Client : NRF (National Research Foundation)
Project : MeerKAT
Type : Interface Control Document (ICD)

INTERFACE CONTROL DOCUMENT: USER AND MEERKAT INFRASTRUCTURE

Document number M0000-0000-031
Revision ..... D
Classification ..... Company Confidential
Authors ..... C. Gumede
Date ..... 05 November 2015

DOCUMENT APPROVAL

	Name	Designation	Affiliation	Date & Signature
Submitted by	C Gumede	System Engineer: Interfaces	SKA SA	
Accepted by	J.P. Burger	Manager: Time and Frequency Systems	SKA SA	
Accepted by	B. Lunsky	Telescope LAN Systems Engineer	SKA SA	
Accepted by	C. Schollar	USE Engineer	SKA SA	
Approved by	Thomas Abbott	MeerKAT Systems Engineer	SKA SA	

DOCUMENT HISTORY

Revision	Date Of Issue	ECN Number	Comments
A	08 Sep 2015	NA	Initial draft for Review
B	06 October 2015	NA	Updated with info from BL and TA regarding internet access by USE
C	28 October 2015	N/A	Adding additional requirements e.g. RFI, Safety and Logistics
D	05 November 2015	N/A	Updating from OAR

DOCUMENT SOFTWARE

	Package	Version	Filename
Wordprocessor	MsWord	Word 2010	M0000-0000-031 USE and MeerKAT INFRA ICD Rev D.docx

COMPANY DETAILS

Name	SKA SA
Physical/Postal Address	3rd Floor, The Park, Park Road, Pinelands, 7405, South Africa
Tel.	+27 21 506 7300
Fax.	+27 21 506 7375
Website	www.ska.ac.za

Table of Contents:

List of Figures

List of Tables

Acronyms and Abbreviations

AC	Alternating Current
AOC	Active Optical Cables
CAM	Control and Monitoring subsystem
C&M	Control & Monitoring function
CBF	CorrelatorBeamformer subsystem
DMC	Digitiser Master Controller
HVAC	Heating Ventilation Air Conditioning
ICD	Interface Control Document
IRD	Interface Requirement Document
KAPB	Karoo Array Processor Building
LAN	Local Area Network
mm	Millimeter
LRU	Line Replaceable Unit
KDRA	KAPB Data Rack Area
Kg	kilogram
kW	kiloWatt
ODF	Optical Distribution Frame
RFI	Radio Frequency Interference
RTS	Receptor Test System
SE	Systems Engineering
SKA	Square Kilometre Array
SP	Science Processor subsystem
STP	Shielded Twisted Pair
QSFP+	Quad Small Form-factor Pluggable (40GbE)
TFR	Time and Frequency Reference (System group)
ToR	Top of Rack
USE	User Supplied Equipment
IPUSE	Image Plane User Supplied Equipment
PTUSE	Pulsar Timing User Supplied Equipment
PDU	Power Distribution Unit
PTP	Precision Time Protocol
SRU	Shop Replaceable Unit
TUSE	Transient User Supplied Equipment

U	1U is equal to 1.75 inches.
V	Unit to measure voltage

Glossary

Term	Definition
Adaptive Optical Cable	These are high performance cable used for short-range, multi-lane data communication and interconnect applications. It integrates four data lanes in each direction with 40Gb aggregate bandwidth. Each lane can operate at 10.3125Gb/s.
Critical Maintenance	Maintenance resulting in the system not being available for science observations.
International Electrotechnical Commission	An organization responsible for the international standards and conformity assessment for all electrical, electronic and related technologies.
Maser Room	This is separate room in the TFR room within the KAPB screened area (KDRA) that only contains Masers and stabilisation equipment. The room is not normally accessible.
Low Density (L/D)	These are typically racks which are used for servers and processors that have lower power consumption and therefore a low requirement for cooling. A maximum heat dissipation of 5kW per cabinet is specified for the low density cabinets. These cabinets can use the hot-isle/cold-isle cooling mechanism as-is without any hot isle air containment screening.
Medium Density (M/D)	These are racks are typically used for high performance servers for data processing. A heat dissipation of more than 5kW, but less than 8kW is specified for these cabinets. To accommodate the higher heat loads, hot isle air containment screening shall be installed to block off air leakage from the hot isles into the cold isles.
U	It is the standard unit of measure for designating the vertical usable space, or height of racks and cabinets. 1U is equal to 1.75 inches.

USE	USE is a generic name for any user-supplied subsystem which interfaces with the MeerKAT telescope. It can be used alone to describe all such systems, or prefixed with an acronym, for example TUSE, PTUSE, etc, to refer to a specific user.

1 INTRODUCTION

M0000-0000-034
PTUSE – CAM
Control and Monitoring

1.1 BACKGROUND

M0000-0000-033
PTUSE IRD
PTP, NTP

TFR

Approximately 11x19" racks (subsequently referred to as "cabinets") are allocated to the USE subsystems are installed in the KAPB Data Rack Area (KDRA). This installation results in a number of physical interfaces between the USE subsystems, Telescope Segment and Infrastructure segment.

PTUSE

TUSE

SP
(data store)

CBF

This Interface Control Document (ICD) defines these physical interfaces between User Supplied Equipment subsystems and MeerKAT Telescope/Infrastructure segments, specifically the Karoo Array Processing Building (KAPB) Building. The intention is that this document defines the input requirements to the USE design in order to meet the constraints imposed by MeerKAT system in KDRA.

