NRAO VLBI ROADMAP

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VLBA FUTURE

• Senior Review results not yet known
• Guess VLBA will survive but need non-NSF funding of part of operations
• Need future improvements
  – Current capabilities getting less interesting
“Mapping the Future of VLBI Science in the U.S.”
- The “Lonsdale - Taylor” report
- A good guide to where the US VLBI effort should go
  - Had significant community input and scientific justification
- Essentially everything that NRAO hopes to do with the VLBA is in the report
- This talk will summarize the recommendations and discuss the status and prospects for implementation
NEAR TERM
(2004-2006)

• Switch to Mark5.  Done (but < 20 on correlator)
• Increase bandwidth to 1 Gbps.  Barely started.
  – Path to 512 Mbps understood - more disks.
  – Significant changes needed to get to 1 Gbps.
• Equip Arecibo and GBT with Mark5.  Done.
  – Formed the HSA
• Upgrade 22 and 43 GHz receivers, 86 GHx septum polarizers, and 3mm antenna performance.  Not done.
  – 22 GHz will be done in 2007.
• Investigate WVR and dual Frequency Observations.  Not done.  WVR moving slowly on VLA.
MID TERM (2007-2009)

• Increase bandwidth to 4-16 Gbps.
  – Getting to 4 Gbps will be a main topic of discussion at this meeting
    • Needs new BBCs, data transmission system, and correlator
  – 16 Gbps a goal but much more expensive
    • New LO/IF and some new receivers
• Implement mm VLBI at LMT, CARMA, SMA, and ALMA.
  – Other than ALMA, is this an NRAO task?
LONG TERM (2010-2013)

• Transition to fiber links.
  – Need the technology
  – Need business model for fiber access
  • This may be the hard part.

• SKA
  – VLBI and linked interferometry no longer distinct
  – Much technology development needed
  – VLA/VLBA future depends somewhat on just what SKA turns out to be - eg frequency range
OTHER RECOMMENDATIONS

• Significantly improve VLBI postprocessing software.
  – CASA (was AIPS++) may do it, but VLBI is not a current CASA priority
  – Incremental AIPS improvements on-going

• Community support
  – User friendly tools
    • Pipelines and scripts
  – Money. Starting student support as at GBT.
4 Gbps by 2010: BBC and SAMPLERS

- A major goal is to get to 4 Gbps by ~2010
- Can use current dual 500 MHz IFs.
- Need new hardware for sampling and channelization.
  - Fast sampler and digital filters
- Choices:
  - EVLA hardware
  - Noto digital BBC
  - Haystack/Berkeley digital BBC
  - Something new
4 Gbps by 2010
DATA TRANSMISSION

• Need more data transmission capacity than Mark5A or Mark5B
• Recording choices:
  – Dual Mark5B+
  – Other Mark5 derivative
  – Other
• eVLBI
  – Need fiber access
4 Gbps by 2010
CORRELATOR

- Current correlator poor beyond 512 Gbps and cannot go beyond 1 Gbps
  - Needs multi-pass or max 10 stations for 1 Gbps
- Choices for wideband correlator:
  - EVLA WIDAR correlator
    - Has 5 extra station inputs. Can do 20 stations at 4 Gbps.
  - Software correlator
    - Fast development and highly flexible
    - Expensive for high bandwidth
  - New hardware correlator
    - Berkeley FPGA style?
    - Small WIDAR?
HAYSTACK COLLABORATION

• Primary opportunities
  – Wide bandwidth recording systems
  – eVLBI

• Possible developments
  – Digital BBC
  – Correlator

• mm VLBI
  – Use of Haystack antenna?
  – Outfitting non-NRAO antennas
End of Roadmap
EVLA WIDAR correlator is designed with enough delay and rate capacity for VLBI.
Station cards can take VSI input:
- May need to have chips populated.
Phase I correlator has 32 station inputs:
- VLA only needs 27. 5 Extra.
- Each input can do:
  - 1 station at 16 GHz (8 GHz per polarization)
  - 2 stations at 4 GHz (2 GHz per polarization)
  - 4 stations at 1 GHz (500 MHz per polarization)
The 5 extra stations provide a much enhanced capability over the current VLBA correlator.
ADVANTAGES OF USING THE WIDAR CORRELATOR

• Correlator being built anyway
• No need to maintain a separate correlator
• High capacity into the future
  – 20 stations at 1 GHz (4 Gbps)
  – 10 stations at 4 GHz (16 Gbps)
• If EVLA2 is built, boundary becomes fuzzy
  – Shared antennas, entangled scheduling …
• Further unifies EVLA and VLBA operations
DISADVANTAGES OF USING THE WIDAR CORRELATOR

- VLBA correlator operations would have to be at the VLA site
- The capacity is high, but is capped
  - Beyond 1 GHz, limited to just the VLBA unless take out some VLA antennas or expand correlator
- Extra stations may be in demand for other uses such as LWA or SKA prototypes.
- May be difficult to expand in the future
  - Parts may no longer be available