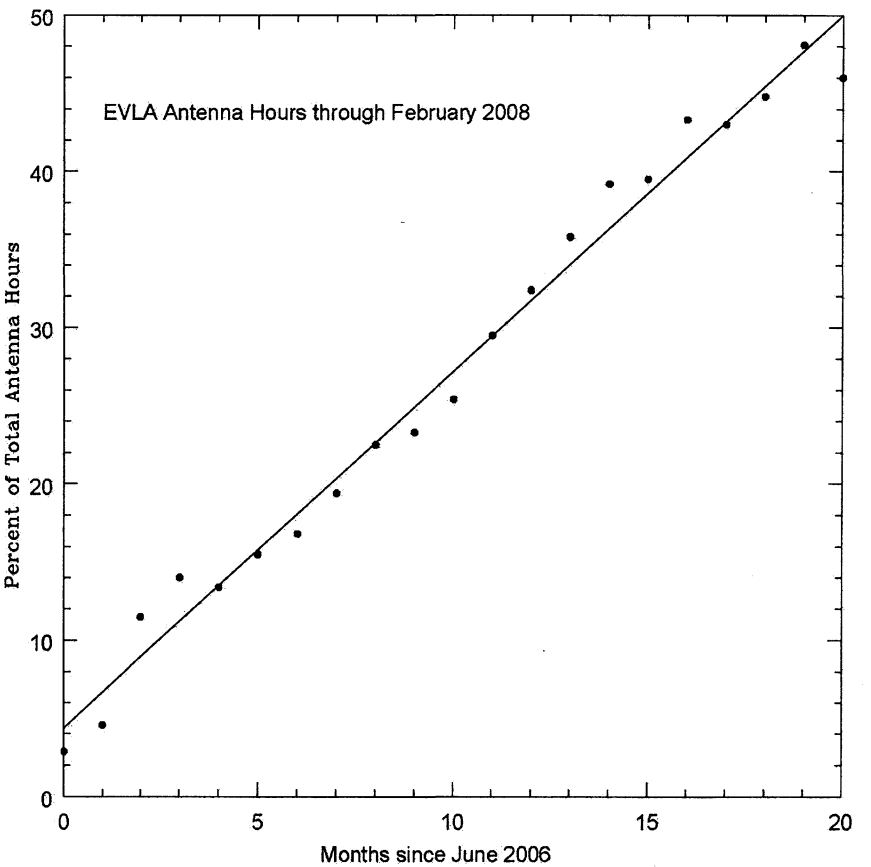
EVLA Capability Forecast

M. McKinnon

March 18, 2008

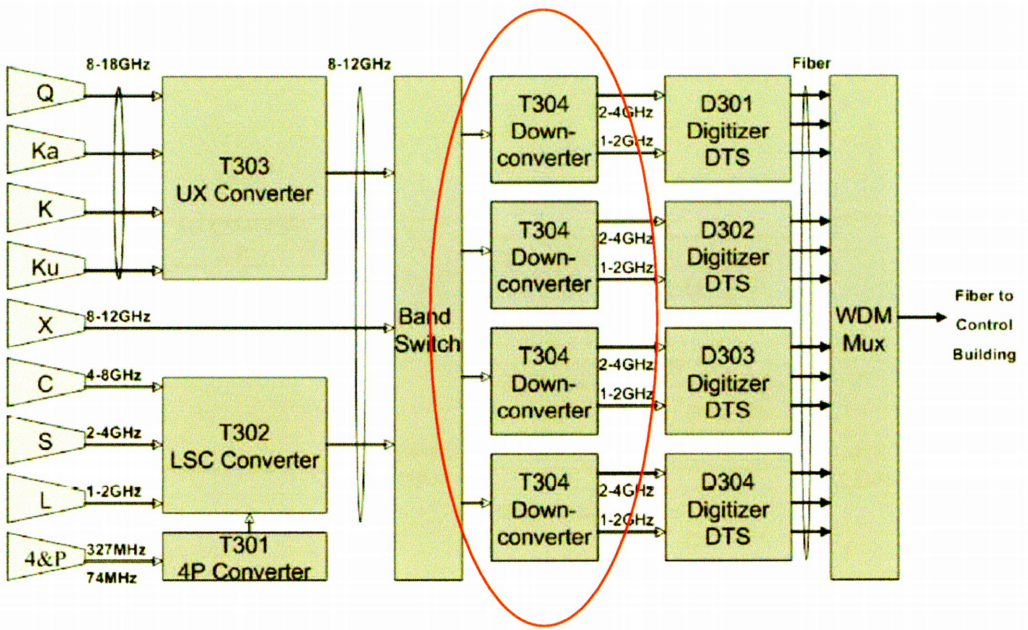
Antennas

- 14 EVLA antennas used in observations
  - Account for 46% of total antenna hours used in observations
  - Lost about 1.5% in Feb due to Ku band-only project
- Slip in recent retrofits of antennas 1 and 4 has pushed overall completion to Sep 2010.
  - Unexpected servo issues with antenna 1
