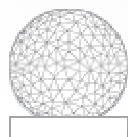


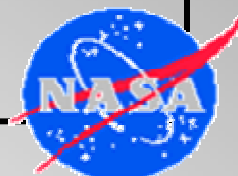


Post-Correlation Processing for the VLBI2010 Proof-Of-Concept System

*Christopher Beaudoin, Arthur Niell
MIT Haystack Observatory*



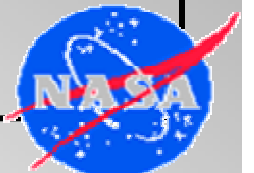
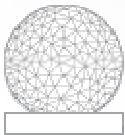
MIT
HAYSTACK
OBSERVATORY



Outline

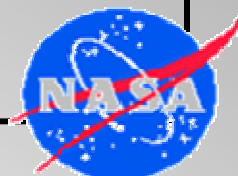
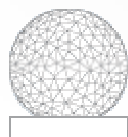
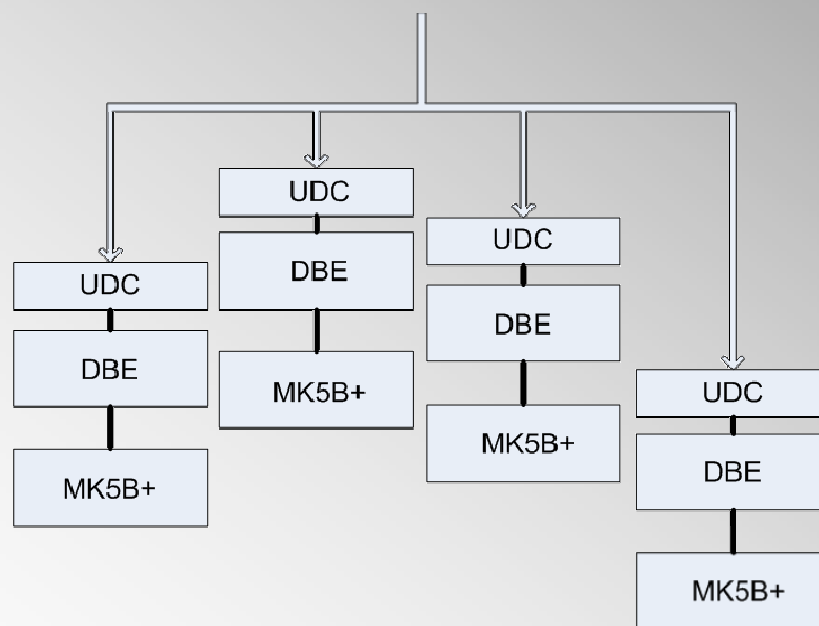


- Review Broadband Signal Chain and Correlator Output
- Post-Correlation Phasor Models
 - Raw Fringe Phasor
 - Phase Calibration Signal Phasor
- Phase Calibration Processing
- Engineering Results
- Future Developments



