

Synchronization And Timing – Local Monitor and Control (SAT.LMC)

Overview, Architecture & Design, Prototype, Tangonization, Issues

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Overview

Synchronization & Timing – Overview

- Part of Signal and Data Transport (SaDT) Consortium.
- Generates and distributes timing signals to the telescope and checks and synchronizes with Global time.
- Consists of
 - SAT.CLOCKS – Generates PPS signals and reference Frequency
 - SAT.STFR.FRQ – Distributes Frequency signals
 - SAT.STFR.UTC – Distributes Timing signals
- SAT equipment *distributed* – CPF, RPC's, Huts, Shelters and DISH Pedestals.
- SAT a sub-element / system (*not* an element)

Team



(L-R) Rajesh Warange (India), Uli Horn (SA), Samantha Lloyd (UK) and Ralph Braddock(UK)
(Samantha is a Network Security expert, and not a SAT.LMC resource)
(Pic taken LMC at the Harmonization Meeting – February 2016 at Trieste)

Synchronization & Timing LMC – Overview

- Monitor and Control the SAT equipment and some of its functions
- Translate and Relay commands from TM to SAT
- Translate and Relay data from SAT to TM
- 2-tier hierarchical Control system. (1 Central Controller and 3 sub-controllers)
- No computational requirements. Rev. 8 not incorporated.
- All control system traffic of SAT.LMC to and from TM and SAT is facilitated by NSDN.

Synchronization & Timing LMC – Status

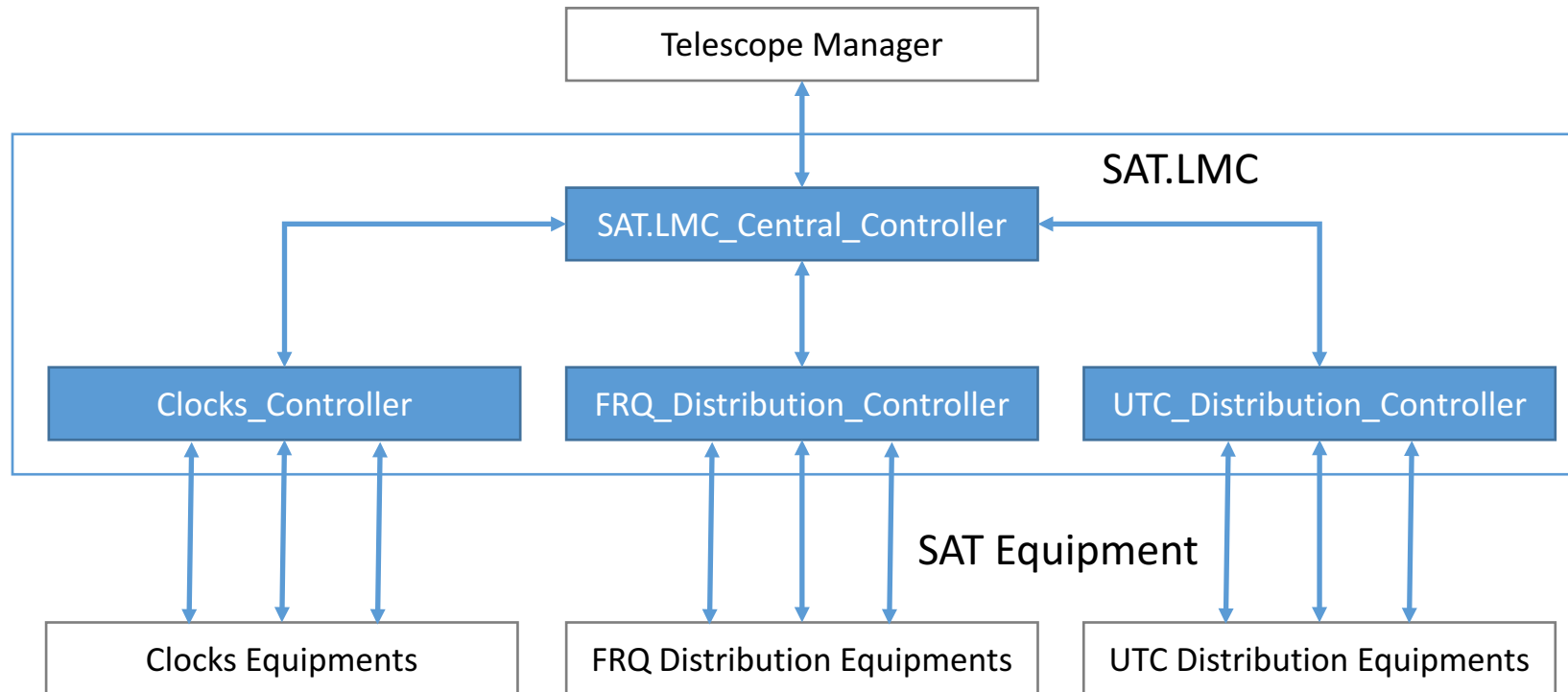
- SAT.LMC L3 and L4 Requirements released
- SAT.LMC – SAT Internal Interface Document at 70%. Will need 3 more updates.
- Prototype – Done by end of 31st August 2016
- SAT.LMC Design baselined with SaDT in April 2016.
- No significant change in DDD from PDR submission.
- Cost Model, INFRA requirements updated as on September 2016.

Design Development Process

- Team consists of 3 team members. All distributed – UK, India and SA.
- SAT.LMC Release Packs released at regular intervals updating *all* (approx. 35 artefacts) artefacts. Pack Releases made on
 - October 2015
 - May 2016
 - December 2016 (planned)
- Iterative process. Enable sharing of consistent information to all stakeholders within the project.
- Use GIT + Bitbucket for repository and version control purposes.
- Use Skype for communications. Meetings on need basis (at least once per week).

