



# VLA EXPANSION PROJECT

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## Correlator Issues



**National Research Council  
Canada**

**Conseil national de recherches  
Canada**

**NRC · CNRC**

# Outline

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- Key WIDAR capabilities for EVLA-I
- “Flexibilities”
- Cost
- EVLA-II decision milestones
- EVLA-II: WIDAR or new design?
- Summary

## Key WIDAR Capabilities for EVLA-I

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- No. of stations: 32 (installed racks for 40; expandable to 256).
- Max. Bandwidth: 8 GHz in each pol'n.
- No. of spectral channels @ max bandwidth: 16,384.
- Max. No. of spectral channels: 262,144 (with 'recirculation').
- Pulsars: fast (<100 usec) phase binning, >1000 bins.
- Quantization: 4 or 8 bits (>10<sup>5</sup> spectral dynamic range).
- Best resolution: ~ 1 Hz.
- VLBI ready.

# “Flexibilities”

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- Trade No. of antennas for bandwidth.
- Trade bandwidth for No. of beams.
- Data routing supports expansion.

...and much more...

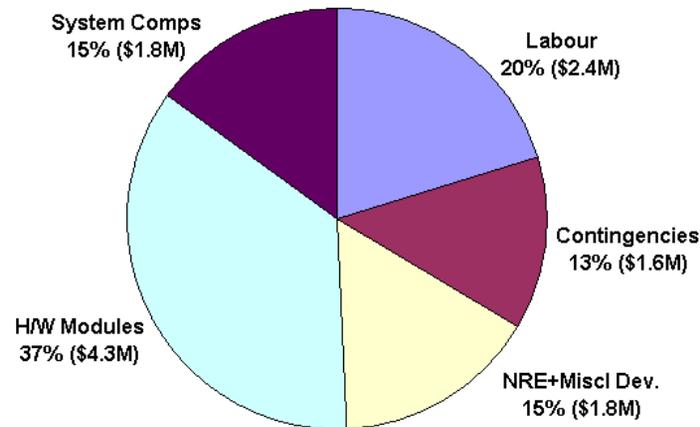
# Cost

- **Planned deliverable for Phase-I:**
  - Full 32-station, 16 GHz with racks+power for 40 stations: ~\$11.8M

**27 VLA + 5 “others”  
Full bandwidth**

**27 VLA +  
10 “others” @ 4 GHz**

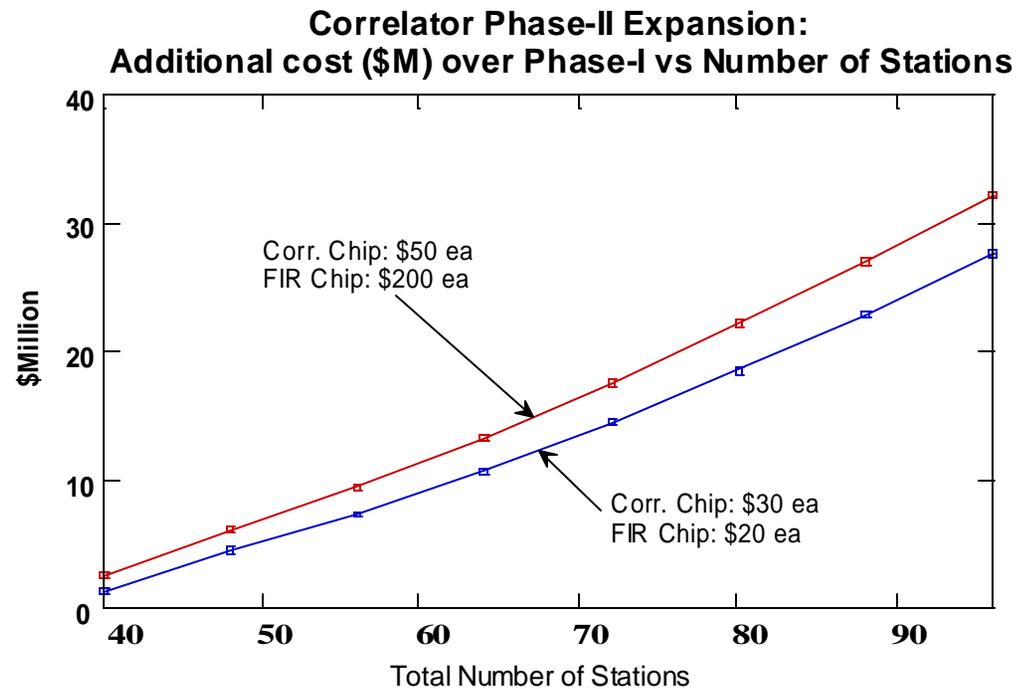
**EVLA Correlator PHASE-I, 32 Stations  
Total Cost Breakdown (15Aug01)**



