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Proxy cable delay calibration

VGOS Correlation Workshop

MIT Haystack Observatory

May 9, 2019

Outline

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- What is it and why do we need it?
- What is is measuring?
- How is it estimated?
- Running the generation script
- Data quality check
- Band-polarization selection

What is it and why do we need it?

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- Stop-gap measure until sites have cable-calibration units installed.
- Estimate a relative delay from p-cal tone phasors for each band and polarization at a station.
- Delay estimate is made for each scan relative to a ‘reference’ scan (using the first).

What is it measuring?

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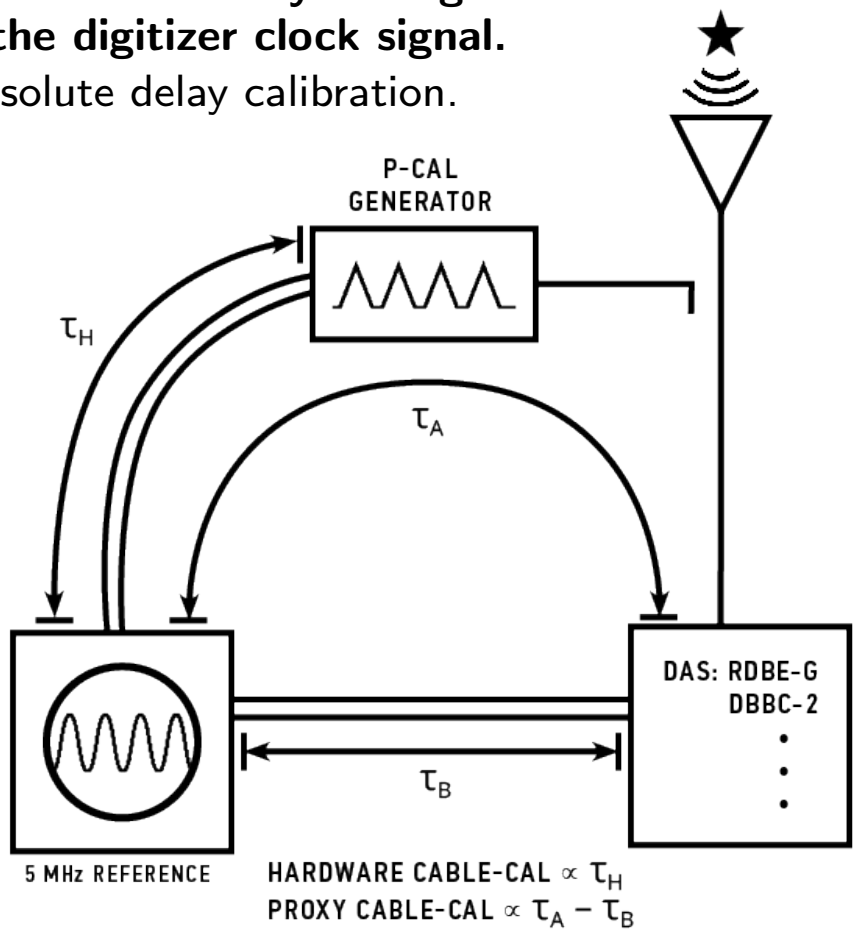
- Hardware cable-calibration units measure the delay for a clock reference single to travel from clock to frontend p-cal distribution board.
- Proxy cable-cal does not measure the cable-delay itself, but makes proxy estimate for for this.
- **This is instead the cumulative delay through the cable and the front-end to the digitizer, relative to the digitizer clock signal.**
- Cannot be used for absolute delay calibration.



How is it estimated?