  - Diversion of personnel to VLBA-SC rust-proof/painting & VLBA-FD bearing change
  - End-of-year vacation



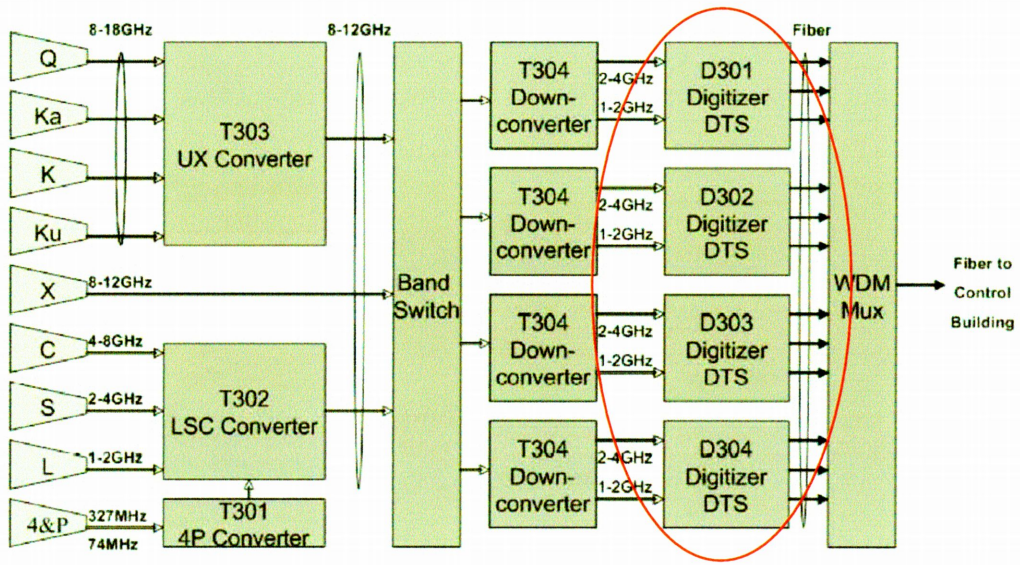
T304 Downconverters

- T304s downconverter EVLA IF to baseband
- T304 upgrades needed for wideband observing
  - Install 2-4 GHz filters
  - Install gain slope equalizers
  - Install total power detectors on “B-D” side
- Schedule
  - Start June 2008 at rate of 1 antenna/month
  - Complete Q3 2010



