

POWER AND SIGNAL DISTRIBUTION PRIMER

For: SKA LOW 2022 Meeting, 2022 February 7

Prepared by: CIRA

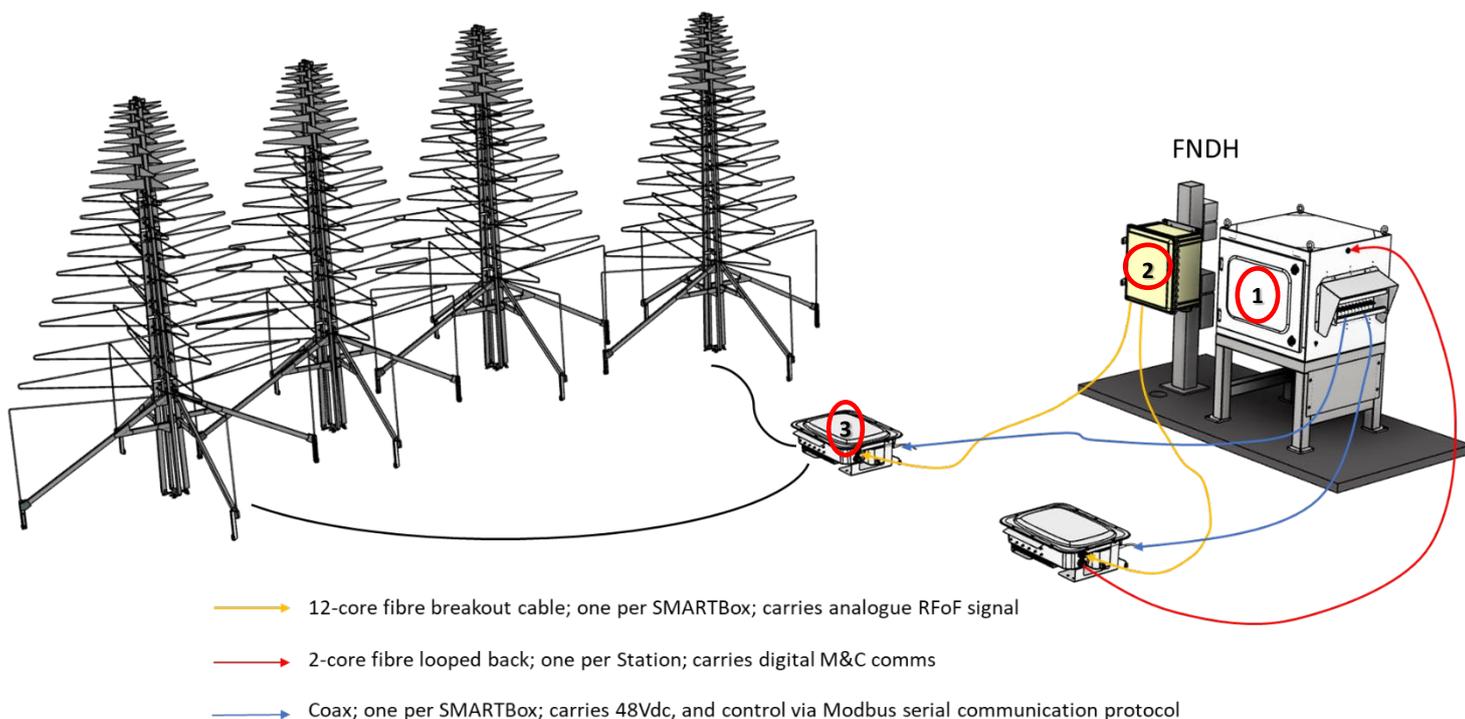
The (Field Station) Power and Signal Distribution (PaSD) system receives power and optical fibre from the site infrastructure and reticulates them to the 256 antennas that represent the primary functional element of the Field Station.

The site infrastructure delivers 230 Vac to each Field Station. The PaSD conditions and distributes this power for utilisation by the antennas and the suite of enabling, supporting, controlling, and monitoring sub-systems that make up the PaSD.

