



Hardware based Simulation Environment

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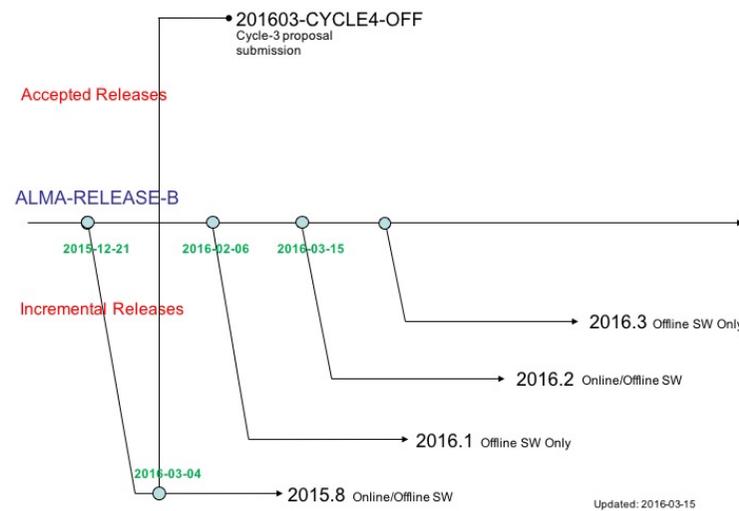
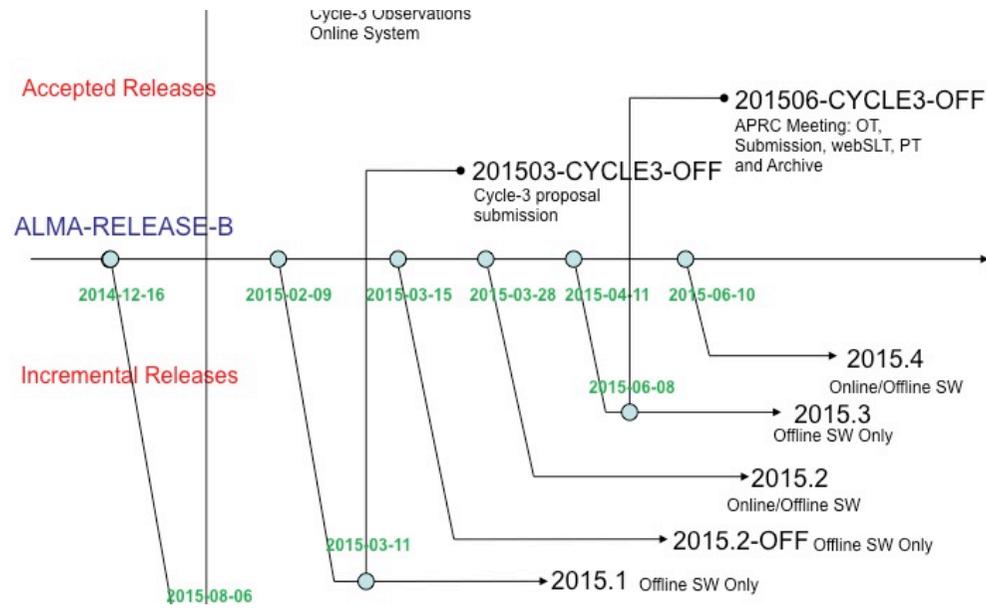
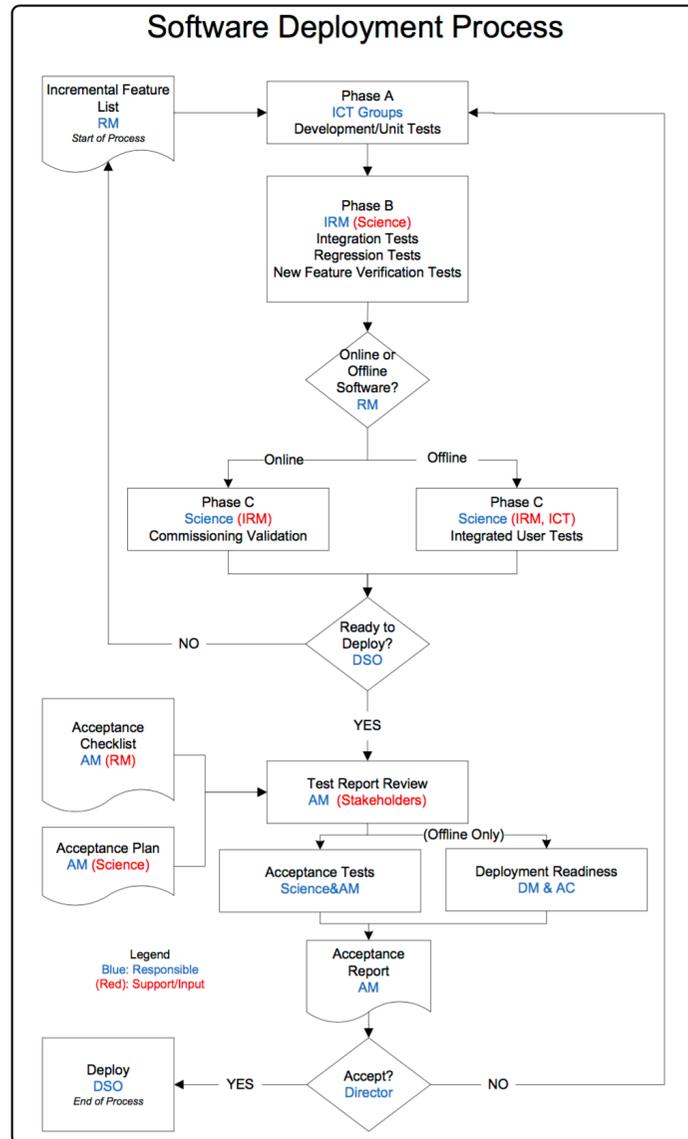


