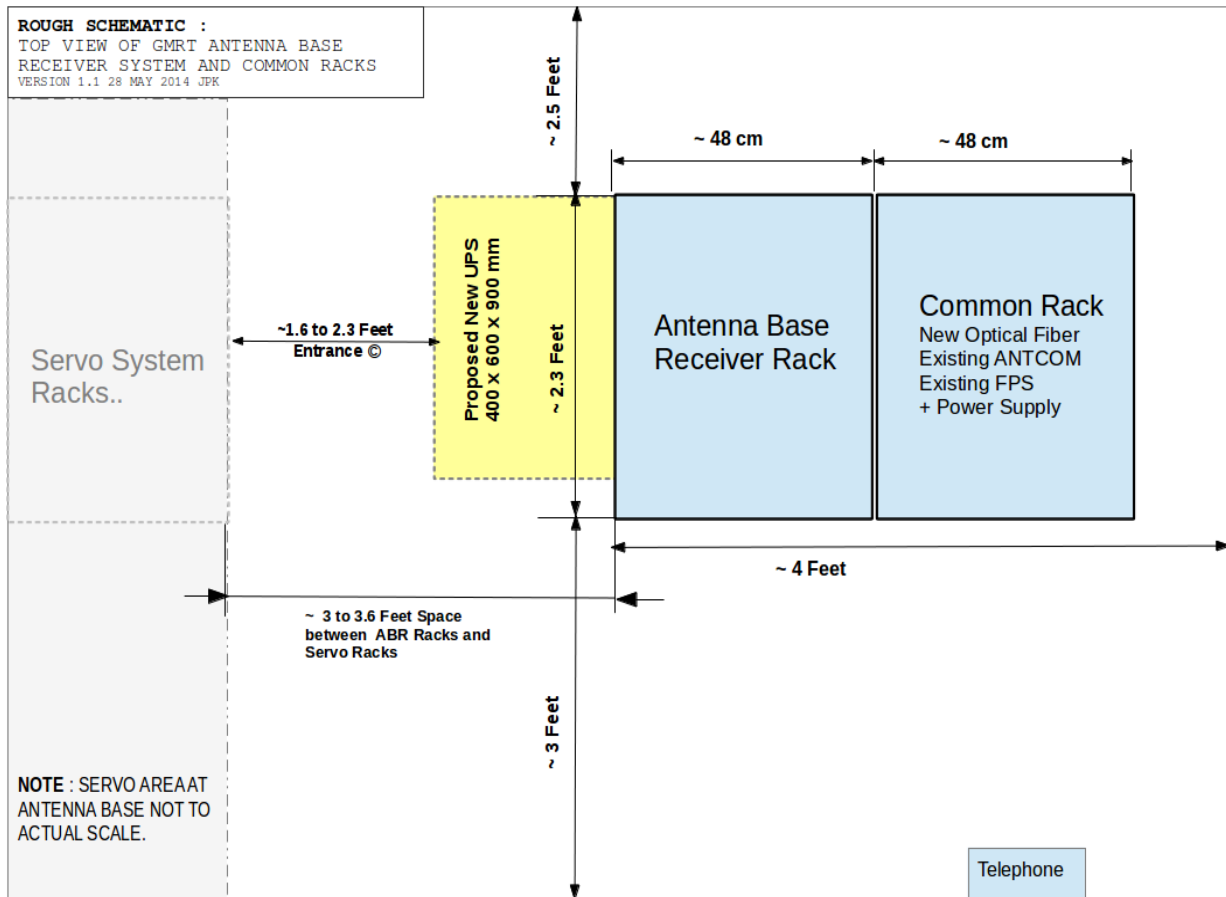


Figure 2: Top view of GMRT antenna base

© Maximum space of 2.3 feet will be available after replacing existing servo racks with the new servo rack under up-gradation

3.2 UPS Requirement :

Approximate load estimated for sub-systems at the antenna base and new planned M&C H/W components are mentioned in the **Table 2**. The details of load calculations for individual sub-systems is given in Appendix-I. In Table 2, we estimated load consumption in amperage after taking inputs from each department personnels.