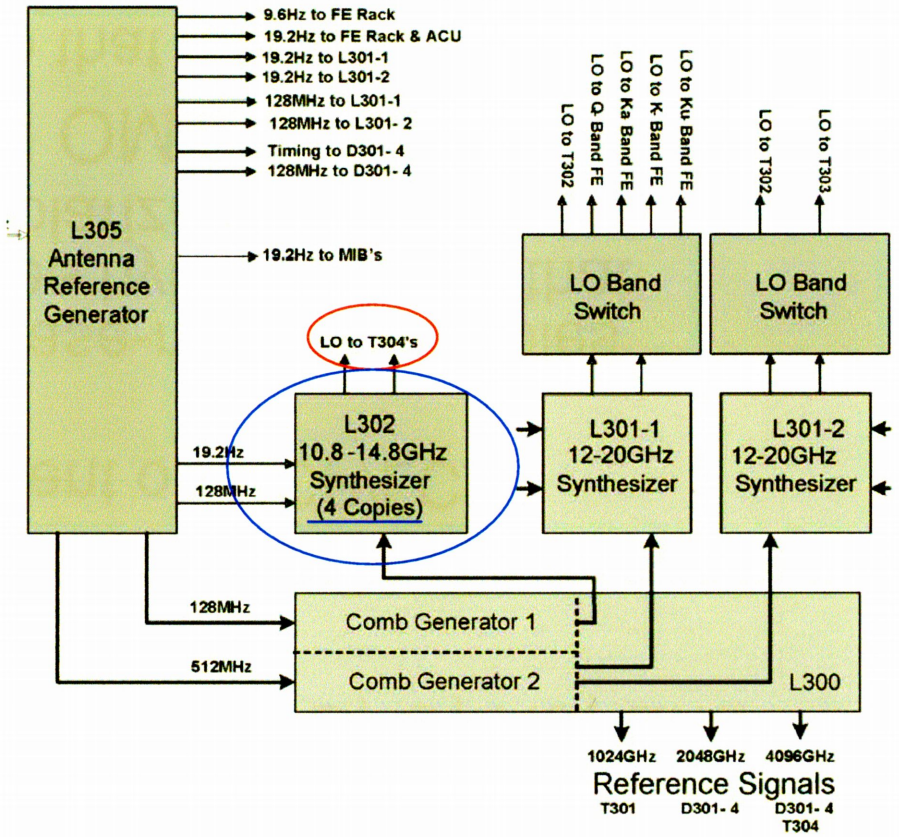
DTS Modules

- DTS modules contain samplers that digitize the EVLA baseband
- DTS upgrades needed for wideband observing
  - Install high speed samplers (4Gsps, 3bit)
  - 2 samplers/module; 4 modules/antenna
- Schedule
  - Start Dec 2008 at rate of 1.5 antenna/month
  - Slows to 1 antenna/month in Q1 2010 when caught up with T304
  - Complete Q3 2010



L302 Frequency Synthesizers

- L302s provide LO signals to the mixers on the T304 downconverters
- Only 1 set of 2 L302s is installed on each EVLA antenna
- Second set needed to drive LO on second wideband data path in each T304 downconverter.
  - Until L302 is installed, maximum bandwidth from each T304 is 2GHz instead of 4GHz.
- Schedule
  - Same as DTS module upgrades
  - Start Dec 2008 at rate of 1.5 antennas/month
  - Slow to 1 antenna/month in Q1 2010
  - Complete Q3 2010