M1000-0001-020
CBF – Consumer
Data products

M0000-0000-035
Science products

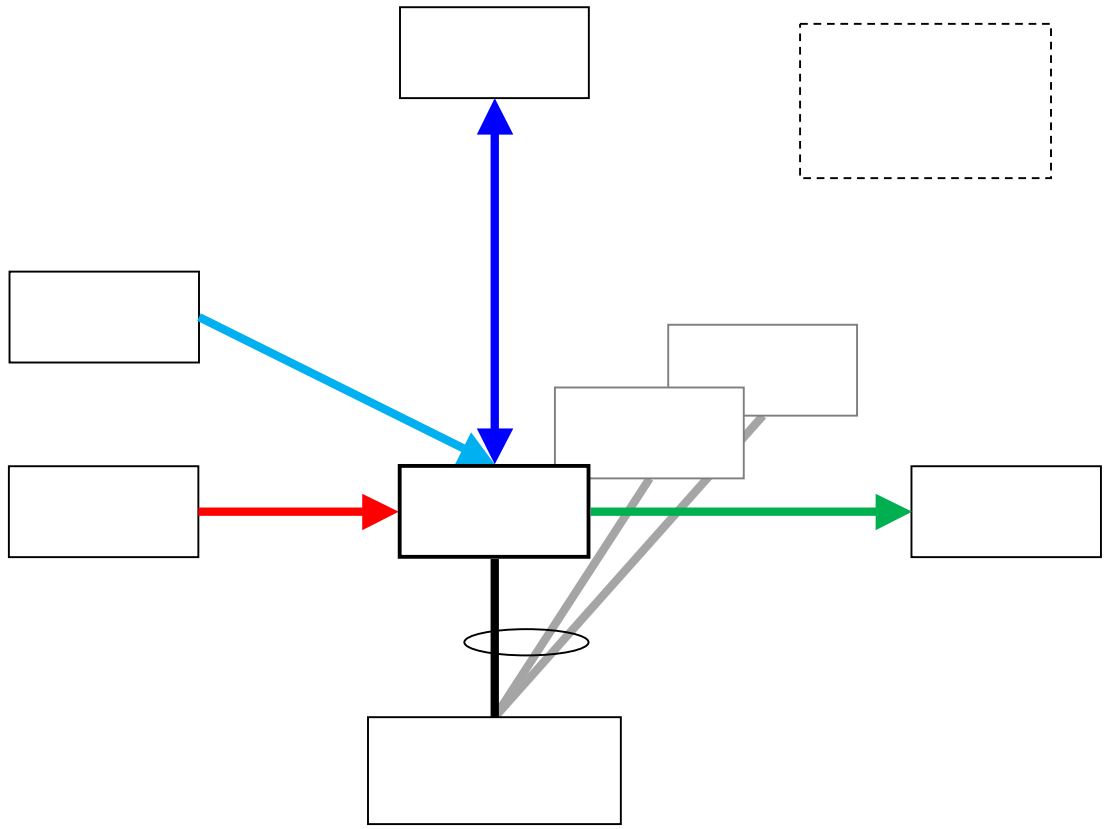
M0000-0000-032
CBF-PTUSE IRD

M0000-0000-031
MeerKAT - USE

MeerKAT
Power, Cooling,
Internet, Rack space

1.2 CONTEXT

The interfaces to the User Supplied Equipment (USE) are defined in several documents, with the major subsystems of MeerKAT. These interfaces are described briefly by the diagram below, to provide some context for the USE.



1.3 SCOPE OF THE DOCUMENT

This ICD describes the interface requirements for where the USE equipment inside the KDRA interfaces with the MeerKAT Infrastructure segment.

This ICD will specify the physical interfaces between the USE and the surrounding MeerKAT/ Infrastructure for the following USE elements:

a. Rack space in the KDRA
b. Power supply to USE
c. Cooling in the KDRA
d. LAN connection
e. TFR Timing signals

1.4 PURPOSE OF THE DOCUMENT

The purpose of this document is to specify the interface between USE and the immediate surrounding Infrastructure and the related boundaries of responsibility.
This document defines the following interfaces between USE and Telescope & infrastructure segments:

a) I.T.M.20.1 PTUSE - User Supplied Equipment cabinets mounting
b) I.T.M.20.2 *TUSE - User Supplied Equipment cabinets mounting*
c) I.T.M.20.3 *IPUSE - User Supplied Equipment cabinets mounting*
d) I.T.C.P.9.1 PTUSE - User Supplied Equipment cabinets power
e) I.T.C.P.9.2 TUSE - User Supplied Equipment cabinets power
f) I.T.C.P.9.3 IPUSE - User Supplied Equipment cabinets power
g) I.T.C.F.18 PTUSE - User Supplied Equipment – Telescope LAN C&M connection
h) I.T.C.F.17 TUSE - User Supplied Equipment – Telescope LAN C&M connection
i) I.T.C.F.8 IPUSE - User Supplied Equipment – Telescope LAN C&M connection
j) I.T.C.F.19 PTUSE - User Supplied Equipment – CBF Raw Science data connection
k) I.T.C.F.21TUSE - User Supplied Equipment – CBF Raw Science data connection
l) I.T.C.F.20 IPUSE - User Supplied Equipment – CBF Raw Science data connection
m) I.T.C.USE - User Supplied Equipment Cooling
n) I.T.TFR.USE - User Supplied Equipment timing signal

2 APPLICABLE AND REFERENCE DOCUMENTS

2.1 APPLICABLE DOCUMENTS:

The following documents are applicable to the extent stated herein. In the event of conflict between the contents of the applicable documents and this document, the applicable documents shall take precedence.

[RD1] C Gumede, M1000-0001-028, Rev3, Interfaces for Telescope Equipment inside the KAPB.

[RD2] B Lunsky, M2400-0000-001, Rev1, Telescope LAN Requirement Specification.

[RD3] SANS 61000-5-2 standard on Electromagnetic Compatibility (EMC)

2.2 REFERENCE DOCUMENTS:

The following documents are referenced in this document. In the event of conflict between the contents of the referenced documents and this document, this document shall take precedence.

[RD4] D. Liebenberg, M0000-0000-023, Rev A, MeerKAT Labelling standard.

[RD5] B. Lunsky, M2400-0000-008 Rev 1, Telescope LAN Design Document

[RD6] C. Gumede, M0000-0000-033 Rev A, PTUSE-TFR Interface Requirement document

[RD7] C. Gumede, M0000-0000-032 Rev A, PTUSE – CBF Interface Requirement document

[RD8] C. Gumede M0000-0000-034 Rev A, PTUSE – CAM Interface Control Document

[RD9] S. Dennehy, M1000-00001-020 Rev 2, CBF – Data Subscriber Interface Control document

[RD10] C. Schollar, M0000-0000-035, Rev A, PTUSE- SP storage interface control document

[RD11] D. Liebernberg, M0000-0000V1-01,Rev 1, MeerKAT System Support Concept

[RD12] T. Kusel, **M0000-0000V1-35**, Rev 1, *MeerKAT Design Description: Safety Requirements Allocation*, 28 June 2011

[RD13] J.Main, SKA SA IT Acceptable Use Policy, Version 1.0, November 2014

3 INTERFACE DESCRIPTION

3.1 Rack installation and space allocation

Error! Reference source not found. provides an overview of the rack's top view layout inside the KDRA. The racks are numbered with a row (A-C) and isle index (1-16) as indicated in **Error! Reference source not found.**. Each row has a total of 16 racks. There are a total 11 x USE racks located in row A and C as shown which are reserved for User Supplied Equipment. There are 6 racks in row A and 5 racks in row C as shown with green highlighted colour on the diagram of Figure 1. Row B is reserved for Correlator-Beamformer racks only. The ODF in row B highlighted in yellow is a small size rack (like a fibre patch panel) and is called optical distribution frame which is used to neatly route fibre cables carrying digitiser data, TFR signals and C&M signals from 64 antennas to different subsystems in the KDRA.

