Instructions on Running and Interpreting the Results of the "Stress Test"

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1   Observing

To run the stress test observing script, execute the file:
/home/mchost/evla/scripts/operations/newstress.evla

- Please make sure to include all the antennas, but exclude any antenna that is known to be not working.

- It is highly preferable to observe under clear weather conditions. Observing during thunderstorms will produce meaningless results. Also, observing while there are thick clouds should be avoided, otherwise the reported sensitivities will look significantly off. Observing while there are thin clouds is OK, however, note that you will see slightly degraded sensitivity values than expected.

2   Running the Data Reduction Script

To run the stress test data reduction script on **evan**:

open a terminal and type
cd /home/evan/Stress/
then execute the script by typing the following file name and hitting enter:
widarstress.run
and follow the instructions on the screen.

- The script will list the archive files of the stress test observations that took place in the past 18 hours, ordered in time sequence (starting from the oldest).

- Then it will ask you which file to download. It will show one file name at a time, and you have to answer by **Y** or **N**.

- If multiple archive files were listed, make sure to answer **N** for the files that you are not interested in.

- Upon choosing the file of interest, the script will show the name of the archive file that it is downloading, and will ask you to copy and paste its name and to hit enter (the name starts with **newstress**).

- Wait for about 15-20 minutes or so, and if everything goes OK, you will see various reports coming out of the printer.

3 The Resulting Files/Reports

The resulting files will be located in the directory **/home/evan/Stress/** and **will carry the date and the time stamp** when thedata reduction script was executed. They will all have the extension **TXT**. There will also be a **.log** file with the same date and time stamp that includes all the details of the data processing. If you wish to access the electronic versions of the files, type **ls -ltrh** in the terminal to see the written files ordered in time (from oldest to newest).

There are five sets of files that will be written by the script. These are:

3.1 Delays

The name of the file carries the string **DELAY**. This is a **single page report**. Its 1st half includes the parallel-hand delays of antennas and IFs that have values larger than ± 8 ns. Its 2nd half reports the cross-hand delays of all frequency bands and of both IFs. Note that the cross-hand delays are not antenna specific but are of the whole array.

What to report: Problematic antennas/receivers may have large parallel-hand delay values. If an antenna is known to be bad, then there is no need to report its delays. However, if an antenna is known to be good but is showing a large delay value, then Ken, Vivek, and/or Michael should be contacted. The same applies for the cross-hand delays. If any value is not in single digit (i.e., larger than ± 10 ns), contact the above noted staff.

3.2 Un-calibrated Gains: *The most important products of the "stress test"*

There will be a set of files that will carry the string **UNCALGAIN**, and there should be **one file per frequency band**. The values seen in these files are the amplitude-calibration gain factors. We are calling these "un-calibrated" because the switched power calibration has not yet been applied on the visibilities.

You will notice that each file has four sections. From top to bottom, these are of:
IF A = IF 1 R pol,
IF C = IF 1 L pol,
IF B = IF 2 R pol,
IF D = IF 2 L pol.

What to report: First, one needs to identify the antennas and/or their IFs/pols that have high values compared to the rest of the antennas/IFs/pols. Seeing larger values on a certain antenna and IF reflects the fact that the particular IF on that particular antenna is noisy, and therefore should be reported.

Note that a scaling factor of 1000=100 has been set for the values. The range of good values per band, as seen in the reports (i.e., not as absolute values due to the scaling factor) are as follows:

Band	Gain Range (1000=100)
L	65-80
S	55-65
C	55-60
X	55-60
Ku or U	50-60
K	70-80
Ka or A	75-85
Q	100-120

Values that are **20% higher** than those noted in the table above should be reported as they reflect noisy antennas/IFs/pols. There is no need to report values that are lower than those listed in the table.

Practical considerations:

- If all IFs on one antenna show high values: Something is wrong with the antenna. Note that if a given antenna is noisy at the various high frequency bands in all IFs and pols, then perhaps the reference pointing has failed. It would be good to look at the reference pointing solutions in order to discard those antennas with bad solutions from any antenna/receiver maintenance tickets.

- If two IFs on one antenna show high values and both have the same polarization (i.e., A and B, or C and D): The particular receiver on that antenna has a problem in that particular polarization.

- If a given IF pair shows high values (e.g., A and C, or B and D): The LO may be bad.

- If only one IF shows high values: Something perhaps is wrong with the downconverter (T304).

3.3 T_{sys} values

There will be a set of files that will carry the string **TSYS**, and there should be **one file per frequency band**. The values seen in these files are of the system temperature T_{sys} as measured by the switched power system. There will also be four sections per file (or band), one for each IF (as noted above).

