Interoffice

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To: Addressee

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Subject: Astronomical Requirements For Future VLA Processing

This is intended to be a working document which will develop into the description of the astronomical requirements as we gather more information. For the present we have only considered the VLA related questions. Any volunteers to supply information, ideas or criticisms are very welcome!

The general outline of document is as follows:
1. Evaluation of present situation.
2. Definition of VLA product.
3. List of major projects.
4. Specification of requirements for these projects.
5. Estimation of relative demand.

1. EVALUATION OF PRESENT SITUATION.

1.1 Definition of bench mark tests to measure the throughput of existing (and proposed) computer systems.

1.1.1 Mapping: 240,000 UV points transformed into a 1024 x 1024 map. Computer operations include loading UV data, sorting, gain application, transform, and output of map.
1.1.2 Cleaning: 1024 x 1024 map cleaned for 3000 iterations.
1.1.3 Selfcalibration: 3000 component selfcalibration on same data base (27 antennas).

1.2 Throughput measurements

1.2.1 AIPS
Mapping tests have been done and are included in appendix 1 (EF).
Clean and selfcalibration still to be done (EF).
We also need the AIPS statistics to find the relative usage of CPU and real time for different programs (EF + GH).
1.2.2 PIPELINE
New test should be done using the same data base (EF + RP)

1.3 Catalogue of existing processing systems. (EF + CV)
Summarize the results of the survey done in the AIPS newsletter. Include in this catalogue non-NRAO facilities with indication on the type of hardware and the time used for VLA reduction.
We also need to estimate the real time available in front of a display.

2. DEFINITION OF THE VLA PRODUCT.

2.1 Output from the VLA site: The series of documents by EF and BC (June 1980) with suitable updates.

2.2 Remote and absentee observing.
Brief summary of the present situation and the statistics of usage (CB).

3. LIST OF MAJOR PROJECTS.

3.1 Observationally motivated with current system.

3.1.1 Continuum observations.
Large field full bandwidth continuum mapping using spectral line mode to achieve maximum field of view.
Full synthesis observations of single objects using standard continumm system.
Snapshots for many different objects or different frequencies.
Large area surveys, e.g. by scanning the primary beam.
Multiple subarray observations.
Phase array observations (including real time selfcalibration)
Moving objects (planets, asteroids, comets)
Astrometry
Very low frequency observations (327 and 75 MHz)
Very high frequency observations (44GHz)

3.1.2 Time variable phenomenon (less than 12 hours).
Active solar observations.
Pulsars.
Flare stars.
Atmospheric studies.

3.1.3 Spectral line projects.
Low brightness emission mapping (HI,NH_3).
High brightness mapping (H_2O,OH masers).
Absorption mapping (OH,H_2CO,HI).
High spectral dynamic range (Recombination lines, HI absorption).
Spectral line snapshots.

3.2 Projects requiring new hardware.

3.2.1 Larger bandwidth continuum observations for higher frequencies (>500MHz).
3.2.2 Baseline extensions - VLA/VLBA hybrid arrays.

3.3 Effects of new signal processing possibilities

3.3.1 Corrections for non - coplanar baselines.
3.3.2 Image restoration algorithms (TC to provide list and estimate of computer requirements).
3.3.3 Extension of the selfcalibration algorithm (e.g. to include first differences).
3.3.4 Improved calibration using better filter algorithms e.g. Kalhman filters (JB), optimum time averaging (ME).
3.3.5 Inclusion of short spacing information.

4. SPECIFICATION OF REQUIREMENTS.

4.1 The following parameters will be tabulated for all the projects listed in section 3.

Number of correlators required.
Sampling interval.
Total observing time.
Number of channels (frequencies x polarization).
Numerical map size.
Components needed for selfcalibration.
Gain interval needed for selfcalibration.
Post processing requirements (CLEAN, other image restoration, modeling,...)

4.2 Relationships have to be established between the above parameters and the following computer tasks:

UV data acquisition.
Editing and calibration.
Map generation.
Map restoration.
Other post processing tasks.

If possible this evaluation will be made in units such as fractions of VAX's. Should we keep the CPU intensive requirements separate from IO requirements?

5. ESTIMATION OF TOTAL DEMANDS.

5.1 Present system

Information can be extracted from our present observing statistics and the statistics of program usage obtained from the DEC10 and the AIPS systems. This can be used to estimate total demand with the existing VLA hardware.

5.2 Future use

This predication is of course very difficult. Future usage resulting from changes to the hardware maybe somewhat more predictable, but future changes in the observing patterns are almost impossible to foresee.

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TIMING OF AIPS MAPPING SOFTWARE

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Ed Fomalont

In order to compare the AIPS mapping performance with the PIPELINE mapping performance, the timing of various tasks--from loading the UV data from tape to storing the map and beam on disk--were measured. The test was made on VAX3 in an otherwise empty machine. For these timing purposes, VAX3 is identical to VAX1 except for less memory in the Array Processor. The results are

TASK	CPU TIME sec	ELAPSE TIME sec	I/O COUNT	COMMENTS
UVLOD	90?	182	10,000?	Forgot to look
UVSRT 237,000 uv points	1090	2010	90,000	
UVMAP 1024x1024 map, beam	480	941	33,000	
GET DATA	157	172	4,000	
GRID DATA	135	310	16,000	
FFT	36	224	5,000	
Store maps	152	235	8,000	

UVSRT and UVMAP were also run in parallel to measure the interaction of the programs in the AIPS-VAX environment. The I/O count and cpu times for each task were nearly identical to those entries above. The elapse times are given below. In the overlap period all of UVMAP was executed and about 60% of UVSRT was executed.

TASK	ELAPSE TIME Series	ELAPSE TIME Parallel	COMMENTS
UVSRT 60%	1206	1873	
UVMAP	941	1873	
GET DATA	172	455	Both UVSRT and UVMAP were reading from the same data base. The parallel time might decrease to 300 sec
GRID DATA	310	630	
FFT	224	344	
Store Maps	235	354	

The results of this parallel execution test are

UVMAP + 60% UVSRT	1873 sec elapse time	parallel run
UVMAP + 60% UVSRT	2147 sec elapse time	series run

For this test about 25% of the elapse time was saved in the parallel run as compared with the series run.