NASA Goddard Spaceflight Center

Sked

VLBI Scheduling Software

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Contents

Conventions

In this manual we employ a variety of typographic conventions. These are summarized below:

Typographic Conventions	
Normal	This font is used for normal text.
Emphasis	Used for *emphasis* in normal text.
Program	Used for program names: *sked*, *drudg*, *solve*, etc.
Computer	Used to distinguish computer output. This includes responses, directory listings, command prompts, etc.
UserInput	Whatever the user types. This can be in response to a prompt.
Argument	Arguments to commands and programs.

Text that appears on the computer monitor is distinguished by being placed in a text box. For example, a directory listing would appear as:

```
bootes: /home/jmg>> ls -lt
drwxrwxr-x  2 jmg mk3   4096 Feb 25 09:39 schedules
drwxrwxr-x 11 jmg mk3   4096 Feb 22 08:34 sked2009Oct01
drwxrwxr-x 12 jmg mk3   4096 Jan 27 10:26 sked_dev
drwxrwxr-x  2 jmg mk3   4096 Jan 26 15:08 sidetime
drwxr-xr-x  2 jmg mk3   4096 Jan 11 16:49 config
drwxrwxr-x  2 jmg mk3   4096 Jan 11 15:48 nut_test
drwxrwxr-x  2 jmg mk3   4096 Dec  9 14:47 update_vdb
drwxrwxr-x 11 jmg mk3   4096 Dec  9 14:06 sked2009Nov16
drwxrwxr-x  2 jmg mk3 118784 May 18  2009 arcfiles
bootes: /home/jmg>>
```

Note that the user's input '**`ls -lt`**' appears in different font from the computer output.

Release Notes. 2012-May-09

This document is a major rewrite of the sked manual. The last time the sked manual was updated was April 15, 1997—over 15 years ago. This is meant to be both a user's manual and a reference.

There is a saying that the "Best is the enemy of Good." The long delay in releasing an update in this manual is an example of this. I have been working on an update since at least 2005, and constantly found ways to improve the manual. This has resulted in delaying the release. In the meantime **sked** continued to change, which resulted in further delays. I have finally decided to go ahead and release the manual in its current form. I think it is fairly complete. As changes are made to **sked** I will update and release the manual.

In a document of this size I am sure there are errors. If you find any errors—large or small—please let me know and I will correct them. If you find some section confusing, please let me know and I will try to clarify it. I am always eager to hear suggestions for improving it.

Many pages have a date at the bottom left-hand corner. This is the date a major change was made to this section. Correcting a spelling error will not result in a date change. Changing an equation or re-writing a section will.

Release Notes. 2016-Jan-31.

This is an update to the 2012-May-09 version of the manual. I have tried to go through and systematically check all commands. Over the last three years there have been several (mostly minor) changes to sked. This manual incorporates these changes. Some sections that were confusing or incomplete, such as that on the **param** command have been expanded and rewritten. I have added a new section on the different sections of the schedule file.

Release Notes. 2018-May-01.

This is an update to the 2016-Jan-31 version of the manual. Several new commands and functionalities were added:

- Command **fill** and parameter **fill_off** ;
- Command and section **group** ;

There were modifications done related to the names of the rack types (DBBCs), merging of the libraries of **sked** and **drudg**, the variable max_obs was increased to 30000, and a modification in the way **sked** accesses the Goddard VLBI SQL database that lists statistics on experiments (see mysql and **monitor**).

Release Notes. 2018-Oct-12.

This is an update to the 2018-May-01 version of the manual. Several new commands and functionalities were added:

- Parameter **`conf_equip`** ;
- New feature to manually select / unselect stations with the **`station`** command ;
- Major option parameter **`SplitTwins`** and section **`TWIN_TELESCOPES`** (these features are still in development).

Summary of Changes Made to Manual	
2012-May-09	Fresh start. Major rewrite of all sections
2013-Apr-23	Addition of Broadband command
2013-Jul-17	Modification of section on SNR calculations to include effect of bit-sampling and correlator efficiency.
2016-Jan-31	This updates the manual with changes made over the last several years.
2018-May-01	This updates the manual with changes made over the last two years.

Chapter 1 Introduction

What is sked?

Sked is an interactive program that helps you prepare schedules for VLBI observing sessions.