Electrical Department personnel practically measured power load at **Antenna C06 and C10** which is also mentioned in **Table 2**. Since practically measured power load for both the C06 and C10 was closely matching, hence steady-current values are given commonly for both the antennas. Inrush current measured at the UPS output using Power Analyzer (Fluke make 435 series) shows that maximum single phase current goes up-to 8.1 Amps and pulse-width is ~ 2 sec. Details of measurements taken at antenna C10 is given in Appendix-III. Note that at present, UPS supports only ABR rack, Telemetry, sentinel and Fiber optic sub-systems.

- **UPS Requirement Study based on information given in Table 2 :**

- (i) Estimated load from Sub-systems power supply or inputs given by Lab personnel is around ~ **3.8 KVA** for new and old systems, for only new systems estimated load is around ~ **2.4 KVA**

- (ii) Practically measured load at the antenna base by electrical personnel is ~ 1.1 KVA for old and new systems. Total inrush current measurements show the instantaneous power load of ~ 3.1 KVA.
- (iii) If isolation transformers (one or two) is outside the UPS, then self current load need to be assumed.

Table 2: Electrical Load of GMRT Sub-systems at the Antenna Base

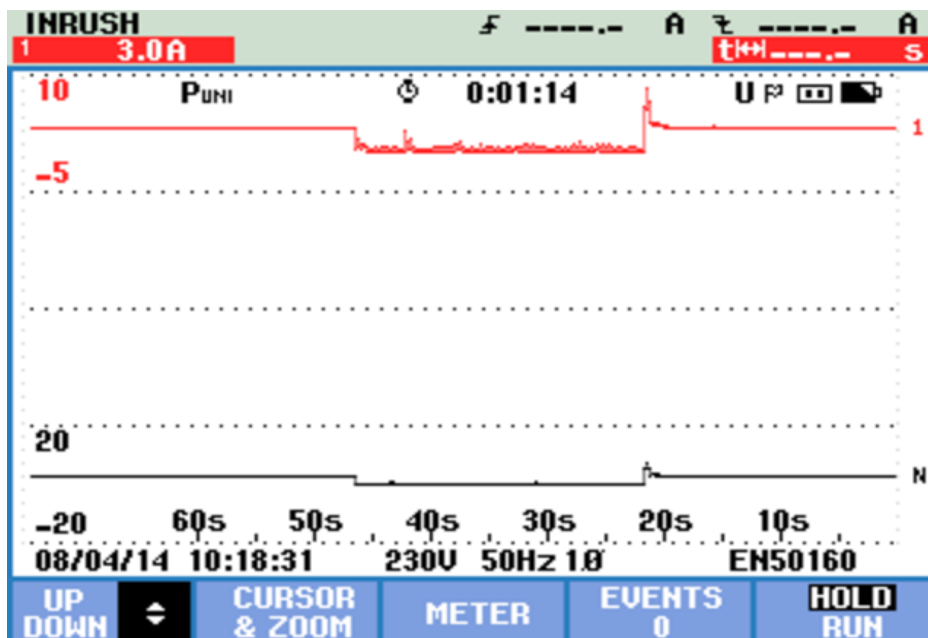
#	Subsystems		Estimated (Based on Sub-system's power supply OR required inputs given by Labs)	Practically Measured at Antenna Base C06 and C10	Peak Load measurements at Antenna Base C10
	Old	New	Power Consumption (Max. Amp)	Amp (+/- 0.1 Amp)	Inrush Current (Max. Amp)
1	Antenna Base Rx (ABR) system + Antcom + Up Conv *	NA	6	3 [†]	5.6
2	OFC	OFC	4 ^α	0.1	1.2
3	FE Power supply	FE Power Supply		0.4	1.6
4	FPS System (Motor load excluded)	-	1.5	0.4	1.7
5	-	Servo control cards (PC104)	2	0.4	1
	Sentinel systems	-	-	0.1	1
7	-	Rabbit Cards + PC + Network Switch	3	0.7	1.75
Total load			16.5	5.1	13.85

† Excluding transformers resistive and core losses ~ 0.7 to 1 amps (In load on condition).

