SKA Central Signal Processor Local Monitor and Control

Sonja Vrcic, NRC-Herzberg, Canada

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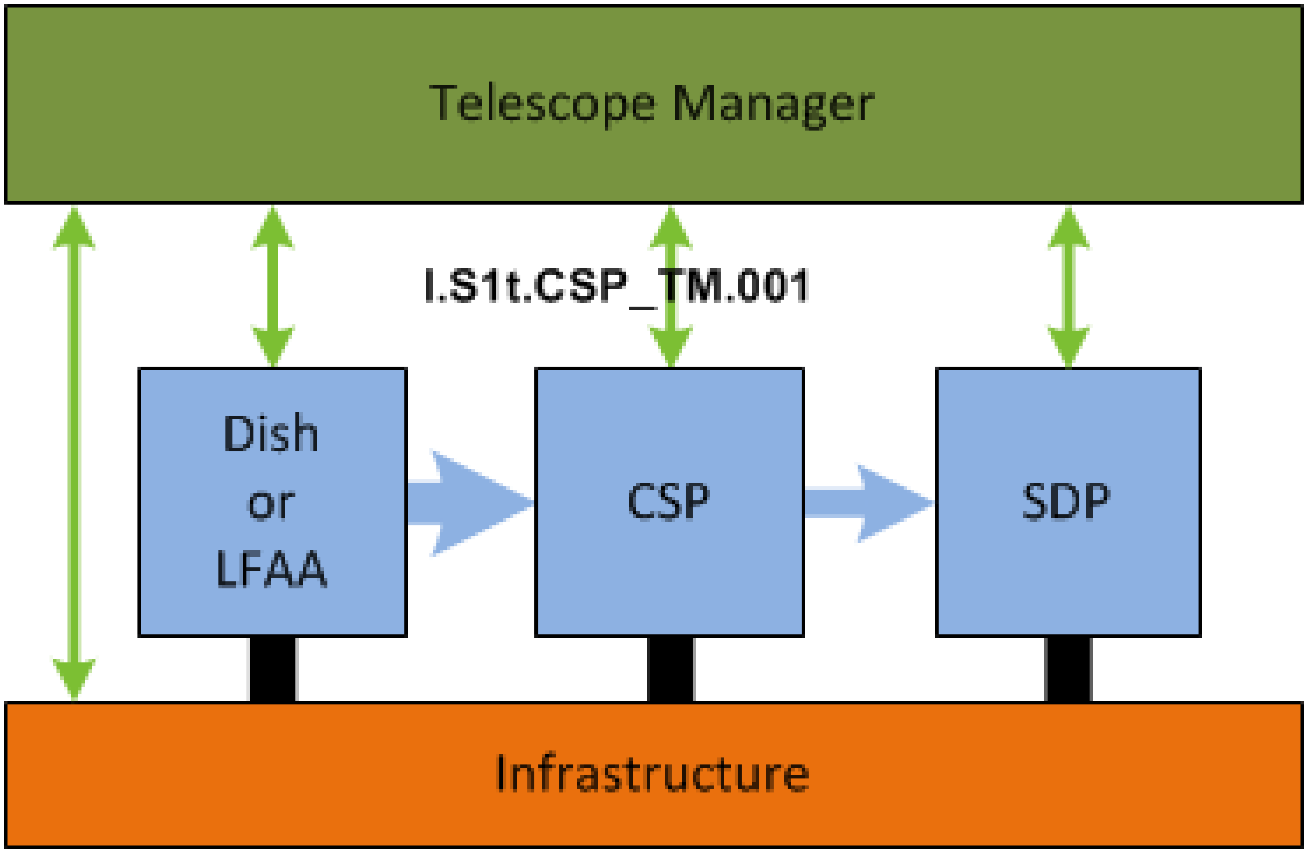
Outline