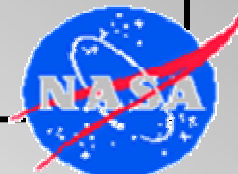
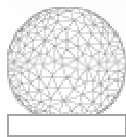
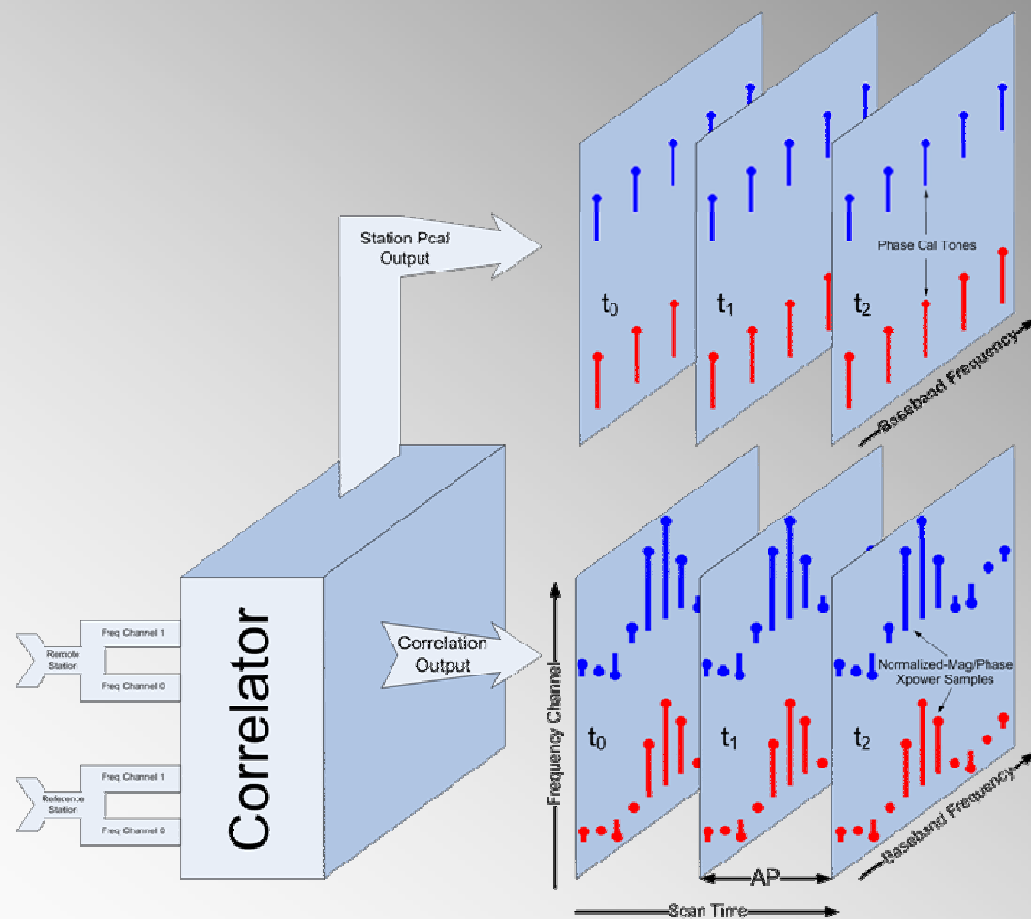
Broadband Signal Chain

- Currently, POC hardware possesses 4 bands with independent LOs and 8-32 MHz frequency channels per band
- RF is split four ways before downconversion by the UDC
- Hardware phase/delays through each “band” are independent



Correlator Output

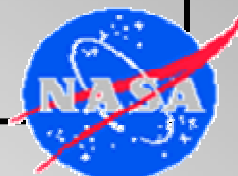
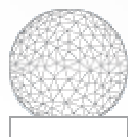
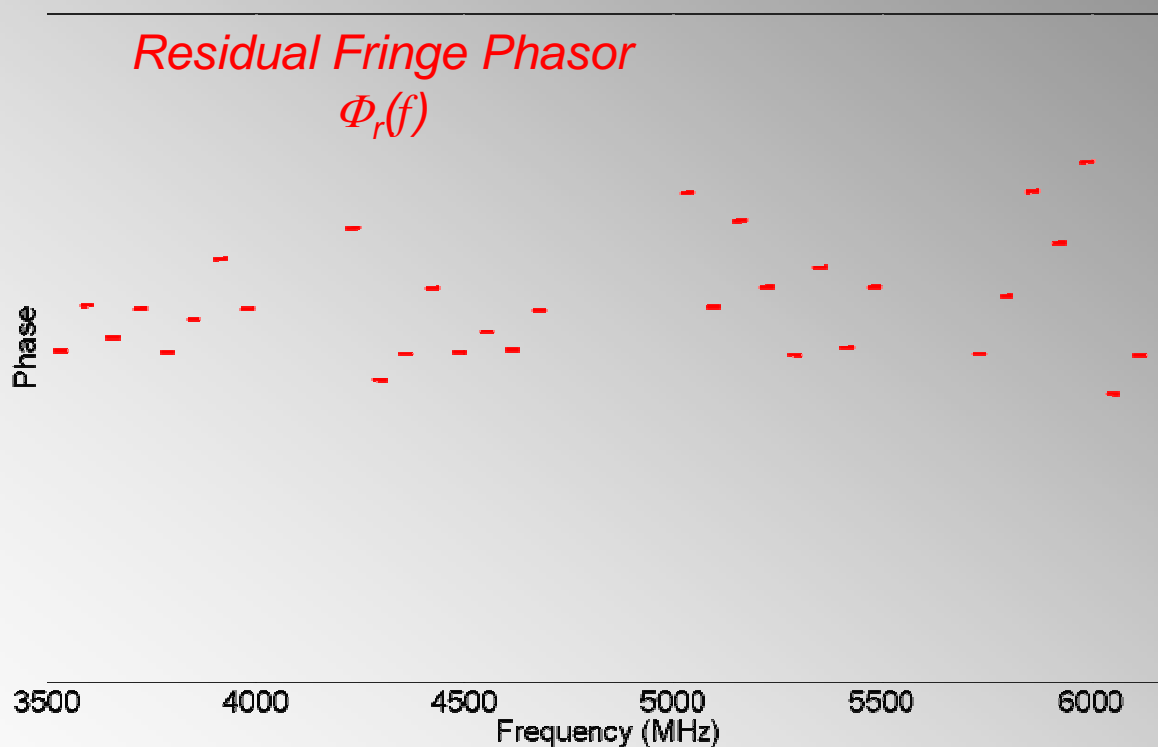
- For each observed frequency channel (and baseline), the correlator provides normalized cross-power and phase cal spectrum as a function of scan time