* Four Fan Trays considered in ABR Rack but only three are installed.

α As per the inputs given in see Plan meeting, Appendix-II

Figure 3: Inrush current Measured at the UPS output (Antenna C10) - Peak load is 8.1 Amps



3.3 Cooling Requirement :

After discussion with Shri. Swamy R.V., Air Conditions unit installed at the antenna base can keep the **temperature 19 to 22 degree C at the antenna base**. The Air conditioning units support is reusable in the GMRT up gradation process, no further cooling need realized.

4. CEB Requirements :

In the Receiver Room, there are total 16 Racks of Analog back-end system (Existing and new), 2 racks of Telemetry system and 8 racks of Fiber Optic system (Existing and new) which are arranged systematically.

In this section, we discuss the proposed re-usability requirements in a view of installation of the new M&C hardware system components which are at smaller scale as compare to other systems. However, we put the re-usability study on UPS requirements by considering all subsystems as UPS is a shared resource. Similarly, cooling requirements are also consider for overall sub-systems present in the receiver room.

4.1 Space Requirement :

The M&C System may have three servers viz. Application Server, Data-Base Server and Proxy Server. In addition to this one 48 port Central Network Switch, GMRT Analog back-end Server PC also envisaged to be installed. Hence a separate 24 U Rack can be placed either in the Receiver Room or near control-room as the GMRT server Glass-room is already occupied with many machines.

Two existing racks of telemetry system (Communication Handler + ANTCOM PIUs) will need a operational support for at least next two to three years hence, space occupied by these racks in the receiver room need to kept as it is.

- **Assuming the rack mounted servers, a 24 U Rack is required for the GMRT M&C system at the CEB.**

4.2 UPS Requirement :

#	Existing and new sub-systems	Power Consumption (Amps) ¹
1	Analog Backend (New GAB 8 Racks + GSB-BB 4 Racks + 3 Racks : LOM, BB-LO, FTS+30to1)	113
2	Fiber Optic System (Existing 4 Racks + New 3 Racks + 1 Ethernet Rack)	11.4
3	Telemetry 2 Racks	4
4	New M&C System hardware Rack -1	10
Total Electrical Load on Receiver-Room Sub-Systems		138.4

Table 3: Electrical load of GMRT sub-systems in the Receiver Room (CEB)

Table 3 shows the estimate for electrical load of GMRT sub-systems in the receiver Room, approximate max power consumption is ~ 139 Amps. Therefore, keeping in mind systems' functionality in receiver room and future scope :

- **The UPS in the receiver room shall support around 40 KVA of electrical load.**

1

4.3 Cooling Requirement :

The cooling requirement in the receiver room discussed among the head of each department and agreed that the Receiver Room temperature for the normal sub-systems' operation shall be in range from 17 to 22 degree Centigrade.

5. Summary :

The proposed requirements after re-usability study based on discussion and inputs from the various department personnel, calculations of available parameters and by considering the assumed constraints are as follows :

- **Antenna Base :**

- (1) **Space Requirements :**

(i) (a) Place new sub-systems in Common Rack. To accommodate new sub-systems in common-Rack, move isolation transformer, AC distribution panel and contractor circuit to other separate place. (b) Utilize 6U space available in ABR rack for new telemetry/M&C sub-systems mainly antenna base computer. (c) To make a space for new MCM Rabbit cards (if more than three Rabbit cards), move existing Telemetry PIUs to ABR Rack and utilize the space for new Rabbit cards.