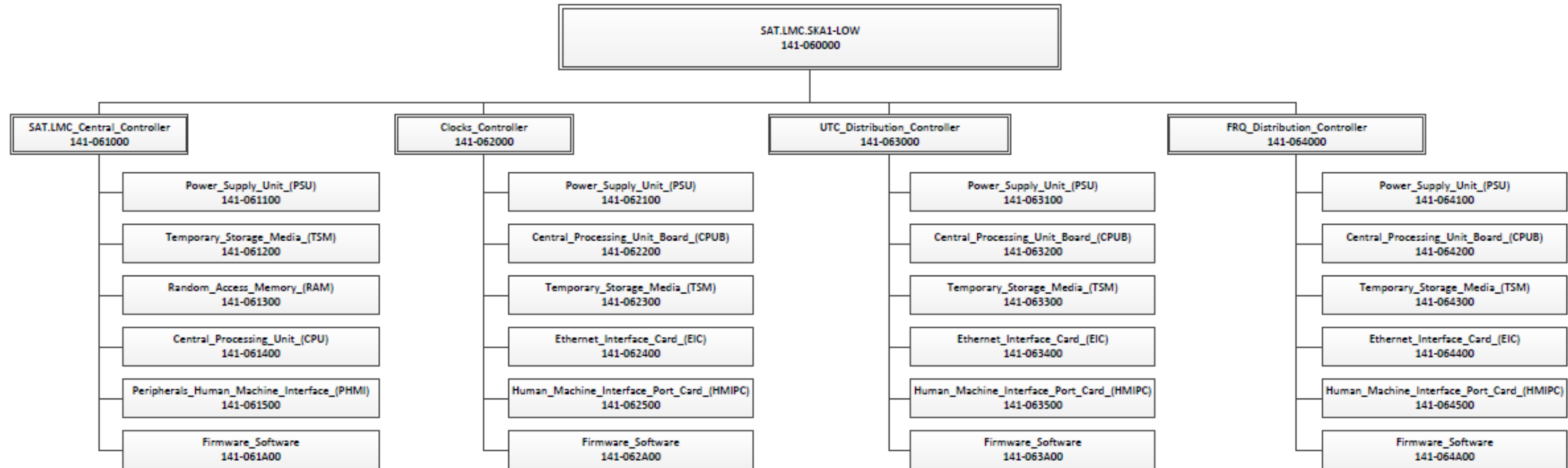
Architecture & Design

Interface Overview



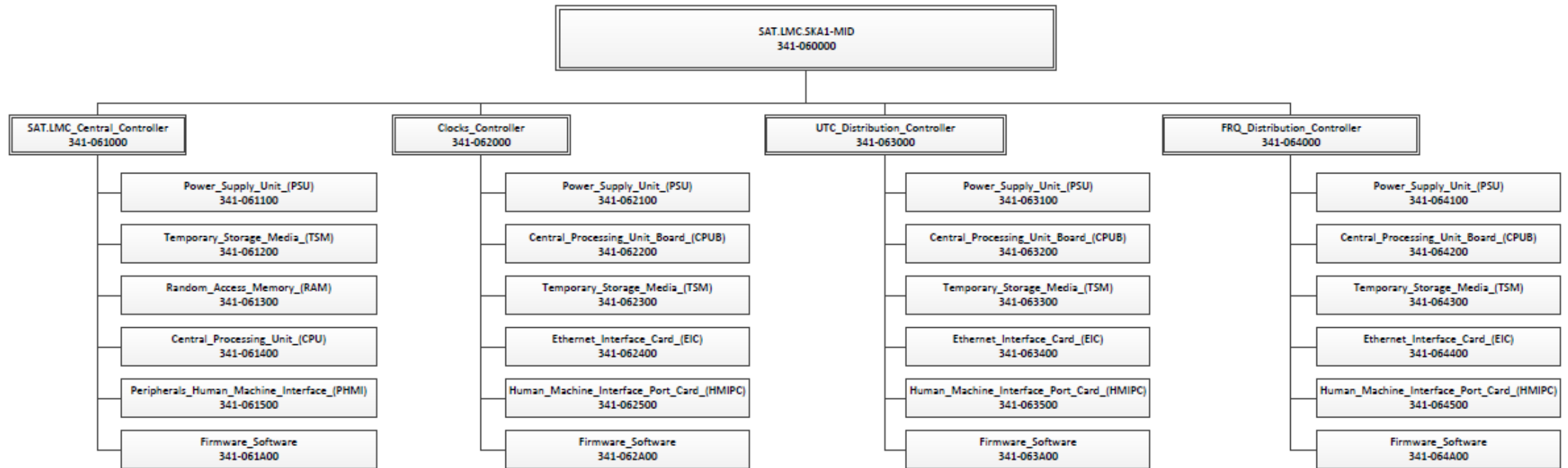
- 2 Tier Hierarchy
- North Bound Interface – Telescope Manager
- South Bound Interface – SAT

Product Breakdown Structure (Low)



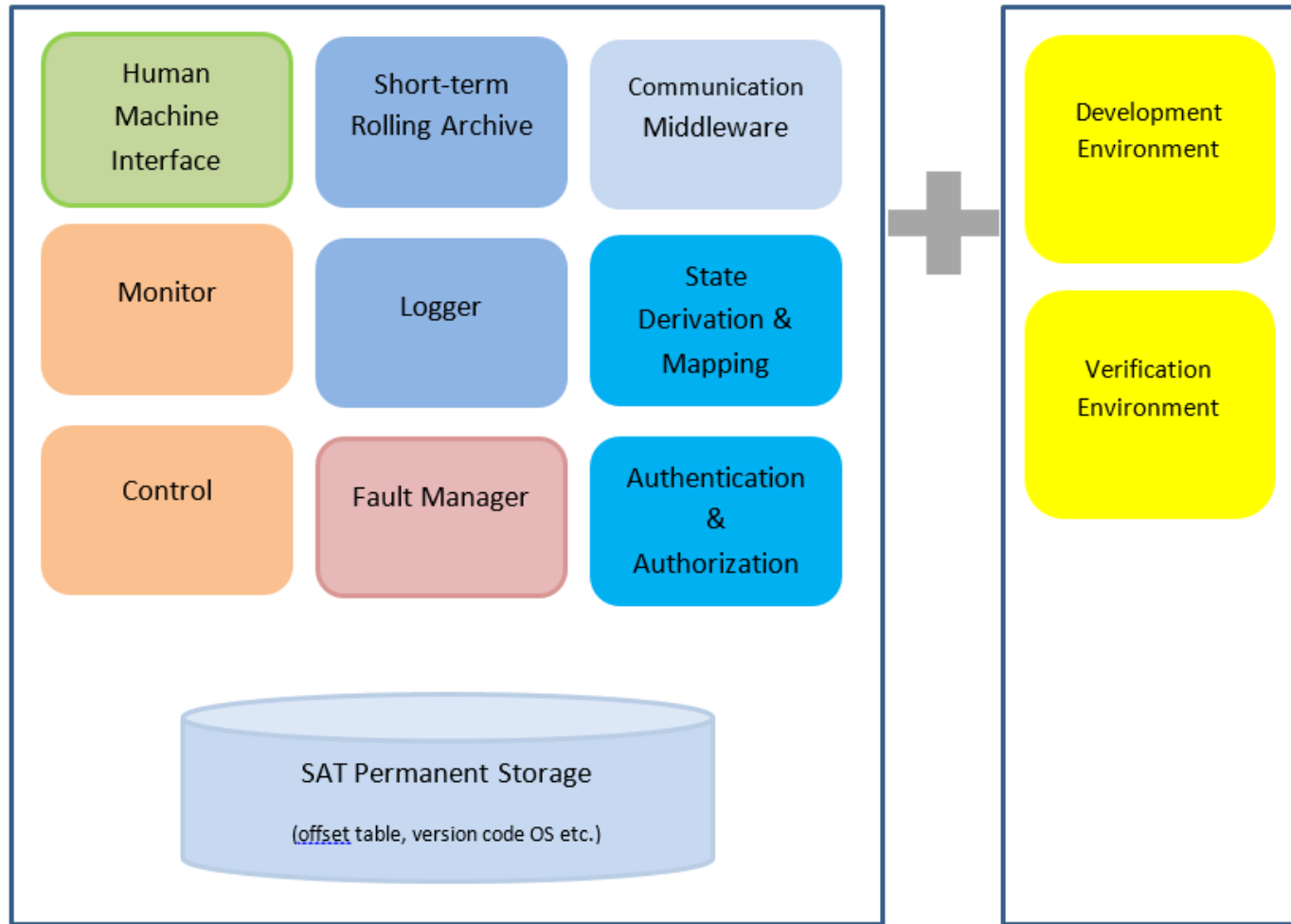
Reference:SKA-TEL-SADT-0000181_DIA_SKA1LowPBS, Rob Gabrielczyk, Issued

