STATUS OF THE LOCAL MONITOR AND CONTROL SYSTEM OF SKA DISHES

S. Riggi[1], C. Trigilio[1], F. Schillirò[1], V. Baldini[3], U. Becciani[1], R. Cirami[3], A. Costa[1], A. Ingallinera[1], G. Nicotra[2], C. Nocita[2], A. Marassi[3]

1   INAF - Osservatorio Astrofisico di Catania, Italy
2   Istituto di Radioastronomia, Radiotelescopio di Noto, Italy
3   INAF - Osservatorio Astronomico di Trieste, Italy

The Square Kilometer Array (SKA) project aims at building the world's largest radio observatory to observe the radio sky with unprecedented sensitivity and collecting area. In the SKA1 phase of the project, two dish arrays are to be built, one in South Africa (SKA1-Mid) and the other in Western Australia (SKA1-Survey). Each antenna will be provided with a local monitor and control system, enabling remote operations to engineers and to the Telescope Manager system. We present the current status of the software system being designed to monitor and control a SKA dish and its sub-systems.

SKA Dish Equipment

The general design for a SKA1-Mid antenna, shown schematically in Fig. 1, foresees a 15-m offset Gregorian dish with a feed-down configuration equipped with wide-band single pixel feeds (SPFs) 0.35-13.8 GHz.

The feed packages are mounted on a feed indexer at the focal position, allowing for changing between the available frequency bands. Only one band will be available for observation at any given time. A RFI-shielded cabinet at antenna pedestal houses digital electronics and hardware for the computing LMC equipment.

Four sub-elements are identified in the SKA1-Mid dish element:

- **Dish Structure (DS)**
- **Single Pixel Feed (SPF)**
- **Receiver (Rx)**
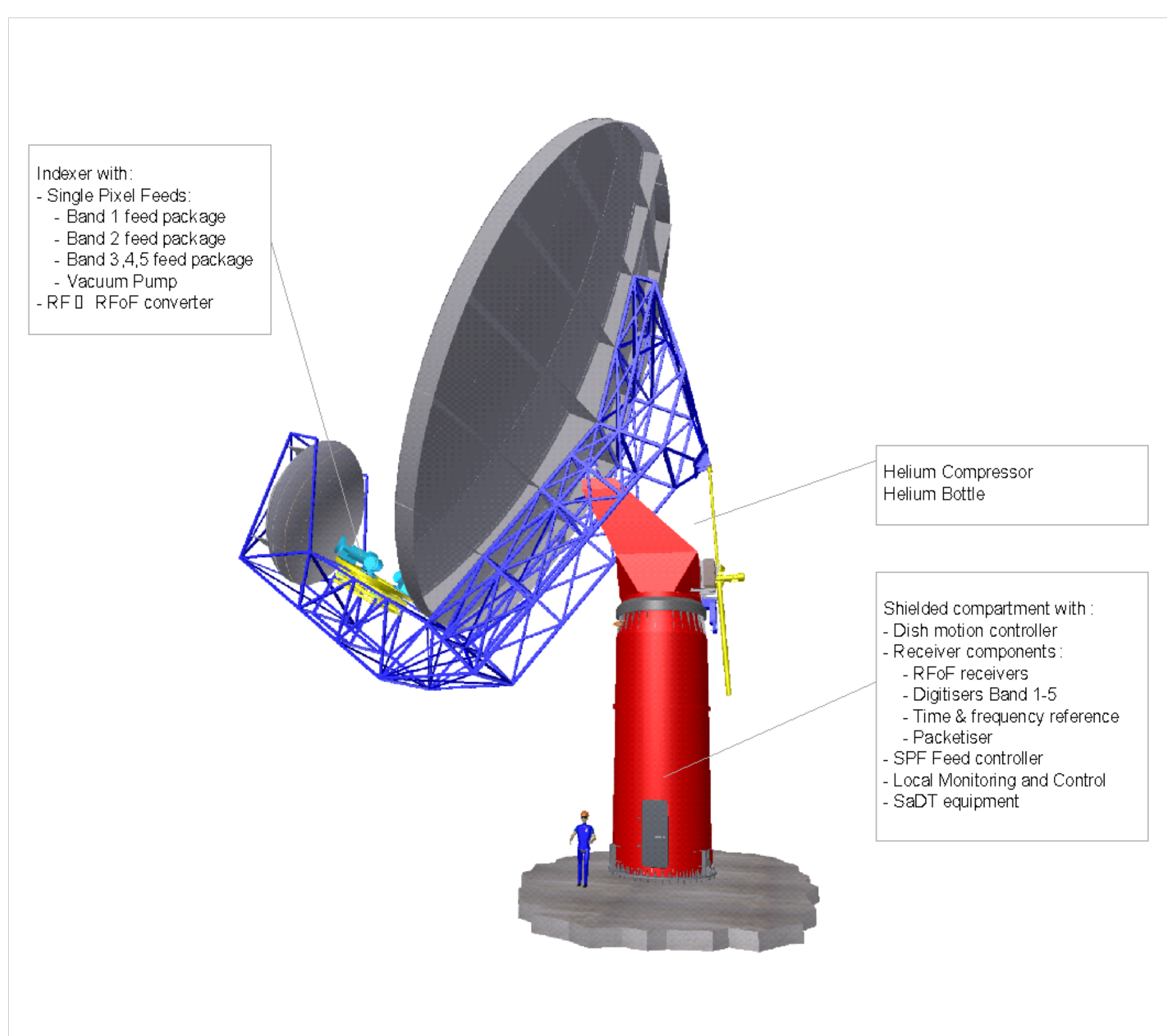- **Local Monitoring and Control (LMC)**