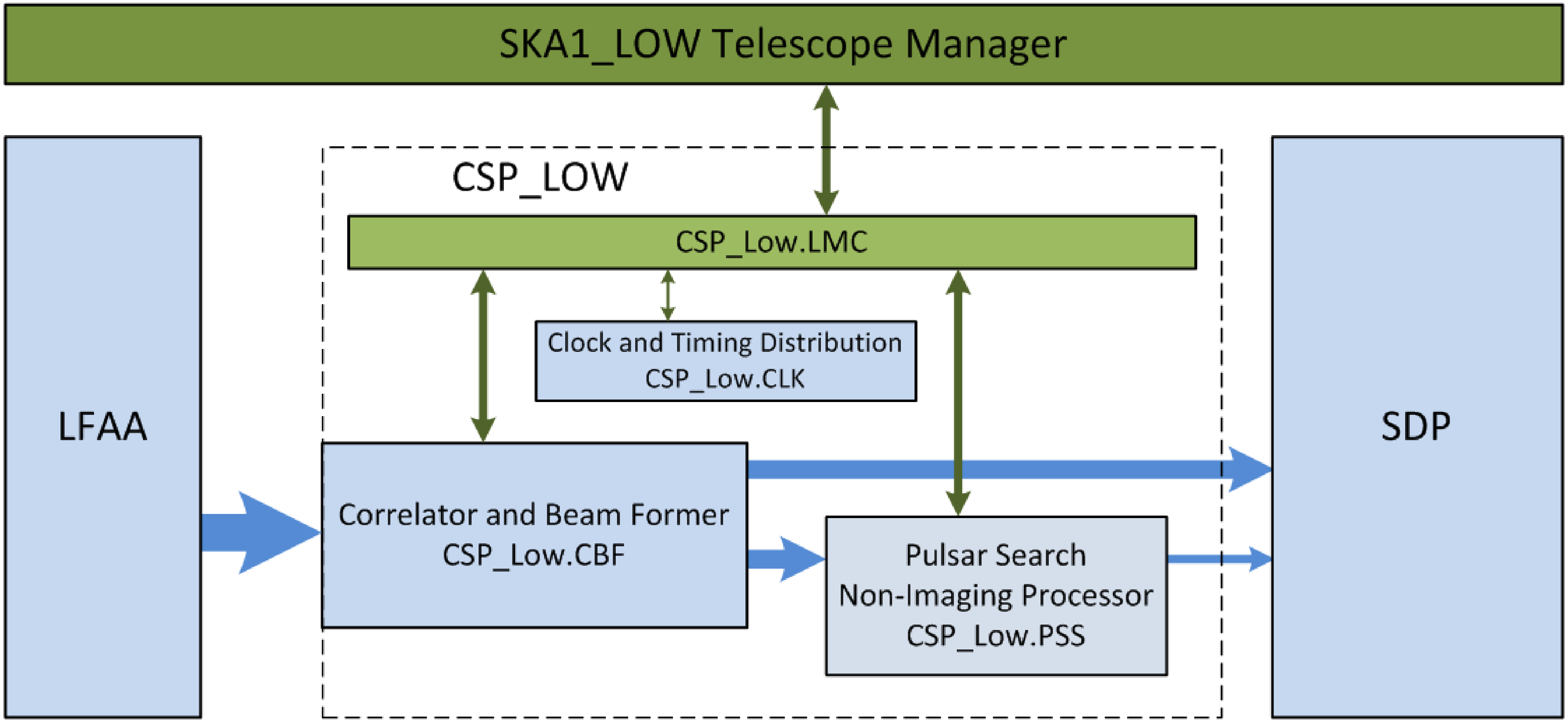
1. CSP design and architecture.
2. Monitor and Control requirements and issues.
3. Assumptions.
4. Technologies considered.
5. Plans for prototyping.
6. Preferred M&C platform / solution.
7. Scope of LMC standardization expected / required / preferred.