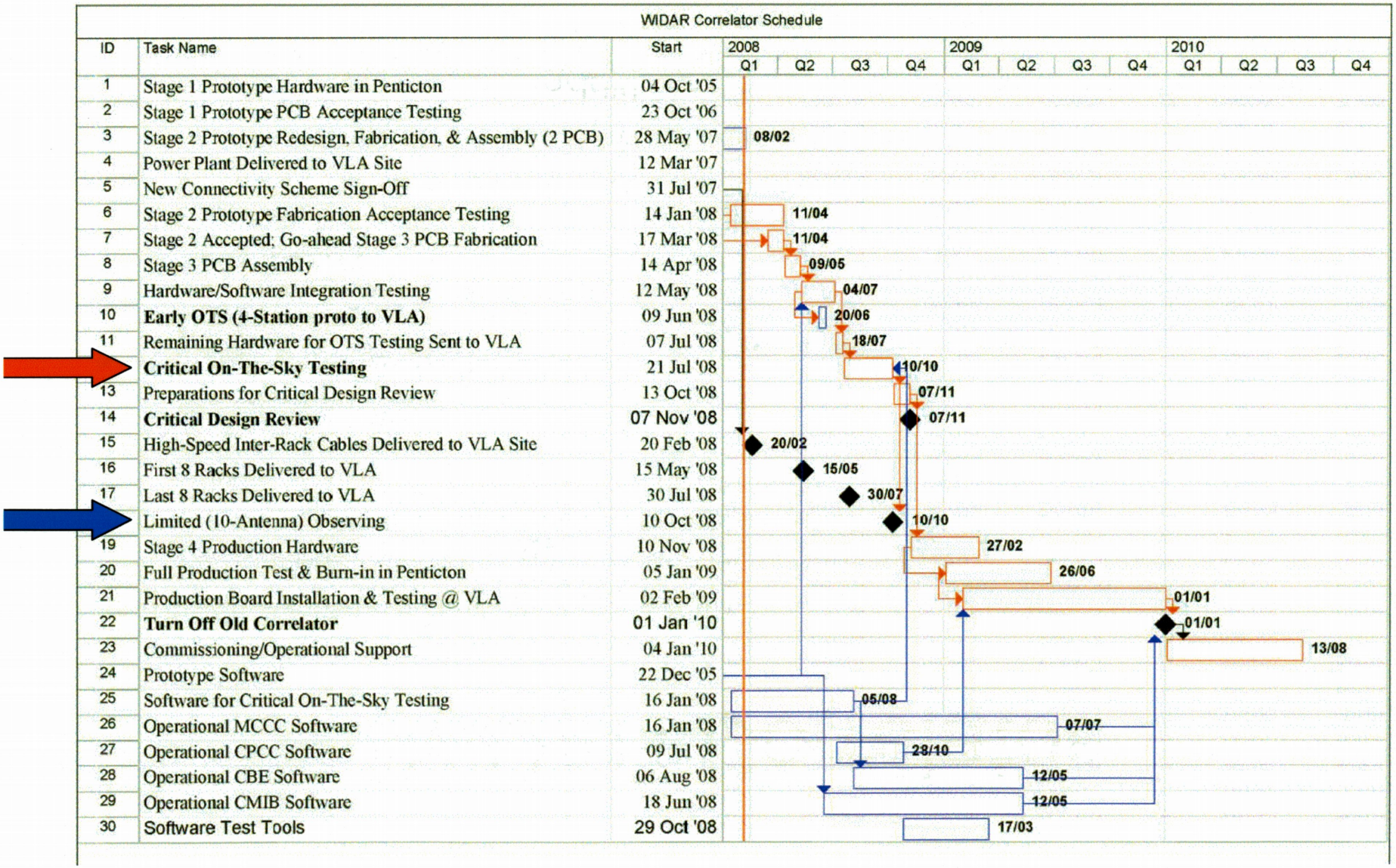
Receivers

- RF and mechanical designs for L, S, C, Ku, and Ka-bands reasonably mature
- Most issues with L, S, and C-band OMTs resolved
  - May need to relax requirement on RCP/LCP polarization axial ratio
  - Good progress made on phase-matching cables between OMT and 90 degree hybrid coupler that converts linear to circular polarization
- X-band design awaits final OMT design
  - Want to keep OMT small so that a small refrigerator can be used and thus avoid the installation of another cryogenic compressor
- L and S-band production are tied together because S reuses L-band dewar can

WIDAR Correlator

- 4-station prototype (see Michael's talk)
  - Stand-alone device designed for critical, on-the-sky (OTS) tests, only
  - Will be installed in VLA correlator room in Jun 2008
  - Critical OTS tests scheduled for Jul-Oct 2008
- 10-station correlator
  - Subset of final correlator
  - Installed in new shielded room
  - Configurations:
    - 10 antennas x 1 baseband each
    - 5 antennas x 2 basebands each
  - Can switch between configurations; preferably not more frequently than weekly
  - Initial use set for OTS tests & software/systems integration starting in late Oct 2008
    - Should have 18 EVLA antennas retrofitted by this time
- Production versions of station and baseline boards now likely to be delivered in 2-4 separate shipments over Feb 2009 – Jan 2010.
- NRAO has almost complete flexibility in how the boards are installed
  - Depending on what boards are shipped when, NRAO can configure the correlator how it wants (see Claire's talk)