Post-Correlation Phasor Models

-Raw Fringe Phasor Model-

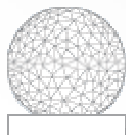
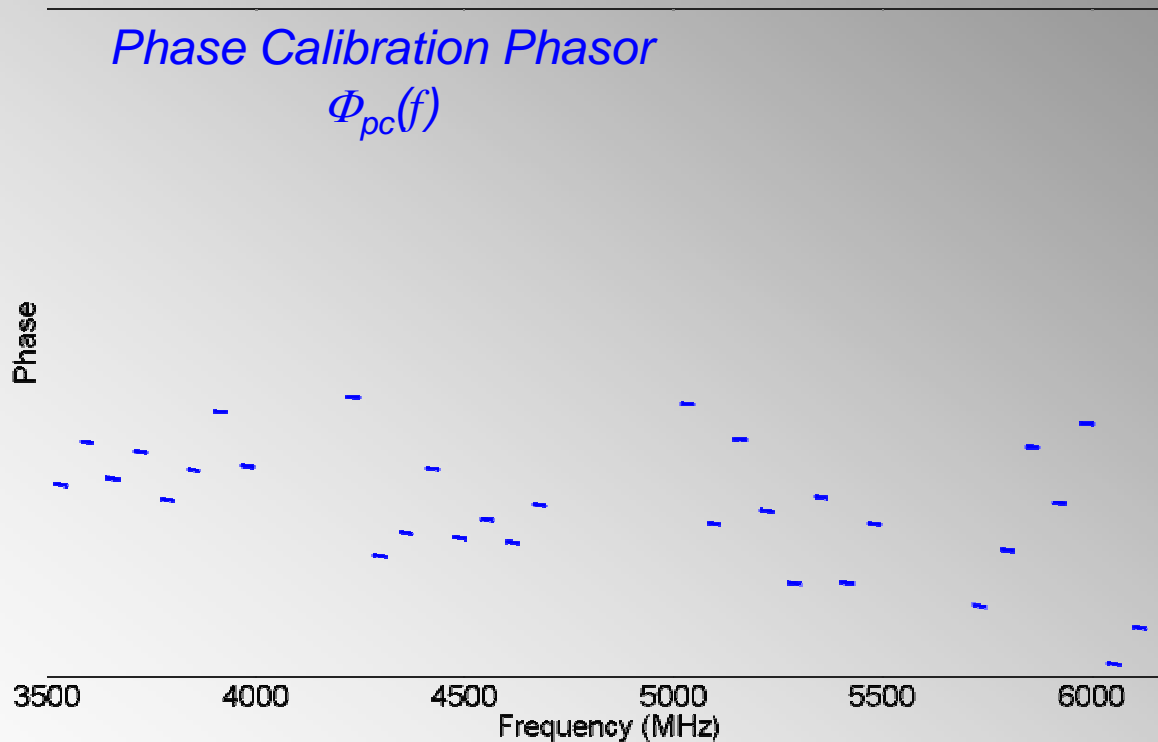
- Consider Correlator Output in Cross-Power Frequency Domain for a single AP and (for the moment) infinite fringe SNR...