Figure 1: Schematic overview of SKA Dish structure

The DISH LMC System

The monitoring and control system of the SKA Dishes involves a large and heterogeneous number of instrumentation to be remotely managed, including the integration of Meerkat and ASKAP precursors. The overall SKA number of monitoring points is roughly estimated larger than 10^6, each antenna contributing with hundreds parameters for SKA1-Mid and few thousands for SKA1-Survey, including antennas and PAF receivers. To ensure complexity and system scalability, a hierarchical architecture of the M&C system was considered.

The Telescope Manager (TM) element at the top of the hierarchy manages the scientific observations and coordinates all the involved telescopes providing their control. The direct monitoring and control task is however performed by Local Monitoring and Control (LMC) at a level below TM. LMC directly communicates to its sub-elements (hardware, software components), assuming these main responsibilities:

- maintaining direct and local connectivity to sub-components, specially in case of TM downtimes;
- executing control commands from TM (setup, configuration, scheduling, life-cycle);
- collecting logging and monitoring information, events and alarms from dish components and reporting them to TM, properly mapped to a SKA common model;
- performing diagnostic operations, fast control (<100 ms rate) and safety actions on dish components;
- performing life-cycle management operations;
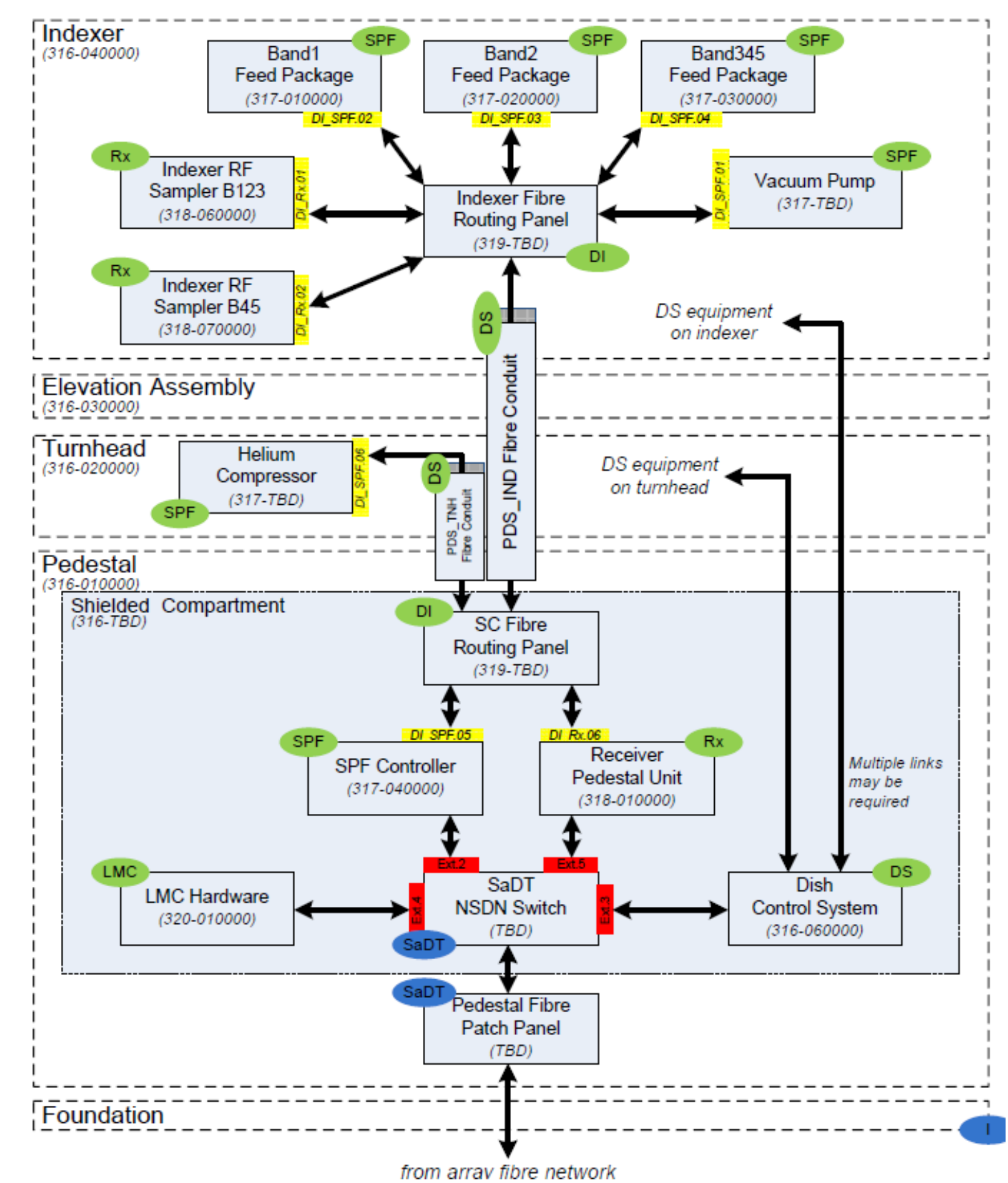- providing drill-down capabilities and remote access to devices or engineering interfaces.