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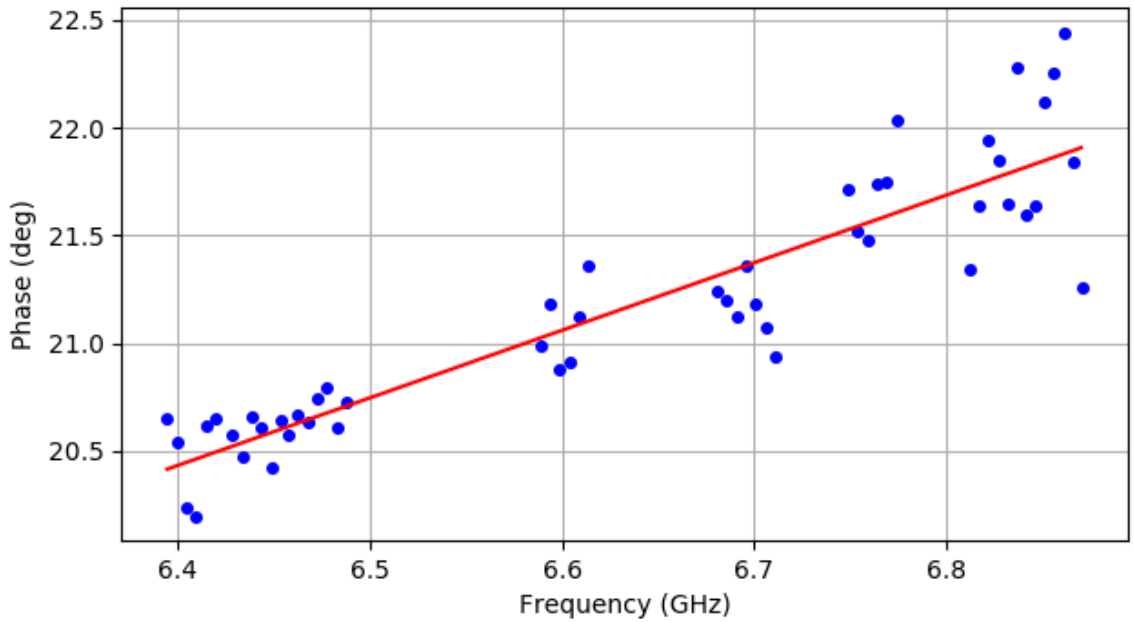
- Accumulated phase-cal data is averaged over each scan.
- Net phase of 'reference' scan is removed to obtain relative phase-change for each scan.
- A linear fit to the relative phase-change for each band-polarization is done to obtain a delay.
- Finally delay estimates from each (selected) band-polarization are averaged together.



Proxy cable-cal delay fit to band-C phase-cal data.

Running the script

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- Requires the Mk4 root 'ovex' files and the type-3 station data files for each station.
- Preferably the data for the entire course of experiment should be available.
- User needs to specify the stations and band-polarizations to be fit. Default behavior is to do all band-polarizations.

Example:

```
pcc_generate.py -o ./pcc_datfiles -b B,C,D -p X,Y -e -f -v 3 GEH ./
```

Selecting band-polarizations

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Some band-polarizations should not be used when averaging the proxy delays. Reasons for this could be:

- Physical difference (e.g. downlink cable for one band is co-ax vs. optical fiber for the others)
- Weak/corrupt p-cal tones destroy delay fit.
- RFI.
- Unknown problem, but radically different delay-trend behavior for each band-polarization.
- Note: Overall trend doesn't matter, we only care about short-time behavior ($<$ clock-interval).