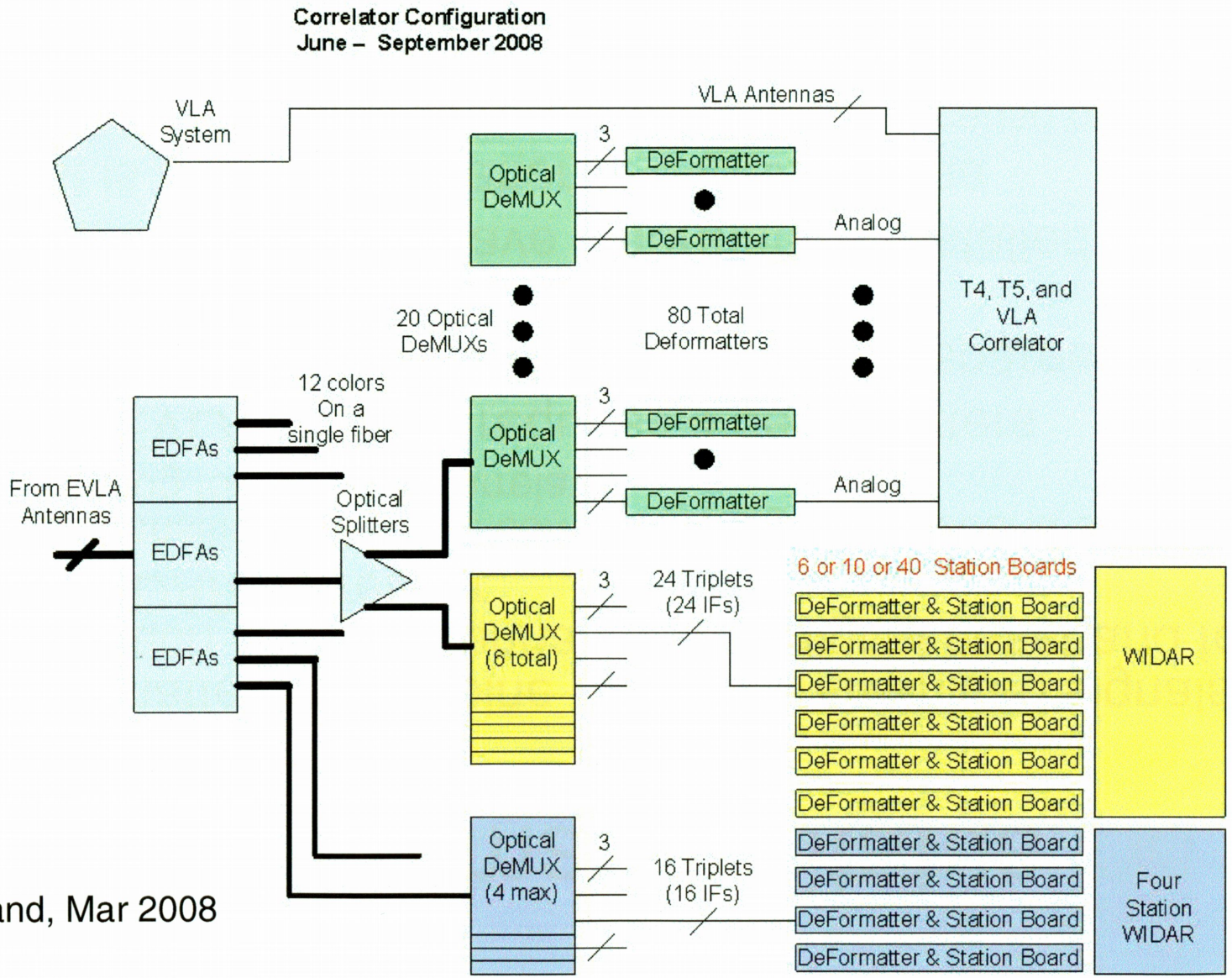
WIDAR Correlator



Deformatter Status

- Deformatters recombine optically transmitted signals from each EVLA antenna into the digital baseband for the WIDAR correlator
  - In transition, they also convert the digital baseband signal to analog for the VLA correlator
- Each EVLA antenna requires 4 deformatters
- Total number of deformatters, including spares: 4x30=120
- 14 EVLA antennas have deformatters installed
- Cost is $10K/deformatter or $40K/antenna
  - Prefer not to build additional deformatters because of expense and “throw away” money/effort.
- Expect 82 deformatters built by end of CY2008.
  - Remainder keeps pace with correlaor board delivery

