Perentie ITF and Verification Environment

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CSIRO Astronomy and Space Science

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SKA Low Consortia Diagram

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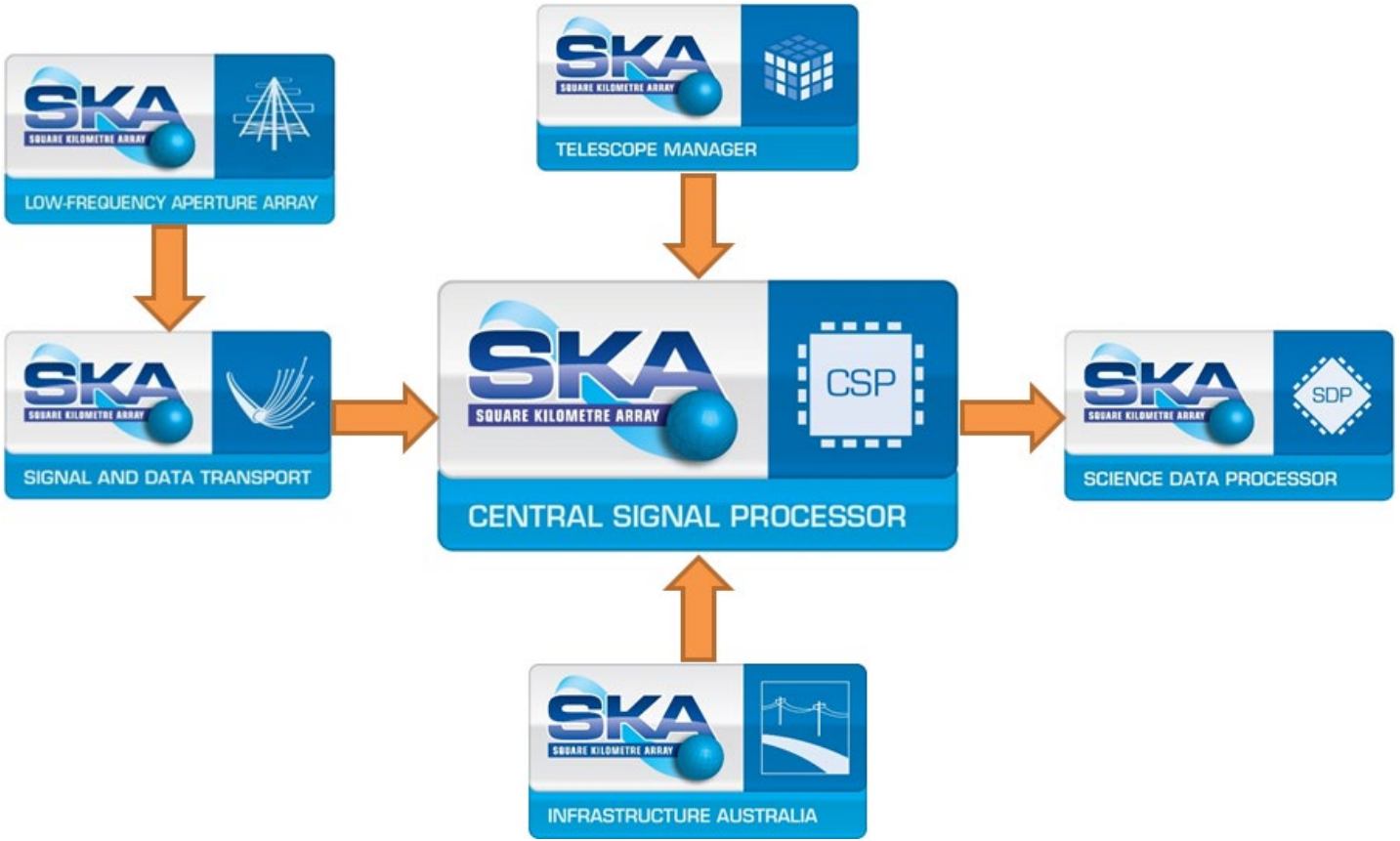
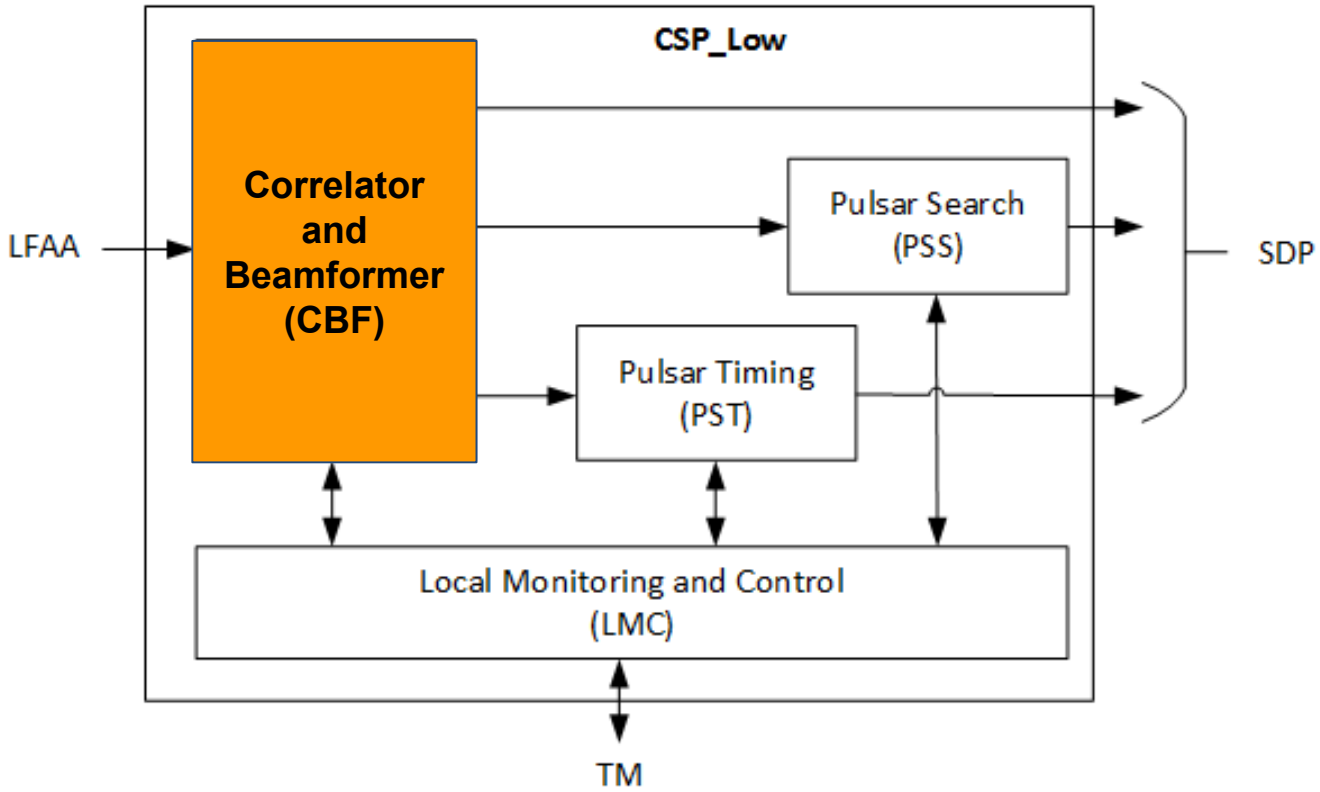
SKA Low Correlator & Beamformer