Data quality check: The good

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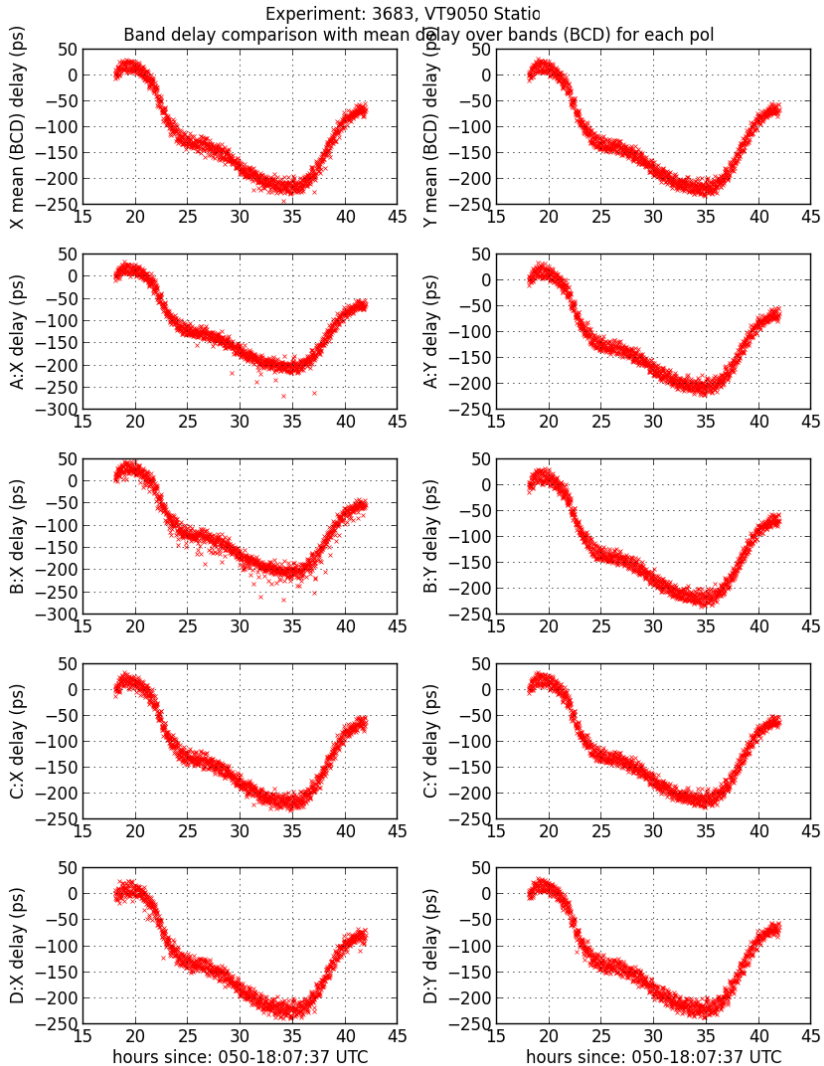
- Examine the proxy delays estimated for each band-polarization during experiment.
- Ideally, each should have consistent proxy cable-delay behavior across all band-polarizations.
- Would like them to be smoothly varying for entire experiment.



Data quality check: The bad

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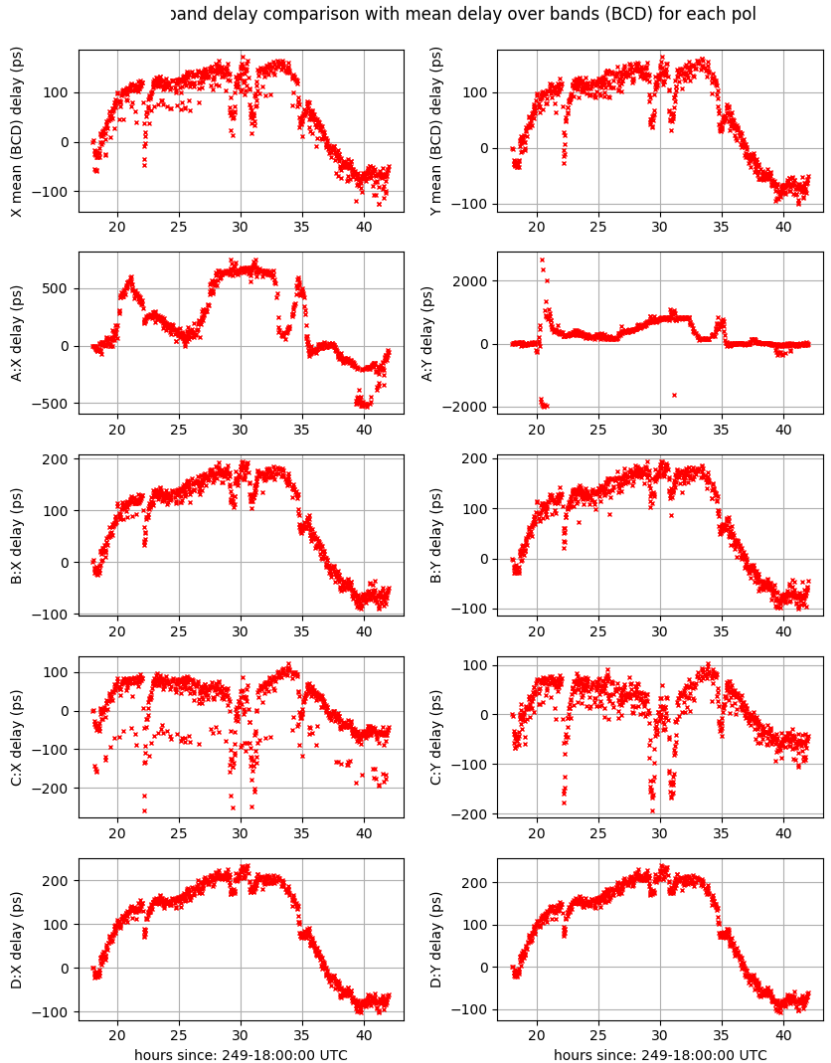
- Sometimes band-polarization trends are corrupted due to unstable phase cal.
- Rapid jumps or outliers, with individual band-polarizations exhibiting different trends.
- This can indicate issues with phase-cal.
- When running `pcc_generate.py` more information can be obtained via '-d' option to provide fit-diagnostics, but this usually increases run-time a lot.



