System Status

- Status of first three antennas
- Digitizer status
- Synthesizer test results
- Things to do
- System block diagrams
System Status
Antenna 13

• First EVLA Prototype - Antenna 13
  – X and L bands available
  – C, K and Q band available Dec 2004
  – Equipped with two IF channels
  – Mostly prototype hardware
  – Will be updated with production hardware after 2\textsuperscript{nd} and 3\textsuperscript{rd} antennas (14 and 16) are completed
  – Tests and evaluation on-going
System Status
Antenna 13

First Light
Antenna 13
(X-Band)
October 2003
System Status
Antenna 13

1st EVLA Prototype - Antenna 13
– First Fringes X-Band – March 2004
– First Fringes L-Band – July 2004
– K and Q band available Dec 2004
– Tests and evaluation on-going
– Will upgrade to four IF channels and production hardware in early 2005
Fringe Phase
Antenna 13 w/ VLA

Fringe Phase for Antennas 13, 8 and 23
Source is 3C273, Frequency 8.448 Ghz

Phase (Degrees) vs. Time (seconds)
System Status
Antenna 14

- 2\textsuperscript{nd} EVLA Prototype - Antenna 14
  - One IF at X band December 2004
  - Four IF channels available January 2005
  - L, C, K and Q bands available Jan 2005
  - Mostly prototypes of production hardware
  - Plan to begin routine observation with VLA Feb 2005
System Status
Antenna 14

- 2\textsuperscript{nd} EVLA Prototype - Antenna 14
  - First Fringes X-Band – Dec 2 2004
    - With VLA and 1\textsuperscript{st} EVLA Prototype (Ant 13)
  - Tests and evaluation on-going
System Status
Antenna 16

• 1\textsuperscript{st} EVLA production antenna
  – Antenna 16
  – Currently in antenna barn
    • Bearing change completed
    • Vertex room gutting in progress
    • Fiber & electrical wiring being installed
  – Electronics hardware
    • Being fabricated in lab
Hardware Status

• Hardware currently installed and operating in the VLA control building:
  – L350 Central Reference Generator
  – L351 Master Offset Generator
  – L353 LO Transmitter
  – L354 LO Distribution
  – DTS Receiver Boards (3)
  – P301 Power Supply
  – 48 VDC Bulk Power Supply and Batteries
Hardware Status

• Hardware currently installed in Antenna 13:
  – L301(x2)/L302 Synthesizers
  – L304 LO/Reference Receiver
  – L305 Antenna Reference Generator
  – T304(x2) Downconverter
  – D301/D303 Sampler/DTS Modules
  – P301 Power Supply (x2)
  – Cisco Network Switch
  – 48 VDC Bulk Power Supply and Batteries
Hardware Status

- Hardware currently installed in Antenna 14:
  - L302 Synthesizers (2nd Generation)
  - L304 LO/Reference Receiver (2nd Generation)
  - L305 Antenna Reference Generator
  - T304 Downconverter (Integrated prototype)
  - D302 Sampler/DTS Modules (2nd Generation)
  - P301 Power Supply (2nd Generation)
  - Cisco Network Switch
  - 48 VDC Bulk Power Supply and Batteries
Hardware Status

• Fiber optics
  – Fiber burial on all three arms complete
  – Antenna 14 fully connected at master pad
  – Antenna 13 fully connected at W10/CW5
  – Fiber spliced to end of west arm for round trip phase testing
  – LO/Reference fiber phase characterization continuing
Digitizers

- 8-bit, 2 Gsps digitizer
  - New single chip design using Atmel 8 bit, 2 Gsps device
  - Installed in DTS module and in use on Antenna 14
  - Used for transition and observation in high RFI bands
Digitizers

- Recreated Waveform
  - 8 Bit Digitizer
  - Processed thru fiber link and FIR filters
  - Output from D/A converter on deformatter
Digitizers

- 3-bit, 4 Gsps digitizer
  - ALMA – 3 bit, 4 Gsps, 4 GHz BW
    • under development in France
  - Rockwell – 6 Bit, 6 Gsps, 12 GHz BW
    • Supposedly sampling next Jan 2005
  - Atmel - 8 bit, 4 Gsps, 5 GHz BW
    • in development
L301 Synthesizer
Phase Noise

L301 #1
HP 3048A Carrier: 16.000E+9 Hz
5/18/04 12:19:52 - 12:25:17

$\epsilon(f)$ [dBc/Hz] vs. $f$[Hz]

12/10/2004
Jim Jackson

EVLA Advisor Committee
14-15 December 2004
L302 Synthesizer Phase Noise
L302 Synthesizer
Long Term & dT Phase Drift

L302 Relative Phase @12.8 GHz

\[ y = -0.002x + 7.7013 \]