CSP Low Sub-elements



- Low.CBF
- Low.PSS
- Low.PST
- Low.LMC

What's Perentie ITF?

- Integration and Test Facility

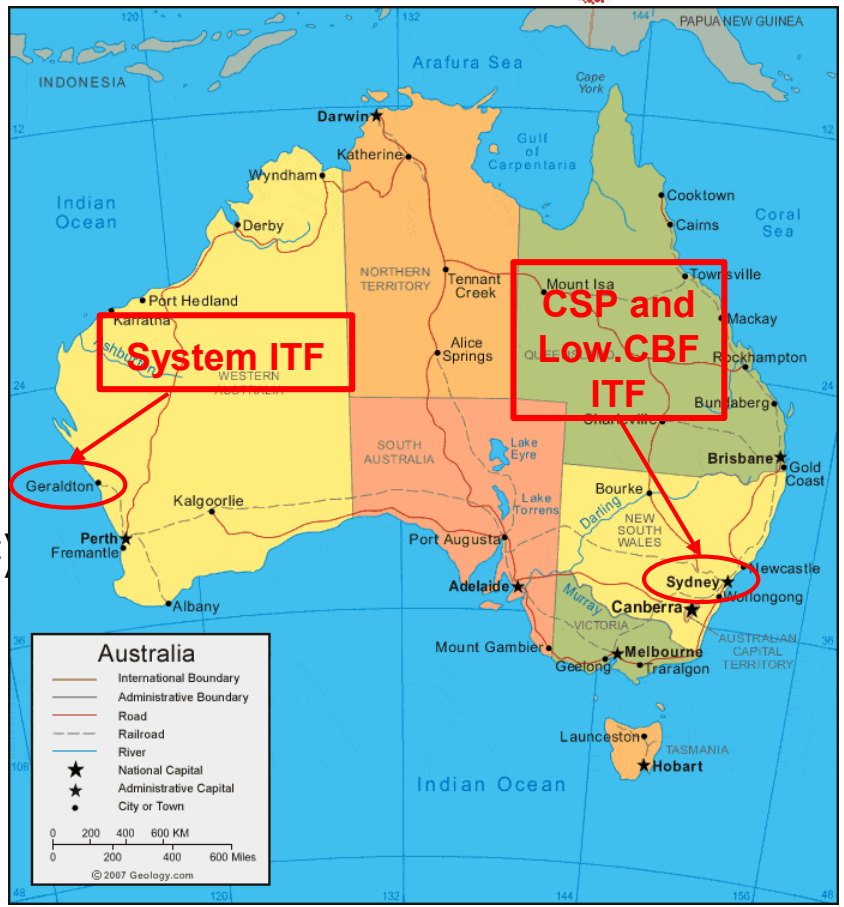
- Emulate Site Infrastructure
  - Power - 3-phase 400VAC, 48VDC
  - Cooling - liquid and air
  - Rack - space, cabling, plumbing, etc
- On-going Development Platform
  - Hardware implementation
  - FPGA firmware
  - M&C software (MACE)
- Integration and Verification Platform
  - Sub-element: LMC, PSS and PST
  - Element: LFAA, SDP, INFRA