**27 VLA +  
20 “others” @ 1 GHz**

# Cost

- Correlator expansion costs for Phase-II:



# Cost

- **40-station** cost breakdown: Total Cost: \$14.9M.  
*Cost over Phase-I system: \$3.1M.*

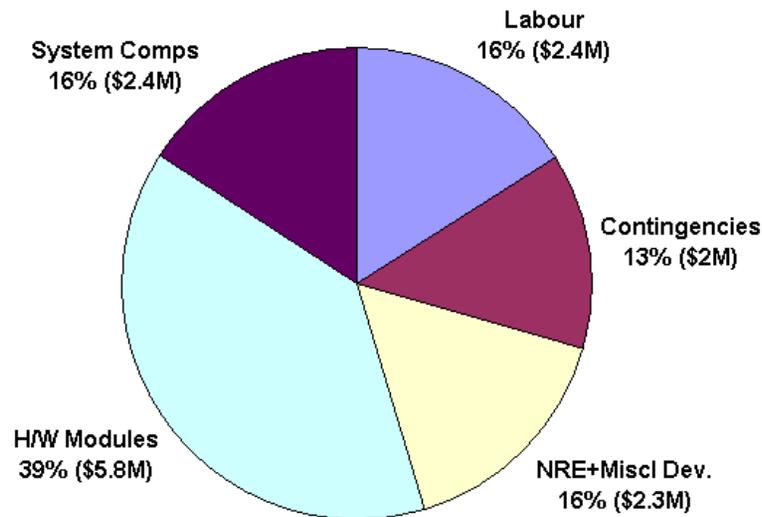
**EVLA Correlator PHASE-II, 40 Stations  
Total Cost Breakdown (15Aug01)**

**27 VLA + 13 “others”  
Full bandwidth**

**27 VLA + 8 NMA +  
10 “others” @ 4 GHz**

**27 VLA +  
26 “others” @ 4 GHz**

**27 VLA + 8 NMA +  
20 “others” @ 1 GHz**



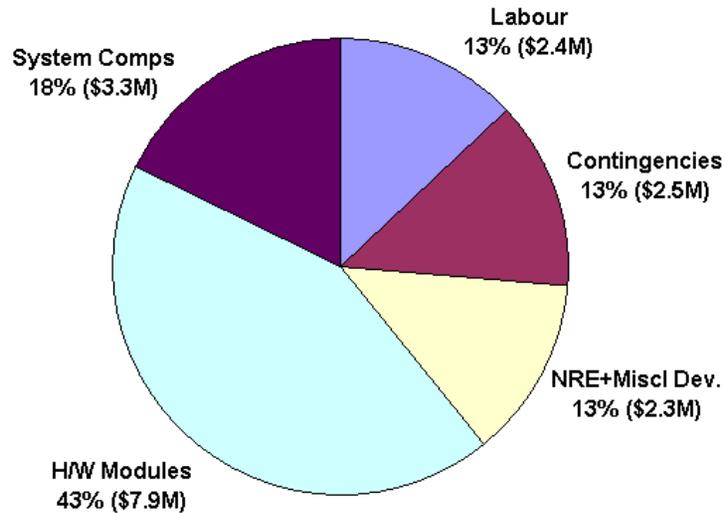
# Cost

- **48-station** cost breakdown: Total Cost: \$18.4M.  
*Cost over Phase-I system: \$6.6M.*