Post-Correlation Phasor Models

-Phase Calibration Phasor Model-

- Also Consider Correlator Phase Cal Output in the Frequency Domain for a single AP

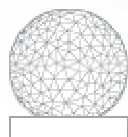
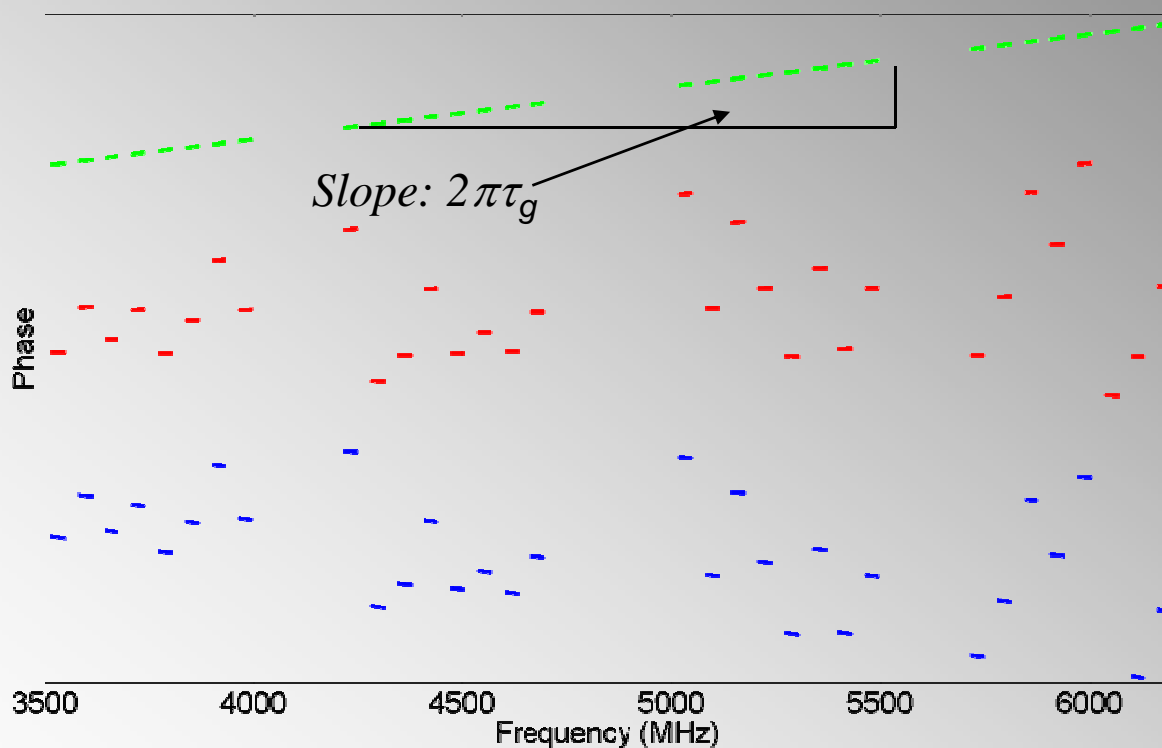


