



Expanded Very Large Array	EVLA-SW-004
	Revision:1.4
	2003-Aug-06
	<i>Requirements</i> S. Durand

EVLA Engineering Software Requirements

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Keywords: EVLA, e2e, Software, Engineering, Requirements	
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Institute:	Date:

Change Record

Revision	Date	Author	Section/ Page affected	Remarks
1.0	2003-Feb-07	B. Butler	All	Initial Version
1.1	2003-Jun-18	B. Butler	All	First Real Draft
1.2	2003-Jul-18	B. Butler	All	Comments from Steve
1.3	2003-Aug-01	B. Butler	All	Comments from computing
1.4	2003-Aug-06	B. Butler	All	First released version

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Introduction

The EVLA will be an extremely versatile instrument, and its design, testing, and maintenance will require focused effort from the engineering staff. It is clear that the engineers will require software to store, access, analyze, and plot engineering data which is created by the various modules making up the EVLA. Therefore it is necessary to write down the requirements of the engineers on the EVLA software, both portions being written by Data Management (DM) and the project itself. This document defines these requirements. It should be noted that this document does not apply to software required to run the VLA currently, or when operating in the “VLA-mode” during the transition period.

This document is one in a series of documents attempting to set down in detail the requirements on all of the different software associated with the EVLA. The other documents are: *EVLA e2e Science Software Requirements*; *EVLA Offline Data Processing Requirements*, *EVLA Operations Software Requirements*, and *EVLA Science Requirements for Real-Time Software*. The requirement priorities and timescales listed herein may conflict with related requirements in the other documents, given that they are driven by the needs of the engineering staff, as opposed to science or operations considerations. This document draws on preceding documents, including the *MIB Software Requirements*, *e2e/M&C Intersections*, EVLA Memos 39, 34, 28, and EVLA Computing Working Documents 26, 25, 22, 20, 16, 13, 12, 10, 9, 6, and 4.

This is a living document and subject to revision at any time by the authors. The intent is to write down the requirements as completely as possible at a given time, but we must retain the ability to remedy oversights, reflect changes in philosophy with respect to the software, and react to the realities of schedule and budget (via feedback from the e2e and EVLA projects).

The prioritizing scheme is described below. Where possible we have made the requirements quantitative, and clearly defined the meaning of qualifiers and adjectives. However, there may be instances where the substance of particular requirements is necessarily subjective (e.g., “ease of use” and “robustness” type requirements). Rather than spelling these out in detail, we have left these “squishy” requirements as-is, and will rely upon the authors and those charged with evaluating and accepting the software to take these properly into account. There are also a number of places, such as the headers to sections, where we discuss the philosophy behind our choice of requirements. In those cases, the discussions are given as *italicized* text and are not meant as requirements in and of themselves.

General description

The main point of contact between the engineers and software will be with respect to monitor and control (M&C) functions. The engineers will have a need to access monitor data, both real-time and historical, and for analysis and plotting of that data. In addition, they will have a need to issue control commands to modules in the EVLA system, via software. We imagine several different scenarios which are applicable here:

- A new (brand new or after maintenance) module is installed on an antenna, and the engineer wants to see the values at the monitor points. The engineer is at the antenna (just after having installed the module), and needs to access the data coming out of the module in real-time. This is akin to the current “data taps”, and requires the existence of a Device Browser Tool. Note that this Tool *must* be able to operate on a computer out at the antenna, independent of ethernet access back to the control building or elsewhere. The engineer then wants a listing or plot of 5 minutes worth of one of the monitor points. This requires that either the Device Browser Tool be capable of doing this, or other Tools exist which can do it. The engineer then wants to overlay a plot of historical data for that particular monitor point on that particular module on the current data. This requires the existence of an archive, and an Archive Browser Tool with the ability to search for and retrieve data, and the ability of the Plotting Tool to do the overlay. The engineer then wants to change a particular control point value, requiring that either the Device Browser Tool supports this function, or that another Tool exists which does.

