EVLA Advisory Committee Meeting

System Status

Jim Jackson, Hardware Systems Engineer
System Status
Overview

• June 2006 Advisory Committee report
• Antenna status
  – Outfitting
  – Retrofit items
• Front end status
• Phase stability
• Electronics
• Digitizers
• Other system highlights
System Status
Responses to 6/06 Adv Comm.

- **L/C Band OMT schedule and testing**
  - L-band OMT first article production components in testing
  - C-Band OMT prototypes built and in testing
- **Round Trip Phase system schedule and performance**
  - On antenna tests late 06 / early 07
  - Expect RTP measurement to meet project requirement
  - Issues with reliability and repeatability
  - New PCB’s and firmware to address hardware instability issues
  - New design being tested in lab and system
  - Ready for production by January 2008
- **Digitizer schedule**
  - Contract awarded 8/31
System Status

Antennas

- Antenna outfitting
  - 11 Antennas turned over to operations
  - 12th Antenna turnover expected by end FY07
  - Now accomplishing one antenna every two months
  - L,C,X,K and Q bands available with 4 IF’s
  - 4/P bands available on most antennas
  - Tests and evaluation on-going
  - Voice over IP (VOIP) phones working and in use
System Status
Antenna Vertex Room
System Status
Antennas

Retrofit Items on early EVLA antennas

- Antennas 14 and 16 have prototype LO hardware
  - Software compatible so doesn’t affect observing
  - Retrofit in CY 2008
  - Simplest approach is to swap out racks (1 week downtime/antenna)

- T304 Automatic Level Control (ALC)
  - Currently only on IF AC in all antennas
  - Will add IF BD in CY08 by simple swap of modules
  - No downtime required – done on maintenance days
  - Lack of capability having minor effect on observation

- T304 Gain Slope Equalizers
  - Will add by swap of modules (at same time as ALC where possible)
  - No downtime required – done on maintenance days
  - Lack of capability having no effect on observation – for WIDAR and 3-bit mode
System Status
Antennas

Retrofit items on early EVLA antennas

- **3-Bit Digitizers**
  - PCB’s added to D301-304 modules in each antenna
  - Will also add additional M&C and diagnostic functions
  - May implement subtle change in transmission protocol
  - Install beginning summer 2008
  - No downtime required - simple swap of D30X modules on maintenance days

- **M302/M303 Utility Modules & J-Boxes**
  - Retrofitted to 10 antennas over duration of project (2 weeks downtime req.)
  - Used for antenna monitoring and maintenance over network
  - Adds capability to monitor cryogenic compressors & HVAC
  -Eliminates dependence on old copper twisted pair line
  - Lack of capability doesn’t affect observing

- **Add 3rd and 4th L302 Synthesizers**
  - Only required for WIDAR correlator
  - No downtime required - done on maintenance days
System Status
Front-Ends

Front Ends

- 4 Band
  - Complete – Using existing VLA receiver

- P-Band
  - Complete – Using existing VLA receiver

- L-Band
  - Horn complete and in production
  - Prototype OMT and receiver in use on antenna 14
  - First article production OMT in lab testing

- S-Band
  - Feed horn built and tested – production contract awarded soon
  - Prototype receiver being developed
  - Wideband OMT being developed - will use scaled down version of L-band

- C-Band
  - Horn complete and in production
  - Interim receiver in production (final receiver minus wideband OMT)
  - Prototype OMT in testing
Front-Ends

- **X Band**
  - Currently using existing VLA receiver
  - New X-Band receiver will be last to be developed
  - New X-Band feed designed, tested and in use on antenna 24

- **Ku-Band**
  - New feed horn to be developed
  - New receiver to be developed – will be based on K-Band design

- **K-Band**
  - Using existing VLA feed and receiver
  - Added block converter and modified LO/IF chain
  - In production

- **Ka-Band**
  - Horn in production
  - Receiver development underway
  - Prototype in lab testing

- **Q-Band**
  - Using existing VLA feed and receiver
  - New MIMIC post amp and block converter
System Status
Phase Stability

• Phase Stability
  – Two primary effects have been noticed
    • Phase changes with ambient temperature & season
    • Phase changes with antenna elevation angle
  – Both first noticed in scientific observation
  – Both verified and localized with specially designed lab and/or on-antenna tests
  – Both seem to be thermally induced
  – Neither seems related to fiber optic system
  – Expect to be able to meet project requirement
System Status
Phase Stability

- Change with ambient temperature
  - Primarily due to HVAC control and vertex room air circulation
  - Being corrected by fine tuning HVAC system control algorithms and adding air circulation fans in vertex room
  - May also need to temperature stabilize receiver enclosures and helix cables
    - Can be accomplished by adding ducting from HVAC blower
  - Worst case - may need to add second blower on upper level
    - Expensive and difficult to retrofit
    - Not considered high probability
  - Slow but constant progress – effects vary seasonally
System Status
Phase Stability

- Change with antenna elevation angle
  - Primarily due to internal thermal performance of some modules
  - Iterative testing and modification of modules in antenna and lab
    - Pinpointed problem to a few specific modules
  - Slow process – effect is small and difficult to measure
  - Current solutions involve mechanical changes to modules
    - L300 Comb Generator and T304 Downconverter
      - Add thermal mass to critical components
    - L301 / L302 Synthesizers
      - Replace certain thermally sensitive cables inside of modules
  - May need to examine T302 LSC Converter
  - Worst case - may also require adding two PLO’s to L300
    - Expensive
    - ALMA had to do this but has more difficult spec.
    - Not considered high probability
System Status
Electronics

Modules/Sub assemblies in final design

- P350/P351 DC/DC power supply
  - PCB Mod to support N+1 redundancy
  - Includes power distribution board
  - Ready for production by January 2008

- L352 LO Round Trip Phase Meter
  - Issues with reliability and repeatability
  - Affects use of higher frequency bands
  - New PCB’s developed – integrated motherboard
  - New design being tested in lab and system
  - Ready for production by January 2008

- 3-bit digitizer PCB(s) for D30x
  - Chip contract awarded
  - Production should begin summer 2008

EVLA Advisory Committee
6-7 Sept 2007
System Status
3 Bit Digitizer

- Competitive bid
  - Sampler chip/set
- Selected on
  - Price (inc. cost of implementation)
  - Specification compliance
  - Availability
  - Support
- Three qualified vendors bid
  - ST Microelectronics (ALMA device)
  - Teledyne Scientific (formerly Rockwell)
  - E2E (formerly Atmel)
- Contract awarded to Teledyne 8/31/2007
  - 6 engineering samples in 7 months
  - 280 production parts in 7-18 months
System Status
3 Bit Digitizer

Teledyne Digitizers on NRAO/EVLA PCB

- Tested in DTS Module by EVLA project
- Used to evaluate EVLA 2-4 GHz signal path and gain slope equalizer
System Status
Other System Highlights

• New shielded room for WIDAR correlator installed & RFI tested
  – 48VDC power system installed and tested
  – HVAC, alarm and fire suppression installed and tested
  – Fiber, network and computing infrastructure being installed now
  – Will be ready well in advance of WIDAR correlator delivery
• Cryogenic compressors & Scott-T boxes in production
• Antenna HVAC systems purchased
• Feed cone assembly in production
• Azimuth fiber cable wrap in production
• All fiber optic cable in the ground and terminated
• Fiber optic termination room complete
• Control building fiber M&C networking in place
Questions?