Phase Calibration Processing

- Phase Calibration Processing for the POC system can be formally expressed as:

$$\Phi_g(f) = \Phi_r(f) \Phi_{pc}^*(f)$$

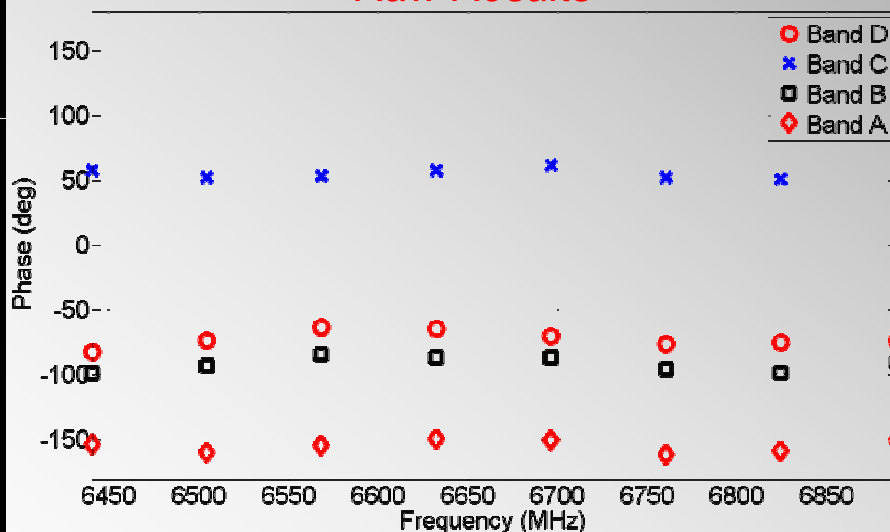
- This process is applied to each correlator AP independently



Engineering Results

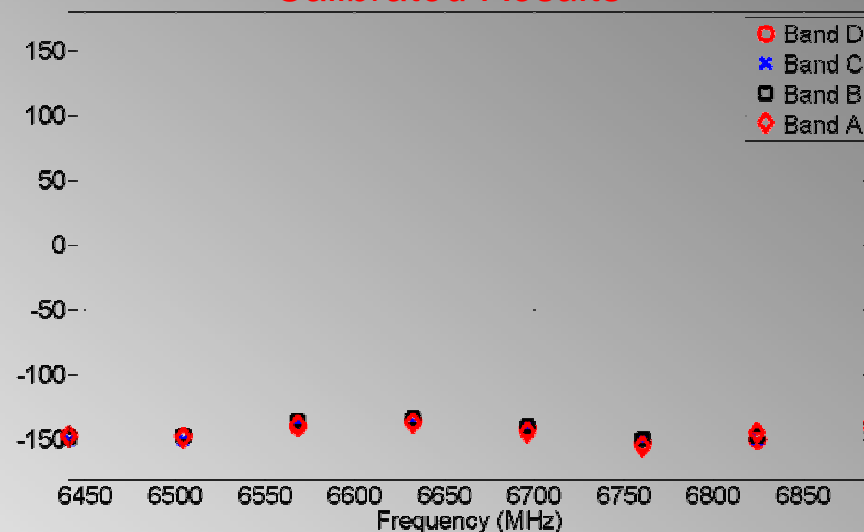
- Conducted 10m observation on source 4C39.25
- All four bands observing 6.40 – 6.9 GHz – VV polarization

Raw Results

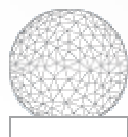


	A	B	C	D
Multiband delay (ns)	-1.970	1.768	6.011	-3.635
Fringe Rate (mHz)	1.522	2.216	2.016	2.043
Fringe Phase (°)	-154.7	-91.5	55.6	-72.2

Calibrated Results

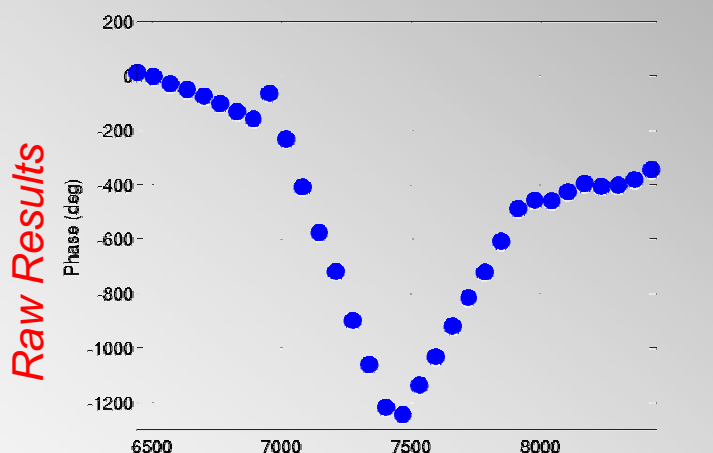


	A	B	C	D
Multiband delay (ns)	0.076	0.069	0.083	0.092
Fringe Rate (mHz)	1.578	1.576	1.586	1.588
Fringe Phase (°)	-144.5	-142.8	-144.6	-143.6

