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Introduction to the Field System for Non-Users

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Abstract

This report provides a brief description of the Field System (FS) for non-users. The Field System (FS) is a suite of programs that provides the coordinating control of VLBI data acquisition at many stations. The basic features of the FS and experiment operations are described. Areas for future development are listed.

1. Basic Features

The Field System (FS) is a software package that provides an interactive and automated control of VLBI stations. The control language is Standard Notation for Astronomical Procedures (SNAP). The FS supports a wide variety of VLBI back-ends. The FS can be adapted to support unique hardware and the antenna found at virtually every station. All events are recorded in an ASCII log with time-stamps. An antenna independent package of programs is provided for pointing and sensitivity measurements. Schedules are provided that automate calibration of the supported longitudinal VLBI recorders. A significant feature of the FS which reduces its cost considerably is that it runs on the free (and freely available) Linux operating system.

2. Supported Equipment

The FS supports a plethora of VLBI back-ends. For practical purposes the FS divides the back-end into two parts: the Data Acquisition System (DAS) and the recorder. The supported DASs include: Mark III, Mark IV, VLBA (including VLBAG), VLBA4, and K4. The supported recorders include: Mark III, Mark IV, VLBA, VLBA4, S2 and K4. In addition the FS can support a second longitudinal recorder, any of: Mark III, Mark IV, VLBA, and VLBA4.

3. Station Adaptation

The FS provides several features that are useful for adapting or customizing it for a particular station. The most fundamental of these is that it is organized into station independent and station dependent parts. The station independent parts provide the basic support for the VLBI back-ends. The station dependent parts can be customized to support the different hardware and antenna interface that is found at a particular station. Distribution of the FS respects the station independent and dependent split. Typically updates only require recompiling and relinking any station dependent programs.

The most important part of the station dependent software is the ANTenna CoNtrol program (ANTCN). The design of the ANTCN program is such that once it is properly implemented at a station, the antenna has certain standard features from the FS's point of view. Once these features

exist, control of the antenna from a schedule and for pointing and sensitivity measurements can be carried out in a station independent fashion.

In addition to ANTCN, there can also be station specific SNAP commands, error messages, control files, equipment checking, and background programs that support the local station environment.

4. SNAP Command Language

The operator and schedule driven interface for the FS utilizes the Standard Notation for Astronomical Procedures (SNAP) command language. Experiment operations are conducted from "schedule files". Testing and equipment set-up is performed with a combination of interactive commands and schedules.

5. SNAP Procedures and Schedules

SNAP commands can be collected together in "procedures" which function as macros of commands to reduce typing of common operations. SNAP schedules contain typically longer sequences of commands such as those needed to carry out an entire observing session.

6. SNAP Syntax

Each command in SNAP starts with a keyword that is usually associated with a hardware module or sub-module. The keyword may also represent a more abstract concept such as a measurement process. Each keyword can typically be used in one of two forms. The first form is to command the set-up of the module and consists of the keyword followed by an equals sign (=), followed by one or more comma delimited parameters. For example:

```
keyword=parameter1,parameter2,...
```

The meanings of the parameters are determined by their order in the list. Usually required parameters are first in the list to minimize the amount of typing necessary. Many parameters may be omitted if sensible defaults exist. Such a command generally doesn't produce a visible response unless there is an error. The approach here is similar to that in UNIX, that "no news is good news".

The second form of a command is to monitor the state of a module. In this case, just the keyword is entered:

```
keyword
```

The response is in the form:

```
keyword/parameter1,parameter2,...
```

The parameters represent the state of the module. Adjustable parameters which can be set by the user are listed first in the same order that they are used in the set-up command form. Addi-

tional parameters that represent information that can only monitored, but not set (e.g., square-law detector power levels) follow.

7. Log File Output

All events that occur are recorded in an ASCII time-tagged log file. The recorded events include operator or schedule issued commands, command responses, and errors. The log file lines are divided into three parts: the time-tag, the type character, and the data. The example below shows a small fragment from a log:

```
2000.010.12:34:56.34;ifd=20,20
2000.010.12:35:10.34;ifd
2000.010.12.35:10.56/ifd/20,20,nor,nor,rem,2785,17345
```

This example shows three log entries. The first is a set-up command that sets the attenuation for the "ifd" module. The semi-colon ";" character between the time-tag and the "ifd=20,20" is the type character which in this case indicates that the command came from the operator rather than a schedule. The second entry is a command to monitor the state of the "ifd" module, again from the operator. The last entry is a monitor response for the "ifd" module. It shows that the attenuators are in fact set for 20 and 20 as previously request. Then some other settable parameters followed by some monitor only parameters are shown. In this case the type character is a slash "/" which indicates this is a module response. Other type characters which are typically seen include colon ":" which indicates a command that came from a schedule and question mark "?" which indicates an error message.

8. Operational Use - Session Preparation

The normal flow of operations begins with the schedule writer (more commonly called the P.I. by astronomers) who provides a VEX or optionally, a Mark III format schedule file (*.skd or *.drg). The schedule file is deposited on a data center server. The stations pick up the schedules from the server.

At each station the DRUDG program is run to create a SNAP schedule (*.snp) and a corresponding session procedure file (*.prc).

Just before the experiment begins the operator makes any necessary manual preparation, connecting cables, setting switches that are not computer controlled, etc.

Figure 1 shows a typical operator at the FS console.

9. Operational Use - Session

Once everything is ready the operator starts the schedule with the "schedule=..." command. The SNAP schedule is run by the FS and the back-end equipment is all set up automatically. Operators usually perform certain "pre-checks" to verify correct operation of the system and check the sign of the cable before the first scan is recorded.

The session runs with the FS controlling the antenna and the back-end. Monitor data and some ancillary data such as cable calibration are placed in the log file (*.log). During the session

operator intervention is normally only required to change tapes or to restart the system if a serious fault such as a power failure should occur.

Figure 1. Seated at the FS console is a typical operator, taking a rest from being the Local Organizing Committee of the first IVS General Meeting.

Figure 2. Typical FS console display.

The typical display the user sees when the FS is running is shown in Figure 2. The display includes a small operator in/out window in the lower left corner, a log display and output window, a larger window in the upper left, and a status and monitor display in the upper right. FS displays vary in size; on most systems these windows take up most of the display.

10. Operational Use - End of Session

After the session the operator may perform some final checks to verify that the system is still healthy. Data from the log file (*.log) is plotted to verify that none of the ancillary data types has developed a problem. The log file is placed on the data center server for use by the correlator and analysts. The tapes are sent to the correlator.

11. Future Improvements

Several improvements in the FS are planned in the fairly near term. These include: (1) automated Tsys measurements, (2) remote operation, (3) more automation, (4) a new utility to standardize "ops" messages, (5) improved log display and searching, (6) S2 DAS support, (7) more test software, and (8) control structures and variables in SNAP.