Product Breakdown Structure (Mid)



Ref:SKA-TEL-SADT-0000181_DIA_SKA1MidPBS.pdf, Rob Gabrielczyk, Issued

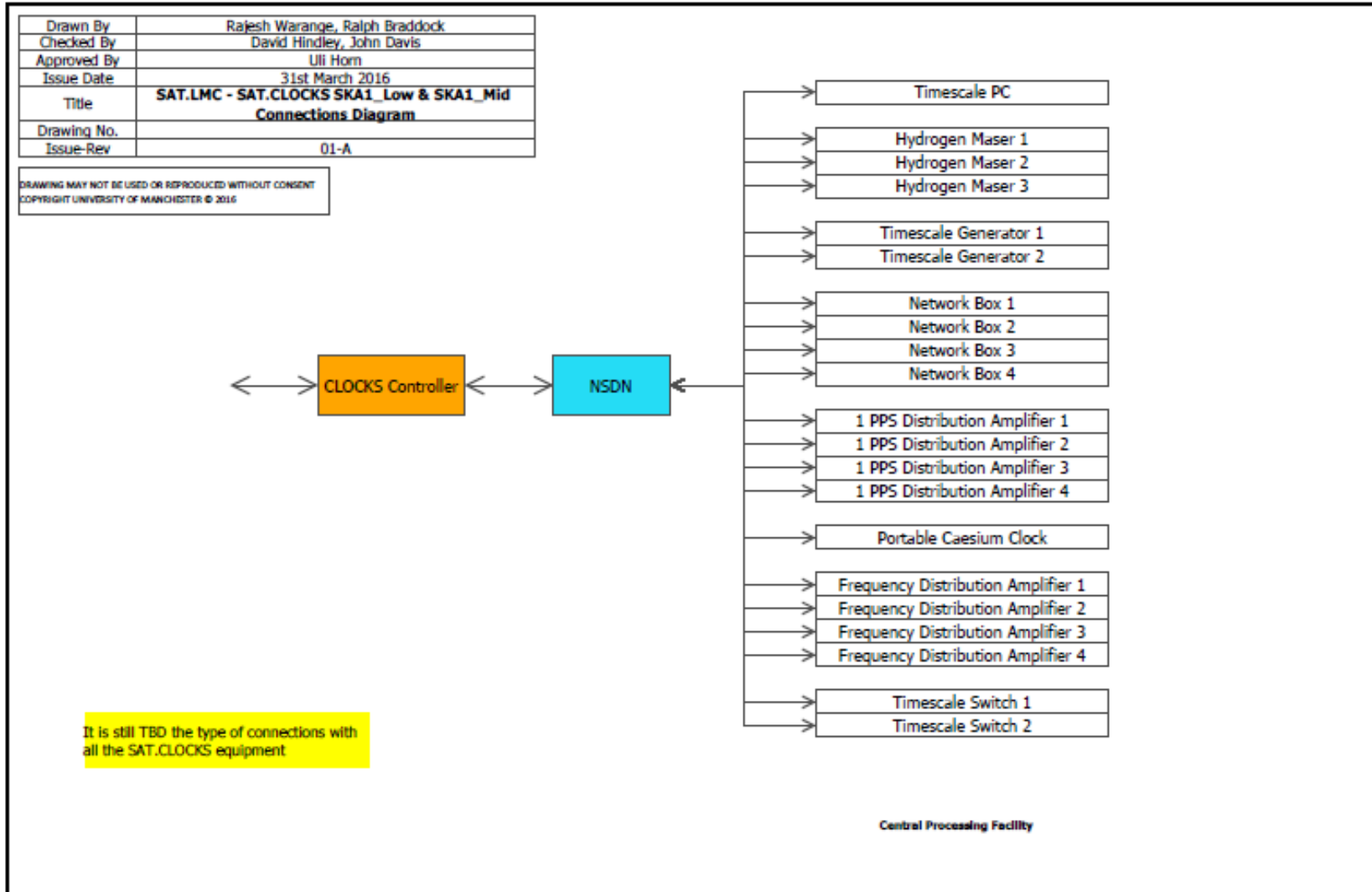
Functional Breakdown Structure



- 12 Modules
- Prototyping helped gather more details on the Verification Environment. (in terms of using Emulators/Simulators).