With sked you can:

- enter an entire schedule interactively,
- automatically have sked select scans for you,
- edit an existing schedule regardless of how it was generated, or
- list, check, evaluate, and summarize any schedule.

Sked is the first program you run in preparation for a VLBI experiment. Sked also offers a convenient way to incorporate catalog information on sources, stations, and observing modes into your schedule. Sked is normally used to schedule geodetic sessions, while *sched*, developed and maintained by Craig Walker of the NRAO, is the program normally used for astronomical scheduling.

When running interactively, sked can display a list of all the sources that are visible at each station at the given time. This aids in selecting the next observation. You can make plots of the distribution of scans made so far, plot the distribution of sources on the sky, and display source visibilities at a station during the day.

Sked can be set up so that it automatically selects scans based on optimization criteria that you specify. The major criteria for optimization are covariance and sky coverage. Among the minor criteria, you can maximize the number of observations and minimize the time between scans. The automatic scheduling feature was originally developed by Heinz Steufmehl of the University of Bonn, Geodetic Institute.

When you attempt to schedule a new scan, sked makes sure the source is visible at all the stations which are to participate in the scan and that the scan can be completed at all stations. Calculations of telescope pointing position and slewing time are computed appropriately, taking into account motion of the source during the slew. Source flux densities and antenna sensitivities can be used, along with user-specified minimum SNRs, to compute scan times for each station automatically. Whether you use automatic scan selection or manual scheduling, all of these features of sked are fully used.

The output of sked is a "schedule file" which is simply an ASCII file with different labeled sections. The convention is to name these files with a .skd extension, e.g., r1431.skd. Schedule

files contain all the information needed to acquire VLBI data at all network stations and then process it at a VLBI correlator. `Sked` can write schedule files in two formats:

- 'Sked' format. This is the original format of `sked` which has evolved over time.
- VEX format. This is a more modern format. Specifications for the VEX format can be found at http://lupus.gsfc.nasa.gov/vex.

`Sked` can read files in either format. We anticipate that the 'sked' format will become obsolete in the near future.

After you generate your schedule, the `.skd` file is copied to a central server location where the participating stations can access it electronically. The stations download the file and then run the Field System program `drudg` to make control files and listings for the experiment.

Definitions

This section gives some definitions used elsewhere in the manual.

scan: A scan is the time period during which a network of stations observes the same source simultaneously; possibly each station observes for a different length of time. A scan constitutes one line in the `$SKED` section of the schedule file. When you run sked interactively, you are scheduling one scan each time you specify a source and network of stations to be scheduled. A scan begins at the same time at all stations participating in the scan.

observation: An observation is a single-baseline recording that would produce one delay point in a data base for analysis. There may be, and usually are, multiple observations for each scan. For example, a 3-station scan produces 3 observations, a 4-station scan produces 6 observations.

subnet: A subnet is a subset of the full network of stations that are participating in an experiment session. The term "subnetting" usually refers to geodetic schedules that make use of many varying subsets of stations, frequently with subnets observing simultaneously.

subconfiguration: A subconfiguration is a group of scans that could be scheduled at about the same time. Each of the scans in a subconfiguration is on a different source and with a different subnet. During automatic scan selection, `sked` considers many possible subconfigurations of the full network as it decides which subconfiguration should be selected. For example, with a 6-station network, some of the possible subconfigurations include:

1. All 6 stations observing the same source (1 scan, 15 observations)
2. 5 stations observing the same source, and one station not participating. (1 scan, 10 observations)
3. 4 stations observing one source, 2 stations observing another source (2 scans, and 6+1=7 observations).

4. 2 stations observing one source, 2 stations another, and 2 stations a third (three scans, three observations).

Each of these possibilities, for each mutually visible source or sources, constitutes a possible sub-configuration. For a 6-station network with moderate baseline lengths, there are usually hundreds of sub-configurations possible at a given time.

Distribution and Support

The files necessary to install the linux version of `sked` are available from:
https://vlbi.gsfc.nasa.gov/software/sked.
Instructions for getting the files and installing the program are found in 'Installation'.

Only the linux version of the program is supported now. This version was derived from the last HPUX version of `sked`, and the source code should compile under both platforms. The source code is written predominantly in standard FORTRAN with some C to interface to system calls. The code should run, with minor modifications, on other platforms. For example, we have developed a DOS/Windows version. If you port `sked` to another platform, please let us know.