Outline

- Quick introduction to IRM process
- Current available simulation approaches
- 5th Quadrant
- Conclusion



ALMA Software Release Management



Updated: 2016-03-15



Available Infrastructure for Testing

■ ONLINE Subsystems

➤ Phase B:

- Simulation: SCO2-STE, **ACSE-STE**,
- Real mode: TFENG-STE, TFINT-STE

➤ Phase C:

- Real mode: AOS-STE, AOS2-STE, TFINT-STE, **AOS64-STE**

■ DATABASE

➤ SCO: ALMAi1, ALMAi2, ALMAi3 accounts

➤ OSF: ALMAT1, ALMAT2 accounts

➤ See <https://ictwiki.alma.cl/twiki/bin/view/SoftOps/DBTaccounts>



Current Simulation

■ Current Simulation Alternatives

- High level (Science Scripts)
 - OSS / IDL simulator
- Middle level (Software)
 - CONTROL: Non-RT simulation
 - CORR: Lags simulation at CDP nodes
- Low level (Hardware)
 - Depends on the production hardware.



Improvements under development

■ Middle Level (Software)

➤ In general

- Simulators do not produce binary data therefore TELCAL, QuickLook and GUIs can not be exercised.
- Timing is incorrect for M&C requests, causes false positives failures.
- Test suits are incomplete in comparison with operation scenarios
- No connection between CONTROL and CORR

➤ CORR Simulators (non-RT)

- Needs to handle a variety of Correlator configurations (spectral channels, channel widths, polarization, etc)

➤ Antenna Simulators (non-RT)

- Needs to track better than 10 arc-sec accuracy
- Provides a better simulation of control loop that locks the WCA



Required Improvements

■ Low Level (Hardware)

- No other alternatives rather than using the production hardware.
- We need simulation at ACU level
 - Or keep using real antenna.
- We need simulation at CORR hardware level.
 - Adapt the existing two antennas Correlator
 - **Procure a 5th quadrant**