- A module emits an alarm (or a value which triggers an alarm in the software). An engineer must then determine the cause of the alarm, whether it is valid, and what to do about it (this could also be the operator, but we make no distinction here). The engineer might be at home, at the AOC, at the VLA, or actually out at the antenna, and needs access to both current and historical values for the monitor points on the module. This requires essentially the same capabilities as the above case.
- An engineer creates a script so that each monday morning, the archive is accessed, the values from several monitor points are retrieved, analyzed (perhaps in various combinations), and plotted (the plot could then be emailed to the appropriate people).

It is strongly desired that all of the Tools be integrated into a single software application, so as to avoid having to run multiple programs (each with perhaps a different GUI or look and feel).

The above requires the existence of an archive, which contains historical data, and the ability to record data separately (perhaps at a much higher rate). The archive should have well defined data products (for instance, recorded at well defined intervals). The separately recorded data is not meant to be archived, unless the engineer decides to keep a record privately.

Whatever software is delivered in the end, it should be straightforward to modify that software, changing or adding functionality. It should be possible to hire a programmer from outside the project (who has not been intimately involved with the history of the software development) to do this in a timely fashion (not taking years for that programmer to learn the “system”).

We note here that most of the engineers are using some flavor of the Windows operating system on their desktops, laptops, and palmtops. Any software which is intended to be run by the engineers on their own computers must be able to run under Windows 2K and XP, and should be able to run under Windows 98 and NT4.0.

Priorities

We have adopted a priority scheme similar to that in the *EVLA e2e Science Software Requirements* document, which is a 2 dimensional scheme encompassing both the importance and the timescale for a particular requirement. We have added a timeframe (“Z”) which is essentially “now,” since the engineers have software needs associated with the test antenna, which will be available in 2003 Q3, not allowing us to wait until 2004 Q2 (which was the earliest timeframe in the other document).

The importance can have the following values:

- 1** = essential
- 2** = important
- 3** = desirable, but not critical

It is intended that Priority 1 items must be present and work with high efficiency. Priority 2 items should be present, though there may have to be sacrifices in performance or availability may be delayed. We expect that the software will fulfill all Priority 1 and 90% or more of Priority 2 requirements. Priority 3 items should be considered for upgrades or development.

The timeframe of deployment is matched to the EVLA Phase I Project schedule (see the *EVLA Project Book*). The timescale phases are:

- Z** = test antennas (2003 Q3)
- A** = transition phase (2004 Q2)
- B** = prototype correlator (2005 Q4)
- C** = shared-risk Science operations (2007 Q2)
- D** = full science operations, completion of EVLA Phase I (2010 Q2)
- E** = “eventually” sometime after completion (ongoing)

A similar prioritization scheme should be used in all of the EVLA software requirements documents.

1 Real-Time Functions

The engineers will have a need to have monitor data from a device dumped to a computer in near real-time. This is like a software version of the current “data taps” for the VLA. At the same time, they will need to control the device, and these two functions should be combined into a single Tool.

1.1 Accessing a Single Device

1.1-R1 There shall be a Device Browser Tool, with the capability to interact with EVLA devices.

Priority: 1 Timescale: Z

1.1-R2 The Device Browser Tool, upon connection to a module, shall display labeled numeric data from each monitor point in the device. Multiple pages of such displays may be needed for devices with many monitor points.

Priority: 1 Timescale: Z

1.1-R2.1 It should be possible to select a subset of all of the available monitor points to be displayed, i.e., select which should be displayed and which not, via a menu or similar method.

Priority: 2 Timescale: A

1.1-R3 The Device Browser Tool shall have a display consisting of a plot of a selected monitor point against time, with automatic scaling of axes and appropriate labels. The plot shall be empty when started, and will grow as data arrives.

Priority: 1 Timescale: Z

1.1-R3.1 It should be possible to plot multiple monitor points on the same plot.

Priority: 2 Timescale: A

1.1-R4 The Device Browser Tool shall have a display consisting of a list of all commands that can be sent to the device.