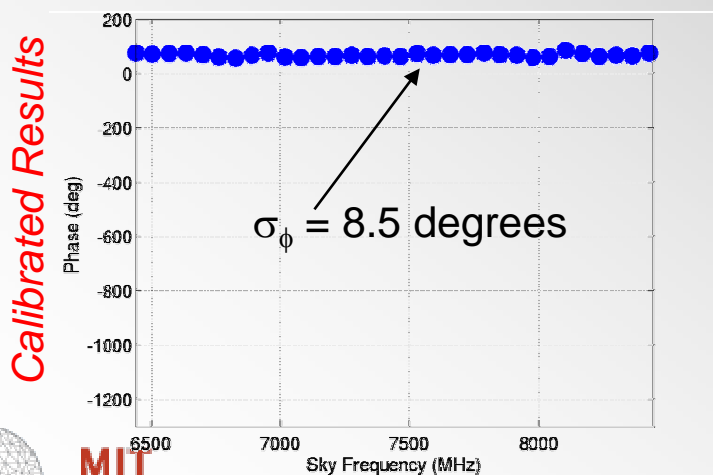
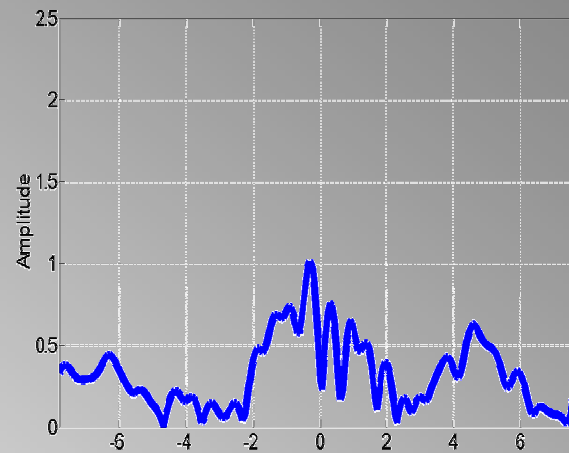


Engineering Results

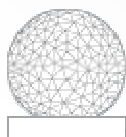
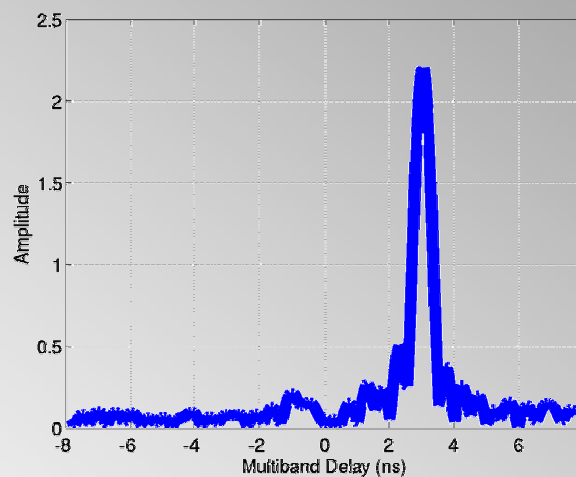
- All four bands observing 6.4 – 8.4 GHz – VV Polarization



Complex
FFT



Complex
FFT



Future Advancements



- Analyze More Bandwidth
- Incorporate Ionosphere Phase in the Fringe Phasor Model
 - In this talk we assumed a linear relationship between raw/cal'd phasors
 - Dispersion in the ionosphere voids this assumption
 - Fringe fitting will incorporate a search for the dispersion term
- Polarimetric Phase Calibration
 - POC system is dual linear polarization so we have four separate delays to consider (HH HV VH VV)
 - In practice, H and V channels will have independent delays but geodetic observable is polarization independent. Difference must be reconciled