CSP Context

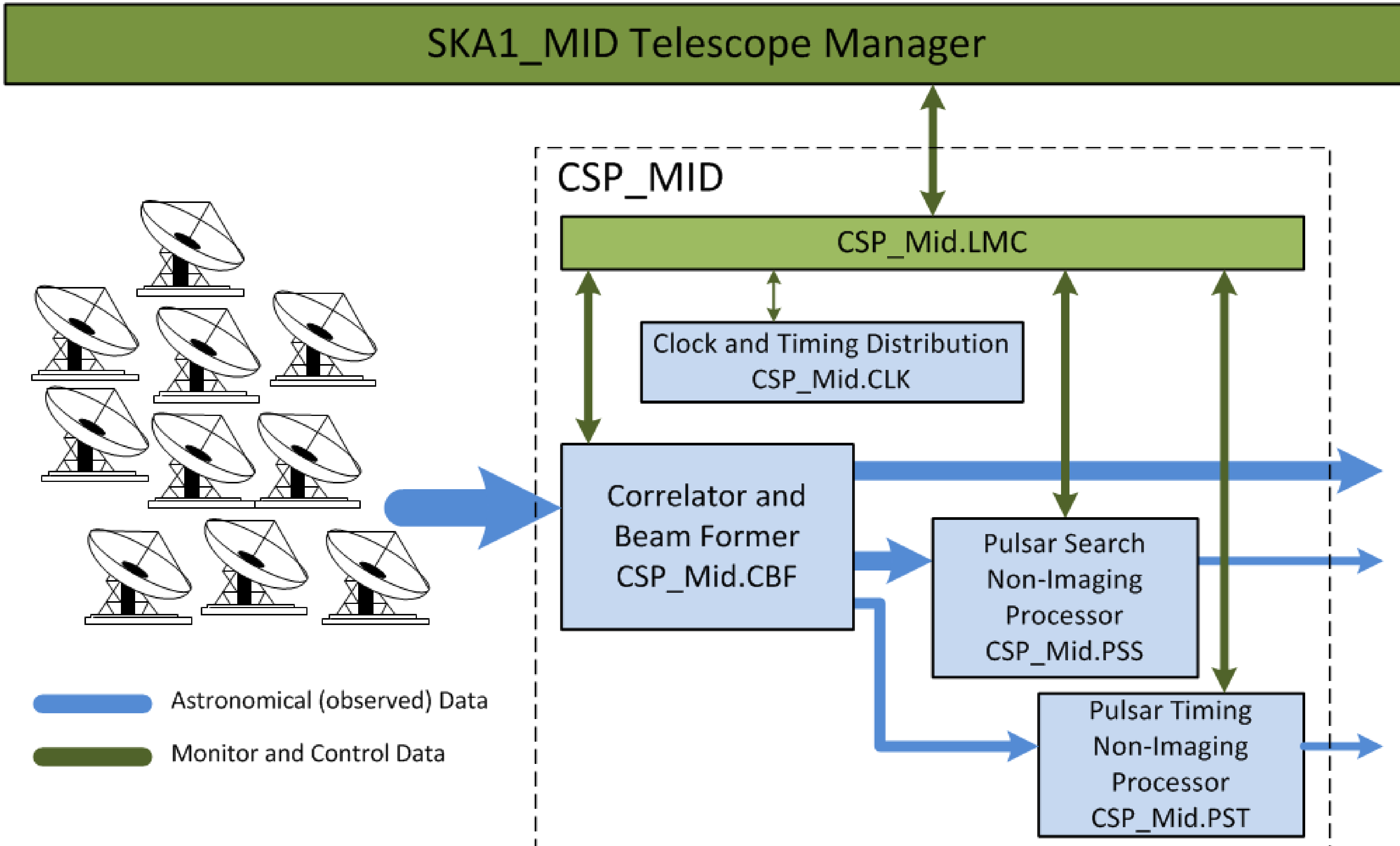


Telescope Manager
I.S1t.CSP_TM.001
Dish
or
LFAA
CSP
SDP
Infrastructure

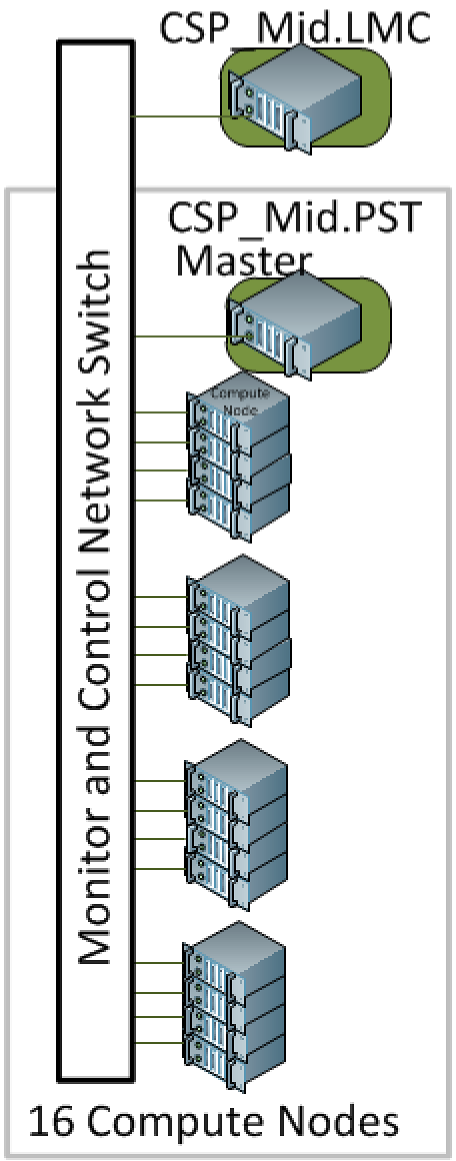
CSP_LOW Sub-Elements and Flow of Data