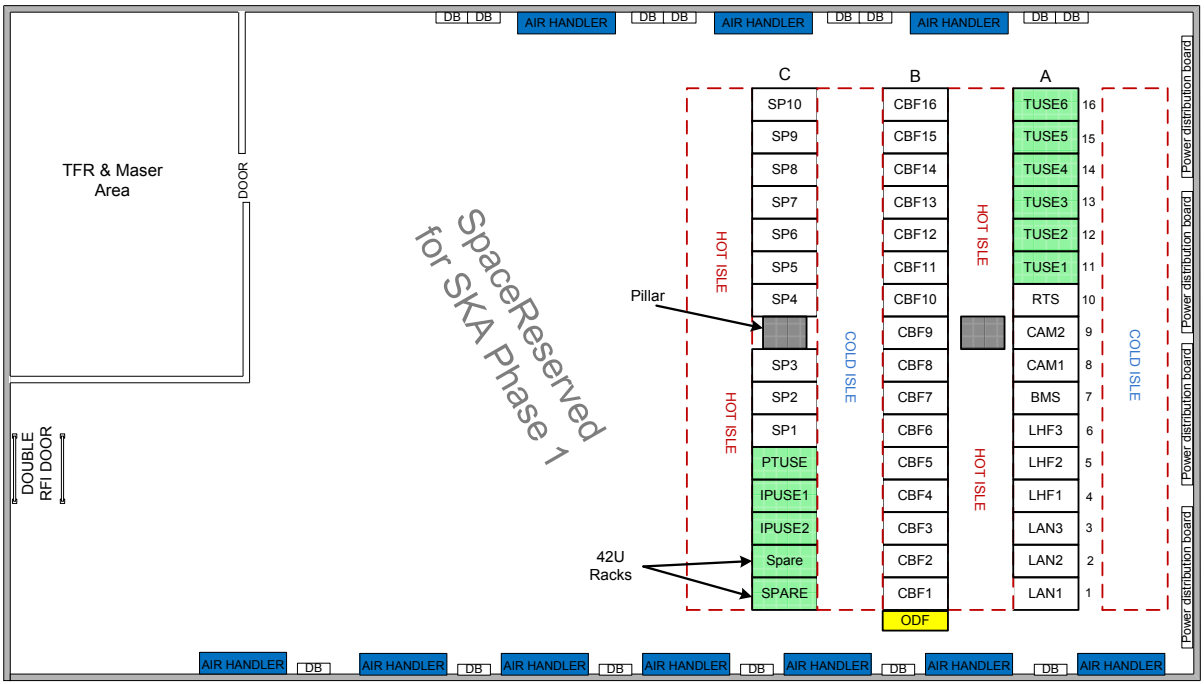


Figure 1: Racks Layout

The MeerKAT racks will be installed at the far end of the KDRA and the remaining space is allocated to SKA Phase 1. ***The mounting of racks is referred to as mechanical interface between USE and MeerKAT and is identify as the position where racks are located with interface numbers (I.T.M.20.1 – I.T.M.20.3) in paragraph 1.4.*** The racks are already installed and mounted in the KDRA in the positions shown in the diagram of Figure 1. The first three rows (A, B &C) are allocated to MeerKAT racks. TUSE racks are allocated in row A while PTUSE and TUSE racks are allocated in row C as per Figure 1.

The racks installed in the KDRA are 42U manufactured by APC, model AR3100 and are

black in colour. The specifications of the racks are further detailed in section 4.1.1. The racks that are installed in the KDRA are as shown in Figure 2.

Figure 2: A Sample of APC rack

Cooling interface description**ERROR! REFERENCE SOURCE NOT FOUND.** below shows a section of the channels in the KDRA illustrating how the racks will be located with respect to the raised floor and the ceiling. The HVAC system is providing cold air from below the floor and the floor tiles for the false floor with ventilation slots.

The heat load capacity of the isles is arranged sequentially as medium density (M/D) and low density (L/D) cabinets.

The raised floor will allow the cold air to flow in from the bottom in the cold isles through the grid tiles in front of each rack. Equipment in the racks will suck cold air from the cold isle and through the equipment to the back of the rack and into hot isle from where it is extracted by the cooling system via the ceiling void.