The values are derived by injecting a 'known' amount of power at the front end, then detecting this power at the back end. The word "known" is in quotes, as the precise value can be wrong. Knowing the value of the known input, and the value at the output, we deduce the value of the total power. Converted to temperature units, this quantity is what we call T_{sys}. The simple equation is:

$$T_{\mathrm{sys}} = \frac{\mathrm{TotalPower}}{\mathrm{SwitchedPower}} \times T_{\mathrm{cal}} \tag{1}$$

Therefore, if the T_{cal} value is too low, so will be the estimate of the system temperature.

The range of good values per band are as follows:

Band	T_{sys} Range (K)
L	25-40
S	25-35
C	25-35
X	25-35
Ku or U	25-35
K	40-60
Ka or A	45-75
Q	65-90

What to report: Antennas that have low or high values compared to the above ranges should be reported. **Note that if the uncalibrated gain values (Section 3.2) are OK, but the Tsys values are off, then something is wrong with the switched power system or the Tcal values**. For instance, and assuming the uncalibrated gain values of Section 3.2 are OK:

- If the Tsys values are off by a factor of a few: The problem may simply be due to a wrong Tcal for an antenna/polarization. Note that Tcal values are per polarization, so a wrong Tcal should affect IFs A and B, or C and D, simultaneously.

- Some antennas may show extremely high Tsys values, or signs such as **** or - - - -: These reflect that something is seriously wrong with the switched power system of these antennas, and should definitely be reported.

Note 1: Clouds will increase the Tsys values, and sometimes dramatically if the clouds are thick. Therefore, and as noted in Section 1, the script should preferably be run in clear weather.
Note 2: If the Tsys values are wrong, then the calibrated gain values (Section 3.4) and the SEFD values (Section 3.5), will also be wrong. The uncalibrated gain values (Section 3.2) will not be affected.

3.4 Calibrated Gains

There will be a set of files that will carry the string **CALGAIN**, and there should be **one file per frequency band**. The values seen in these files are the amplitude calibration gain factors after applying the switched power calibration, hence the name "calibrated". Therefore, the values here should all be close to 1 (+/- 15%) if everything was OK with the antenna. **Note that there is a scaling factor for the values reported here (1000=10) to show them as percentage, so a value of 1 would be listed as 100**. Because the values in these files are calibrated by the switched power (and therefore are expected to be close to 1), it helps us in quantifying the scale of the problem.
There will also be four sections per file (or band), one for each IF (as noted above).

What to report: If an antenna/IF shows values far from 100 by at least $\pm 15\%$, it would be either because something is wrong with the antenna/IF, or with the switched power. For instance:

- If the calibrated gain values are off from 100 by at least $\pm 15\%$, but the uncalibrated gain values (Section 3.2) are OK, then something is wrong with the switched power system, or the Tcal values are off. This can easily be confirmed by looking at the T_{sys} files as described in Section 3.3.

- If the calibrated gain values are off from 100 by at least $\pm 15\%$, but the T_{sys} values (Section 3.3) are as expected, then something is wrong with that particular antenna/IF/pol. This can easily be confirmed by looking at the uncalibrated gain files as described in Section 3.2

3.5 SEFDs

There will be a set of files that will carry the string **SEFD**, and there should be **one file per frequency band**. These are calibrated autocorrelation amplitudes, and they are a measure of the **total** system power – nearly all of which is from the receiver. So if we have a noisy receiver, the autocorrelation amplitudes will be very high. Units of Janskys are used for convenience: the 'SEFD' in Jy is that source flux which would double the system power (or, that source flux which equals the receiver noise).

Band	SEFD(Jy)
L	~400
S	~360
C	~300
X	~300
Ku or U	~250
K	~500-700
Ka or A	~600-800
Q	~1000-2000

Noisy receivers will show high SEFDs. However, since these values are derived after applying the switched power, wrong T_{cal} values and/or dysfunctional switched power systems will lead to wrong SEFDs. Therefore, if the SEFD is high, it can be due to either problematic switched power, wrong T_{cal}, or a problematic antenna/IF, assuming the observations were carried out in clear weather. Having the **TSYS** and the **UNCALGAIN** can help in finding the origin of the problem. It is worth noting that looking at the SEFD values is not critical, because the outputs of the previous sections will provide enough information on what the problem may be. The SEFDs are useful in reporting the sensitivities on absolute scales. Also note that when 27 antennas are included in the observations, then the SEFDs of every other antenna will be reported, i.e., there will not be anything reported for half of the antennas. This is because the SEFDs are derived from the autocorrelations, and WIDAR can only deliver the autocorrelations for half the antennas if there are 27 of them in the observations. However, considering that the reports from the other sections cover all the possible aspects of finding issues, it is better to have 27 antennas and lose half the SEFDs.