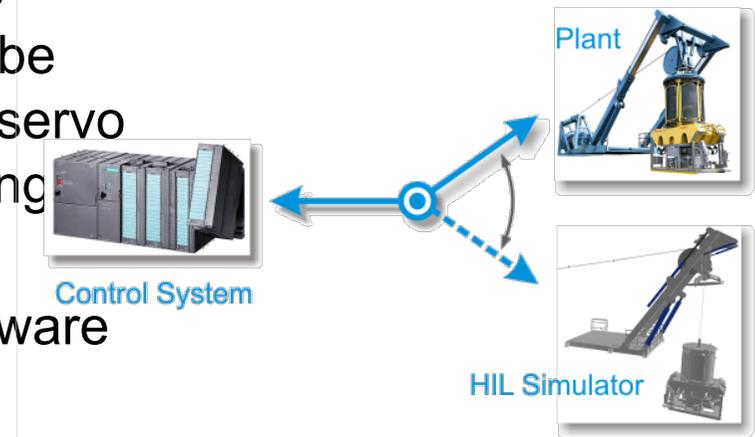
Simulation Approaches

■ non-RT Simulation

- Part of the code base is different, and will not be tested
- Doesn't exercise the hardware communication layer
- Non additional hardware is required

■ MIL / HIL

- Code base doesn't change, it's the same
- Exercise the hardware communication layer
- More “realistic” simulation behaviors can be implemented in mathematic models, i.e.: servo movements, temperature variation, pointing performance
- More expensive: required additional hardware





Non-RT Simulations in ALMA