OR

Place a new mountable rack at the antenna base for installing M&C Hardware components which includes PC, Screen, Keyboard and network switch which can fit into 18 to 24 U Rack.

(ii) Place a new UPS near the ABR rack. Available entrance space after placing the new UPS near ABR rack is around ~ 1.6 to 2.3 Feet (Refer Figure 2).

(iii) To make provision of space for future expansion of subsystems, instead of individual power supply for each sub-system share a common power supply among two to three possible sub-systems.

- (2) **Electrical Power Requirements :**

(i) Estimated load from Sub-systems power supply or inputs given by Lab personnel is around ~ 3.8 KVA for new and old systems, for only new systems estimated load is around ~ 2.4 KVA

(ii) Practically measured load at the antenna base by electrical personnel is ~ 1.1 KVA for old and new systems. Total inrush current measurements show the instantaneous power load of ~ 3.1 KVA.

- (3) **Cooling Requirement :** Operating temperature range at the antenna base shall be within 19 to 22 degree Centigrade.

- **Receiver Room at the CEB :**

- (4) **Space Requirement :** Assuming the rack mounted servers, a 24 U Rack is required for the GMRT M&C system at the CEB.

- (5) **Power Requirement :** The UPS in the receiver room shall support ~ 40 KVA of electrical load.

- (6) **Cooling Requirement :** The Receiver Room temperature for the normal sub-systems' operation shall be in range from 17 to 22 degree Centigrade.

Above requirements after further review and approval can be implemented at one or two antenna at prototype level.

Acknowledgement : Authors thanks to group heads of each department for their cooperation. J.Kodilkar thanks to shri. Pravin Raybole and shri. Navanath Shinde for their extended helps in terms of understanding the sub-system requirements related to Fiber Optic system and Analog Systems.

Appendix-I : Power Consumption calculations.

1. Antenna Base Sub-systems :

1.1 Antenna Base Receiver System : Total Requirement ~ 6 Amps

ABR Power Supply ~ 2 Amps + 4 Fan Trays each of 1 Amp = 6 Amps.

ABR Power Supply :

$$30 \text{ V, } 5 \text{ A} = 150 \text{ W}$$

$$17 \text{ V, } 7 \text{ A} = 119 \text{ W}$$

$$17 \text{ V, } 7 \text{ A} = 119 \text{ W}$$

$$10 \text{ V, } 6 \text{ A} = 60 \text{ W}$$

$$448 \text{ W} \sim 450 \text{ W}$$

$$\text{Current} = 450 \text{ W} / 230 \text{ Volt} = 1.8 \text{ amp}$$

1.2 FPS system : Total 3 Amps.

Half HP motor of 375 Watt (~1.5 amp) + 2 Amps for the FPS sub-systems = 3.5 Amps

2. Receiver Room Sub-systems :

2.1 Analog Back-end Systems in the Receiver Room : Total Load 113 Amps

In each rack of Analog Back-end ~ 2 amps of Power Supply and five Fan-trays each of ~ 1 amp is assumed, hence power load estimate as follows :

Three Racks BB-LO, LOM, FTS+30to1	3 * 7 Amps	=	21
Four Base-Band Rack for GSB	4 * 7 Amps	=	28
Eight new GAB Racks	8 * 8 Amps	=	64

113 Amps

2.2 Fiber Optic System : Total load ~ 11.4 Amps

Fiber Optic System contains four Racks for existing system (One Power Supply Rack + three OF system Racks) and new three Fiber Optic System racks plus one Ethernet connection Racks. Each old rack is having 2 Fan trays, each of ~ 1 amp and new rack has one Fan tray ~ 0.4 amp.