SKA ITF Locations

- Three levels of ITF for CSP
  - Sub-element - Low.CBF
  - Element - CSP
  - System - Telescope

- Low.CBF and CSP ITF: Sydney
  - Low.CBF activities (Internal ops)
  - CSP activities (CBF, PSS, PST, LMC)

- System ITF: Geraldton
  - System activities (LFAA, CSP, SDP)



SKA Construction Phases

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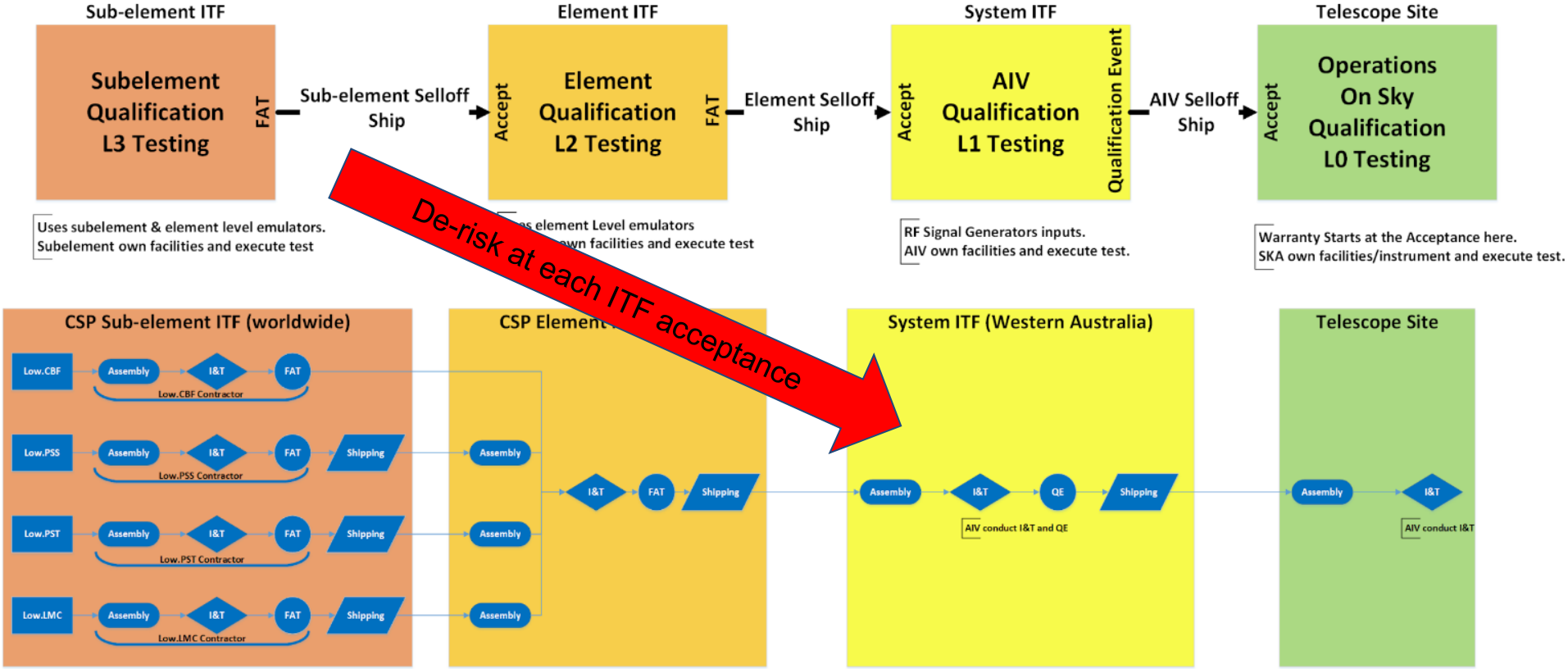