Priority: 1 Timescale: Z

1.1-R5 The Device Browser Tool shall support sending any of these commands to the device, with data entry as numeric, hexadecimal, logical, or text as appropriate.

Priority: 1 Timescale: Z

1.1-R5.1 The first request to send a command should require some security check (password or other).

Priority: 1 Timescale: Z

1.1-R5.2 These commands shall include setting of monitor point sampling rates, separately for each monitor point. The fastest allowed sample rate for this tool is 52 msec (the standard EVLA timing tick).

Priority: 1 Timescale: Z

1.1-R5.2.1 When sending a command to change a monitor point sampling rate, it should also be required to set the time interval over which this change is requested. The default should be that the change is implemented until the Device Browser Tool is exited.

Priority: 1 Timescale: Z

1.1-R5.3 It shall be possible to send a command while a display specified in 1.1-R2, 1.1-R3, or 1.1-R4 is active.

Priority: 1 Timescale: Z

1.1-R5.4 It shall be possible to send a command repetitively with a specified repetition rate.

Priority: 1 Timescale: Z

1.1-R5.5 It shall be possible to read in an ASCII file with a list of specified commands and timing (absolute or relative), and have those commands be sent to the device at the proper times.

Priority: 1 Timescale: Z

1.1-R5.6 There shall be a command which will put the device into its initial state, for a given setup, when possible.

Priority: 1 Timescale: Z

1.1-R5.7 It shall be possible to “record” sets of commands typed and/or read in during an interactive session, and write them to a file (with associated “start recording” and “stop recording” commands).

Priority: 2 Timescale: A

1.1-R5.8 When feasible, it should be possible to put the device into a previously occupied state, by issuing the proper set of commands to do so. For control points which have an associated monitor point (especially one which logs the sent commands), this could be effected by querying and recording (in the software) the previous command or value each time a new command is sent to the device to modify a control point. This is similar to an “undo” function.

Priority: 2 Timescale: A

1.1-R5.8.1 For commands which can be “undone,” it should be required that a time interval over which the command should remain in effect. The default should be that it takes effect immediately and remains in effect until the Device Browser Tool is exited.

1.1-R6 The Device Browser Tool shall operate if it is connected to the same ethernet subnet as the computer controlling the device. No other computer or network activity shall be required for the Tool to function.

Priority: 1 Timescale: Z

1.1-R7 The Device Browser Tool shall operate if connected to other subnets than the one to which the device computer is connected. Appropriate provisions for security and for transportation of the data shall be provided.

Priority: 2 Timescale: A

1.1-R8 The Device Browser Tool shall have the capability of writing a named file on its local computer while running the display specified in 1.1-R2. The file will consist of either blank or comma separated fields, the first of which will be the time (in MJD and decimal fraction), and a subsequent column for each of the monitor points. The first row of the file will be the monitor point labels.

Priority: 1 Timescale: Z

1.1-R8.1 The default behavior shall be that rows will be written at the rate of the most rapidly updating monitor point, with repeated values for monitor points which update more slowly.

Priority: 1 Timescale: Z

1.1-R8.2 It shall be possible to interrupt the file writing during data recording, gracefully, without exiting the Tool completely (i.e., execute a “stop writing to file now” command).

Priority: 1 Timescale: Z

1.1-R8.3 It shall be possible to select a subset of all available monitor points to be written to the file, rather than getting all of them.

Priority: 2 Timescale: Z

1.1-R8.4 It shall be possible to specify different sampling rates for the monitor data that go to this file vs. those that go to the display, again recognizing that the fastest allowed sample rate for this tool is 52 msec (the standard EVLA timing tick).

Priority: 2 Timescale: A

1.2 Fast Data Dump

If it is desired to collect data more rapidly than the standard EVLA timing interval (52 msec), then special software must be used. In addition, it should be possible to read out the formatter and deformatter buffers into a display or file.