Deformatters



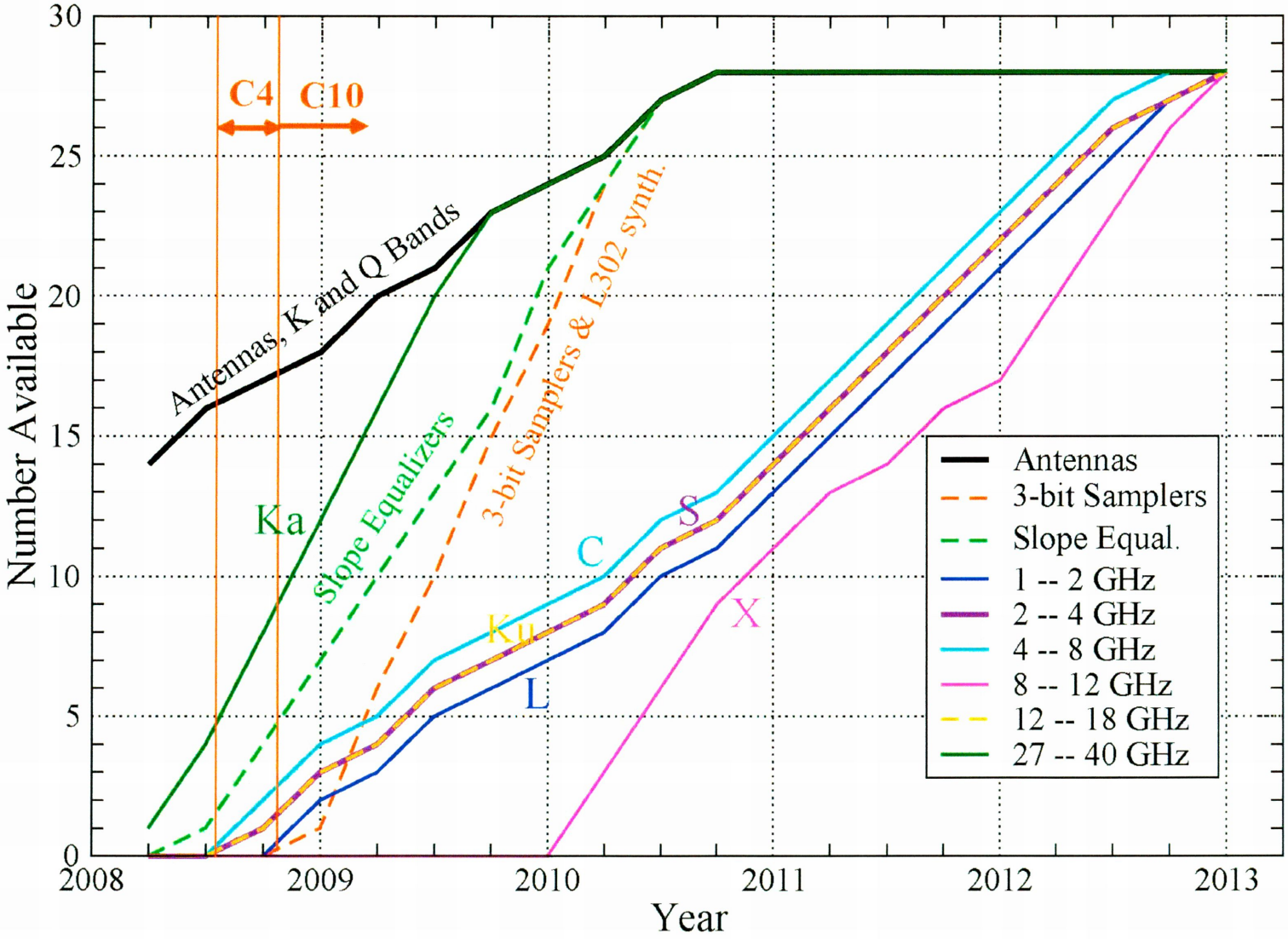
S. Durand, Mar 2008

Deformatter Configuration

- Data paths
  - VLA correlator
    - Deformatters installed in 2 deformatter racks which can support a total of about 20 antennas (20x4=80 deformatters)
    - DAC in deformatter sends analog signal via RF cable to correlator
  - WIDAR
    - Deformatters installed in WIDAR station racks
    - Direct digital connection to WIDAR; analog signal/RF cable not required
    - Deformatters deployed initially for 10-station correlator (10x4=40 deformatters)
- Optical splitter allows antenna data streams to be split between deformatters for both correlators
- See Claire's talk about how to deploy deformatters and configure WIDAR

EVLA Wideband Receiver Availability

Prepared March 2008



R. Perley, Mar 2008

Software Slides

Material covered by Bryan.