CSP Low Overview

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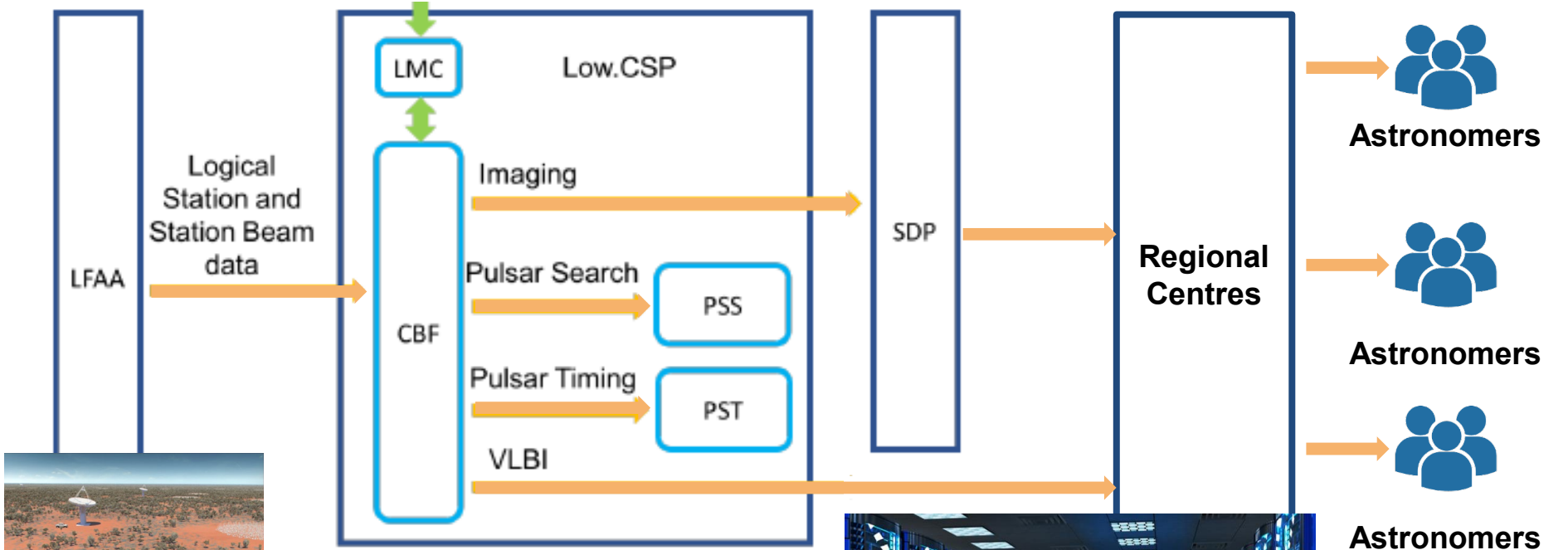
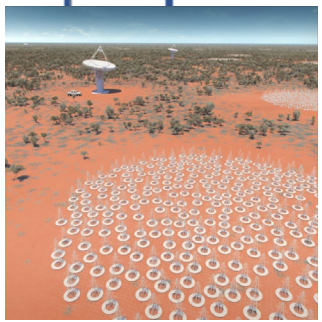
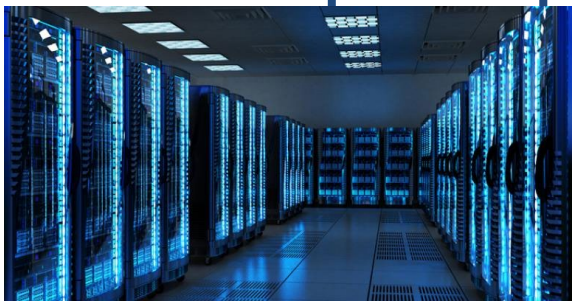
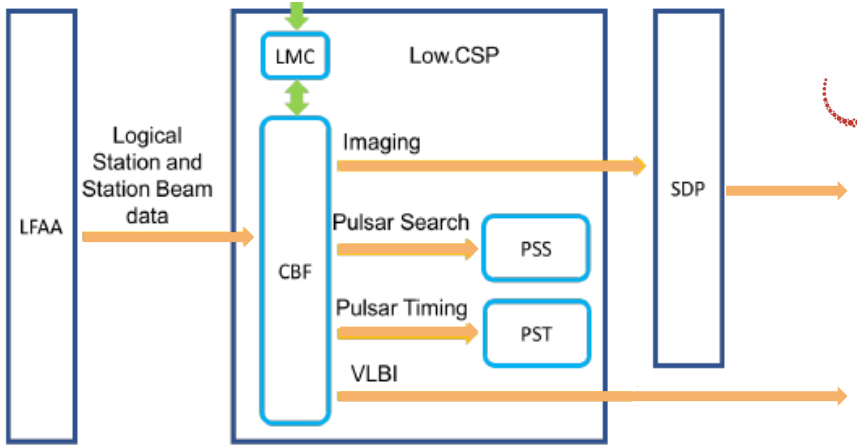