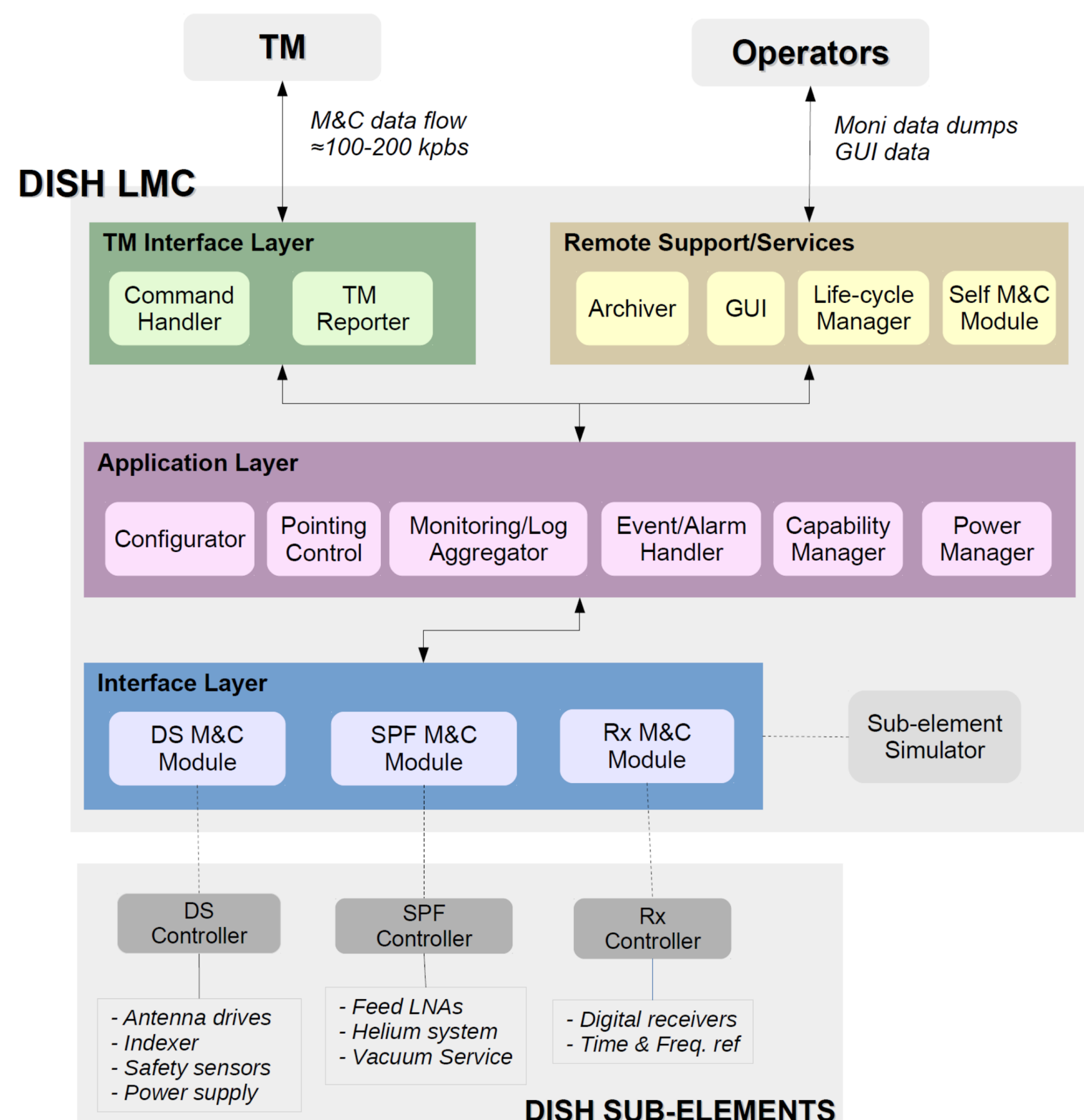**Figure 2: Dish Monitoring and control interfaces with sub-elements**

LMC Design

The LMC software system can be viewed as a collection of modular packages, each providing a set of functionalities, organized in a three-level hierarchical structure:

- the bottom level comprises interface modules for the DS, SPF and Rx controllers, implementing communication access, control commands and retrieval of monitoring information;
- the middle layer implements built-in high-level functionalities and collective operations on sub-elements.
- on top of the hierarchy, TM interface module is responsible to execute high-level commands from TM (defined in a standardized TM-LMC interface model), making use of service functionalities implemented in the middle layer.

LMC functionalities are designed using an architectural platform based on:

- **SysML** model based approach for high level language modeling;
- **TANGO** as framework layer;
- **C++** and **python** as languages.

Figure 3: Logical view of Dish LMC software architecture