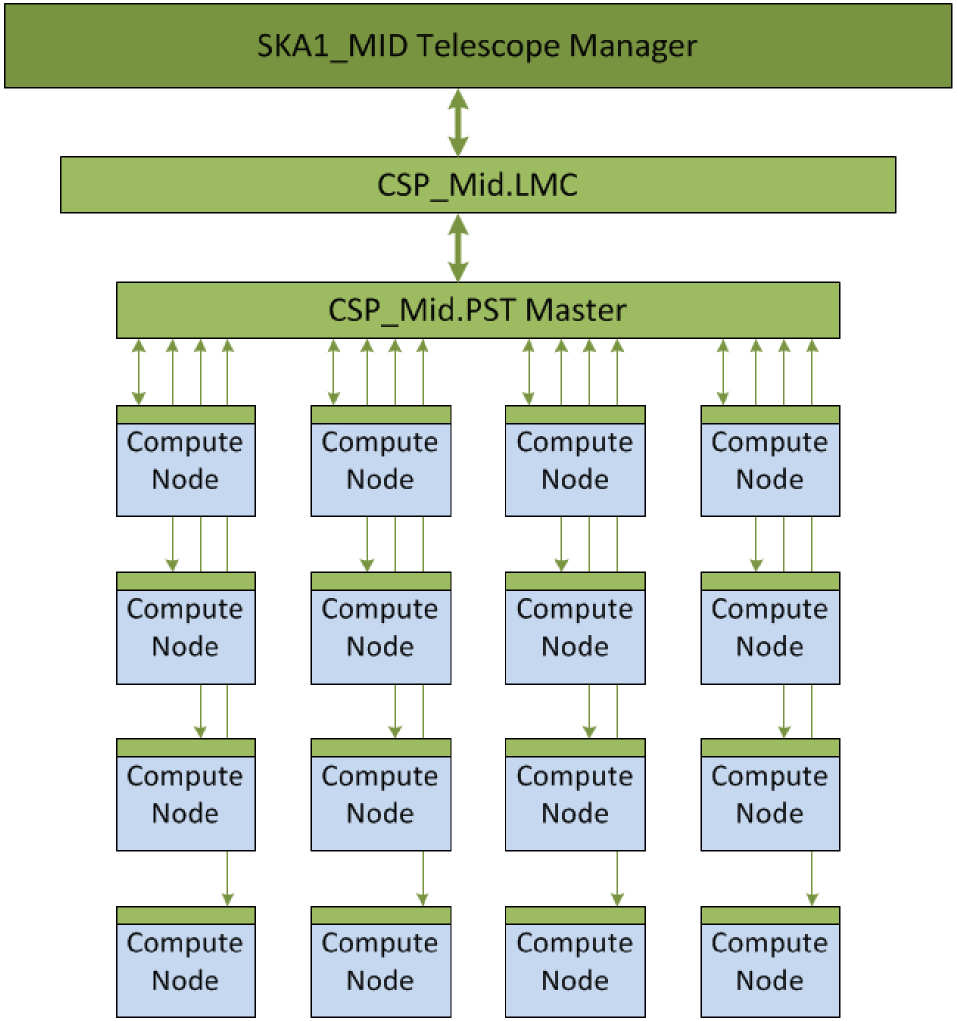


CSP_Mid Sub-Elements and Flow of Data



CSP_MID.PST


CSP_Mid.LMC
CSP_Mid.PST
Master
Monitor and Control Network Switch
Compute
Node
16 Compute Nodes