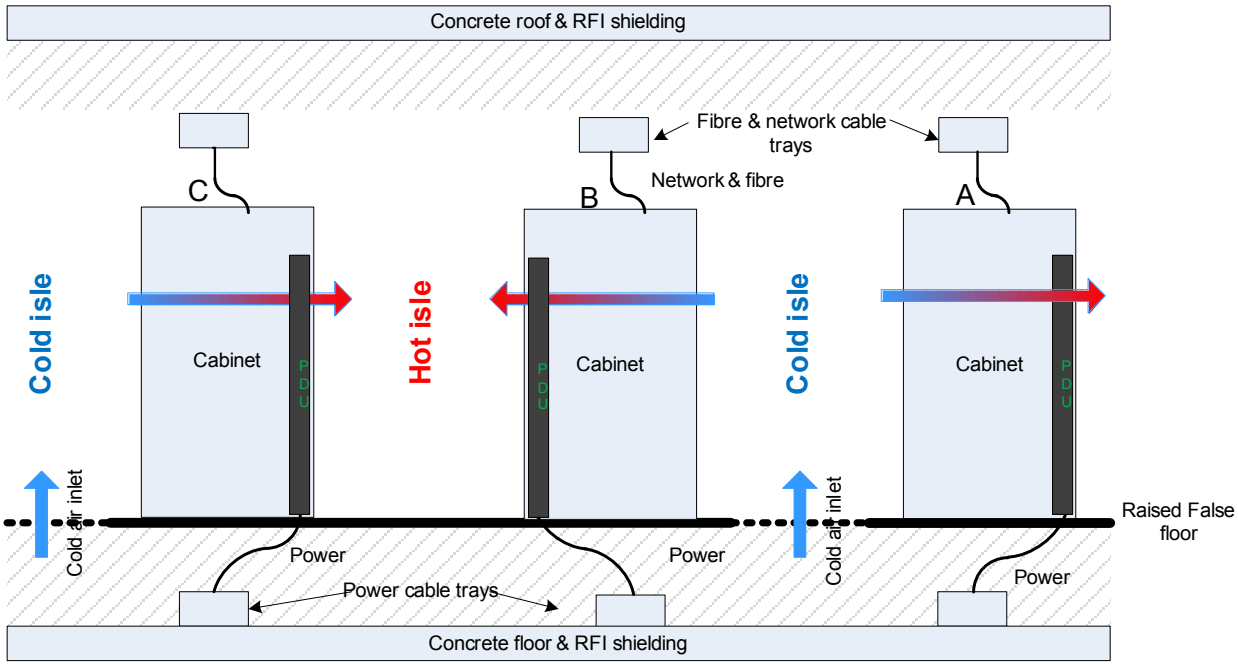


Figure 3: Racks cooling layout

3.2 Power distribution

The installed racks are in rows A-C as shown in the layout of **Error! Reference source not found.** will be supplied with power from the infrastructure under the false floor. This arrangement will allow the provision of dual three phase power (400V-AC) reticulation under the raised floor to each power distribution unit (PDU) installed in each rack as shown in Figure 4. The power provision from infrastructure is in a form of redundant 3-phase buses to allow back up in case one bus fails. There are two power buses under the falls floor and each PDU will be supplied from different 3 phase (400V) bus. The PDU's that were chosen provides a number of outlets to bring power to rack equipment. APC Switched Rack Power Distribution Units (PDUs) enable advanced, user-customizable power control and active monitoring. The PDU allows remote outlet level controls allow power on/off functionality for power recycling to remotely reboot equipment and restrict unauthorized use of individual outlets. These PDU are easily mountable vertically in racks or enclosures and occupies zero-U of valuable rack space, which allows more equipment in the rack. Units that mount vertically are optimized to fit in a AR3100 NetShelter enclosures.

Figure 4: PDU

The PDU will in turn provide single phase (230V-AC) to the servers installed in the racks. Each PDU provides 21xC13 and 3xC19 IEC female connector ports. The 230V AC is provided by a number of IEC C13 connectors to the rack mounted equipment inside the rack. There is choice to have a single PDU or two PDU's on each side at the rear of the rack. The PDUs are controlled by CAM subsystem which allows systems to be safely shut down when needed. The specification of the PDU is discussed in section 0.

3.3 CAM Network layout

USE equipment will be controlled by CAM subsystem like any other subsystem of MeerKAT. Figure 5 shows physical interfaces (LAN connections) between each subsystem and MeerKAT LAN network. The MeerKAT LAN network consists of network cables, network switch and ToR switches. The ToR switches will be located at each USE racks and will be connected via 10Gbase–LR fibre cable to the Telescope LAN switch which is located in rack A9. The MeerKAT C&M network allows different subsystems to communicate over the network as shown in Figure 5. The interface between PTUSE and the CAM subsystem is defined in a different ICD [RD8].

A low cost maintenance switch will also be provided as part of MeerKAT Telescope LAN to all USE racks and will be paid for by USE. This is used to perform remote management of the servers and PDUs sometimes referred to as out of band management. The Telescope Management network will run at 100BASE-T in parallel with the MeerKAT Telescope control network. Telescope LAN subsystem is responsible for all Telescope LAN network equipment including switches, patch panels and cables between switches and MeerKAT Telescope C&M switch (TCM) in rack A9 shown in Figure 1.

LAN cables will consist of fibre, AOC and shielded twisted pair cables in order to reduce RFI. The LAN cables will be routed using cable management system called raceways which is

provide above each rack and will neatly route cables into each rack towards the back.

The cables will be colour coded using MeerKAT colour coding scheme as defined in paragraph 3.3.5.6 of document [RD5]. MeerKAT telescope project is using raceways cable management system to route all cables.

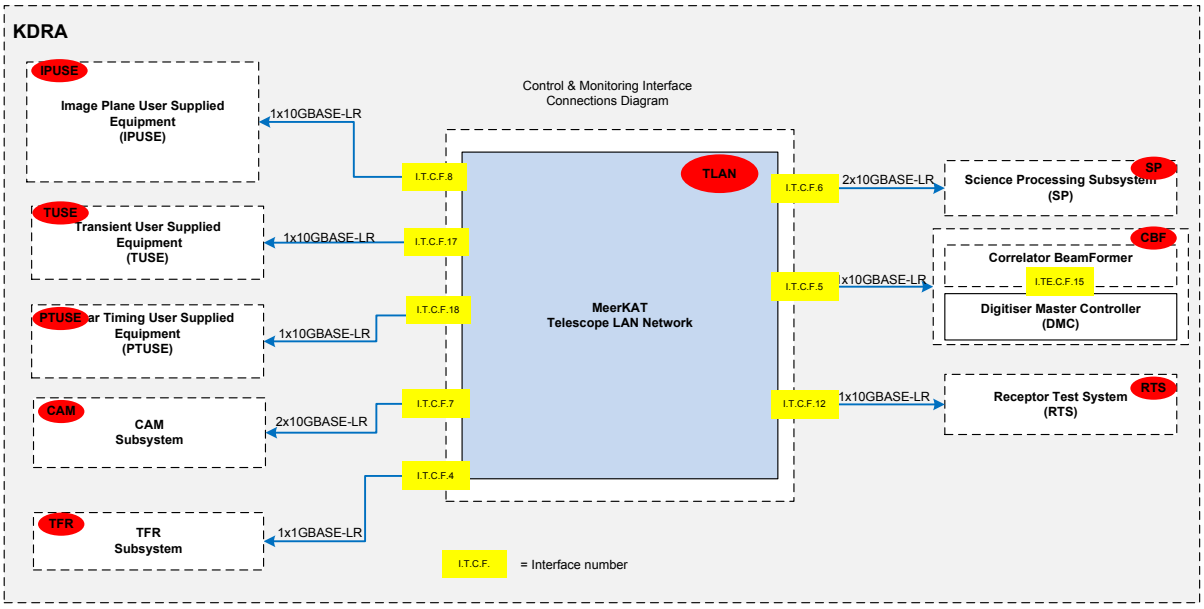


Figure 5: MeerKAT Telescope LAN connections

A simplistic view of the Telescope LAN connection is shown in Figure 5, and this diagram illustrates how the subsystems are interconnected. There are current changes proposed for how the SP subsystem is connected to the Telescope LAN (I.T.C.F.6) and this will be implemented once the engineering change is approved. A Top-of-Rack (ToR) topology is used for the Control and Monitoring network. In this topology, each rack contains a 1U switch (ToR) which is used a getway to the rest of the MeerKAT Telescope LAN network. This “leaf node” switch connects all the equipment inside the cabinet using high-speed, cost-effective copper connections (1000BASE-T suggested) between each device in the rack and the ToR switch. If the subsystem has few ToR switches, it will be through the ToR switch that 10Gbase-LR network link from USE subsystem connects to the Telescope LAN network as shown in Figure 6. If the USE subsystem has many ToR switches, an aggregation switch will be used to connect to a 10Gbase-LR network link to MeerKAT Telescope LAN. MeerKAT will provide network cables between the ToR switch and MeerKAT Telescope C&M switches located in rack A9.