Existing three OF Racks :

$$(10 + 10 + 15) \text{ V} * 5 \text{ A} = 175 \text{ Watt} * 3 \text{ Power Supply} = 2.28 \text{ Amps}$$

$$2 \text{ Fan Tray per Racks} * 3 \text{ Racks} = 6.00 \text{ Amps}$$

New Racks :

$$(15 + 15) \text{ V} * 3 \text{ A} = 90 \text{ Watt} * 4 \text{ New Racks} = 1.56 \text{ Amps}$$

$$\text{Fan Tray (0.4 Amps)} * 4 \text{ Racks} = 1.60 \text{ Amps}$$

11.4 Amps

2.3 Telemetry System : Total load ~ 4 Amps

Telemetry contains two racks consist of Communication Handlers and Antenna communication PIUs.

Telemetry Power Supply :

$$30 \text{ V, } 5 \text{ A} = 150 \text{ W}$$

$$17 \text{ V, } 7 \text{ A} = 119 \text{ W}$$

$$17 \text{ V, } 7 \text{ A} = 119 \text{ W}$$

$$10 \text{ V}, 6 \text{ A} = 60 \text{ W}$$

$$448 \text{ W} \sim 450 \text{ W Current} = 450 \text{ W}/230 \text{ Volt} = 1.8 \text{ amp}$$

For two racks total load assumed ~ 4 Amps.

2.4 New M&C Hardware :

There will be total six servers for in-house and outsource M&C development. Each server considered around 450 watts. Hence rough total estimates for M&C system is assumed around **10 Amps**.

Appendix-II : Plan Meeting Discussion (February 5th, 2013)

Meeting Called by : Prof. Y. Gupta

Attendees – Shri. R. V. Swami, Suresh Kumar, Ajit Kumar, S. Nayak, Pravin Raybole, C.P. Kanade, J. Kodilkar, Navanath Shinde, Rajsingh Uprade and Naresh Sisodia.

Minutes of meeting based on MoM of Plane meeting send by Prof. Y. Gupta and discussion among stakeholders.

- **Minutes**

#	Type	Description
1	Clarification	It was clarified by operation and Electrical group that antenna base measurement of electrical load was taken at the A.C. Power supply source (Isolation transformer for ABR rack and at the Front-end Power supply).
2	Correction - FE-OF	<ul style="list-style-type: none"> • FE and OF Power supply will be separate. OF Power supply estimation is 3 Amp Max, whereas FE Power supply take maximum ~ 10 Amp? (This need to be confirmed because previous FE power supply estimation was up to 4 Amp). • Space indicated by Optical Power supply shown in <i>Figure 4</i> changed to Optical Network.
3	Amendment in <i>Figure 5</i> : UPS location	<p>The new UPS can have the isolation transformer(s) integrated into it, without increasing its footprint (only height may go up); UPS can be located in the space between the ABR and servo racks -- this has been done in one antenna with the new UPS and can be checked for suitability; final configuration of the UPS can be decided once the load calculations have been refined.</p> <ul style="list-style-type: none"> • Proposed UPS Location will near ABR Rack. <i>See Figure 6: Top of view of GMRT Antenna Base.</i>
4	Discussion – Space availability for the sub-systems being upgraded (OF, FE, and M&C Systems).	<ul style="list-style-type: none"> • All new servo growth to be accommodated in the servo racks (or in-situ replacement of existing units). Similarly, new FPS space requirements can be fulfilled by re-utilizing/replacing the existing FPS space. • Space for FE and OF rack can be availed by moving isolation transformer out of Common-rack or by installation of a new UPS with integrated isolation transformers. • Space requirement for the new M&C/telemetry system can use the space available in the ABR Rack or free space in common-rack.
5	Action – Peak load measurements	<ul style="list-style-type: none"> • Individual team members from each department (mainly Analog and FE/OF Sub-system) need to verify total load measurements given in Table 4. Also measure the peak load current at the antenna base with a help of person from electrical department. • Agreed that peak load requirement (e.g. inrush current) can be balanced out by <u>synchronized delayed switching on of different units</u> -- this is already implemented to some extent at present. New power consumption estimate to be made & final UPS capacity to be matched to it.