Low.CBF ITF Overview



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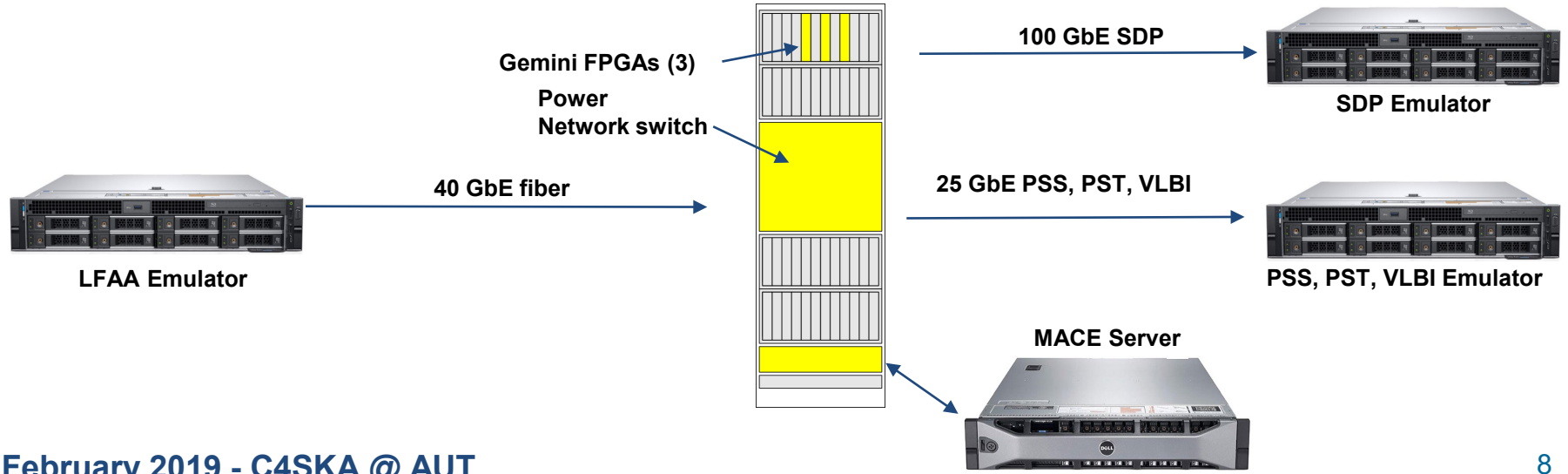
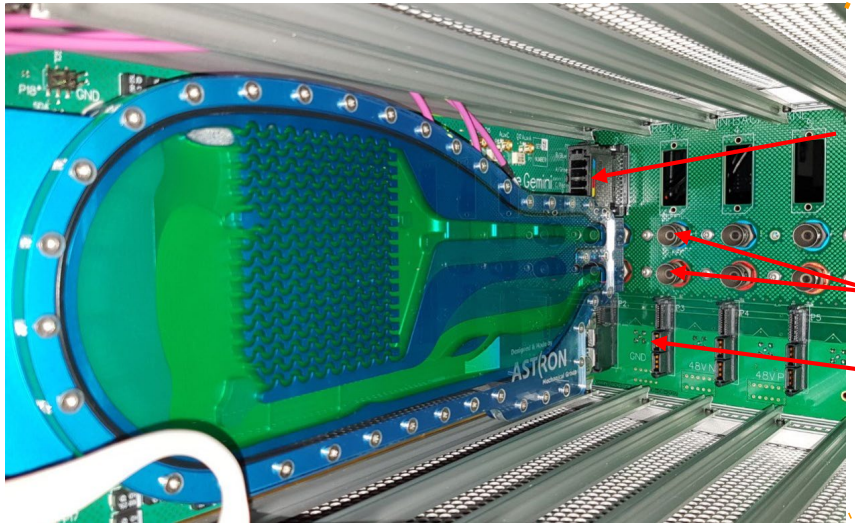
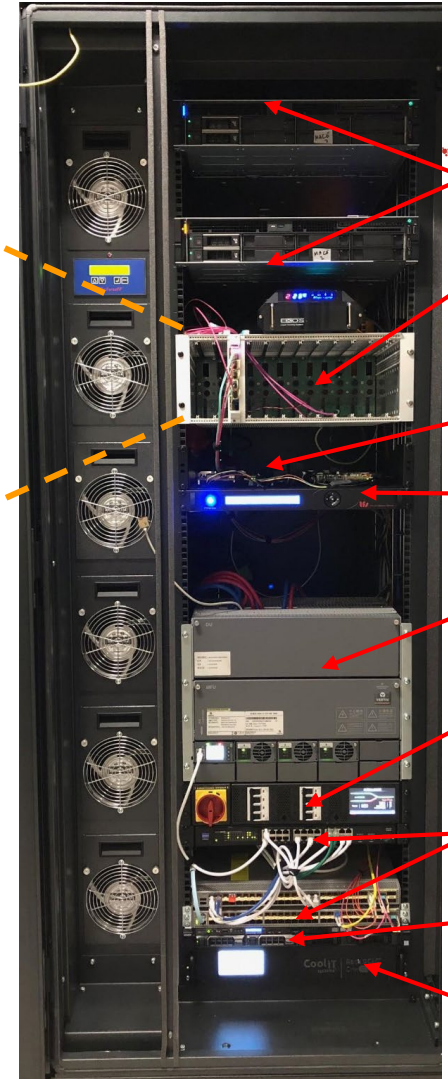