1.2-R1 Data sampling faster than the system heartbeat rate (52ms) shall be provided, when needed, by creating monitor points whose values are an array of numbers representing a time sequence of samples.

Priority: 2 Timescale: A

1.2-R2 Where possible, such monitor points should be incorporated in the device standard software.

Priority: 2 Timescale: A

1.2-R3 The Device Browser Tool shall have the capability of receiving and appropriately displaying such monitor points.

Priority: 2 Timescale: A

1.2-R4 Monitor points returning arrays of values shall also be provided for such functions as reading the contents of formatter and deformatter buffers.

Priority: 2 Timescale: A

1.3 Accessing Multiple Devices

The Device Browser Tool is meant to access a single device of any type. There are occasions when an engineer will want to access multiple devices simultaneously. For such occasions, a Special Device Browser Tool can be defined by the engineer, with well-defined devices, and monitor and control points.

1.3-R1 Specialized Tools for the diagnosis and maintenance of particular devices or subsystems will be provided as experience dictates.

Priority: 2 Timescale: A

1.3-R2 Such Tools shall display a small immutable set of monitor points and allowable control commands directed to their special purpose.

Priority: 2 Timescale: A

1.3-R3 Such Tools shall not be restricted to monitoring or controlling a single device.

Priority: 2 Timescale: A

1.3-R4 Such Tools shall provide the same facilities as the Device Browser Tool for changing monitor point sample rates, reading a file with commands, writing the data to an output file, and network connectivity.

Priority: 2 Timescale: A

2 Archived Data

These requirements cover the archiving of all data which the engineers will need to access. We recognize that astronomical data must also be archived, but that topic is covered in the EVLA e2e Science Software Requirements document, except in isolated instances below.

2.1 Archive Definition

2.1-R1 There shall be an EVLA archive which stores all data obtained with the EVLA. This archive shall include:

2.1-R1.1 environmental data (e.g., weather data, WVR, APM, GPS);

Priority: 1 Timescale: A

2.1-R1.2 monitor and control data;

Priority: 1 Timescale: A

2.1-R2 There shall be a backup for the archive to protect the data from catastrophic failure and loss.

Priority: 1 Timescale: A

2.1-R3 The archive shall include all data measured by the EVLA system including times when the array was not producing astronomical data, or when devices are not functioning properly.

Priority: 1 Timescale: A

2.1-R3.1 When monitor points or devices are not functioning properly, the stored value shall indicate so.

Priority: 1 Timescale: A

2.1-R4 The archive shall be accessible over the normal internet, i.e., it must not be required that the engineer be physically at the EVLA site or AOC.
Priority: 1 Timescale: A

2.1.1 Timing

2.1.1-R1 All archived data shall have a defined interval between data points, which shall only be changed when warranted (approval process to be determined by engineering and operations management). The minimum value of this interval is 52 msec.
Priority: 1 Timescale: A

2.1.1-R2 This defined interval does not have to be the same for every data point (e.g., detector voltages might be recorded every 0.1 seconds, while ambient temperature might only be recorded every minute).
Priority: 1 Timescale: A

2.1.1-R3 The data shall be archived and made accessible as soon as practical after they are taken or produced, but not more than a few minutes.
Priority: 1 Timescale: A

2.1.1-R4 Each recorded data entry shall contain a time-stamp that is referenced to the array clock (i.e., not off by some large arbitrary offset due to internal clock slews within modules).
Priority: 1 Timescale: A

2.1.2 Environmental Data

The environmental data in the archive shall include:

2.1.2-R1 all measured weather data (e.g., temperature, relative humidity, wind speed and direction, barometric pressure);
Priority: 1 Timescale: A

2.1.2-R2 any available RFI monitoring data;
Priority: 2 Timescale: B

2.1.2-R3 other atmospheric sounding data, if available (e.g., atmospheric phase monitor, tipping radiometer, FTS);
Priority: 3 Timescale: D

2.1.3 Monitor and Control Data

Monitor and control data stored in the archive shall include:

2.1.3-R1 For each module in the array:

2.1.3-R1.1 module description and identification number;
Priority: 1 Timescale: A

2.1.3-R1.2 module status (e.g., error flags);
Priority: 1 Timescale: A

2.1.3-R1.3 monitor point information (e.g., module temperatures, voltages).
Priority: 1 Timescale: A

2.1.3-R1.4 antenna on which the module resides (if appropriate);
Priority: 1 Timescale: A

2.1.3-R1.5 a history of commands sent to each control point (if appropriate);
Priority: 1 Timescale: A

2.1.3-R2 instrumental parameters (pointing model parameters, referenced pointing offsets, antenna locations, transmission delays, subreflector rotation, focus curve parameters, frequency setup, source name and position, etc...).

Priority: 1 Timescale: A

2.2 Accessing the Archive

Access to the archive is envisioned as a frontend to some database software. So, in the current NRAO database management scheme, this Tool would be a frontend (GUI or CLI) to access the Oracle database software, which would subsequently be used to access the archive. We do not envision an entirely new piece of archive searching and retrieval software being written, since most of what is needed is already contained in the normal Oracle tools.

2.2-R1 There shall be an Archive Browser Tool to access (search and retrieve data from) the archive.

Priority: 1 Timescale: A

2.2-R1.1 The Archive Browser Tool shall be accessed via a GUI.

Priority: 1 Timescale: A

2.2-R1.1.1 The GUI should be platform independent.

Priority: 2 Timescale: A

2.2-R1.1.2 The GUI should have the same look and feel as the other Tools.

Priority: 3 Timescale: B

2.2-R1.2 The Archive Browser Tool shall have a CLI to interrogate the archive from scripts or other Tools.

Priority: 1 Timescale: A

2.2-R1.3 The Archive Browser Tool shall be able to access astronomical data (visibilities, e.g.) from the appropriate archive, in addition to the environmental and monitor and control data.

Priority: 2 Timescale: D

2.2-R1.4 The Archive Browser Tool shall be able to accept (properly verified) web-based search and extraction requests.

Priority: 3 Timescale: D

2.2-R2 It shall be possible to retrieve data from the archive with the Archive Browser Tool based on a specification of the time range and the desired quantities.

Priority: 1 Timescale: Z

2.2-R2.1 It shall be possible to retrieve all quantities in the archive.

Priority: 1 Timescale: Z

2.2-R2.2 Monitor and control data shall be selectable based on antenna, device ID, or desired monitor point, or any logical combination thereof.

Priority: 1 Timescale: Z

2.2-R2.3 The results of a retrieval shall be returned as a time series of the requested products, consisting of either blank or comma separated fields, the first of which will be the time (in MJD and decimal fraction), and a subsequent column for each of the returned quantities. The first row will be labels for the columns.

Priority: 1 Timescale: Z

2.2-R2.3.1 It shall be possible to specify whether this output goes directly to the GUI or CLI or to a file.

Priority: 1 Timescale: Z

2.2-R3 It shall be possible to search the archive with the Archive Browser Tool.

Priority: 2 Timescale: A

2.2-R3.1 It shall be possible to search on time range, antenna, device ID, desired monitor and control data, or desired environmental data, or any logical combination of these fields.

Priority: 2 Timescale: A

2.2-R3.2 The Archive Browser Tool shall allow search criteria based on more complicated combinations of search fields (e.g., "find me all data with sampler voltage > x, AND cryostat temperature < y").

Priority: 2 Timescale: B

2.2-R3.3 Regular expressions including wild card and ranges shall be available for searching.

Priority: 2 Timescale: D

2.2-R3.4 The search criteria used for database search shall be shown with search results and shall be able to be modified.

Priority: 2 Timescale: E

2.2-R3.5 The data resulting from a search shall be returned as a time series of the requested products, consisting of either blank or comma separated fields, the first of which will be the time (in MJD and decimal fraction), and a subsequent column for each of the returned quantities. The first row will be labels for the columns.