12/10/2004
Jim Jackson

EVLRA Advisor Committee
14-15 December 2004
L302 Synthesizer
20 degree dT

L302 Relative Phase @12.8 GHz

\[ y = 0.0866x - 48.355 \]
L302 Synthesizer Stability

- Direct relation to temperature
- Long term drift at constant temperature
  - ~ 0.002 deg / min (source unknown)
  - ~ 0.00016 deg / min / GHz
  - 8x better than spec of .0013 deg / min / GHz
- Phase change with temperature
  - 0.25 deg / hr / °C
  - 0.01 deg / 30 min / GHz / °C
Things to Do

• Phase stability testing of LO System
  – Test two systems in one antenna through fiber
  – Test all modules in environmental chambers
  – Have been limited by time and available hardware

• Detailed analysis of LO round trip phase in fiber
  – Previous data dominated by equipment error
  – Redesigned RTP measurement system now ready

• Detailed analysis on effect of DC/DC converters
  – So far not an issue but needs closer examination
Things to Do

• Gain stability testing of IF system
  – Currently having a possible issue with this
  – Test all modules in environmental chambers
  – Have been limited by time and available hardware

• Improve repeatability in modules
  – Some modules still must be calibrated and installed as matched sets – would like to avoid this

• Detailed analysis of ground system noise
  – Seems to be issues in both antennas and building
EVLA Antenna IF Diagram
EVLA Antenna
IF Diagram

- T303 UX Converter
- T302 LSC Converter
- T301 4P Converter
EVLA Antenna
IF Diagram
EVLA Control
Building IF Diagram
EVLA Control
Building IF Diagram

WDM DeMux

DTS Receiver
FIR/DAC
DTS Receiver
FIR/DAC
DTS Receiver
FIR/DAC
DTS Receiver
FIR/DAC

WIDAR Correlator

0-50MHz

VLA → EVLA Transition Mode

VLA T4 & T5
VLA T4 & T5
VLA T4 & T5
VLA T4 & T5

Fiber from Antenna

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EVLA Control

Building LO Diagram

- VLA IAT Clock (Transition)
- Sigma Tau Maser
- VLBI Timing Source (GPS, etc..)

0.1Hz
5MHz to VLA
5MHz
EVLA Control
Building LO Diagram

VLA IAT Clock (Transition)

Sigma Tau Maser

VLBI Timing Source (GPS, etc.)

L350 Central Reference Generator

- 0.1Hz
- 5MHz to VLA
- 5MHz
- 128MHz to WIDAR
- Timing to WIDAR
- 19.2Hz to MIB's

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EVLA Control
Building LO Diagram

VLA IAT Clock (Transition)

Sigma Tau Maser

VLBI Timing Source (GPS, etc..)

LO Master Rack
- 128MHz to WIDAR
  - Timing to WIDAR
- 19.2Hz to MIB’s

L350 Central Reference Generator
- 512MHz
- 128Hz
- 512Hz

L354 Offset Generator
- 512MHz (3 copies)
- 512000128Hz (3 copies)

L351 Offset Generator
- SYNC (3-copies)
- 128Hz (3-copies)
- 5.12MHz (3-copies)
EVLA Control
Building LO Diagram

LO Master Rack
- 128MHz to WIDAR
- Timing to WIDAR
- 19.2Hz to MIB's

L350 Central Reference Generator
- 512MHz

L351 Offset Generator
- 128Hz
- 512MHz (3 Copies)

L354 Distributor
- 128MHz to WIDAR
- Timing to WIDAR

L353 LO Xmit RTP Recv
- 512MHz RTP

L352 RTP Measure
- RTP Fiber From Antenna

L355 Timing Distributor
- 128Hz (3-copies)
- 5.12MHz (3-copies)

Antenna LO/RTP Racks (3 Racks – 1 Shown)
- LO Fiber To Antenna

VLA IAT Clock (Transition)
- 0.1Hz

Sigma Tau Maser
- 5MHz to VLA

VLBI Timing Source (GPS, etc..)
- 5MHz

Antenna LO/RTP Racks (3 Racks – 1 Shown)
- RTP Fiber From Antenna

LO Master Rack
- 128MHz to WIDAR
- Timing to WIDAR
- 19.2Hz to MIB's

L350 Central Reference Generator
- 512MHz

L351 Offset Generator
- 128Hz
- 512MHz (3 Copies)

L354 Distributor
- 128MHz to WIDAR
- Timing to WIDAR

L353 LO Xmit RTP Recv
- 512MHz RTP

L352 RTP Measure
- RTP Fiber From Antenna

L355 Timing Distributor
- 128Hz (3-copies)
- 5.12MHz (3-copies)

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14-15 December 2004
EVLA Antenna LO Diagram

LO Fiber From Building

L304 LO Receiver

512MHz +SYNC

RTP Fiber To Building

LO Fiber From Building
EVLA Antenna LO Diagram

L304 LO Receiver

L305 Antenna Reference Generator

- 9.6Hz to FE Rack
- 19.2Hz to FE Rack & ACU

Timing
- 128MHz
- 2048MHz
- 4096MHz

- To D301-4

- 19.2Hz to MIB’s
- 4096MHz to T304
- 1024MHz to T301
Questions?