Questions, problems, and comments may be addressed at any time to John M. Gipson at: John.M.Gipson@nasa.gov.

My goal is for `sked` to be bug free at all times. If you find a bug, please inform me and I will fix it as soon as possible.

Backward Compatibility

There have been few changes in the format of the schedule file over the lifetime of `sked`. The program remains backwards compatible, that is, it can read and understand any of the old types of schedules. Some parameter names have changed but the basic information about sources, stations, observing modes, and scans should be read correctly into `sked`.

The schedule file format was compatible with the requirements of the Mark IIIA correlator. The Mark IV correlator requires VEX format and so the conversion of a schedule to VEX is essential before the session can be correlated. This step may be done by the correlator.

History of *Sked*

`Sked` was originally written by Nancy Vandenberg in the late 1970s. The table on the following page gives some highlights in its evolution. `Sked` is currently maintained by the VLBI group at NASA's Goddard Space Flight Center, and John Gipson has primary responsibility for it.

Highlights in the Development of Sked	
1978	Basic program created (Nancy Vandenberg). Command line input. Manual selection of scans. Catalogs for sources, stations, equipment.
1981	Automatic calculation of antenna motion and tape handling.
1988	Automatic selection of observations (Autosked). Heinz Steufmehl of the University of Bonn, Geodetic Institute. Optimization by strict covariance.
1992	Evaluation of schedules using SOLVE simulations. Creation of pseudo-databases to evaluate formal errors.
1993	Autosked merged into standard version. "Strange" schedules.
1995	Beginning of rule-based schedules.
1996	Mark IV/VLBA recording mode support added. Last time sked documentation updated.
1997	Numerous changes. Support for VEX files. Y2K fixes. New Java-based catalog interface. S2 and K4 support.
2002	John Gipson takes over development/maintenance. Fill-in mode. Best-N Source Selection.
2004	Linux port. Alexey Melnikov IAA: Beginning of death of HP-sked. Astrometric option; Specify min, max observing targets for set of sources.
2005	Full support of Mark5A disk-based recording.
2006	Downtime: Ability to specify when an antenna is unavailable.
2007	Resurrection of covariance optimization. Found and fixed various bugs in algorithms. Still not used routinely. By-product: `sked` can predict formal errors internally.
2008	Master command: Read session setup from master file. Check session against master file.
2009	Station limit raised from 32→64, and made parameter.
2013	Initial support for broadband observing.

Chapter 2 Getting Started

In this chapter we give an overview of some of the most important commands in sked. By the end of this chapter the reader should be able to generate the most common schedules.

Starting sked

VLBI schedules are contained in ASCII files that contain all of the information required to schedule and run the session. By default these have the extension '.skd'.

Usually the first step in generating a new schedule is to start with an existing schedule that has similar characteristics. For example, to generate an 'r1' schedule, you start with a previous 'r1'. By default, sked assumes that a schedule file has the extension .skd. If the extension is not given, sked will automatically add it to the filename. The following command opens the schedule file r1410.skd in the current directory:

```
bootes: /home/jmg/schedules>> sked r1410
sked: Automatic/Interactive VLBI Scheduling Program
      JMG/NRV/AEM HP/Linux SKED 2010Jan27
RDCTL02 - Reading system control file /usr/local/bin/skedf.ctl
RDCTL02 - Reading local control file skedf.ctl
Reading session: R1410
$OP
$SKED          659 scans
$SOURCES        60 sources
$FLUX
$STATIONS        7 stations
$CODES
$HEAD
Re-reading CODES.     (1 frequency codes)
Re-reading HEAD.
Re-reading FLUX.
Re-reading $OP section
$PARAM
PRSET22 - Initializing schedule starting time to 2009-355-17:00:00
Source      Start      DURATIONS
name     yyddd-hhmmss   Ny  On  Sh  Tc  Wf  Wz  Zc
1611+343 09355-170000|  70 172     172 110  67    |
End of listing.
?
```

After announcing itself, sked gives the version date, 2010Jan27 in the above example[1], then reads in two configuration files: /usr/local/bin/skedf.ctl and skedf.ctl. These files tell sked where to find catalogs which contain station and source information, where to write temporary files, etc. The first file is a global configuration file. The second is an optional local configuration file, which, if present, overrides the values in the global file. Sked then reads in the schedule file, and summarizes what it finds in it. At very end, sked lists the first scheduled scan, and then stops with the sked prompt, which is "?"