Data quality check: The ugly

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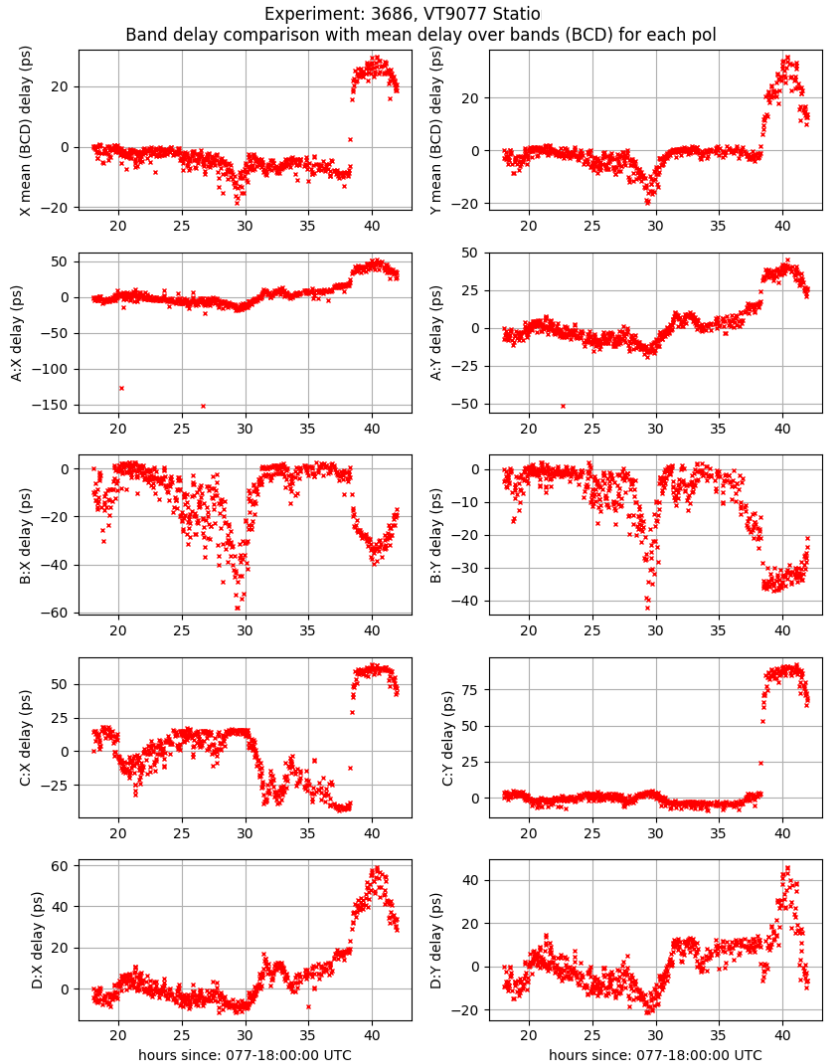
- Sometimes the proxy cable-cal delays are indeterminate.
- Little consistency between different bands or polarizations.
- Cannot be used for delay correction.



Selecting band-polarization with pcc_select.py

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- Need to specify the experiment name and the band-polarizations to be averaged for each station
- Can select good band-polarizations collectively, or individually via a comma-separated list.

Example:

```
pcc_select.py -e vt9063 -d ./pcc_datfiles/ -s G:BCD:XY H:BX,BY,CX,DY
```

- Output is .pcmt files, which will be processed by vgosDbProcLogs.