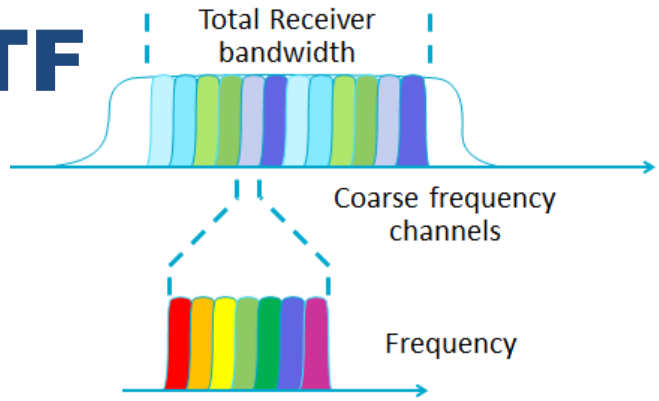
Low.CBF ITF Today





- **Gemini Subrack**
  - **Gemini LRU (Line-replaceable unit) + Heatsink**
  - **Liquid cooling and power on backplane**
- **Rack Power and cooling, networking, server**
- **Sensing points (thermal, liquid)**
- **Emulator servers (LFAA, PSS, PST and LMC)**

What's happening in the ITF

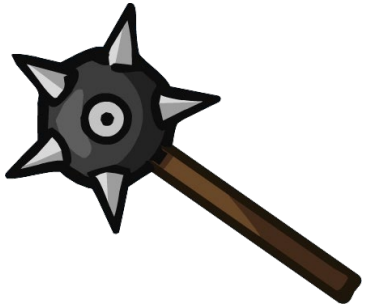


Signal processing and communications

- Development DSP firmware (E.g Filterbank,COR)
- Emulation of LFAA data input from a station
- Capture and checking of Low.CBF output to SDP

Monitoring and Control Environment (MACE)

- 10GbE based network for control and monitoring of each device
- Tango based emulation of LMC
- Automated testing



Infrastructure - power, cooling, cabling

- Full redundant rack power
- Liquid cooling, leak monitoring
- Fibre, power, plumbing management

ITF Safety and Protection

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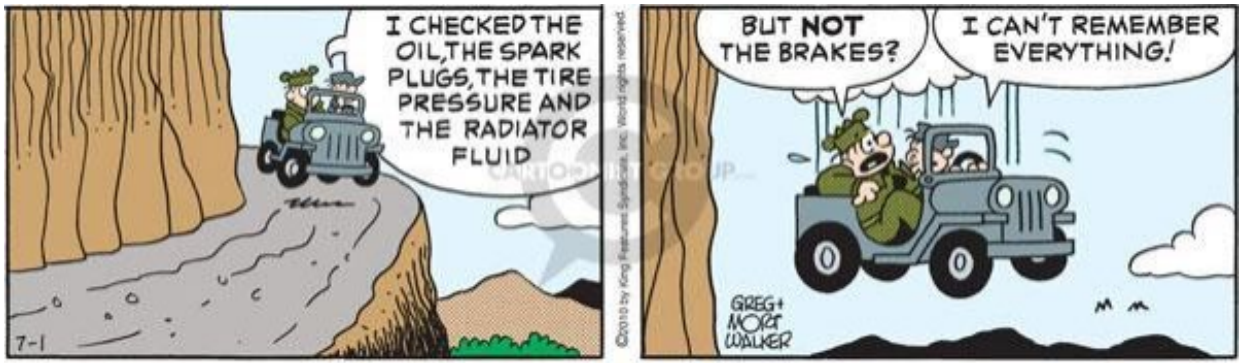
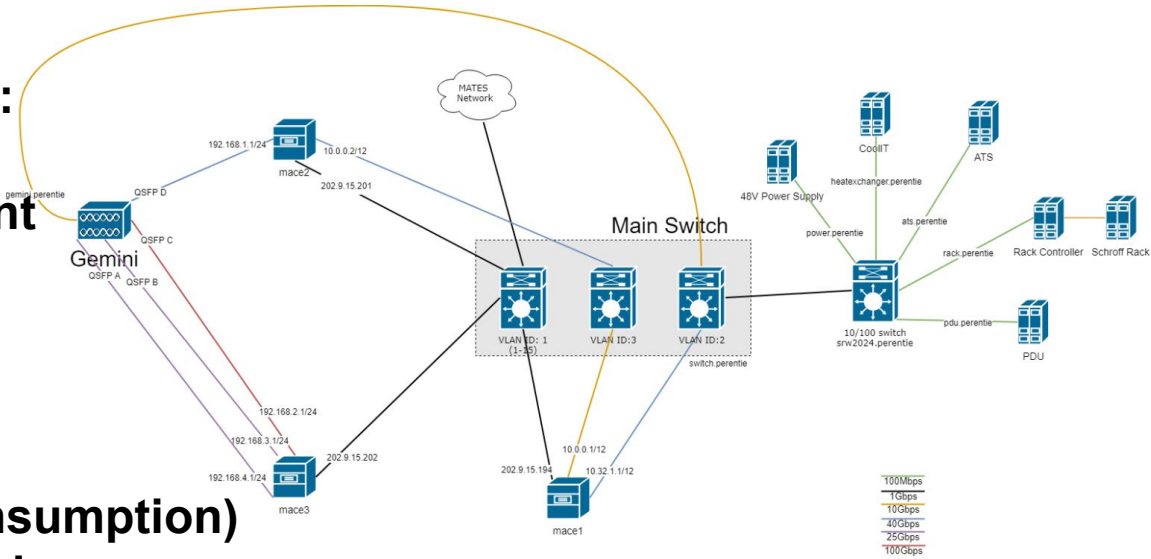
- Operating in remote area
- Autonomous safety precautions
  - Automated shutdown sequence at emergency
  - Liquid cooling fail
  - Power failure
  - Failure/event logging