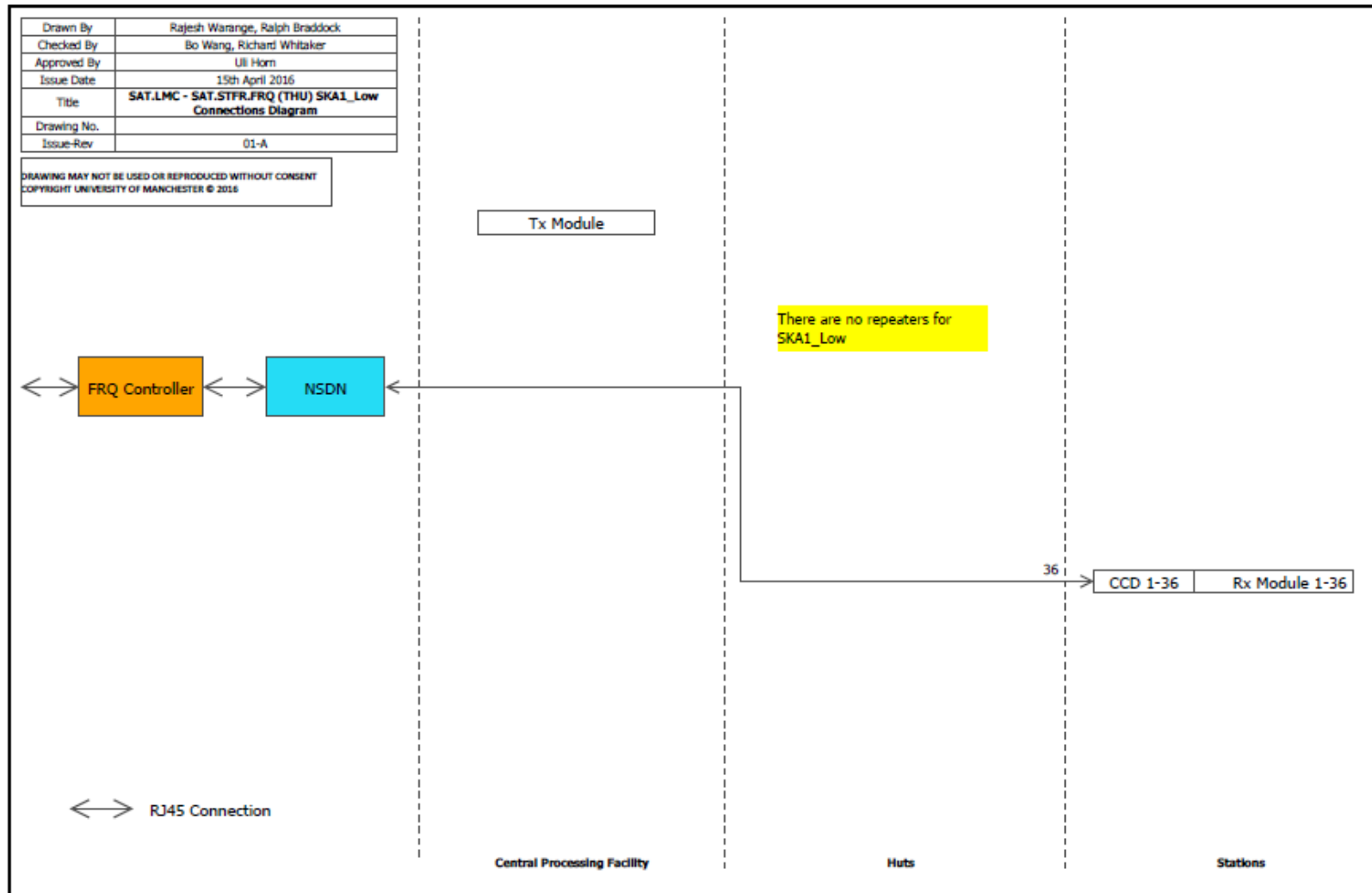
SAT Interfaces

SAT.LMC – SAT.CLOCKS (Low + Mid)



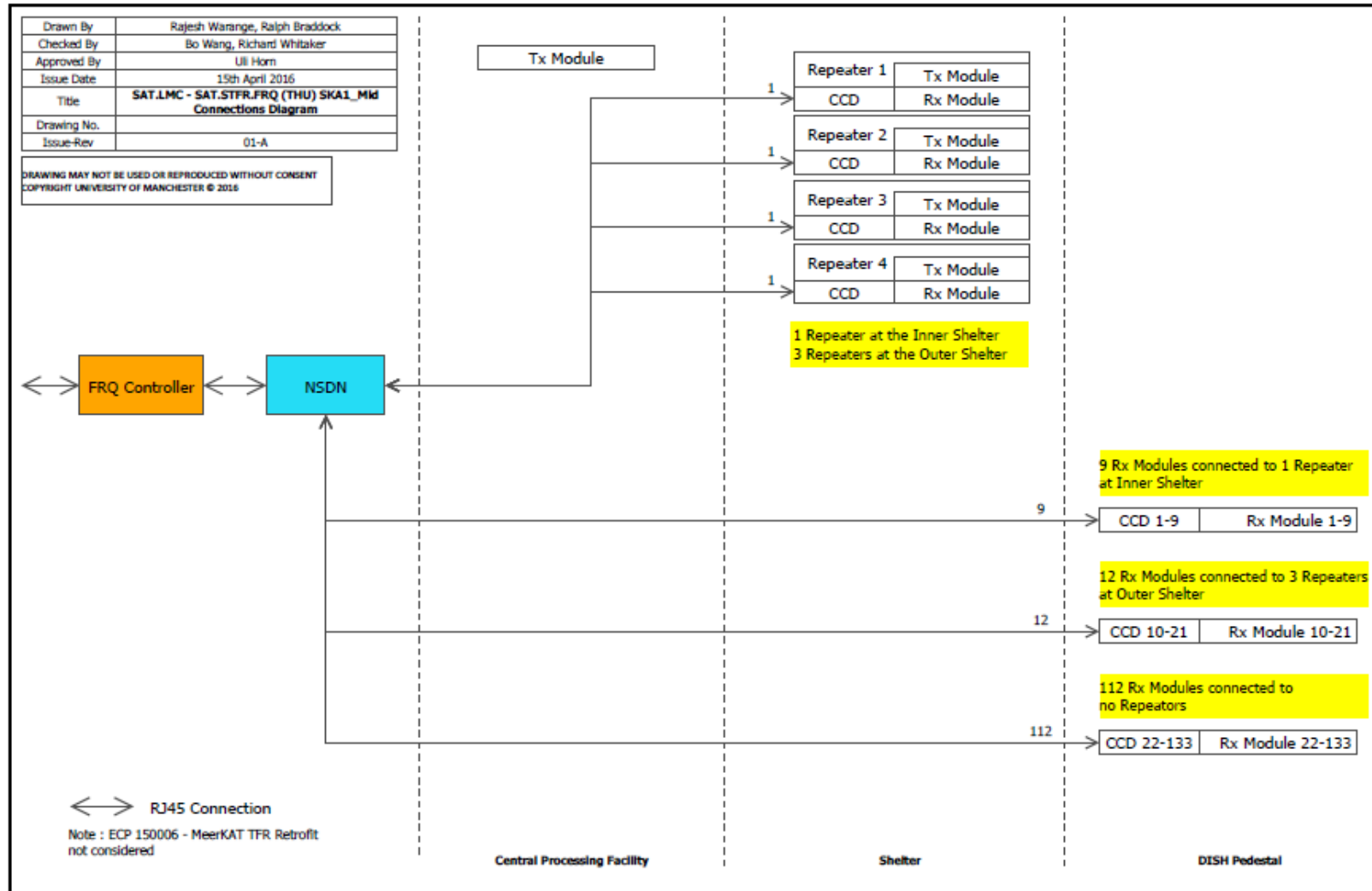
- 8 type of equipment
- 21 physical connections
- All RJ45 (through NSDN)

SAT.LMC – SAT.STFR.FRQ (THU_Low)