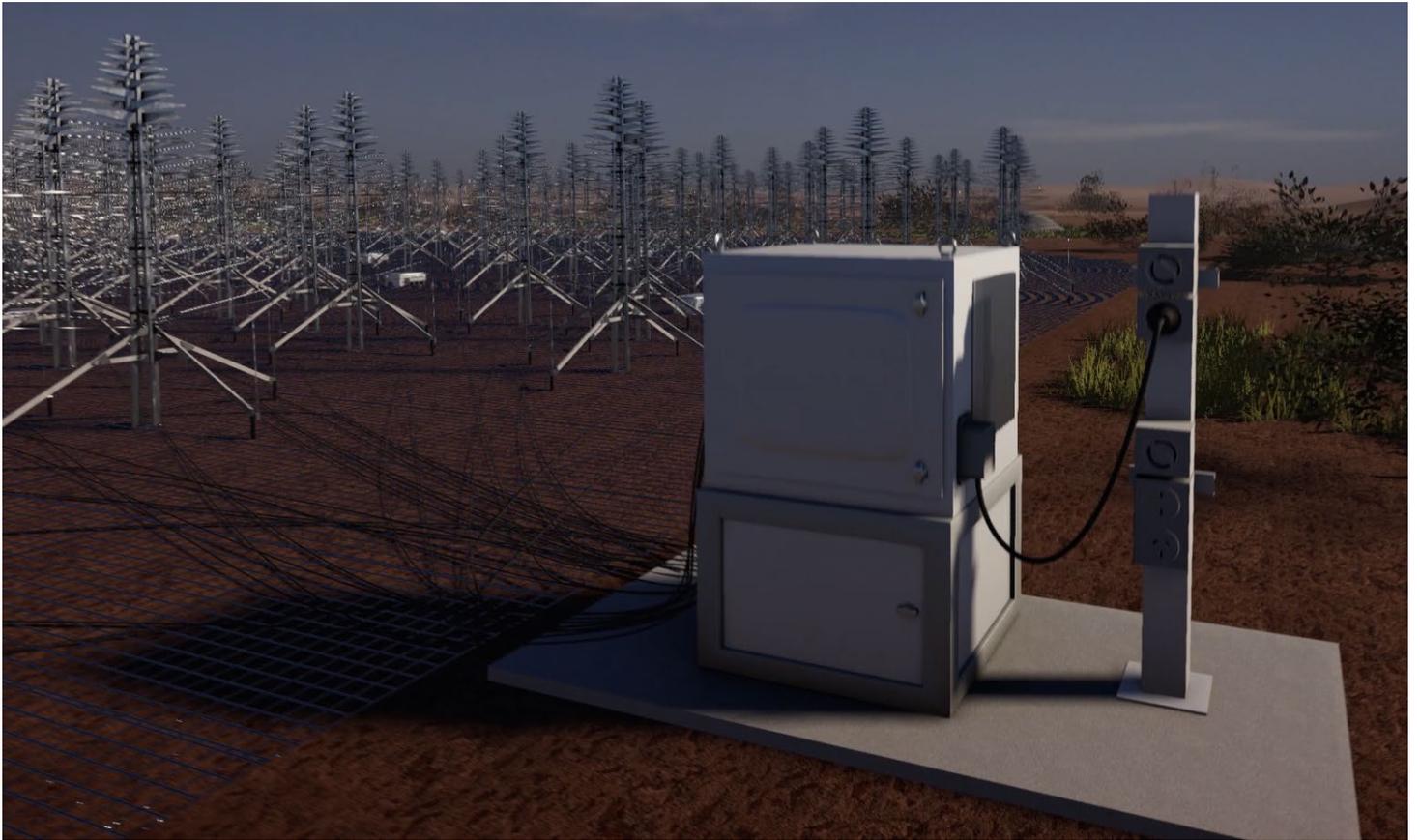
The site infrastructure delivers a 288-core optical Fibre Cable Assembly (FCA) to each Field Station. The 'upstream' end of each FCA is terminated to the Station Signal Processing System (SPS) within the CPF/RPF. The PaSD completes the analogue signal path, from antennas in the field to the SPS, by distributing fibre within the Field Station.

