Distributed Control System for the Test Interferometer of the ALMA Project

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ALMA

- No fewer than 64 12-meter antennas located at an elevation of 5000 m in Llano de Chajnantor, Chile.
ALMA, continued

- Imaging instrument in all atmospheric windows between 10 mm and 350 µm.
- Array configurations from approximately 150 m to 10 km.
- Spatial resolution of 10 milliarcseconds — 10 times better than the VLA and the HST.
- Able to image sources arcminutes to degrees across at one arcsecond resolution.
ALMA, continued

- Velocity resolution under 0.05 km/s.
- Faster and more flexible imaging instrument than the VLA.
- Largest and most sensitive instrument in the world at millimeter and sub-millimeter wavelengths.
- Point source detection sensitivity 20 times better than the VLA.
ALMA Partners

• USA
  – National Radio Astronomy Observatory (NRAO)

• Europe
  – European Southern Observatory (ESO)
  – Centre National de la Recherche Scientifique
  – Max-Planck-Gesellschaft
  – Netherlands Foundation for Research in Astronomy and Nederlandse Onderzoekschool Voor Astronomie
  – United Kingdom Particle Physics and Astronomy Research Council
Test Interferometer (TI)

- Test instrument being constructed at VLA site using prototype equipment, especially for evaluating and comparing antenna designs.

- TICS: Test Interferometer Control System
TICS Architecture, Physical
TICS Architecture, Logical
ALMA M/C Bus (AMB)

- CAN bus
- 1 Mb/s data rate
- Single master
- Custom bus protocol
- 2000 transactions per second
- Timing event for synchronization
Devices

- Run on antenna bus master computer (ABM), array real-time machine (ARTM) and correlator control computer (CCC), all PPC/VME/VxWorks machines
- Most perform communication with hardware devices
- Device and their properties are ACS distributed objects
Example Devices

- antenna mount system
- helium compressor
- first local oscillator controller
- master clock
- correlator
- laser synthesizer
Timing

- Array time is distributed throughout array
- Initialized to GPS time
- Maintained by local maser clock
- Central reference generator produces array-wide timing events, with a 48 ms period
- Synchronization provided via timing events
- Timing event–associated monitor or control transactions on CAN bus specified relative to timing events
Fine Tuning Synthesizer Device

- component of first and second local oscillators (LO)
- fine adjustment of LO frequency: 10 – 50 MHz
- phase offset capability (for phase switching)
- direct digital synthesizer can produce a wide range of phase/frequency outputs (for fringe tracking)
FTS Module Hardware
FTS Sequence Diagram

LO: Local Oscillator

FTS: FTS

Phase Model Server

H/W

AMS or rcvr

setMultiplierValue(int)

startNewModulation(EpochS)

newPhaseFnCE(

'get phase function'

"load parameters"

"update source"

"restart"

"update delta frequency"
Status

- February ’02: TICS 0.2 release
  - mount control
  - optical pointing telescope
  - holography
- Mid-April ’02: VertexRSI antenna delivery