**EVLA Correlator PHASE-II, 48 Stations  
Total Cost Breakdown (15Aug01)**

**27 VLA + 21 “others”  
Full bandwidth**

**27 VLA + 8 NMA +  
26 “others” @ 4 GHz**



**27 VLA +  
42 “others” @ 4 GHz**

**27 VLA + 8 NMA +  
52 “others” @ 1 GHz**

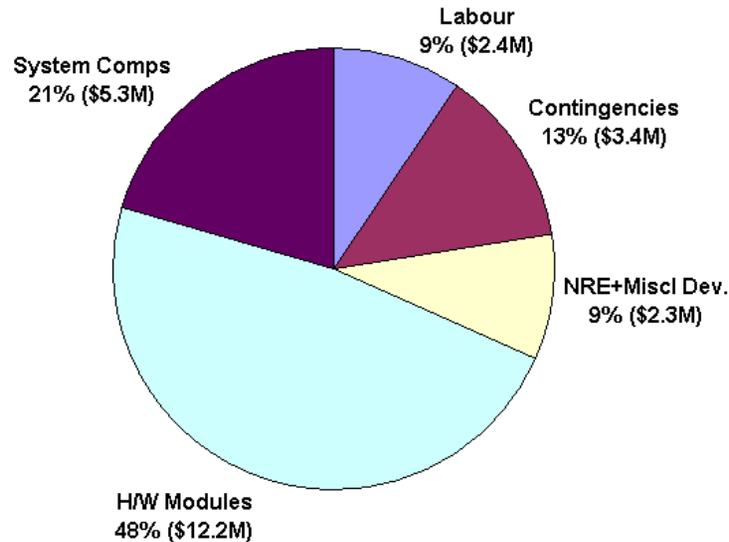
# Cost

- **64-station** cost breakdown: Total Cost: \$22.5-\$26M.  
*Cost over Phase-I system: \$10.7M - \$14M.*

**EVLA Correlator PHASE-II, 64 Stations  
 Total Cost Breakdown (15Aug01)**

**27 VLA + 37 "others"  
 Full bandwidth**

**27 VLA +  
 74 "others" @ 4 GHz**



**27 VLA + 8 NMA +  
 58 "others" @ 4 GHz**

**27 VLA + 8 NMA +  
 116 "others" @ 1 GHz**

# EVLA-II decision milestones

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- **Q4 2005:** Correlator production part ordering starts. Premium time to include expansion (one order, quantity price breaks, production infrastructure).
- **Q4 2006:** Production complete...testing (last chance to expand with 2nd production run).
- **>>2007:** “re-spin” of boards but retain architecture + infrastructure?

## EVLA-II: WIDAR or new design?

- **New design advantages:**
  - better/faster/cheaper technology.
  - improved signal processing? (promising developments driven by SKA ‘large N’).
  - more performance + functionality?
- **New design disadvantages:**
  - new architecture, new infrastructure + S/W base.
  - development time + cost.
  - subtle limitations/side-effects?

- **Retain WIDAR advantages:**
  - retain infrastructure + S/W base.
  - high performance, flexible, expandable.
  - maturity, stability, no dev. time- (lowest cost)?
- **Retain WIDAR disadvantages:**
  - historically, new technology rapidly makes existing correlators obsolete.
  - unable to meet unforeseen ‘new science’ requirements?
  - cost-effective ‘on the road to the SKA’?

# Summary

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- **EVLA-I 32-station ‘WIDAR’ correlator (\$11.8M):**
  - High performance, flexible, expandable.
- **EVLA-II correlator:**
  - 40 stations costs *additional* \$3.1M.
  - 48 stations costs additional \$6.6M.
  - 64 stations costs *additional* \$11M - \$14M.
  - Suitable for an inhomogeneous array of elements: flexible connectivity; tradeoff bandwidth for number antennas and number of beams.
  - Build on the Phase-I infrastructure and software/hardware base.
- **WIDAR or new correlator?**
  - Advantages and disadvantages...wait and see?