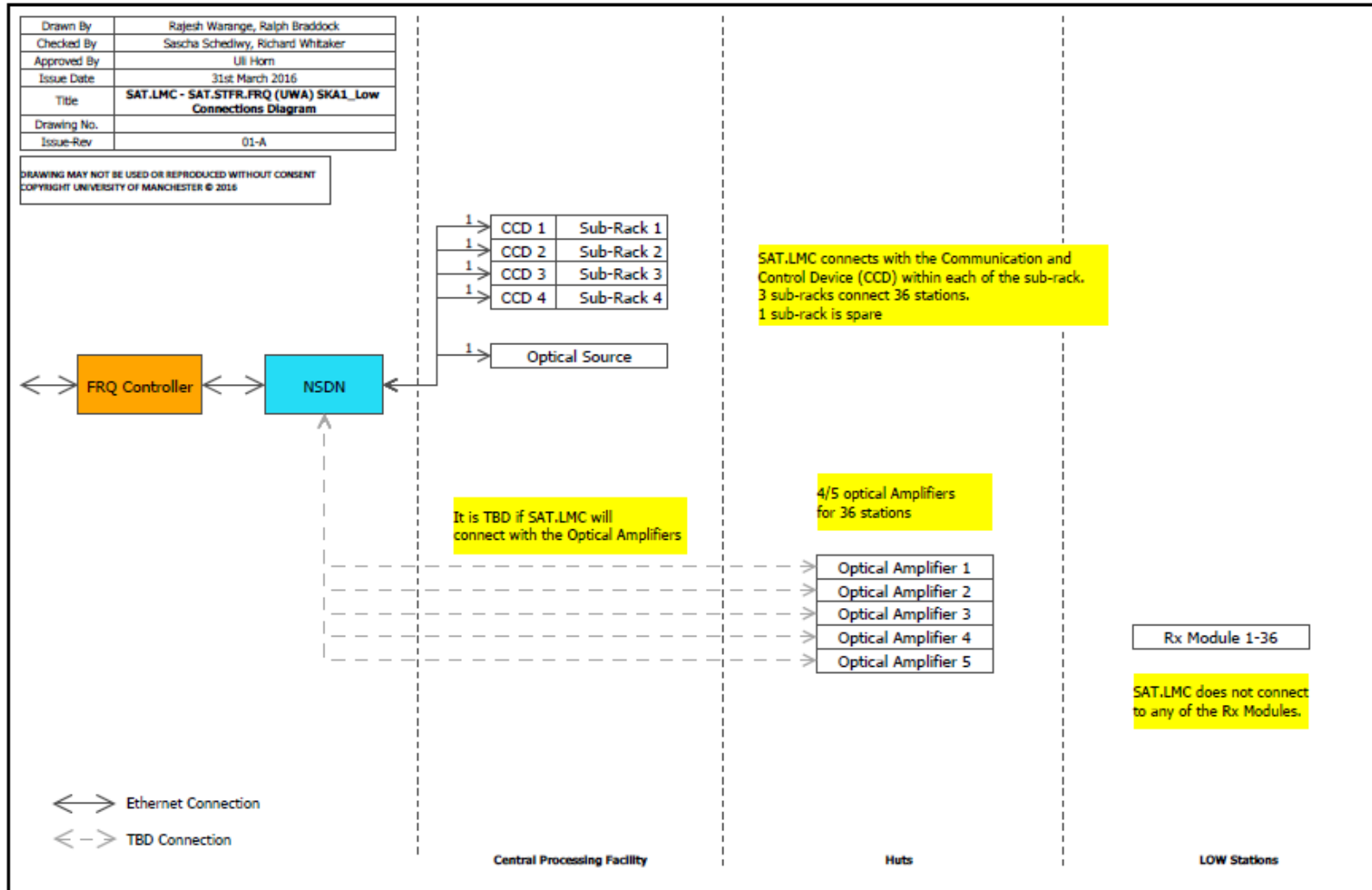
- 1 type of equipment
- 36 physical connections
- All RJ45 (through NSDN)

SAT.LMC – SAT.STFR.FRQ (THU_Mid)



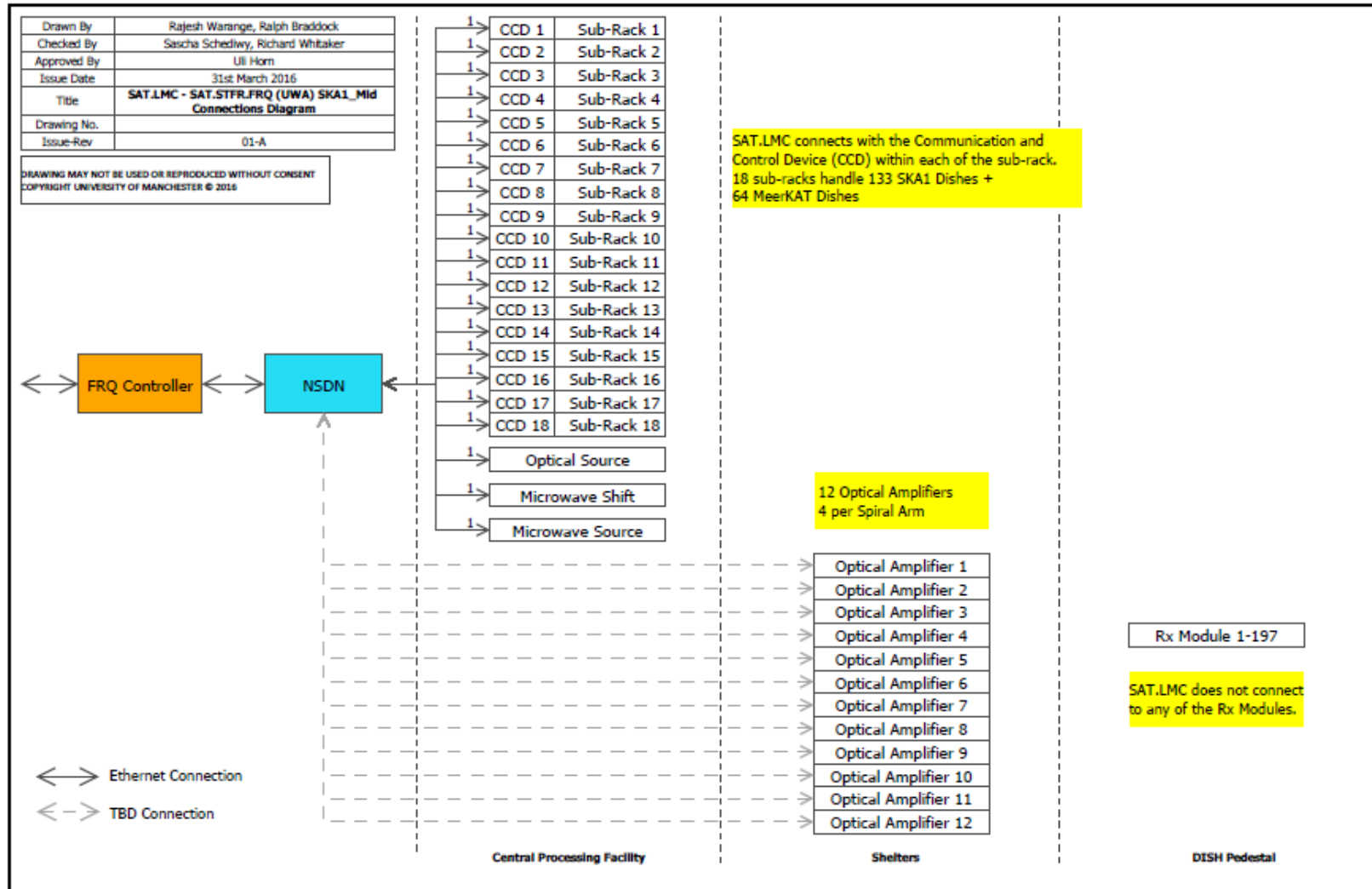
- 1 type of equipment
- 137 physical connections
- All RJ45 (through NSDN)

SAT.LMC – SAT.STFR.FRQ (UWA_Low)