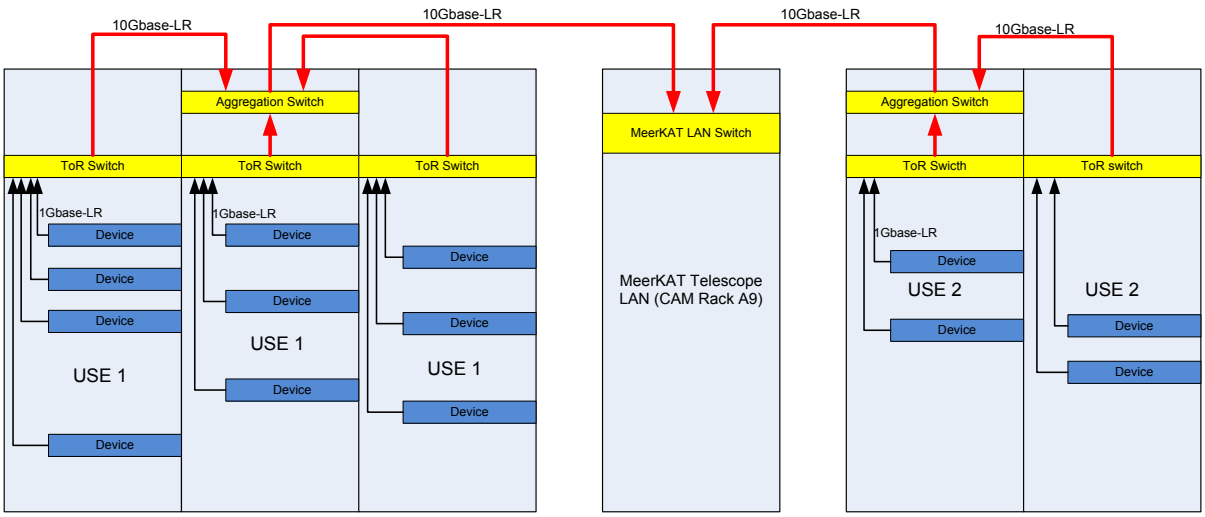


Figure 6: Control and Monitoring topology

Equipment in the USE racks will also need to connect to ToR switches located in the USE racks. This network will be used for control and monitoring of the USE equipment (devices). These switches and associated cables are not part of the MeerKAT system and need to be supplied and installed by the user. It is strongly recommended however that the same model switches and cables are procured and installed by the MeerKAT technical team, to eliminate any risk of incompatibility. The switches will form part of the C&M network and will be managed and configured by the Telescope LAN subsystem as described in [RD8].

USE equipment on site in the KDRA will have free access to internet services via the C&M interface. MeerKAT will provide services such as SSH (port 22), HTTP/s (port 80/443), FTP (port 21), SMTP (port 25) detailed requirements are found in 4.1.4 . Peak Internet rate shall at all times be limited to 100Mbps. Monthly internet rate will be less than 1 Mbps.

All USE users shall comply with SKA Internet Fair Usage Policy in [RD13] at Cape Town offices and in the Karoo.

USE will not be allowed to plug their equipment directly to any other MeerKAT equipment other than that specified in this document.

3.4 RAW Science Data Network

Figure 7 shows subsystems that requires connection in order to transfer raw science data using the signal data network, the interface points and lines of responsibility. The MeerKAT Telescope has decided to use Active Optical Cables (AOC) to transfer data between the CBF subsystems and USE subsystems. The CBF data switch is the point where each

subscriber to the raw science data will interface to the CBF subsystem which is located in row B.

As more users connect to the CBF data switch, the lowest layer of the switch needs to be enlarged to provide additional ports. New ports require new switches themselves, up cables and down cables. The switch hardware must be kept completely homogenous and all parts must be procured and installed through SKA-SA who will use the original supplier.

The data network interface diagram shown below uses AOC and these are connected to QSFP$^+$ connectors of the CBF data switch. The QSFP$^+$ connectors will be used as standard connectors in transmitting raw science data between the CBF and other subscriber of the data in the MeerKAT Telescope system.

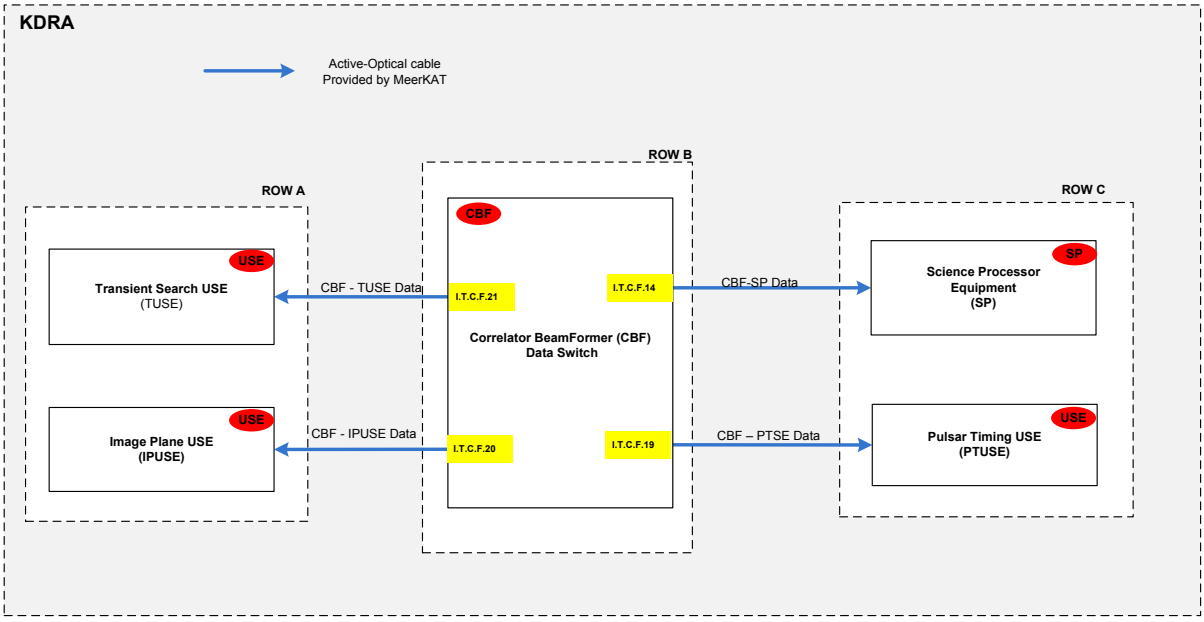


Figure 7: RAW Science Data network

3.5 TFR Interface

Each USE subsystem will receive Precision Time Protocol time signal for synchronisation which is provided by the Time Frequency Reference (TFR) subsystem which is responsible for the distribution of timing signal precision time protocol to the whole MeerKAT Telescope system. Each subsystem will subscribe to the PTP time service which is available on the Telescope C&M LAN network. USE must ensure that the servers are able receive the time signal by running PTP client software. The TFR time signal is time source which all subsystems will subscribe to within Telescope LAN as shown in Figure 5. A TFR functional interface to USE will be defined in a separate document [RD6].

