



Graphical User Interfaces (GUIs) for the Green Bank Telescope

Gareth Hunt

November 14, 1997
(revised January 9, 1998)

Abstract

After analysis of the available options with the time constraints, it is a clear decision to use Tcl/Tk as the GUI for development of the operator and engineering interfaces to the GBT.

Contents

1	Introduction	3
2	GUIs already in use on the GBT	3
3	GUIs still needed for the GBT	3
4	Constraints	3
5	Basic Options	4
6	CLI and GUI builder	4
7	The Decision	4

1 Introduction

Now that the general policy for GUIs has been set [McKinnon, GBT Memo 172], it is time to make the technical decision on which GUI tool to use to provide the necessary functionality.

2 GUIs already in use on the GBT

Because of various historical decisions, there are already two major GUIs in use on the GBT project.

- Aggregates of data, both astronomical and engineering, are stored in FITS files, which are then read into the AIPS++ data analysis system. The command line interface (CLI) for AIPS++ is Glish. The GUI based on Glish, using unbundled Tk widgets, is Glish/Tk. Analysis of astronomical data and recorded engineering data will thus be done using Glish/Tk.
- The observer interface, to be used to control the GBT by an observer, has also been developed using extensions of Glish/Tk.
- The Metrology group has developed engineering control and diagnostic procedures using Visual C++ and Borland C++. Graphical displays are produced by piping the data to Excel spreadsheets. This is the only part of the GBT project that uses PCs.

3 GUIs still needed for the GBT

The M&C group has designed a system which provides easy access to the control and monitor of all electronics hardware. A couple of efforts to display and control the devices with visual interfaces have been aborted. The purpose of this memorandum is to document the decision on the selection of a GUI to be used to develop the displays needed for two aspects of GBT operation.

- The telescope operators need summary data and control to supervise the operation of the GBT.
- The engineering staff need control of individual electronic components and display of instantaneous data.

4 Constraints

The selection is constrained by the following:

- The displays produced using the GUI must be ready on a time-scale of weeks to months. The engineering displays are needed as hardware is completed and connected to the M&C hardware. The operator displays must be ready and tested by operations at least a month, preferably more, before "first light," currently projected for the end of 1998.
- It is desirable to minimize the total number of GUI systems in use to provide displays.
 - A telescope with a homogeneous set of GUIs will be easier to operate.
 - A smaller number of GUIs will be easier to maintain and enhance.
- The displays must execute on a Unix system. This precludes the wealth of options available for the PC architectures.

5 Basic Options

For the operator and engineering GUIs, there are several basic options.

1. The Tool Command Language and Tool Kit (Tcl/Tk). Tcl is a string oriented CLI; Tk is a graphical widget set. This is a general GUI in use at many real-time control sites. Tcl/Tk is widely supported and has a wealth of widgets available, although it is not clear how important this will be. Screens developed in Tcl/Tk can be customized by non-programmers. Tcl/Tk has a GUI builder that is readily extensible. It is freely available. It is also available on PC platforms. The major disadvantage is that it is an additional GUI.
2. Glish/Tk. Glish is a powerful, general purpose, CLI with strong mathematical support. The Tk widget set available with Glish is based on an independent release of a subset of the standard Tk widget set. Glish and Glish/Tk have the advantage that they are supported at the NRAO by the AIPS++ group, and that decisions have already been taken to use them on other parts of the GBT.
3. A GUI based on a general engineering tool such as LabView. This has the great advantage that such tools run on PCs. The Metrology engineering displays could be modified eventually to use the same GUI.
4. Java. Sun appears to be reducing their extensive support for Tcl/Tk in favor of Java and JavaScript. The strategy seems to be to merge Tcl/Tk applications with Java. Java has the major advantage that it is designed for use on the Web. It could also be retrofitted into the Metrology computers.
5. Other options cannot be considered in detail. The time needed to analyze, choose, and learn other packages would be too long to achieve the goals under the present time constraints.

In fact, the time difficulties expressed in the last option also apply to options 3 and 4. So we are left with the first two options.

6 CLI and GUI builder

Although the need for a mathematical scripting language for data analysis is obvious, the operations and engineering groups did not see a great need for this for interaction with instantaneous data. Arithmetic and logical combinations of small quantities of data are all that were foreseen. This can easily be handled by a CLI much less powerful than Glish.

The Tcl/Tk GUI builder, Visual Tcl (vTcl), is a powerful development tool. In tests, it appeared that it was several times faster to produce a display window of widgets using vTcl rather than generating the appropriate number of lines of Glish code by hand. The total number of lines of Tcl produced also was only slightly greater than necessary in Glish.

In addition, there is a well defined and fully supported interface to vTcl using the Simplified Wrapper and Interface Generator (SWIG), which allows interfaces to other software packages to be generated by vTcl automatically. SWIG, as part of the Tcl/Tk development kit, is also freely available. The custom interface routines are written as simple C functions and simple function descriptors. This should be straightforward to use to extend Tcl to allow widgets to communicate directly to the raw command and control interfaces of the M&C software. It should also be straightforward to maintain.

7 The Decision

After analysis of the available options with the time constraints, it is a clear decision to use Tcl/Tk as the GUI for development of the operator and engineering interfaces to the GBT.