Included for compatibility with EVLA forecast.

Software - 1

- Software needed through transition timescale (present – Q4 2009)
  - Monitor and Control
    - Binary data format, Apr 2008
    - Science data model, Oct 2008
    - Integrate WIDAR w/ EVLA M&C, Oct-Dec 2008
  - Science Support Systems
    - Observation preparation and proposal submission tools
      - On timescales needed for proposal calls from added receiver bands
    - Observation scheduling tool
      - To support resident shared risk observing in Q4 2009
    - Archive access tool
      - Basic visibility data, Q3 2008
      - All visibility, monitor, and meta-data, Q4 2009

Software - 2

- Software needed for transition (continued)
  - Data post-processing (CASA)
    - Read data from prototype correlator, Q3 2008
    - Write UVFITS compatible with AIPS, Q3 2008
    - Data display task, Q3 2008
    - Calibration/imaging of limited fields, Q4 2009
    - Means of handling large data sets, Q4 2009
  - Algorithm development
    - Narrow field imaging, unconfused sources, Q1 2009
    - Data editing, Q4 2009
    - Narrow field imaging, confused sources, Q4 2009

More Deformatter Slides

Similar material as in Claire's presentation.

Included for compatibility with EVLA forecast.

What Happens in March 2009?

- Deformatter rack limit of 20 antennas will occur in March 2009.
  - At that time, the VLA correlator will receive signals from 7 VLA antennas and 20 EVLA antennas
- Question is tied to issue of when to shutdown VLA correlator
  - WIDAR schedule suggests this happens in Jan 2010.
  - May be possible to do this sooner, Sep 2009 (see Claire's talk)
- Currently, there are 3 options to consider:
  - Continue to use VLA correlator and 10-station WIDAR
  - Shift all deformatters to WIDAR; shutdown VLA correlator
  - Always require 27 antennas to the VLA correlator

Deformatter Option A

- Continue to use VLA correlator & 10-station WIDAR
  - Does not require production of additional deformatters and optical splitters/demultiplexers.
  - Total number of antennas to VLA correlator will decrease after Mar 2009
    - Example: A total of 25 antennas (5 VLA + 20 EVLA) will be in use just prior to the possible shutdown of the VLA correlator on Sep 2009.
    - Case 1: Continue to use retrofitted antennas (21+) by sending their signals directly to 10-station WIDAR
      - Would not always have identical antennas at both correlators
      - Number of unshared antennas is the number of retrofits beyond 20
    - Case 2: Retrofitted antennas beyond the 20th could sit idle
      - We should put new EVLA antennas in the array to check performance and let an older EVLA antenna sit idle
      - Opportunity to perform retrofits on EVLA antennas 13 and16?

Deformatter Option B

- Shift all deformatters to WIDAR and shutdown VLA correlator and waveguide
  - VLA becomes a 20-antenna EVLA in Mar 2009
    - Number of antennas increases as EVLA antennas are retrofitted
  - Does not require production of additional deformatters and optical splitters/demultiplexers.
  - Requires excellent progress on WIDAR delivery, performance, and systems integration
    - Not very likely since production board delivery starts in Feb 2009. X
  - Requires earlier delivery of high level software (e.g. OPT) to accommodate correlator modes
  - Would relieve maintenance burden of VLA correlator and waveguide on a timescale earlier than previously planned

Deformatter Option C

- Always require 27 antennas to the VLA correlator
  - Will require the production of additional optical splitters and demultiplexers because we must make arrangements to get signals from EVLA antennas 21-27 to the VLA correlator.
    - Cost is $6K for a rack + $3K/antenna for splitters and demultiplexers
  - Will deplete the number of basebands that can be sent to the 10-station correlator since deformatters will have to be used to get signals from the EVLA antennas to the VLA correlator
    - Or could build additional deformatters at cost of $40K/antenna
  - May prolong maintenance requirements for VLA correlator and waveguide
  - May have to resort to this option, in part, if:
    - WIDAR is delayed significantly and/or …
    - SSS and M&C software is buggy or delayed.
  - Not desirable from project perspective because of throw away money/effort. **X**