Priority: 1 Timescale: Z

2.2-R3.5.1 It shall be possible to specify whether this output goes directly to the GUI or CLI or to a file.

Priority: 1 Timescale: Z

3 Analysis

It will be necessary to do analysis on the data which is returned by the Archive Browser Tool or the Device Browser Tool. Engineers in many cases may choose to read the data into other analysis packages, but there should be at least some analysis capability which is supplied without having to have special separate analysis software. It is an implicit assumption here that all analyses are as a function of time.

3-R1 There shall be an Analysis Tool which shall analyze the output (files) from the Archive Browser Tool and the Device Browser Tool.

Priority: 1 Timescale: B

3-R1.1 The Analysis Tool shall be accessed via a GUI (possibly the same one as the other archive Tools).

Priority: 1 Timescale: B

3-R1.1.1 The GUI should have the same look and feel as the other Tools.

Priority: 2 Timescale: B

3-R1.1.2 The GUI should be platform independent.

Priority: 2 Timescale: B

3-R1.2 The Analysis Tool shall have a CLI to allow access from scripts or other Tools.

Priority: 1 Timescale: B

3-R1.3 The Analysis Tool shall be directly accessible from the Archive Browser Tool, Device Browser Tool, and Plotting Tool.

Priority: 2 Timescale: C

The Analysis Tool shall be able to:

3-R1 Calculate combinations of mathematical functions of the different quantities in the data entries (for example, calculate the “Y factor” from the voltages in the entry, or calculate $\sqrt{e_1}/(e_2 + e_3)$ where e_1 , e_2 , and e_3 are three of the columns in the entry).

Priority: 1 Timescale: B

3-R2 Specify time sub-ranges to be analyzed.

Priority: 1 Timescale: B

3-R3 Calculate standard statistical quantities:

3-R3.1 median;

Priority: 1 Timescale: B

3-R3.2 moments (mean, standard deviation, skew, kurtosis, etc...);

Priority: 1 Timescale: B

3-R3.3 maximum absolute deviation from mean;

Priority: 1 Timescale: B

3-R4 Remove trends in either the raw or combined quantities:**3-R4.1** simple mean or median;*Priority: 1 Timescale: B***3-R4.2** running mean or median, with specified width;*Priority: 1 Timescale: B***3-R4.3** polynomial fit, of specified degree;*Priority: 1 Timescale: B***3-R4.4** spline fit, of specified degree and end conditions;*Priority: 3 Timescale: D***3-R5** Specify alarm or flag conditions to be indicated, based on values of entries (for instance, look through this data set, and tell me if column 3 in the data entries is ever > 4).*Priority: 2 Timescale: C***3-R6** The results of an analysis, if appropriate, shall be returned as a time series, consisting of either blank or comma separated fields, the first of which will be the time (in MJD and decimal fraction), and a subsequent column for each of the quantities. The first row will be labels for the columns.*Priority: 1 Timescale: A***3-R6.1** It shall be possible to specify whether this output goes directly to the GUI or CLI or to a file.*Priority: 1 Timescale: A*

4 Plotting

It will be necessary to plot the data which is returned by the Archive Browser Tool, the Device Browser Tool, or the Analysis Tool. Engineers in many cases may choose to read the data into other plotting packages, but there should be at least some plotting capability which is supplied without having to have special separate plotting software. We do not envision the creation of completely new plotting software, since there are already in existence good packages to do so. We rather envision this as a front-end to some already existent plotting package (e.g., PGPLOT, super mongo, xmgrace, etc...).