Appendix-III : Inrush Current Measurement – Antenna C10

Inrush current measured at the Ador Power UPS o/p using Power analyzer (Fluke make 435 series)

Date	Time	Half Cycle Current A RMS L1 MAX	Half Cycle Current A RMS N MAX
04/08/2014	10:17:34 421msec	3.1	3.1
04/08/2014	10:17:34 671msec	3.1	3.1
04/08/2014	10:17:34 921msec	3.1	3.1
04/08/2014	10:17:35 171msec	3.1	3.1
04/08/2014	10:17:35 421msec	3.1	3.1
04/08/2014	10:17:35 671msec	3.1	3.1
04/08/2014	10:17:35 921msec	3.1	3.1
04/08/2014	10:17:36 171msec	3.1	3.1
04/08/2014	10:17:36 421msec	3.1	3.1
04/08/2014	10:17:36 671msec	3.1	3.1
04/08/2014	10:17:36 921msec	3.1	3.1
04/08/2014	10:17:37 171msec	3.1	3
04/08/2014	10:17:37 421msec	3.1	3.1
04/08/2014	10:17:37 671msec	3.1	3
04/08/2014	10:17:37 921msec	3.1	3.1
04/08/2014	10:17:38 171msec	3.1	3
04/08/2014	10:17:38 421msec	3.1	3
04/08/2014	10:17:38 671msec	3	3
04/08/2014	10:17:38 921msec	3.1	3.1
04/08/2014	10:17:39 171msec	3	3
04/08/2014	10:17:39 421msec	3.1	3.1
04/08/2014	10:17:39 671msec	3	3.1
04/08/2014	10:17:39 921msec	3.1	3.1
04/08/2014	10:17:40 171msec	3.1	3.1
04/08/2014	10:17:40 421msec	3.2	3.1
04/08/2014	10:17:40 671msec	3.1	3.1
04/08/2014	10:17:40 921msec	3.1	3.1
04/08/2014	10:17:41 171msec	3.1	3.1
04/08/2014	10:17:41 421msec	3.1	3.1
04/08/2014	10:17:41 671msec	3.1	3.1
04/08/2014	10:17:41 921msec	3.2	3.1
04/08/2014	10:17:42 171msec	3.1	3.1
04/08/2014	10:17:42 421msec	3.1	3.1
04/08/2014	10:17:42 671msec	3.1	3.1
04/08/2014	10:17:42 921msec	3.1	3.1
04/08/2014	10:17:43 171msec	3.1	3.1
04/08/2014	10:17:43 421msec	3.1	3
04/08/2014	10:17:43 671msec	3	3.1
04/08/2014	10:17:43 921msec	3.1	3.1