3.6 RFI

Radiated RFI requirements should be verified in a reverberation chamber which is located in the Cape Town office before the equipment is shipped to site. The RFI requirements for User Supplied Equipment are applicable to subsystems that are located inside the KDRA which is RFI shielded enclosure as described in [RD3].

3.7 Logistics, safety, handling

The logistical support concept such as packaging, handling, storage and transportation for equipment that forms part of the MeerKAT system is defined in the document found **Error! Reference source not found.**. A subset of these requirements is applicable to User Supplied Equipment and they will be further described in section 4 of this document. The safety and security of all the equipment which will be deployed is covered in the document [RD12]

4 INTERFACE DEFINITION

4.1 RACKS SPACE ALLOCATION AND POWER

[R.T.P03] The telescope shall provide the necessary power capacity and space in the KAPB building on site for a USE back-end.

The following tables define all the interface requirements between MeerKAT and different User Supplied Equipment. The requirements a guidelines of what is expected from the USE and MeerKAT. Each requirement will then be further verified and the method used for verification is described in section 5 of this document.

4.1.1 Rack space Interface Requirements

Table 1: USE Rack Interface Definition

Req No	Interface Requirement
I.T.M.USE.1	USE equipment shall fit in rack that has the following dimensions: • 1991 x 600 x 1070mm (H x W x D) external dimensions • 42U x 19”x 1000mm internal dimension
I.T.M.USE.2	Racks for USE shall hold up to 1000 kg of equipment including the weight of the rack which is 125 kg on to the false floor.
I.T.M.USE.3	The racks shall be provided with cable management for both copper and fibre to eliminate cable stress and maintain a neat, organized cable layout within a rack.
I.T.M.USE.4	Each USE shall provide at least 2U space on upper level of the racks for mounting the ToR and maintenance switches.
I.T.M.PTUSE.1	Pulsar Timing USE subsystem shall be allocated one (1x42U) rack on row C located at C5 in the KDRA.
I.T.M.PTUSE.2	Pulsar Timing equipment shall use at least 10U space (including network equipment) of the available 42U in a rack provided.
I.T.M.IPUSE.1	Image Plane USE subsystem shall be allocated two (2x42U) racks in row C located as C3 – C4 in the KDRA.
I.T.M.TUSE.1	Transient USE subsystem shall be allocated six (6x42U) racks in row A located as A11 - A16 in the KDRA.

4.1.2 USE Power Interface Definition

Table 2: USE Power Interface definition

Req No	Interface Requirement
I.T.P.USE.1	All USE equipment shall use switched, zero-U power distribution units (PDU) with model AR8981. The cost of the PDU shall be for USE account.
I.T.P.USE.2	USE shall supply power leads between the rack equipment (devices) and the PDU, the connector on one end of the power lead shall conform to IEC C13(male)
I.T.P.USE.3	The power dissipation per rack for USE subsystem shall be 5kW and shall not exceed 8kW.
I.T.P.USE.4	The voltage level for all USE equipment in the racks shall be a nominal of 230V AC with variation of 6%.
I.T.P.USE.5	USE shall have a supply voltage with a frequency regulation of 50 Hz ± 1Hz.
I.T.P.USE.6	Servers with dual power supplies shall be connected to two different PDU's installed in each rack.
I.T.P.USE.7	Power cables in each rack shall be labelled as per [RD4].
I.T.P.PTUSE.1	Pulsar Timing USE subsystem shall be allocated with two PDUs mounted vertically at the back of the rack connected to the two power buses.
I.T.P.TUSE.1	Transient USE shall be allocated two PDUs per rack (total of 12) mounted vertically at the rear of the rack connected to the two power buses.
I.T.P.IPUSE.1	The Image Plane USE subsystem shall be allocated with two PDUs per rack (total of 4) mounted vertically at the rear of the rack connected to the two power buses.

4.1.3 USE cooling Requirements

Table 3: USE Rack Cooling Requirements

Req No	Interface Requirement
I.T.C.USE.1	Cooling shall be supplied to the rack in the KDRA in the form of a hot/cold isle mechanism.
I.T.C.USE.2	The airflow from the HVAC system shall be from front (cold isle) of the rack and exhausted to the back (hot isle).
I.T.C.USE.3	The temperature of air in all areas of the KAPB cold isle sections shall be maintained at a dry bulb temperature between 18°C and 27°C.
I.T.C.USE.4	The maximum heat load per low density rack/cabinet shall be 5kW.
I.T.C.USE.5	The maximum heat load per medium density rack/cabinet shall be 8kW.
I.T.C.USE.6	The humidity of the air in all areas of the KAPB cold isle sections shall have a maximum Relative Humidity of 60% and a maximum dew point temperature of 15°C.

I.T.C.USE.7	The air in all areas of the KAPB cold isle sections shall have a minimum dew point temperature of 5.5°C over the entire dry bulb temperature range.

4.1.4 USE CAM & Data network Requirements

Table 4: USE Network Interface

Req No	Interface Requirement
I.T.CM.USE.1	The MeerKAT Telescope shall provide a network of cable trays above the equipment racks for routing of network cables and raceways for fibre cables and AOC.
I.T.CM.USE.2	USE shall provide devices (servers) with network ports (1GbE) for connecting to the ToR switch used for C&M of USE devices.
I.T.CM.USE.3	USE shall provide maintenance network ports with a speed of at least 100Mbs for connecting each device to the MeerKAT Maintenance network.
I.T.CM.USE.4	All USE users shall comply with SKA Internet Fair Usage Policy (provide link to intranet) at Cape Town offices and in the Karoo.
I.T.CM.USE.5	MeerKAT shall provide internet services, eg. SSH (port 22), HTTP (port 80), FTP (port 21), SMTP (25)
I.T.CM.USE.6	Peak Internet rate shall at all times be limited to 100Mbps and Monthly internet rate shall be less than 1 Mbps
I.T.CM.USE.7	VPN connections shall be provided for access to the Karoo for USE owners not located at Cape Town office.
I.T.CM.USE.8	USE shall be assigned IP addresses in a private range, access will only be possible from the Karoo and Cape Town LAN.
I.T.CM.USE.9	The USE in the Karoo will not be given any external-facing addresses
I.T.CM.USE.10	All network cables in the racks and those leaving the rack shall be labelled as per [M0000-0000-023]
I.T.CBF-PTUSE.1	PTUSE shall use 4x15m of 40Gbps AOC to connect between CBF data switch and PTUSE.
I.T.CBF-PTUSE.2	CBF shall use four (4) QSFP^{+} ports at the CBF data switch in row B for PTUSE.
I.T.CBF-TUSE.1	CBF shall use sixty four (64) QSFP+ ports at the CBF data switch in row B for TUSE.
I.T.CBF-TUSE.2	TUSE shall use 64x15m of 40Gbps AOC to connect between CBF data switch and TUSE.
I.T.CBF-IPUSE.1	CBF shall use four (4) QSFP+ ports at the CBF data switch in row B for IPUSE.
I.T.CBF-IPUSE.2	IPUSE shall use 4x15m of 40Gbps AOC to connect between CBF data switch and IPUSE.
I.T.TFR-USE.1	USE shall use MeerKAT LAN network to receive PTP datagram from TFR for synchronising their time with MeerKAT Telescope system time