- Generate the same amount of network load in comparison to a real observation.
 - CORBA messages.
 - Events in notification channels (logging, delay events, control realtime events)
 - Binary data between IFProc. (TTP sender to receivers)
 - Binary data between CDP Nodes and CDP master
 - Binary data between CDP Master and, TELCAL receivers, ARCHIVE receivers.
 - Monitoring data.
- All high level functionalities related to observing modes, subarrays, monitoring system are the same as the production env.
- The same Scheduling Blocks are used than in operation.



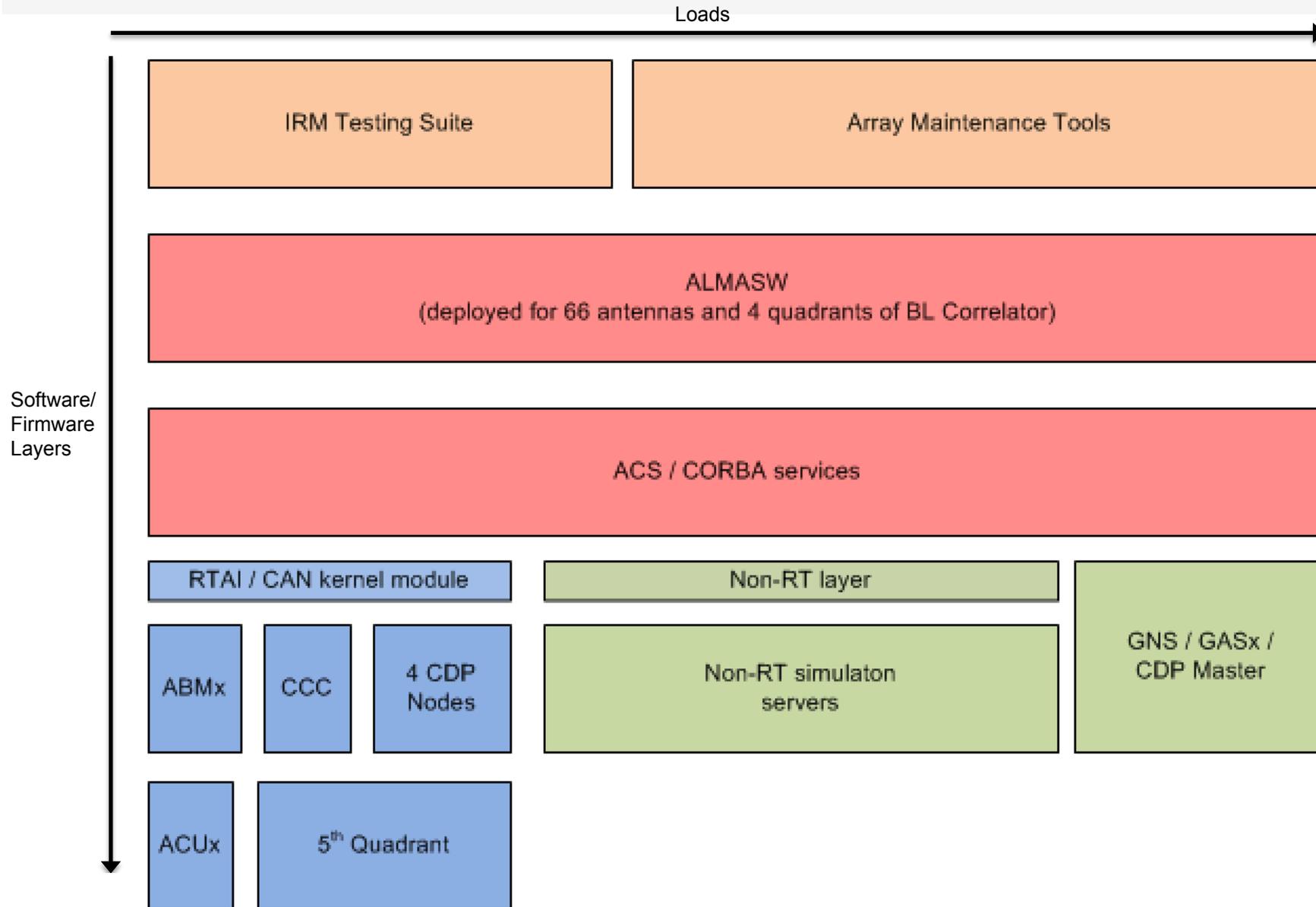
Non-RT Simulations in ALMA ...