04/08/2014	10:17:44 171msec	3.1	3.1
04/08/2014	10:17:44 421msec	3.1	3.1
04/08/2014	10:17:44 671msec	3.1	3
04/08/2014	10:17:44 921msec	1.7	0.6
04/08/2014	10:17:45 171msec	1.1	0.2
04/08/2014	10:17:45 421msec	1.1	0.3
04/08/2014	10:17:45 671msec	0.6	0.3
04/08/2014	10:17:45 921msec	0.4	0.4
04/08/2014	10:17:46 171msec	0.5	0.4
04/08/2014	10:17:46 421msec	0.6	0.4
04/08/2014	10:17:46 671msec	0.5	0.7
04/08/2014	10:17:46 921msec	0.6	0.4
04/08/2014	10:17:47 171msec	0.8	0.1
04/08/2014	10:17:47 421msec	0.7	0.3
04/08/2014	10:17:47 671msec	0.4	1
04/08/2014	10:17:47 921msec	0.6	0.8
04/08/2014	10:17:48 171msec	0.6	0.2
04/08/2014	10:17:48 421msec	0.5	0.2
04/08/2014	10:17:48 671msec	0.4	0.2
04/08/2014	10:17:48 921msec	2.6	0.4
04/08/2014	10:17:49 171msec	1.5	0.4
04/08/2014	10:17:49 421msec	1.6	0.3
04/08/2014	10:17:49 671msec	0.8	0.5
04/08/2014	10:17:49 921msec	0.4	0.5
04/08/2014	10:17:50 171msec	0.2	0.2
04/08/2014	10:17:50 421msec	0.5	0.4
04/08/2014	10:17:50 671msec	0.2	0.3
04/08/2014	10:17:50 921msec	0.4	0.7
04/08/2014	10:17:51 171msec	0.4	0.4
04/08/2014	10:17:51 421msec	0.8	0.6
04/08/2014	10:17:51 671msec	0.6	0.2
04/08/2014	10:17:51 921msec	0.6	0.3
04/08/2014	10:17:52 171msec	0.6	0.7
04/08/2014	10:17:52 421msec	0.7	0.6
04/08/2014	10:17:52 671msec	0.8	0.2
04/08/2014	10:17:52 921msec	0.8	0.4
04/08/2014	10:17:53 171msec	0.9	0.2
04/08/2014	10:17:53 421msec	1	0.4
04/08/2014	10:17:53 671msec	1.3	0.2
04/08/2014	10:17:53 921msec	0.8	0.6
04/08/2014	10:17:54 171msec	0.4	0.2
04/08/2014	10:17:54 421msec	0.4	0.2
04/08/2014	10:17:54 671msec	0.7	0.6
04/08/2014	10:17:54 921msec	0.3	0.6
04/08/2014	10:17:55 171msec	0.4	0.4

**Power
off**

04/08/2014	10:17:55 421msec	1	0.4
04/08/2014	10:17:55 671msec	0.4	0.2
04/08/2014	10:17:55 921msec	0.7	0.7
04/08/2014	10:17:56 171msec	0.7	0.5
04/08/2014	10:17:56 421msec	0.6	0.4
04/08/2014	10:17:56 671msec	0.2	0.4
04/08/2014	10:17:56 921msec	0.8	0.2
04/08/2014	10:17:57 171msec	0.2	0.2
04/08/2014	10:17:57 421msec	0.5	0.2
04/08/2014	10:17:57 671msec	0.8	0.6
04/08/2014	10:17:57 921msec	0.6	0.2
04/08/2014	10:17:58 171msec	0.5	0.3
04/08/2014	10:17:58 421msec	0.8	0.4
04/08/2014	10:17:58 671msec	0.7	0.3
04/08/2014	10:17:58 921msec	0.7	0.4
04/08/2014	10:17:59 171msec	1	0.2
04/08/2014	10:17:59 421msec	1.1	0.5
04/08/2014	10:17:59 671msec	0.6	0.2
04/08/2014	10:17:59 921msec	0.9	0.5
04/08/2014	10:18:00 171msec	0.6	1
04/08/2014	10:18:00 421msec	0.7	0.6
04/08/2014	10:18:00 671msec	0.6	0.4
04/08/2014	10:18:00 921msec	0.7	0.4
04/08/2014	10:18:01 171msec	0.4	0.6
04/08/2014	10:18:01 421msec	0.2	0.6
04/08/2014	10:18:01 671msec	0.5	0.7
04/08/2014	10:18:01 921msec	0.6	0.4
04/08/2014	10:18:02 171msec	0.6	0.5
04/08/2014	10:18:02 421msec	0.4	0.2
04/08/2014	10:18:02 671msec	0.6	0.6
04/08/2014	10:18:02 921msec	0.4	0.3
04/08/2014	10:18:03 171msec	0.7	0.2
04/08/2014	10:18:03 421msec	1	0.4
04/08/2014	10:18:03 671msec	0.8	0.4
04/08/2014	10:18:03 921msec	1.4	0.5
04/08/2014	10:18:04 171msec	0.8	0.4
04/08/2014	10:18:04 421msec	0.7	0.2
04/08/2014	10:18:04 671msec	0.5	0.2
04/08/2014	10:18:04 921msec	0.8	0.4
04/08/2014	10:18:05 171msec	0.3	0.2
04/08/2014	10:18:05 421msec	1	0.2
04/08/2014	10:18:05 671msec	0.7	0.2
04/08/2014	10:18:05 921msec	1.1	0.3
04/08/2014	10:18:06 171msec	0.6	0.2
04/08/2014	10:18:06 421msec	0.9	0.6
04/08/2014	10:18:06 671msec	0.6	0.3
04/08/2014	10:18:06 921msec	0.5	0.5
04/08/2014	10:18:07 171msec	0.7	0.2