4.1.5 RFI Requirements

Table 5: USE RFI Requirements

Req No	Interface Requirement
I.T.RFI.USE.1	Commercial and non-developmental electronic items shall be EMC/RFI certified according to the CISPR 22 standard for Class B devices, or a SKA SA approved equivalent.
I.T.RFI.USE.2	The design shall comply with the blue highlighted sections of the highlighted version of the SANS 61000-5-2 standard on Electromagnetic Compatibility (EMC) as supplied by SKA SA.
I.T.RFI.USE.3	The design shall follow the NRS 083-2 and 083-3 code of practice for the application of Electromagnetic Compatibility standards and guidelines in electricity utility networks.

4.1.6 Logistical requirements, Safety, product marking and handling

Table 6: Logistics Requirements

Req No	Interface Requirement
I.T.LR.USE.1	All LRU's and SRU's with a mass of more than 15 kg shall be designed with integral lifting eyes or other provision for handling.
I.T.LR.USE.2	All LRU's and SRU's shall be packaged in such a way that they can be transported by road, air, rail and sea, in adverse weather conditions, without incurring any damage when handled in the normal robust ways of these transport modes.
I.T.LR.USE.3	Packaging container sizes/colours will be limited to reduce range and cost and shall be standardised for all LRU's and SRU's, i.e. CLIP-LOK containers, and shall preferably be ISO standard sizes. ***(optional)***
I.T.LR.USE.4	Packaging for LRU's and SRU's shall be provided by the supplier of the LRU's and SRU's.
I.T.LR.USE.5	Packaged LRU's and SRU's must have markings securely attached on the outside of the packaging container.
I.T.LR.USE.6	All components and spares of the PTUSE subsystem shall be stored under conditions as defined in "Class 1.1: Weatherprotected, partly temperature-controlled storage locations" of the ETSI EN 300 019-1-1 standard
I.T.LR.USE.7	All component mounted in the racks with connectors shall be labelled to allow identification during installation and maintenance of the equipment.
I.T.LR.USE.8	All wiring harnesses and their connectors shall be labelled to allow identification of the harness/connector while the harness is installed.

I.T.LR.USE.1	Equipment that, when improperly operated or handled, may jeopardise the safety of personnel or result in a hazardous situation, shall be clearly marked to such effect.
I.T.LR.USE.9	Switches and controls used by operators or technical personnel shall have their functions clearly marked in the English language. Product Markings shall be clearly visible during storage and operations.
I.T.LR.USE.10	The PTUSE shall enable the CAM subsystem to power down PTUSE racks.
I.T.LR.USE.11	Goal: PTUSE devices in the KAPB shall automatically shut down when the temperature exceeds a safe operating threshold.
I.T.LR.USE.12	Items shall as far as practically possible, be designed to be locally fail safe, and not rely on external components to operate safely.

5 INTERFACE VERIFICATION

Table 7: Interface Verification

Req No	Requirement	Verification Method	Responsibility
I.T.M.USE.1	USE equipment rack dimensions	Inspection	SKA SA
I.T.M.USE.2	USE rack can hold up to 1000 kg of equipment	Inspection	SKA SA
I.T.M.USE.3	The racks shall be provided with cable management for both copper and fibre	Inspection	SKA SA
I.T.M.USE.4	Each USE provides at least 2U space on upper level of the racks	Inspection	SKA SA
I.T.M.PTUSE.1	PTUSE shall be allocated (1x42U) rack on row A located at C5 in the KDRA.	Inspection	SKA SA
I.T.M.PTUSE.2	PTUSE equipment shall use 10U space in a rack	Inspection	SKA SA
I.T.M.TUSE.1	Transient USE subsystem shall be allocated four (6x42U) racks in row A located as A11 - A16 in the KDRA.	Inspection	SKA SA
I.T.M.IPUSE.1	IPUSE shall be allocated four (2x42U) racks in row C located as C3 – C4 in the KDRA.	Inspection	SKA SA
I.T.P.USE.1	All USE equipment shall use switched, zero-U power distribution units (PDU) with model AR8981.	Inspection	SKA SA
I.T.P.USE.2	USE shall supply power leads between the rack equipment and the PDU with IEC 13 connector	Inspection	SKA SA
I.T.P.USE.3	The power consumption per rack for USE subsystem shall be 5kW and shall not exceed 8kW.	Inspection	SKA SA
I.T.P.USE.4	The voltage level for all USE equipment in the racks shall be a nominal of 230V AC with variation of 6%.	Test	SKA SA
I.T.P.USE.5	USE shall have a supply voltage with a frequency regulation of 50 Hz ± 1Hz.	Test	SKA SA
I.T.P.USE.6	Servers with dual power supplies shall be connected to two different PDU's installed in each rack.	Inspection	SKA SA
I.T.P.USE.7	Power cables in each rack shall be labelled as per [RD4] document.	Inspection	USE
I.T.P.PTUSE.1	Pulsar Timing USE subsystem shall be allocated with two PDUs connected to the two power buses.	Inspection	SKA SA
I.T.P.TUSE.1	Transient USE shall be allocated two PDUs per rack (total of 12) connected to the two power buses.	Inspection	SKA SA
I.T.P.IPUSE.1	The Image Plane USE subsystem shall be allocated with two PDUs per rack (total of 4) connected to the two power buses.	Inspection	SKA SA