SKA1_MID Telescope Manager
CSP_Mid.LMC
CSP_Mid.PST Master
Compute Node
Compute Node
Compute Node
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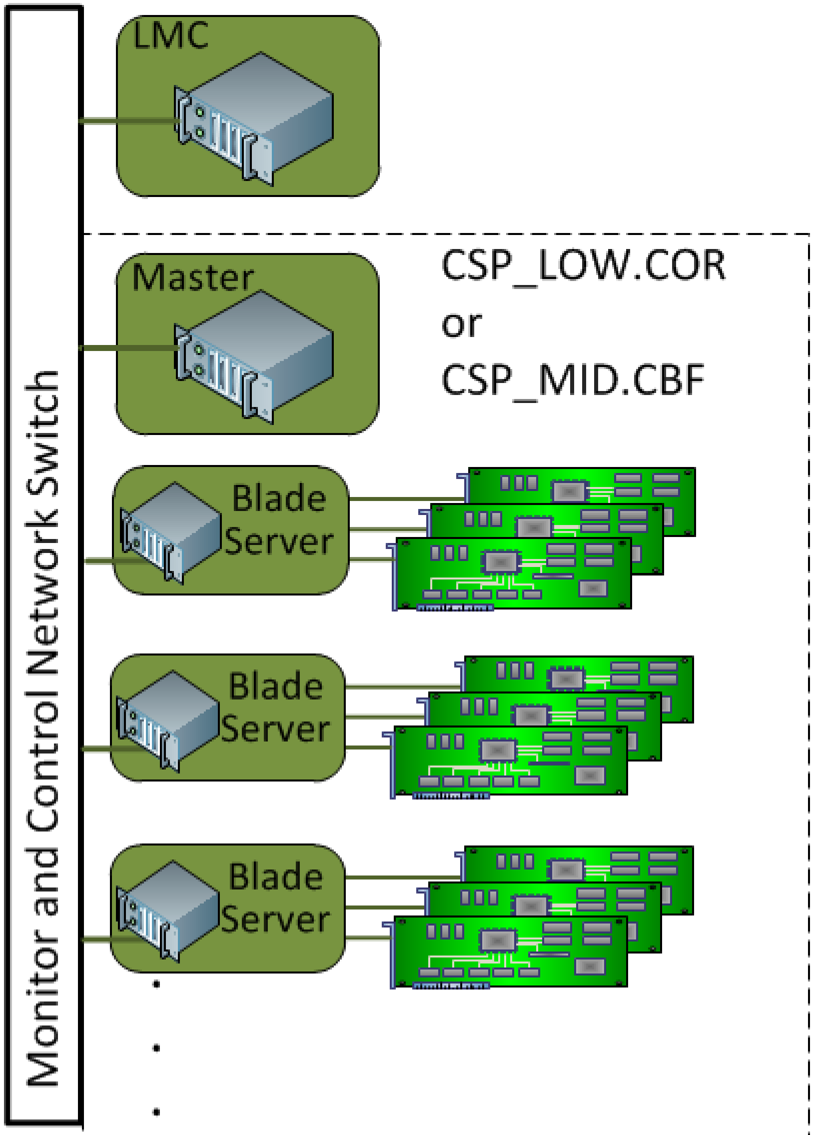