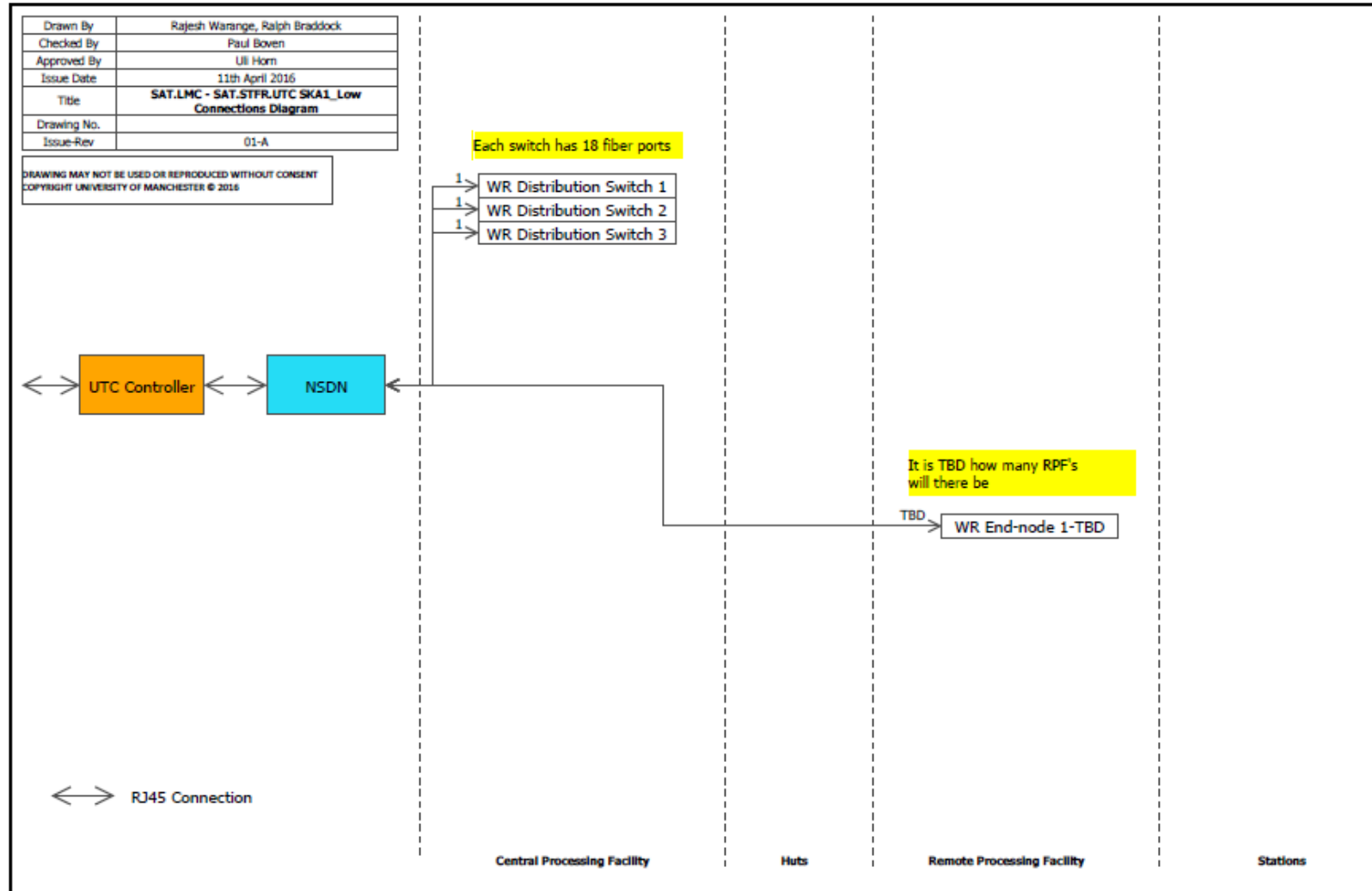
- 2 type of equipment
- 10 physical connections
- All RJ45 (through NSDN)

SAT.LMC – SAT.STFR.FRQ (UWA_Mid)



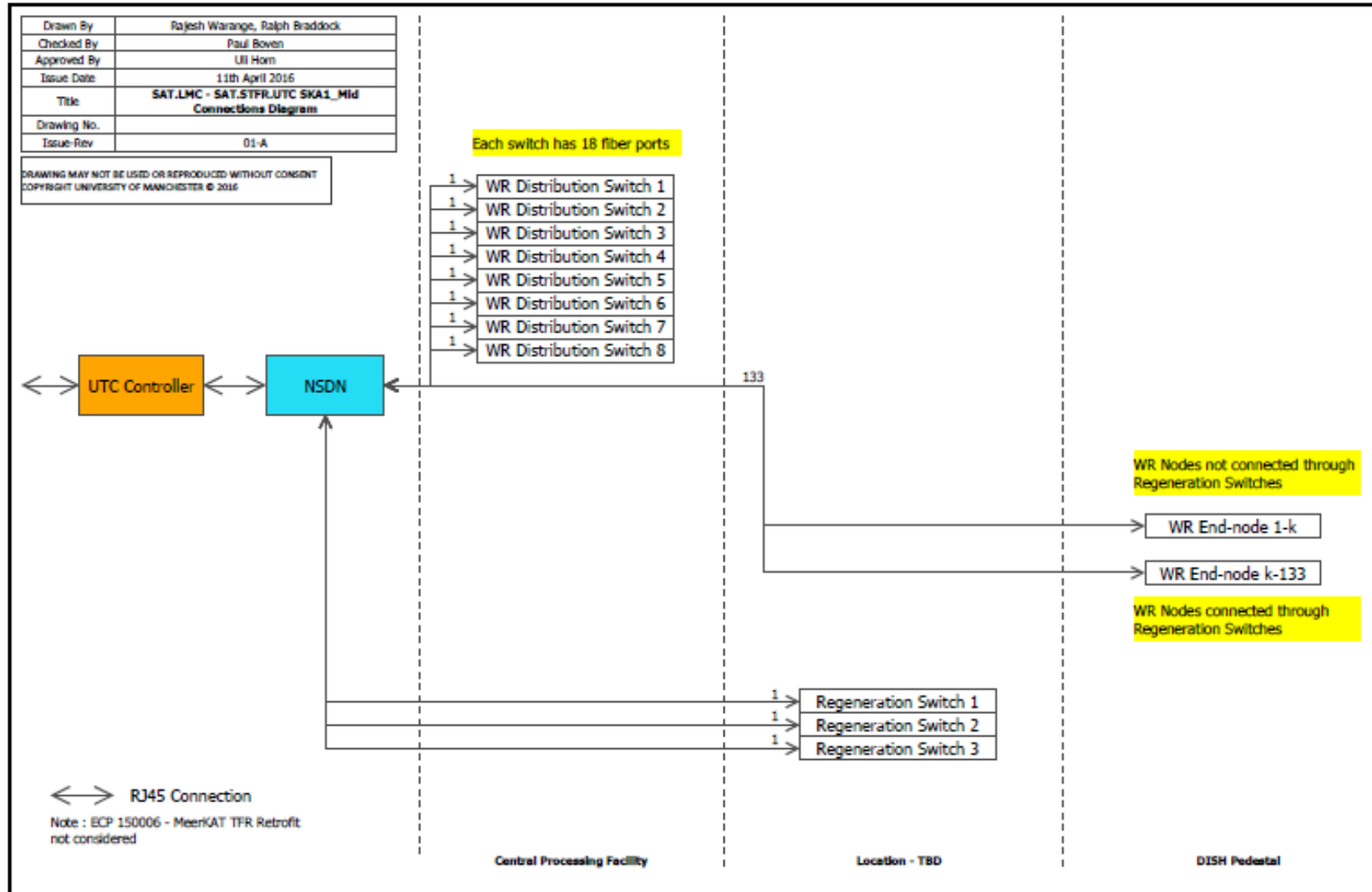
- 4 type of equipment
- 33 physical connections
- All RJ45 (through NSDN)

