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To: VLBA Postprocessing Group

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Subject: Model accountability and averaging.

It is important to be able to reconstruct the "observables" from the contents of VLBA data sets. The observables are the total delay, delay rate, and phase that would have been measured if no model had been removed from the data by the correlator or post-processing programs. This could be done by storing the data in the form of the totals. However this would mean recalculating a model for most operations performed with the data. For an instrument that is meant primarily for mapping in which the residuals are needed, it is more reasonable to store the residuals and enough information about the model to reconstruct the totals. To do this, we plan to store the model totals in each visibility record. Also, during calibration processing when, by the current plans of the post-processing group, we will have a gain table, the model totals corresponding to the time of each gain record will be stored in the gain record. Since the fringe fitting results will also reside in the gain table as incremental values, geodetic/astrometric analysis will probably use only the final gain table, although the data itself could be used. The main use of the model values in the visibility records would be to allow a change to be made to the model accurately without being able to reproduce the original model calculations - the new model is calculated and the difference between it and the values in the visibility records is applied to the data. The gain table values would have to be updated at the same time.

The main problem with maintaining the model values with the data is presented by averaging. The time of an averaged record will not, in general, correspond to the time of an input record. Therefore the model values corresponding to the averaged record cannot be copied from the input data file. Since the model values are likely to be changing very rapidly, a simple interpolation also will not work. Note that the gain table entries need not be changed when the data is averaged so the totals stored there would still be correct. After reviewing many possible ways to maintain accountability through averaging, we suggest that the average program have the following options:

1. No attempt is made to provide a model value for each averaged record. The output visibility records would be shorter since they would not contain the model values. This is fine for many (most?) applications. Accountability is maintained in the gain table which will suffice even for geodetic analysis

unless it is desirable to change the model actually applied to the data. Also, one can always return to the original archive data set which will always be accountable.

2. The average program calculates a model and either uses the differences between it and the original model to interpolate the original model or actually applies the new model to the data. The interpolation option can only be used when the differences are slowly varying (the program should check that this is true). The new model option involves altering the input data by the difference between the original model and the new one. After averaging, the new model value corresponding to the average time is calculated.

The above options will satisfy most needs. Only when the differences between the average program's model and the model totals in the input data change too fast for interpolation will averaging with accountability be impossible without changing the data. Such cases should be rare and would be very difficult to handle by any method.