- But it doesn't allow to exercise software layers related to:
 - CDP nodes interface to CORR hardware
 - CCC CAN communication with CORR electronics
 - ABM CAN communication with ACU
 - ABM CAN communication with FE devices
 - ABM CAN communication with BE devices
 - ABM CAN communication with Compressor device

- Without meaningful data produced in the non-realtime simulation of Correlator, we could not exercise extensively code related to:
 - TELCAL algorithms
 - Quicklook visualisations



Hybrid Approach





Additional Hardware Required

- 5th quadrant “partially equipped”.
- 4 CDP nodes
- 1 CCC
- 4 real antennas (including FE/BE devices)
- 4 set of LLC/SAS
- 1 CRG/CRD
- 1 Photonic reference
- 10 Racks (and a place to install them)
- Power/cooling, etc



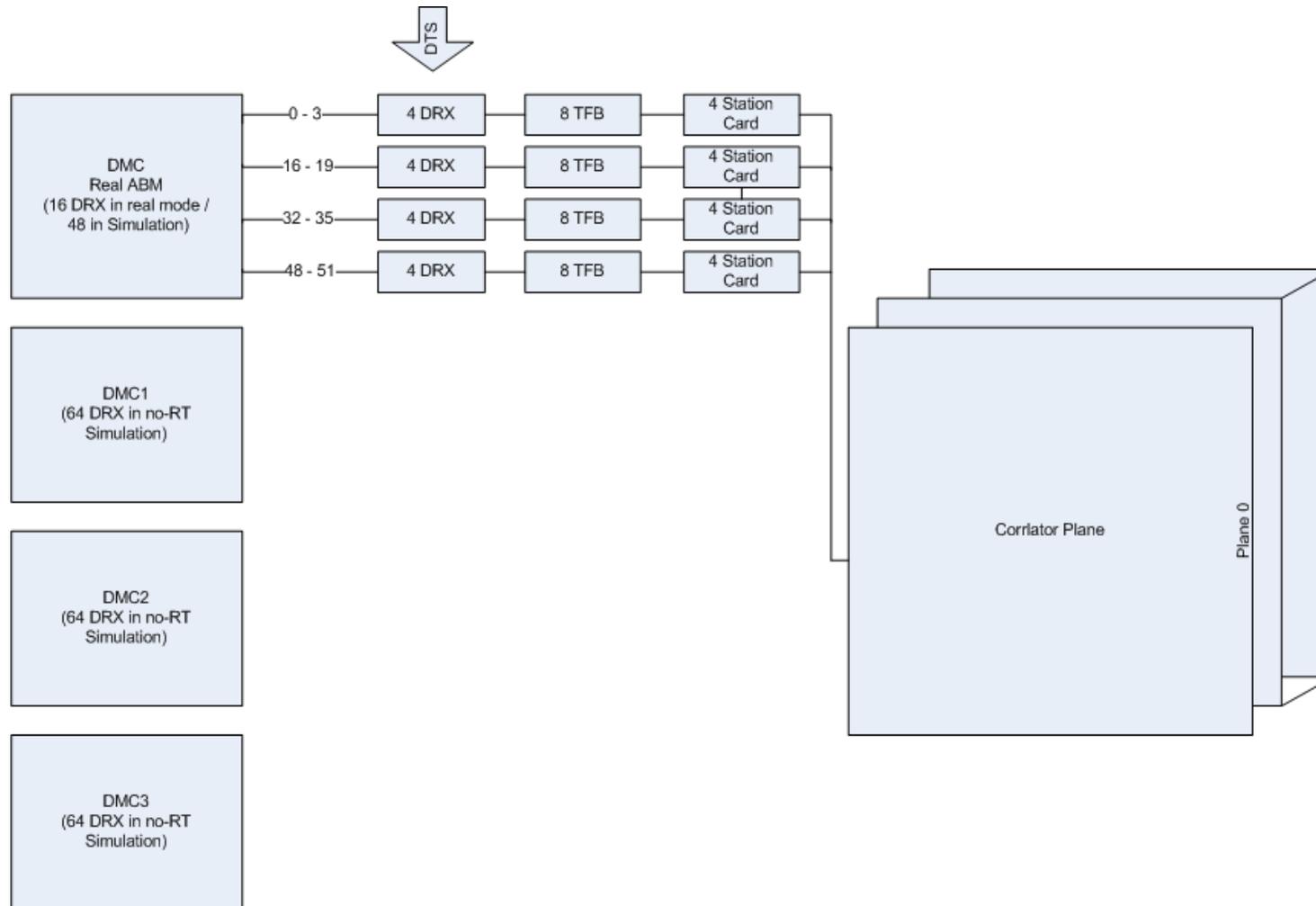
5th Quadrant Configuration

- D.1) 1 BBPs, 64 antennas Correlator
 - Allow to test CDPNodes software layer
 - Allow to test CCC software layer
 - Allow to test Correlator firmware
 - **Aimed for phase B testing (Verification)**

- D.2) 4 BBPs, 16 antennas Correlator
 - Allow to generate meaningful data in the 4 BBPs in order to exercise the PIPELINE.
 - **Aimed for phase C testing (Validation)**