The PaSD system that supports each Field Station includes:

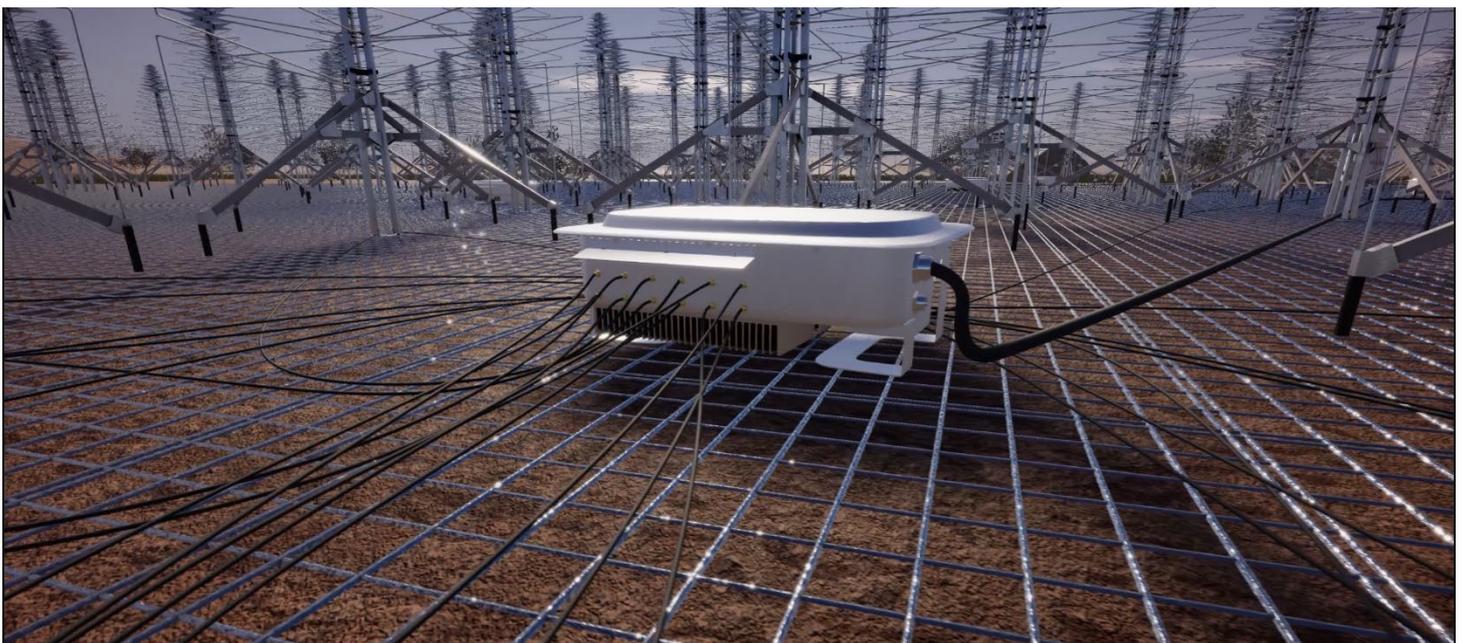
- 1 x Field Node Distribution Hub (FNDH)
- 24 x SMARTBoxes
- Cabling: optical fibre and coax interconnects between FNDH and SMARTBoxes



The FNDH (pictured below) is the interface point between an individual station power and signal distribution, and the whole array power and fibre reticulation. The FNDH is positioned ~3m from the circumference of the steel mesh Ground Plane that defines the physical extend of the Field Station.



Each SMARTBox (pictured below) receives the analogue signal from (up to) 12 antennas; converts the signal to an optical RF-over-fibre signal; and transmits the signal to the FNDH for wider distribution. The SMARTbox also controls the power being supplied to the antennas.



PaSD Principal Sub-systems:

Power and Signal Distribution (PaSD)

The intra-node power and fibre distribution implementation, including QTY1 Field Node Distribution Hub, QTY24 SMART Boxes and the components required to connect them to the site power and fibre infrastructure.

Field Node Distribution Hub (FNDH)

Breaks out and distributes power and fibre from the single point of delivery adjacent to each Field Node to the QTY24 SMART Boxes.