Initial MACE Setup

- Monitoring And Control Environment

- MACE server and network switch installed
  - 96 ports, 10GbE switch
- MACE Networking connects:
  - Gemini LRU
  - COTS support equipment
  - Emulator servers
- Initial M&C function
  - Gemini LRU
  - COTS equipment
  - Measure power (PF, consumption)
  - Safety, e.g thermal shutdown



Low.CBF ITF Network Diagram

LFAA Emulator Verification

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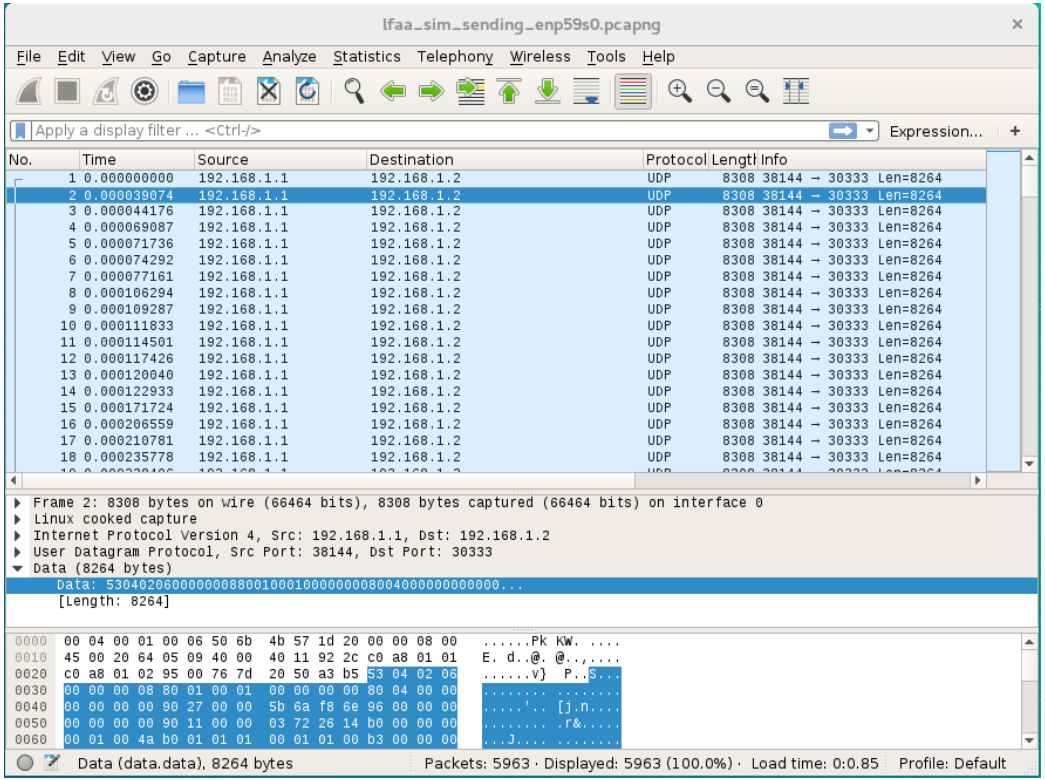
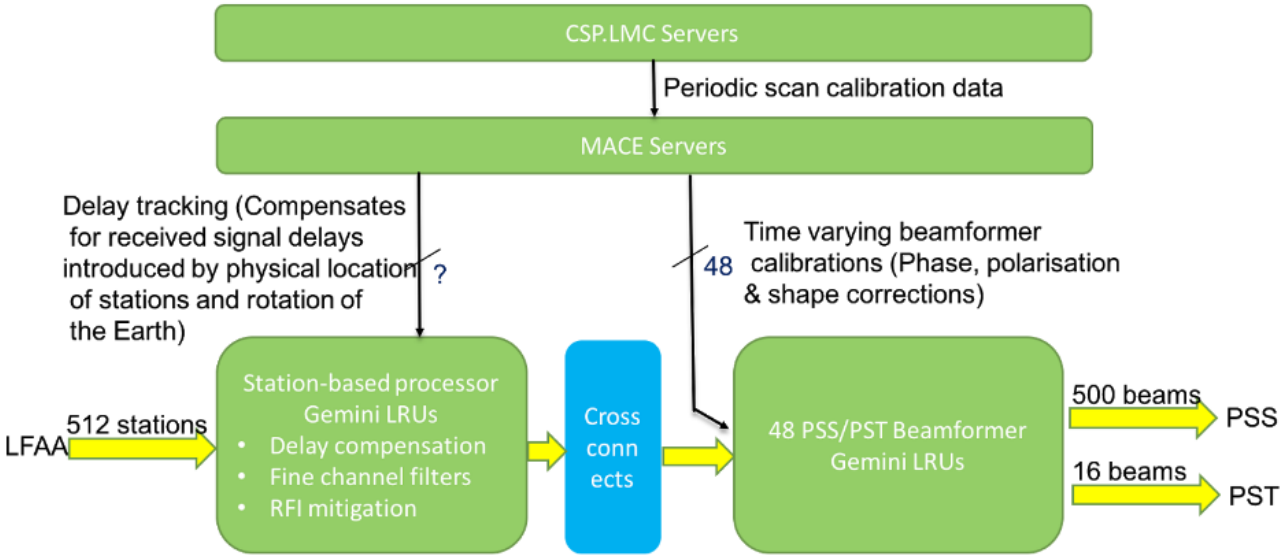
- Sending emulated LFAA station data to Gemini FPGA card
  - Matlab generated packets
  - Jumbo 8k packets
  - 40 GbE optical link
  - Achieved 7Gbps (with minimal effort)
- Working on optimizing the emulator performance to increase data rates so that two full stations can be on a 40G link (22Gbps)