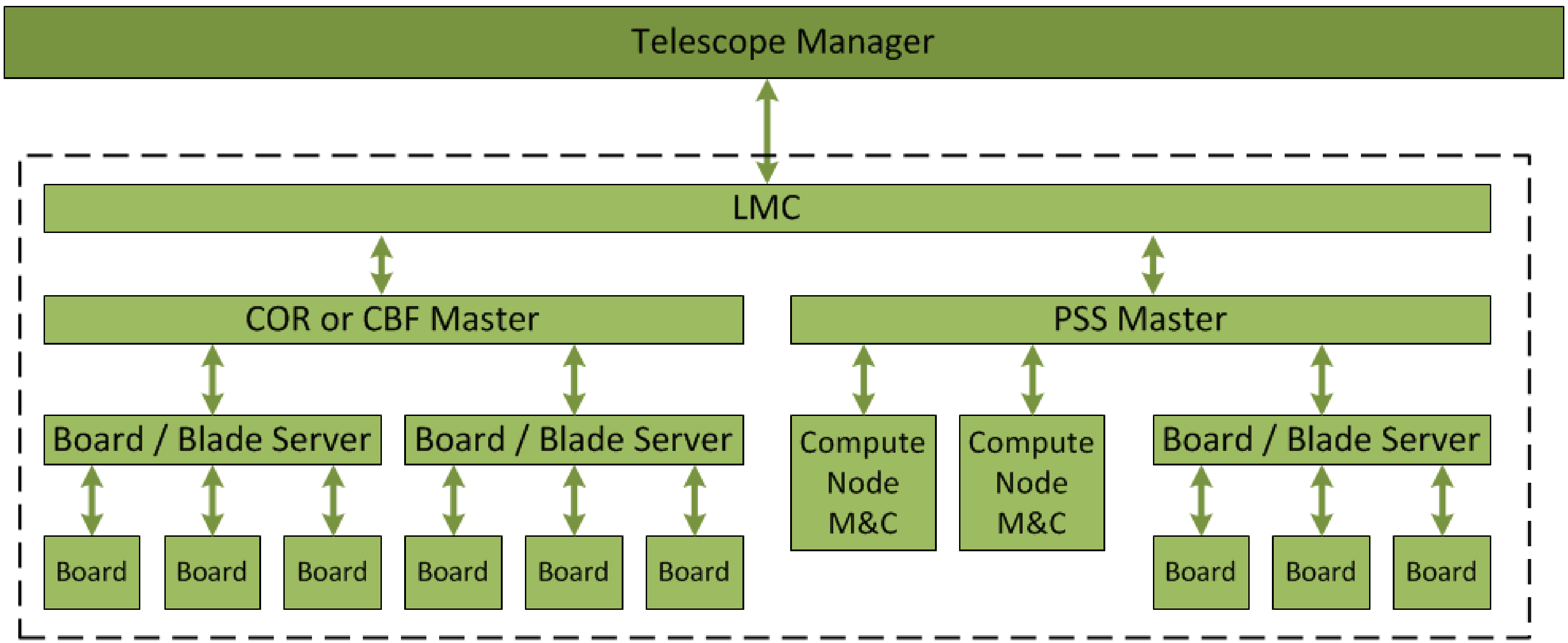
CBF Implementation

- Probably FPGA based
- Exact number of boards TBD (up to couple hundred, probably less).
- CBF Master a single point of contact from LMC.
- M&C communication is hierarchical, no need to exchange M&C messages between the blade servers.
- CBF Number of boards 64 – 200 (~).
- PSS Number of servers:

  Number of beams / 2.

CSP Monitor and Control

- CSP consists of computers and digital hardware.
- Fixed configuration.
- Hierarchical communication.



CSP M&C Requirements

- Usual:
  - Generate alarms and events.
  - Allow TM to set and get parameter value.
- Engineering parameters.
- File transfer required to deploy software and firmware updates, copy log files to remote location (debugging and troubleshooting) and to provide input for PSS and PST.