FNDH Electronics Package (EP)	1	Contains all components that handle power, monitoring and control within the FNDH. This package is housed in a single EMC and weather-proof enclosure.
FNDH Power Module	4	Receives 230Vac and outputs filtered 48Vdc and 5Vdc. Also accepts control inputs and provides status outputs for the 48Vdc PSU. Note the 5Vdc supply is “always on” while mains power is present.
FNDH Monitoring and Control Module (MCM)	5	Comprised of the Communications Gateway (below), Control Board and QTY28 PDoC boards. This module enables the measurement and communication of various system health parameters in the FNDH and can also turn ON/OFF individual SMART Boxes under MCCS control.
FNDH Communications Gateway	6	Second level EMI/RFI shielded enclosure containing electronics which convert digital signals from two incoming fibres first to copper Ethernet and then to low-speed serial for M&C data communication to the FNDH and SMART Boxes.
FNDH Fibre Package (FP)	2	The entire system for interconnecting the incoming 288-core Fibre Cable Assembly and the QTY24 12-core Field Node Breakout Cables (FNBC) distributed to the SMART Boxes.
SMART Box	3	
The power and communications aggregation point for (up to) QTY12 antennas. The SMART Box reticulates power to and provides health monitoring of each Antenna via the associated FEM. Implemented as two enclosures that interface to each other, the Electronics Package and the FEM Package.		
SMART Box Electronics Package (EP)	7	Small EMC enclosure containing all power and M&C electronics for the SMART Box. Consists of the PDoC, PSU and MCU and a filter/connector board.
SMART Box Power and Data over Coax (PDoC)		Interfaces to a corresponding PDoC in the FNDH via coaxial cable which carries 48Vdc and low-rate control and telemetry data between the FNDH and SMART Box MCU.
SMART Box Power Supply Unit (PSU)		Receives 48Vdc from the SMART Box PDoC and converts to nominal 4.6Vdc to power the MCU and FEMs
SMART Box Microcontroller Unit (MCU)		Receives data from SMART Box PDoC and power from the SMART Box PSU, controls ON/OFF power to individual antennas via the FEM, returns FEM/Antenna health data to MCCS.
SMART Box Filter and Connector Board		Applies heavy filtering to all power and control signals leaving the SMART Box EP Enclosure to minimise interference with the FEMs in the FEM package.
SMART Box Electronics Package Enclosure		Metallic enclosure for the SMART Box Electronics Package designed specifically for high EMC/RFI isolation as well as weather proofing.

SMART Box FEM Package**8**

The equipment consisting of the FEM Package Enclosure and installed FEMs and supporting electronics that constitutes the system to convert antenna signals from QTY12 Antennas from electrical to optical analog signals.

SMART Box FEM Package Enclosure

Enclosure containing QTY12 FEMs. Implemented to minimise and stabilise internal temperature which in turn ensures optimal FEM function. Accepts the Field Node Breakout Cable (FNBC) from the FNDH.

SMART Box Front End Modules (FEMs)**9**

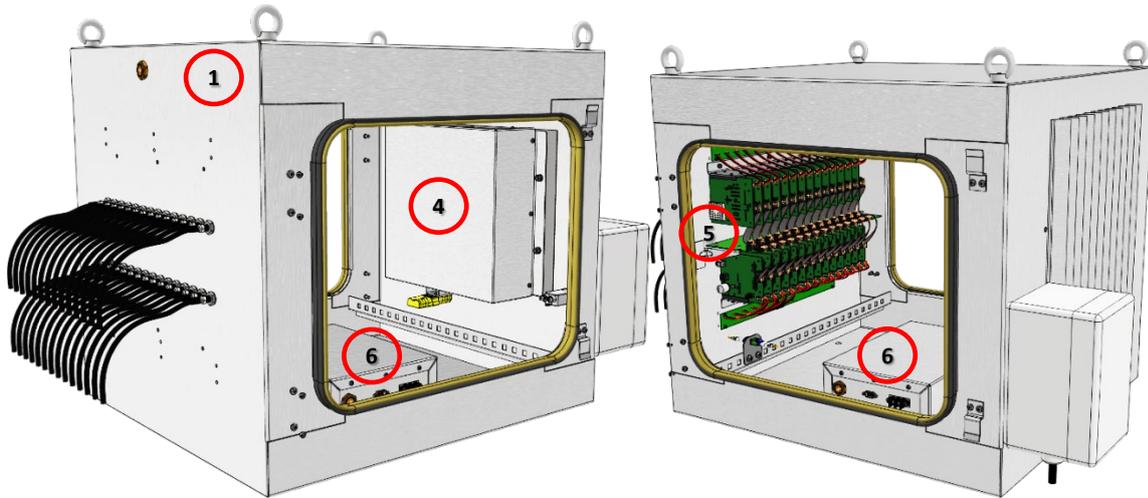
Customer Specified Equipment: Separately manufactured and supplied dual-polarisation analog electrical to fibre optic conversion module treated herein as an externally specified “black box”.