MACE Verification

- Verify communication between MACE server and Gemini FPGA Card
  - Achieves ~5Gbps throughput over 10GbE
  - Able to update Jones polarisation matrices in real time

Now also considering a multicast update mechanism to reduce server load



Perentie Initial Engineering GUI

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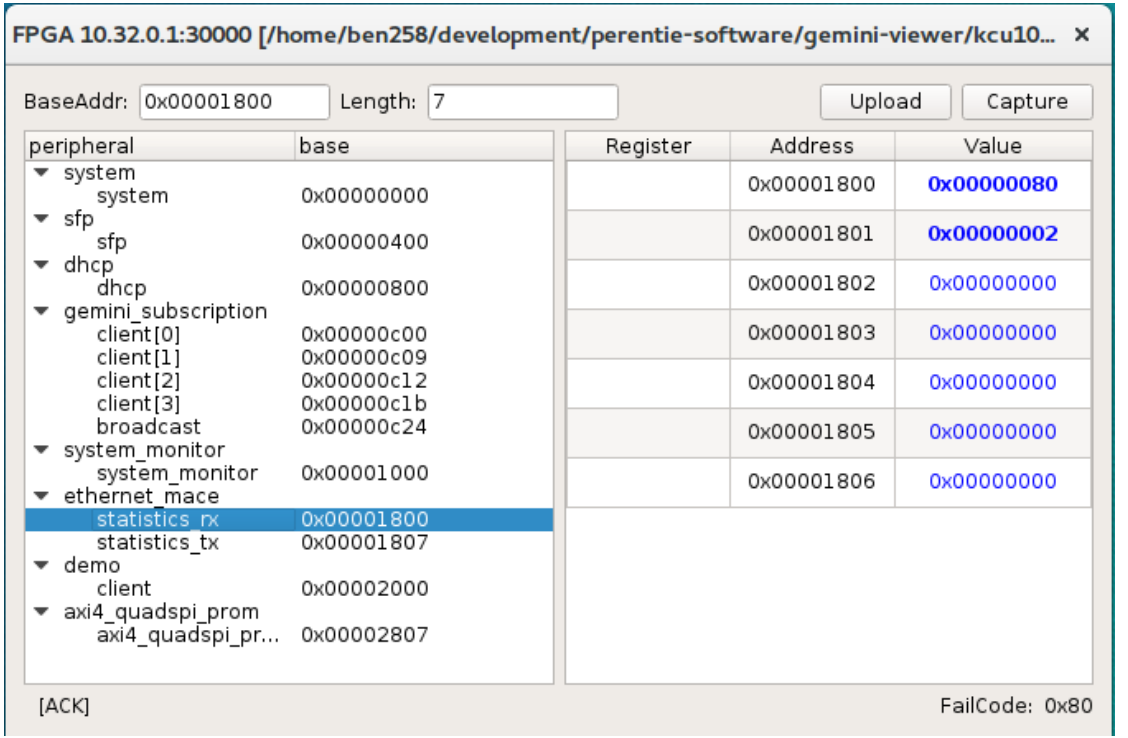
- Initial steps toward Tango controls GUI
  - End-to-end functionality
  - GUI for low-level access to FPGA registers via network
  - Access to parameters in FPGA devices



What's next?

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Hardware

- Gemini HBM pre-production (x5)
- Implementing optical cross connect HW
- Complete cabling and plumbing distribution

Software

- Function to capture outputs of FPGA
- More complete LMC Tango software

Firmware

- More DSP
- Communications
- Memory buffering (HBM)

Sub-element integration (ICD)

- With LMC, PSS, PST

ITF Head Start Benefits

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Risk reduction:

- Demonstrate that system design meets requirements
- De-risk internal and external interfaces earlier
- Verify construction roll-out schedule

Development:

- Develop hardware, firmware and software under site environment
- Continuous test and verification of software and firmware during development

Safety:

- Demonstrate system behaves in exceptional circumstances
- Prove fail-safe condition during environmental extremes

Questions / Discussion?

Thank-you!

Super zig-zag road but a strategic life supply line (WW2)