SAT.LMC – SAT.STFR.UTC (Low)



- 2 type of equipment
- 3+ physical connections
- All RJ45 (through NSDN)

SAT.LMC – SAT.STFR.UTC (Mid)



- 3 type of equipment
- 144 physical connections
- All RJ45 (through NSDN)

Use Cases

- Have a set of 11 SAT.LMC Use Cases across the various functions – Initialization, Setup, Monitor, Control, State Change etc.
- Have 2-3 Use Cases from CLOCKS – Emergency Timescale Switch, Normal Timescale Switch and GNSS Calibration.

SAT.LMC IICD

- IICD 70% (percentage based on remaining iterations/updates. 2 more updates until final revision)
- Spreadsheet (and not .docx) of Interface specifications
- Too many specifications across interfaces - .docx not the right format
- Current IICD has 33 specifications across each interface
- Data as available on April 2016. *Things have changed.*



Prototype

Prototype

- Started February 2016 and ended August 2016
- Prototype Scope and Plan document submitted to SaDT in April 2016.



- Scope included 31 tasks covering SAT Integration, Design Concepts, TANGO Concepts, Hardware Verification and Programming Language
- Prototype Report submitted. Under Review.
- An as intermediate document, a '*TANGO Study*' document was passed on to the Harmonization Group and the TANGO community.
- '*TANGO Study*' submitted to the Harmonization & TANGO community

Prototype Integrations

- Integration worked out with CLOCKS –
 - Issuing commands to Maser at NPL and a Device Server at Manchester University.
 - Pulling files from BIPM (standalone Python program and not TANGO'ing)
 - Integration worked out with the FRQ –
 - Communication & Control Device at Pickmere (e-MERLIN) telescope and TANGO Device Server at Jodrell Bank.
 - Integration worked out with UTC –
 - With the WR Switch
 - With an SNMP Switch (in the absence of WR switch)
 - Emulators / Simulators used / written to test certain integrations.
- (All details in the Prototype Design Report)*

TANGOnization

TANGO Naming Conventions

- Shared a document 'SAT.LMC Device Naming Conventions' during April 2016.
- [facility] domain/family/member needs to have a *location* !! Devices distributed, hence the request for having a location field – cspf, rpf, hut, shelter, Dish pedestal.
- Have a list of all SAT-interfacing Device Servers and its instances. Device Servers based on Equipment-type (input gotten during the Harmonization Meeting at Trieste 2016)

Logging

- 11 Level 4 requirements for Logging
- The following TLS levels planned to be implemented within SAT.LMC –
 - OFF, FATAL, ERROR, WARN, INFO, DEBUG
- SAT logging requirements limit – 1 Hz
- Manufacturer logs to be logged as-is?
- COTS equipment having logs that are accessible in the form of files and not through API?
- Time stamp representation within Logs?

Archiving

- No requirements generated currently.
- No Element Archive necessary (The Central archive and the Element archive sit at the same location, hence the probability of failure is the same).
- Could the rolling archive be called the Element Archive?
- The Central Archive needs to be accessible and available for debugging of SAT equipment.
- Fixed period Sampling V/s Event Based
 - Fixed period sampling for supplying a 'heartbeat' of the remote device. (the polling period needs to be determined to capture required response rate)
 - If the attribute remains constant, an event based archiving is preferred.

Alarms and Events

- Working on Alarm and Event requirements with SAT
 - The FRQ and UTC sub-system could be handled through TANGO
 - CLOCKS dump alarms in a file?
- FRQ has 'spectrum attributes'. Alarm generation through the TANGO control system works on limits applicable to ALL index values (and not specific ones) of the spectrum attribute !!!
- How to TANGOnize alarms from SAT as a whole still to be worked out, especially correlating alarms across all SAT sub-systems.

Human-Machine Interface

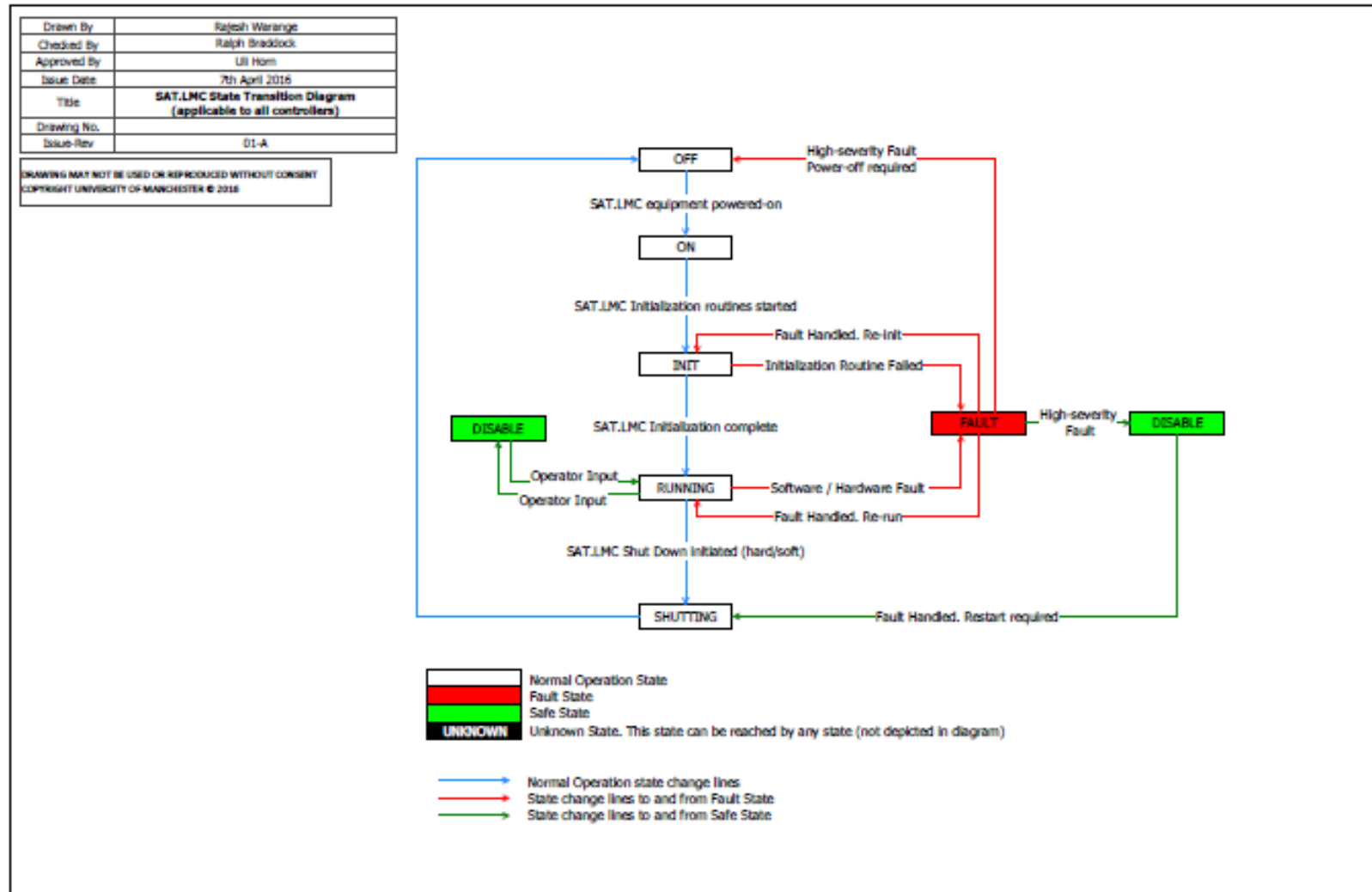
- 12 Level-4 requirements generated.
- SAT.LMC concept User Interface document created. Proposes a 'page-hierarchy' that the operator/TM could/should use to access SAT sub-system data and to issue commands.



