

# Review of proposed list of SDP plots related to signal integrity displays for commissioning (TSK-1637)

- Recommended SDP plots
  - Data quality per Antenna versus time (time scrolling), Data quality versus baseline (matrix display)
  - Baseline spectrum with various integration options (time, baselines, etc.)
  - Visibilities (amplitude and/or phase) as a function of time and baseline or time and frequency.
  - UV coverage/weight distribution
  - Snapshot image
  - Results of online instrumental calibrations
    - Phase and amplitude closure for calibrators
    - Antenna-based complex gains (using source model and visibility data)
    - Bandpass calibrations
    - Polarisation calibration
    - Flux scale
    - RFI masking
    - All automatically flagged data
- Recommended CSP plots
  - Radiometer
  - Periodogram
  - Power and phase (with baseline fit), cross-correlation power vs time lag, auto-correlation and cross-correlation power and phase spectrum per polarisation
  - Results of online instrumental calibrations
    - Instrumental signal path delays
- Recommended TM plots
  - Results of online instrumental calibrations
    - System temperatures
- Potentially missing plots
  - Antenna pointing, az/el
  - Astrometry/positional offsets.
  - Uncalibrated bandpass
  - Spectral index
  - Wind speeds
  - Cable wraps
  - Ionospheric metrics

## Recommended SDP plots

### Data quality per Antenna versus time (time scrolling), Data quality versus baseline (matrix display)

- **Key Data required:** Some metric of data quality, time.
- **Data processing:** Choice of metric is open for discussion, a combined metric of % flagged data, rms noise of good data, and phase error would be one feasible choice.
- **Notes:** Will wish to display per antenna and baseline. Will matrix display per baseline really be a feasible slice of the data? ~20000x20000 matrix, challenging to display. Perhaps a metric of data quality for selected sets of baselines could improve this further, only displaying metrics for sub-arrays within the core and individual remote stations.

### Baseline spectrum with various integration options (time, baselines, etc.)

- **Key Data required:** Complex visibilities, time, baseline, frequency.
- **Data processing:** Trivial, simple plot of pre-existing quantities.

### Visibilities (amplitude and/or phase) as a function of time and baseline or time and frequency.

- **Key Data required:** Complex visibilities, time, baseline, frequency.
- **Data processing:** One may envisage pseudo-colour waterfall plots of (i) baseline versus time, iterable per channel, and (ii) channel versus time, iterable per baseline.
- **Notes:** <=10 sec refresh rate. Useful for commissioning, albeit challenging to digest all baselines on 10 sec time scales. Is calibration applied to the visibilities?

### UV coverage/weight distribution

- **Key Data required:** uvw-data, weights
- **Data processing:** Challenging. Requires smart approach. 10 secs of uv-data equates to ~400GB of data for plotting (assuming 60000 channels). Data stirring? i.e. plot random sample? Many points also overlapping with/on top of one another. Only plot indicative channels across band? i.e. 10 selected channels is 64MB per 10 sec. Density plots likely helpful.
- **Notes:** <=10 sec refresh rate.

## Snapshot image

- **Key Data required:** uvw-data, complex visibilities.
- **Data processing:** FT. See uv-coverage comments.
- **Notes:** <=10 sec refresh rate.

## Results of online instrumental calibrations

### Phase and amplitude closure for calibrators

- **Key Data required:** calibrated complex visibilities, or the complex visibilities and appropriate calibration tables.
- **Data processing:** Simple. Multiplication/division & complex conjugates.

### Antenna-based complex gains (using source model and visibility data)

- **Key Data required:** antenna gain tables.
- **Notes:** Would want to plot gains versus time/frequency, per antenna.

### Bandpass calibrations

- **Key Data required:** bandpass calibration tables.
- **Notes:** Would want to plot bandpass solutions versus time/frequency, per antenna.

### Polarisation calibration

- **Key Data required:** polarisation calibration tables.
- **Notes:** Would want to plot leakage, injected-noise signal (if available), etc. versus time/frequency, per antenna.

### Flux scale

- **Key Data required:** flux density measurements of observed sources, for comparison with GSM.
- **Notes:** likely various dependencies: elevation, frequency, etc. Perhaps could provide median value of all cross-matched flux densities.

### RFI masking

- **Key Data required:** RFI Masking data.
- **Notes:** The masks can be saved, and therefore this format would ideally be used to generate plots.

### All automatically flagged data

- **Key Data required:** Flagging Masking data.
- **Notes:** The automatically flagged data is likely to also be saved in a similar mask format to that used for RFI masking. This format would ideally be used to generate plots.

## Recommended CSP plots

### Radiometer

- **Key Data required:** antenna voltages, time.

- **Data processing:** None.
- **Other Requirements:** channel frequencies.
- **Notes:** with time resolution of  $\leq 100\text{ms}$ . will wish to plot data over a finite bandwidth, likely not any full band. Requires spectral resolution.

## Periodogram

- **Key Data required:** antenna voltages, time.
- **Data processing:** FT.
- **Other Requirements:** channel frequencies.
- **Notes:** use for RFI excision.

## Power and phase (with baseline fit), cross-correlation power vs time lag, auto-correlation and cross-correlation power and phase spectrum per polarisation

- **Key Data required:** cross-correlated antenna voltages (for X & Y).
- **Data processing:** cross-correlation of voltages.
- **Other Requirements:** integration time, channel frequencies.
- **Notes:** Auto-correlation and cross-correlation power & phase spectrum per polarisation.  $\leq 1\text{sec}$  refresh rate. Will calculate for XX, YY, XY, YX.

## Results of online instrumental calibrations

### Instrumental signal path delays

- **Key Data required:** delay measurements
- **Notes:** It is not clear that these data will be with SDP, but will definitely be with CSP, that will maintain a delay tracking memory buffer to trace the error between actual implemented delays and a model of the delay. Plot may be more suitable for CSP.

## Recommended TM plots

### Results of online instrumental calibrations

#### System temperatures

- **Key Data required:** System temperatures per antenna.
- **Notes:** There are ways to approximately measure this, from e.g. the flux scale and noise, but there is an anticipation that Telescope Manager (Telescope State) will likely have direct measurements of  $T_{\text{sys}}$ .

## Potentially missing plots

### Antenna pointing, az/el

- Proposed Allocation: TM

### Astrometry/positional offsets.

- Overall source offsets relative to cross-matching with the GSM. Proposed Allocation: SDP

### Uncalibrated bandpass

- Good indicator and diagnostic of persistent and intermittent RFI. Proposed Allocation: SDP

## **Spectral index**

- Good indicator of systematics, existing RFI, and calibration across the observing band. Proposed Allocation: SDP

## **Wind speeds**

- Proposed Allocation: TM

## **Cable wraps**

- Proposed Allocation: TM

## **Ionospheric metrics**

- Proposed Allocation: TM