CSP M&C Requirements

- Set, start and stop processing of observed data:
  - create sub-array,
  - set observing mode,
  - start/stop processing and/or transmission.
- Need ability to specify Activation Time for SET commands.
- During an observation (scan):

1. TM provides periodic updates for a sub-set of parameters:
   - Delay models – for MID probably once a second,
   - Coefficients used in beamforming – minutes, tens of seconds?
   - RFI information (masks).
2. CSP generates ancillary data and sends it to TM.

CSP M&C Requirements

- PSS requires data from external sources:
  - Known pulsars
  - Long term RFI
  - Short term RFI
  - Satellite positions
  - BRDZ list

TM forwards these as needed (at initialization, before an observation (scan) starts and/or when the list changes.

Assumptions

- Multicast will be supported for transmission of alarms.
- A single SET Parameters, GET Parameters and Response message may contain value for many parameters. A message may contain value for hundreds, if not thousands, of parameters.

This is useful in order to report the full set of parameters for components, sub-elements and even elements (all MPs, all alarms, and similar).

Prototyping

- Prototypes for Pulsar Search and Pulsar Timing exist but require re-work to be productized.
- Pulsar Timing prototype implements advanced web-based interface.
- Pulsar Search implements rudimentary user interface.
- Down-select for the Correlator and Beamformer (Low.CBF and MID.CBF) implementation proposals still to be performed.
  - Most proposals are based on existing technologies (PCB boards). Design team may prefer to use existing protocols and other tools to speed up development.
  - Prototyping for the proposal based on the new technology starting now – need to choose protocol stack and other technologies now !

Technologies – considered, preferred

- For CSP a simple solution would suffice, e.g.:
  - ❖ XML or JSON over HTTP.
  - ❖ REST approach (each device maintains own status and is able to report it).

Framework - Pros:

- ✓ Use of a *good and stable* 'framework' which provides a lot of add-on functionality can save development time.
- ✓ For instance, an alarm display provided by the 'framework' could be used by individual elements and sub-elements during testing.

Framework - Cons:

- – 'Framework' may impose solutions not appropriate for SKA.
- – Dangerous dependency on the 'support community' that may have different agenda, requirements and schedule.
- – Is SKA expected to provide resources to contribute to the development and maintenance of the framework ?

Technologies – considered, preferred

- In the list of proposed technologies EPICS and TANGO seem to be the most prominent (promising).
- EPICS seems to be better suited for a different type of system, processing plant or similar.
- SKA will consist mostly of computers and digital hardware.
  - Representation will be highly hierarchical, TM, Element LMC and Sub-element masters will translate high-level parameters into configuration of hardware (firmware) and software.
  - Low-level parameters exposed only when there is a problem (alarm, failure).

Standardization - expected / preferred

- Preferred: Use the same communication protocols and message encoding for external and internal M&C communication.
- Expect: common design, look-and-feel and approach for engineering interfaces (GUIs).
- Data bases – CSP will use a data base internally to store some information (alarms). Define a common data base technology (at least for general M&C purpose)?
- Expected SKA standards for:
  - Operating system to be used for M&C servers (Linux, flavor?)
  - Programming languages (Java, Python, C++, C). Versions?
  - Libraries - GUIs, graphic visualization, protocol stack, etc.
  - Naming conventions, etc.

Issues

- Need all those decisions ***now***, before massive amount of time and effort is invested in the development and testing of prototypes.
- But how ? Prototyping has already stared and due to absence of 'SKA standards' each group will define own standards, i.e. technologies of choice.
- It will be very costly, perhaps even impossible, to impose harmonization later.
- Result: each telescope will use a patchwork of technologies which will increase the cost of maintenance and upgrades.
- Who will define standards? When?

Issues / Concerns

- Both EPICS and TANGO advertise new versions, but those seem to be in relatively early stages of development.
- Can we relay on (one of) them ?
- What is the advantage of EPICS compared to SNMP ?

Questions ?

Thank you !