4-R1 There shall be a Plotting Tool or Tools which shall plot the output from the Archive Browser Tool, the Device Browser Tool, and the Analysis Tool.*Priority: 1 Timescale: A***4-R1.1** The Plotting Tool shall be accessed via a GUI.*Priority: 1 Timescale: A***4-R1.1.1** The GUI should have the same look and feel as the other Tools.*Priority: 2 Timescale: A***4-R1.1.2** The GUI should be platform independent.*Priority: 2 Timescale: B***4-R1.2** The Plotting Tool shall have a CLI to allow access from scripts or other Tools.*Priority: 1 Timescale: C***4-R1.3** The Plotting Tool shall be directly accessible from the other Tools.*Priority: 2 Timescale: C***4-R2** The Plotting Tool shall be able to plot 2-D (single functional value vs. time, for example) data.*Priority: 1 Timescale: A***4-R2.1** It shall be possible to specify ranges for all axes.*Priority: 1 Timescale: A***4-R2.2** It shall be possible to specify autoscaling for all axes.*Priority: 1 Timescale: A*

- 4-R2.3** It shall be possible to specify subsampling for one of the axes (e.g., give me every 4th sample in time, or give me a single data point every 10 seconds).
Priority: 1 Timescale: A
- 4-R2.4** It shall be possible to specify simple interpolation on one of the axes.
Priority: 2 Timescale: B
- 4-R2.5** It shall be possible to specify filtering on one of the axes, of the following types:
- 4-R2.5.1** boxcar (mean);
Priority: 1 Timescale: A
 - 4-R2.5.2** median;
Priority: 1 Timescale: A
 - 4-R2.5.3** gaussian, with specified width;
Priority: 2 Timescale: C
- 4-R2.6** It shall be possible to specify that the data points are connected by line segments, or represented by symbols (of at least a few types).
Priority: 1 Timescale: A
- 4-R2.7** It shall be possible to specify the colors of the line segments or symbols.
Priority: 1 Timescale: A
- 4-R2.8** It shall be possible to specify labels - for the overall plot, and for the X- and Y-axes, separately.
Priority: 1 Timescale: A
- 4-R2.8.1** It shall be possible to specify different fonts (at least roman, italic, bold, and greek) for the labels.
Priority: 2 Timescale: C
 - 4-R2.8.2** It shall be possible to specify superscripting and subscripting control for the labels.
Priority: 2 Timescale: C
 - 4-R2.8.3** It shall be possible to specify different colors for the labels.
Priority: 2 Timescale: C
 - 4-R2.8.4** It shall be possible to specify different relative character sizes for the labels.
Priority: 2 Timescale: C
- 4-R2.9** It shall be possible to specify axes and tick marks in some detail, or allow defaults to be determined automatically.
Priority: 2 Timescale: C
- 4-R2.10** It shall be possible to specify a proper “scale” in real world coordinates for either or both axes.
Priority: 2 Timescale: C
- 4-R2.11** It shall be possible to specify a relative line width for labels, axes, and plot symbols or lines, separately.
Priority: 2 Timescale: C
- 4-R2.12** It shall be possible to overlay multiple plots of different quantities on the same plot, with the same sampling on the X-axis (e.g., receiver temperature and ambient temperature both as a function of time).
Priority: 2 Timescale: C
- 4-R2.13** It shall be possible to output an electronic plot file which can be saved or printed:
- 4-R2.13.1** as PostScript or PDF;
Priority: 1 Timescale: A
 - 4-R2.13.2** as a bitmapped format (JPEG, GIF, PNM, etc...)
Priority: 2 Timescale: C

5 Documentation and Help

There should be sufficient documentation and help facilities for all of the Tools described here so that somebody not familiar with the software can use only those facilities to become proficient at running the Tools. Such documentation and help should be easily accessible.

5-R1 There shall be a variety of help and documentation facilities available from the GUI and on the Internet for the various Tools. These shall include:

5-R1.1 Context-based help provided in the GUIs for the Tools.

Priority: 1 Timescale: A

5-R1.2 An introductory “cookbook,” including examples, designed to let a novice user, possibly without extensive knowledge of the EVLA, know how to operate the software efficiently.

Priority: 1 Timescale: B

5-R1.3 A more detailed User’s Manual.

Priority: 1 Timescale: C

5-R1.4 A complete Reference Manual for functions, operation, and installation for each of the Tools.

Priority: 2 Timescale: B