DRX connections





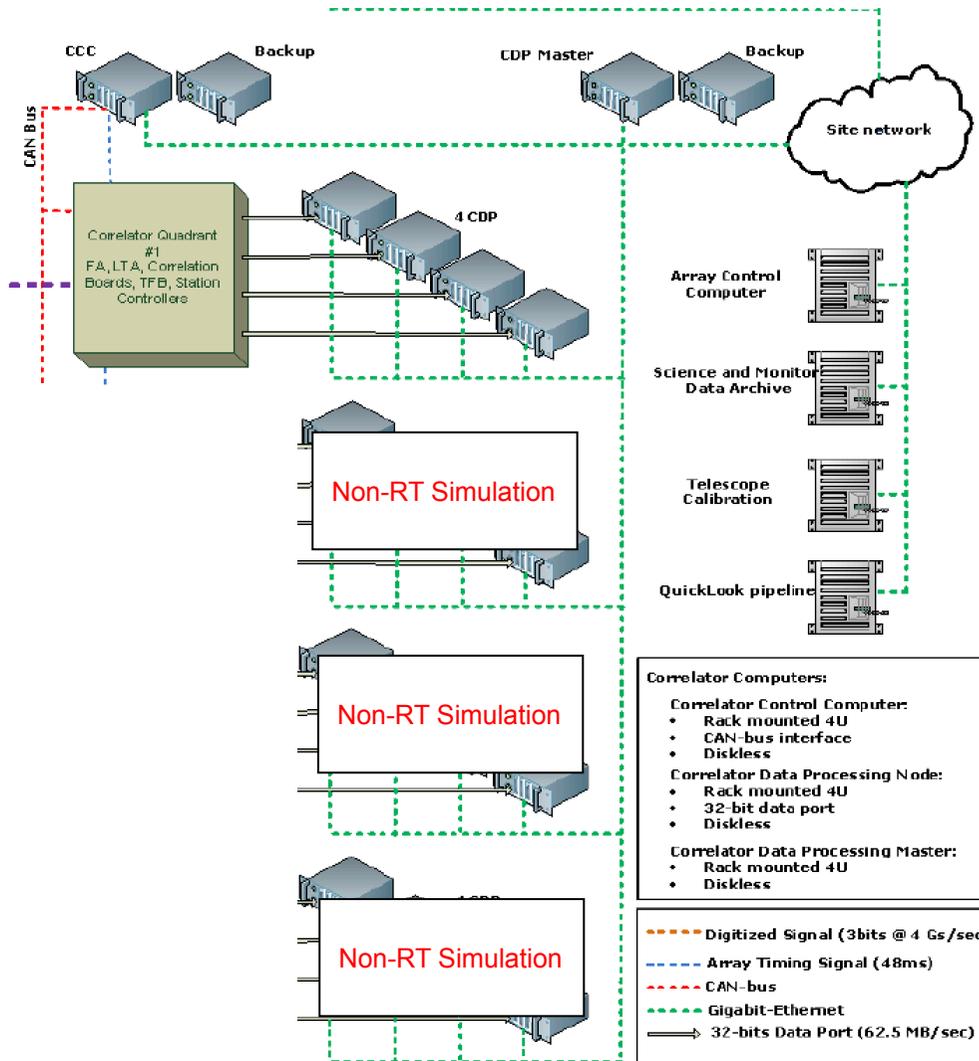
Correlator Plane (D.2 conf.)



- The D.2 configuration doesn't need to be developed from scratch.
- We used to operate under this configuration with the very first quadrant at the OSF, but...
- "1-Quadrant configuration" firmware haven't be maintained since 2013 (the last version was committed to CVS at 5/17/2013 7:51 AM)



CDP Nodes, CCC



- In D.1. configuration:
 - 4 CDP nodes will be connected as in production (all 4 nodes receive data from a the same BBP)
 - 1 CCC will monitor the single available quadrant
 - How CCC will be affected by not finding hardware of other quadrants in the CAN bus?
- In D.2 configuration:
 - Each CPD node will received data from different BBP
 - What is the impact in the CDP node software ?



LO connections

- The CLOA2 ML and MLD can be used to derive a Laser reference signal to the new CLO
- 1 CRG/CRD
- 1 LS
- 4 LLC / 4 SAS



Project Schedule

- June 2016: Finalize the design
- July 2016: Detailed costing of additional hardware
- Aug 2016: Presentation to ALMA Development Funds.
- If it is funded:
 - Two years is required to assemble and install the 5th quadrant at the OSF
 - Meanwhile, several proof of concepts needs to be validated.



Advantages

- The ALMA software under testing is the same than the one running in the operation. All pieces of software are exercised/tested before going to production.
- Test bench for testing hardware and firmware of Correlator
- More Correlator electronics to serve as hot spares of production Correlator.
- Provide enough time to reproduce complex problems and to verify the fixes provided by developers.
- Platform can be used to validate the compatibility of new model of electronic hardware
- Validate modifications of procedures in the production environment
- Become a training environment, for both hardware, software engineers and operators.