Field Node Breakout Cable (FNBC)

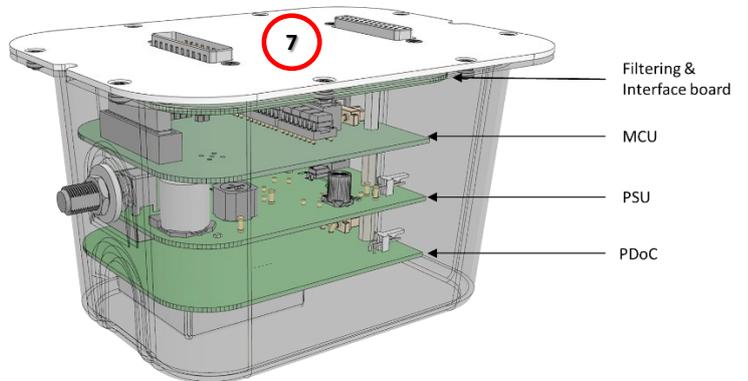
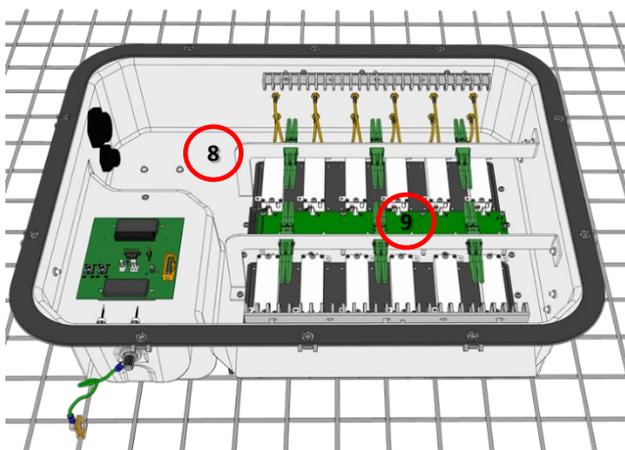
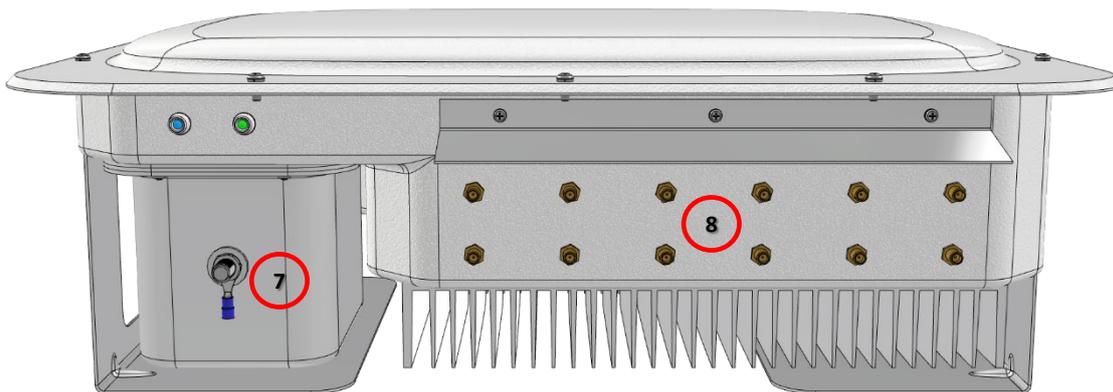
12-core optical-fibre cable that distributes fibre from the single point of delivery at the FNDH to the SMART Box.

FNDH PSU Cable Assembly

This is an RG-6 Quad-shield coaxial cable with outdoor rated compression-fitted F-type coaxial connectors. It is attached between a given port on the FNDH Electronics Package Enclosure, to the F-Type port on the SMART Box Electronics Package.



FNDH major component identification (doors not shown)



SMART Box major component identification