I.T.C.USE.1	Cooling shall be supplied to the rack in the KDRA in the form of a hot/cold isle mechanism.	Inspection	SKA SA
I.T.C.USE.2	The airflow from the HVAC system shall be from front (cold isle) of the rack and exhausted to the back (hot isle).	Inspection	SKA SA
I.T.C.USE.3	The temperature of air in all areas of the KAPB cold isle sections shall be maintained at a dry bulb temperature between 18°C and 27°C.	Inspection	SKA SA
I.T.C.USE.4	The maximum heat load per low density rack/cabinet shall be 5kW.	Inspection	USE
I.T.C.USE.5	The maximum heat load per medium density rack/cabinet shall be 8kW.	Inspection	USE
I.T.C.USE.6	The humidity of the air in all areas of the KAPB cold isle sections shall have a maximum Relative Humidity of 60% and a maximum dew point temperature of 15°C	Inspection	SKA SA
I.T.C.USE.7	The air in all areas of the KAPB cold isle sections shall have a minimum dew point temperature of 5.5°C over the entire dry bulb temperature range.	Inspection	SKA SA
I.T.CM.USE.1	The MeerKAT Telescope shall provide a network of cable trays	Inspection	SKA SA
I.T.CM.USE.2	USE shall provide devices (servers) with network ports (1GbE).	Inspection	SKA SA
I.T.CM.USE.3	The MeerKAT Telescope shall provide a network of cable trays above the equipment racks for routing of fibre and network cabling.	Inspection	SKA SA
I.T.CM.USE.4	USE shall provide devices (servers) with network ports (1GbE) for connecting to the ToR switch used for C&M of USE devices.	Inspection	USE
I.T.CM.USE.5	USE shall provide maintenance network ports with a speed of at least 100Mbs	Inspection	USE
I.T.CM.USE.6	VPN connections shall be provided for access to the Karoo for USE owners not located at the Cape Town office	Inspection	SKA SA
I.T.CM.USE.7	USE shall be assigned IP addresses in a private range and specific VLANS with access only possible from Karoo and Cape Town office.	Inspection	SKA SA
I.T.CM.USE.8	MeerKAT shall provide internet services, eg. SSH (port 22), HTTP (port 80), FTP (port 21), SMTP (25)	Demonstrate	SKA SA
I.T.CM.USE.9	Peak Internet rate shall at all times be limited to 100Mbps and Monthly internet rate shall be less than 1 Mbps	Demonstrate	SKA SA
I.T.CM.USE.10	All USE users shall comply with SKA Internet Fair Usage Policy at Cape Town offices and	Inspection	USE

	in the Karoo.		
I.T.CM.USE.11	All network cables in the racks and those leaving the rack shall be labelled as per [RD4]	Inspection	SKA SA
I.T.CM.USE.12	USE shall be assigned IP addresses in a private range, access will only be possible from the Karoo and Cape Town LAN.	Demonstrate	SKA SA
I.T.CM.USE.13	The USE in the Karoo will not be given any external-facing addresses	Demonstrate	SKA SA
I.T.CBF-PTUSE.1	PTUSE shall use 4x15m of 40Gbps AOC to connect between CBF data switch and PTUSE.	Inspection	SKA SA
I.T.CBF-PTUSE.2	PTUSE shall use four (4) QSFP+ ports at the CBF data switch in row B for PTUSE.	Inspection	SKA SA
I.T.CBF-TUSE.1	TUSE shall use sixty four (64) QSFP+ ports at the CBF data switch in row B for TUSE.	Inspection	SKA SA
I.T.CBF-TUSE.2	TUSE shall use 64x15m of 40Gbps AOC to connect between CBF data switch and TUSE.	Inspection	SKA SA
I.T.CBF-IPUSE.1	IPUSE shall use four (4) QSFP+ ports at the CBF data switch in row B for IPUSE.	Inspection	SKA SA
I.T.CBF-IPUSE.2	IPUSE shall use 4x15m of 40Gbps AOC to connect between CBF data switch and IPUSE.	Inspection	SKA SA
I.T.TFR-USE.1	USE shall use MeerKAT Telescope LAN network to receive PTP datagram.	Demonstrate	SKA SA
I.T.RFI.USE.1	Commercial and non-developmental electronic items shall be EMC/RFI certified according to the CISPR 22 standard for Class B devices, or a SKA SA approved equivalent.	Inspection	SKA SA
I.T.RFI.USE.2	The design shall comply with the blue highlighted sections of the highlighted version of the SANS 61000-5-2 standard on Electromagnetic Compatibility (EMC) as Inspection supplied by SKA SA.	Inspection	SKA SA
I.T.RFI.USE.3	The design shall follow the NRS 083-2 and 083-3 code of practice for the application of Electromagnetic Compatibility standards and guidelines in electricity utility networks.	Inspection	SKA SA
I.T.LR.USE.1	All LRU's and SRU's with a mass of more than 15 kg shall be designed with integral lifting eyes or other provision for handling.	Inspection	SKA SA
I.T.LR.USE.2	All LRU's and SRU's shall be packaged in such a way that they can be transported by road, air, rail and sea, in adverse weather conditions, without incurring any damage when handled in the normal robust ways of these transport modes.	Inspection	SKA SA
I.T.LR.USE.3	Packaging container sizes/colours will be	Inspection	SKA SA

	limited to reduce range and cost and shall be standardised for all LRU's and SRU's, i.e. CLIP-LOK containers, and shall preferably be ISO standard sizes. ***(Optional)***		
I.T.LR.USE.4	Packaging for LRU's and SRU's shall be provided by the supplier of the LRU's and SRU's.	Inspection	SKA SA
I.T.LR.USE.5	Packaged LRU's and SRU's must have markings securely attached on the outside of the packaging container.	Inspection	SKA SA
I.T.LR.USE.6	All components and spares of the PTUSE subsystem shall be stored under conditions as defined in "Class 1.1: Weatherprotected, partly temperature-controlled storage locations" of the ETSI EN 300 019-1-1 standard	Inspection	SKA SA
I.T.LR.USE.7	All component mounted in the racks with connectors shall be labelled to allow identification during installation and maintenance of the equipment.	Inspection	SKA SA
I.T.LR.USE.8	All wiring harnesses and their connectors shall be labelled to allow identification of the harness/connector while the harness is installed.	Inspection	SKA SA
I.T.LR.USE.1	Equipment that, when improperly operated or handled, may jeopardise the safety of personnel or result in a hazardous situation, shall be clearly marked to such effect.	Inspection	SKA SA
I.T.LR.USE.9	Switches and controls used by operators or technical personnel shall have their functions clearly marked in the English language. Product Markings shall be clearly visible during storage and operations.	Inspection	SKA SA
I.T.LR.USE.10	The PTUSE shall enable the CAM subsystem to power down PTUSE racks.	Demonstrate	SKA SA
I.T.LR.USE.11	Goal: PTUSE devices in the KAPB shall automatically shut down when the temperature exceeds a safe operating threshold.	Demonstrate	SKA SA
I.T.LR.USE.12	Items shall as far as practically possible, be designed to be locally fail safe, and not rely on external components to operate safely.	Demonstrate	SKA SA