Adobe Acrobat
Document

- Does *not* propose any technology.
- Operator interface / Engineering Interface is treated the same way.

States

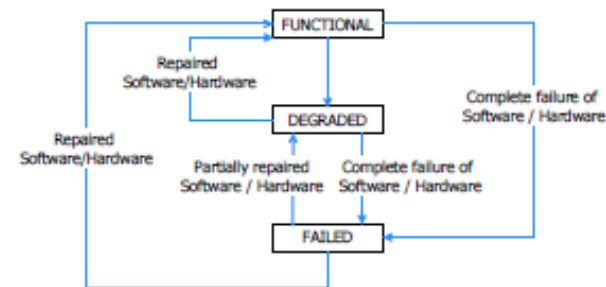


- SAT.LMC State Transitions worked out.
- TANGO side of things – still need to worked out !!

Status

Drawn By	Rajesh Warange
Checked By	Ralph Braddock
Approved By	Ull Horn
Issue Date	7th April 2016
Title	SAT.LMC Status Transition Diagram (applicable to all controllers)
Drawing No.	
Issue Rev	01-A

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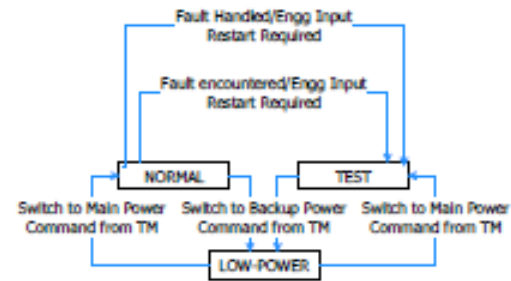


- SAT.LMC Status Transition worked out
- TANGO side of things – still need to worked out !!

Modes

Drawn By	Rajesh Warange
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Title	SAT.LMC Mode Transition Diagram (applicable to all controllers)
Drawing No.	
Issue-Rev	01-A

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- SAT.LMC Modes Transition worked out
- TANGO side of things still need to worked out !!

TODO's

- State, Status and Modes *Mapping*. Working out on getting details from SAT.
- Alarm Management needs working out. List of alarms, use-cases, alarm handling algorithms still need worked out with SAT.
- List of alarms generated from SAT.LMC !!!
- Redundancy not incorporated. Outputs (draft available end of Sept. 2016) of FMECA session to be taken as motivation, given the requirements.
- Hardware currently uses PC104. Need some performance verifications to choose it as final.
- Sub-arrays

Risks and Issues

Risks / Issues

- 2 concepts (Tsinghua University, China and University of Western Australia, Australia) for SAT.STFR.FRQ in progress. Downselect Jan-end. UWA/THU interface design postponed after downselect.
- Certain functional requirements (E. g. deciphering failure of Tx Modules) need assessment if TM should/could contribute and how?
- PUSH/PULL of BIPM Data? TM Role? SAT.LMC Role?
- Need to identify capabilities. Will need TM, SAT, SAT.LMC discussion.
- MeerKAT Maser Integration?
- SAT Calibrations?
- SAT Use Cases?

- ~~SAT Overview (1 slide) – Brief introduction on SAT. (DDD)~~
- ~~SAT.LMC Overview (1 slide) – Brief introduction on SAT.LMC (DDD)~~
- ~~SAT.LMC Design Process (1 slide) – Brief introduction on SAT.LMC Design Process (Rajesh)~~
- ~~SAT.LMC Prototype (1/2 slides) – Major tasks~~
- SAT.LMC Architecture
 - ~~Deployment View (Rajesh) – SAT.LMC controllers (CPF) and the equipment locations (RPF/Dish Pedestal etc.)~~
 - ~~PBS (Rajesh – RGK given)~~
 - FBS (Rajesh - DDD)
 - ~~Interface View (Rajesh – Connection Diagram)~~
 - Software View (Rajesh+Ralph) – 2nd
 - Hardware View (Ralph – DDD) - 2nd
- SAT.LMC Design
 - ~~Alarms (in terms of TANGO) – RB, FRQ – Get values as spectrum attributes. TANGO has a limitation that the range check happens for ‘all’ values and not for individual values. We can solve the problem by putting in IF conditions and then setting up the STATE. CLOCKS – RB. How the TANGO Control System reads the file. UTC – RaW. – 2nd~~
 - ~~HMI (?) – Rajesh (Same as that put into the HMI concept document + Requirements)~~
 - ~~State Management (in terms of TANGO) – We haven’t thought about it~~
 - Monitor Module (in terms of TANGO) – How we are going to implement the TANGO Monitor module. To see how all the other SAT equipment are to be monitored. / FRQ – RB, CLOCKS – RaW, UTC – RB+RaW
 - Control Module (in terms of TANGO) – How we are going to implement the TANGO Control module. To see how all the other SAT equipment are to be controlled / FRQ – RB, CLOCKS – RaW, UTC – RB+RaW
 - Naming Conventions (Devices/Device Servers) – Rajesh (Review Harmonization document and comment.
 - ~~Logging – RB (Concept+Requirements and how SAT.LMC handles it) – 2nd~~
 - ~~Archiving – UH + RaW~~

(Concept + Requirement, How SAT.LMC solves it using TANGO – Hierarchical Diagram of controllers and Device Servers)