04/08/2014	10:18:07 421msec	0.8	0.1
04/08/2014	10:18:07 671msec	0.4	0.4
04/08/2014	10:18:07 921msec	0.5	0.2
04/08/2014	10:18:08 171msec	0.6	0.7
04/08/2014	10:18:08 421msec	0.7	0.6
04/08/2014	10:18:08 671msec	0.6	0.4
04/08/2014	10:18:08 921msec	0.4	0.2
04/08/2014	10:18:09 171msec	0.5	0.2
04/08/2014	10:18:09 421msec	5.8	5.7
04/08/2014	10:18:09 671msec	8.1	7.8
04/08/2014	10:18:09 921msec	6.6	6
04/08/2014	10:18:10 171msec	3.7	3.7
04/08/2014	10:18:10 421msec	3.6	3.6
04/08/2014	10:18:10 671msec	3.6	3.6
04/08/2014	10:18:10 921msec	3.5	3.5
04/08/2014	10:18:11 171msec	3.3	3.3
04/08/2014	10:18:11 421msec	3.4	3.2
04/08/2014	10:18:11 671msec	3.2	3.2
04/08/2014	10:18:11 921msec	3.2	3.2
04/08/2014	10:18:12 171msec	3.1	3.2
04/08/2014	10:18:12 421msec	3.1	3.2
04/08/2014	10:18:12 671msec	3.1	3.1
04/08/2014	10:18:12 921msec	3.2	3.1
04/08/2014	10:18:13 171msec	3.1	3.1
04/08/2014	10:18:13 421msec	3.1	3.1
04/08/2014	10:18:13 671msec	3.1	3.1
04/08/2014	10:18:13 921msec	3.1	3.2
04/08/2014	10:18:14 171msec	3.1	3.1
04/08/2014	10:18:14 421msec	3.1	3.1
04/08/2014	10:18:14 671msec	3.1	3.1
04/08/2014	10:18:14 921msec	3.1	3.1
04/08/2014	10:18:15 171msec	3.1	3.1
04/08/2014	10:18:15 421msec	3.3	3.1
04/08/2014	10:18:15 671msec	3.1	3.1
04/08/2014	10:18:15 921msec	3.1	3.1
04/08/2014	10:18:16 171msec	3.1	3.1
04/08/2014	10:18:16 421msec	3.1	3.1
04/08/2014	10:18:16 671msec	3.1	3.1
04/08/2014	10:18:16 921msec	3.1	3.1
04/08/2014	10:18:17 171msec	3.1	3.1
04/08/2014	10:18:17 421msec	3.2	3.1
04/08/2014	10:18:17 671msec	3.1	3.1
04/08/2014	10:18:17 921msec	3.2	3.2
04/08/2014	10:18:18 171msec	3.1	3.1
04/08/2014	10:18:18 421msec	3.1	3.1

**Power
ON**



04/08/2014	10:18:18 671msec	3.1	3.1
04/08/2014	10:18:18 921msec	3.1	3.1
04/08/2014	10:18:19 171msec	3	3.1
04/08/2014	10:18:19 421msec	3.1	3.1
04/08/2014	10:18:19 671msec	3.2	3.1
04/08/2014	10:18:19 921msec	3.1	3.1