[1] This is useful for debugging purposes. The version date and the date of creation are written to the sked file, and appear towards the top.

Sked Command Syntax

Sked has about 80 commands, and many of these commands take arguments. This effectively increases the number of commands and options to several hundred. All commands take the general form:

Command *Optional Arguments*

Case Insensitive. All sked commands and arguments *except* filenames are case insensitive.

Minimal Matching. For ease of use, users only need to specify enough letters of a command to distinguish it from other commands. This principal is called *minimal matching*. That is a user only needs to enter enough letters of a command to distinguish it from other commands. Hence the following commands are all equivalent. **List, li, lis.** The use of minimal command matching is illustrated below:

```
? list .
Source      Start      DURATIONS
name     yyddd-hhmmss   Ny  On  Sh  Tc  Wf  Wz  Zc
1324+224 09355-173144|  46      43      46        |
End of listing.
? li beg-171000
Source      Start      DURATIONS
name     yyddd-hhmmss   Ny  On  Sh  Tc  Wf  Wz  Zc
1611+343 09355-170000|  70 172     172 110  67    |
1418+546 09355-170340|  57  99  78      99  48    |
1519-273 09355-170612|              117 117        |
0014+813 09355-170626|  43  43  43          43  43|
2141+175 09355-170915|  44  63          63  43    |
End of listing.
?
```

In the above example, the user first asked *sked* to list the current scan '**list .**' ('.' has a special meaning in sked) using the full form of the list command. Then the user used an abbreviated form of this command to list all scans from the start of the session to 17:10:00.

Ambiguous or Unknown Commands. If sked cannot determine the command from the users input, it issues a warning message:

```
? ma
ma command ambiguous
?
```

If sked cannot determine a command, it reports an error:

```
? charm
Command not found: charm
?
```

Since (this version) of sked has no charm command, sked returns with a warning message.

Time and Time Ranges

Current Time. When generating a schedule, sked keeps a pointer which points to the last scan scheduled. The time associated with this is called the *current time.* (There are actually many 'current' times, one for each antenna in the schedule.)When scheduling a new scan, it will occur as

soon after this time as possible, taking into account the duration of the scan and the time required for the antenna to move to a new source.

When the user lists a schedule, this pointer is left at the last scan listed. This may or may not be the last scan scheduled. If the user schedules a new scan, `sked` will insert the scan afterwards and as soon as possible. Hence, care must be taken in scheduling to ensure that this pointer always points to the last scan scheduled.

Specifying Time. Many commands specify either a time or time-range. A time can be specified in a variety of ways. The most precise is to specify the complete year (specified by two digits), Day of Year (DOY), hours, minutes and seconds: `09355170000`. If the year or DOY is omitted, sked takes these values from the *current time*. In specifying time the user can put in optional "/" and ":" to increase readability. Hence if the year is 2009, and the day of the year is 355, the following times are all equivalent:

```
09355170000
09/355/17:00:00
17:00:00
```

`Sked` also knows about some special times that have symbolic names. In the table below all the names in a given row are synonymous.

Special Sked Times	
`., Now`	Current time
`^, Begin, Start`	Beginning of experiment
`*, End, Last`	End of experiment or last scan scheduled, depending on context

Specifying Time Ranges. A time range is specified by giving a starting time and ending time separated by a "-". The following are all valid time ranges:

```
beg-171000
^-end
.-193000
```

The first time-range is from the beginning of the session to 17:10:00. The second from the start of the session to the last scheduled scan. The third example is from the current time to 19:30:00.

Stations and Subnets

Stations are specified in *sked* by a two-character station ID. (The station ID can be found by using the **`station list`** command which displays information various information about the station including its ID.)

A subnet is a set of stations that either observe together or are scheduled together. These are specified by a list of two character station IDs, optionally separated by dashes. The following are all equivalent subnets:

```
NyOnWfWz
```

nyonwfwz

Ny-On-Wf-Wz

For ease of readability, we recommend starting each two station ID with a capital letter. `Sked` recognizes "_" as a special subnet—this is the subnet consisting of all stations in a session.

Fourteen Useful Sked Commands

Sked has about 80 commands, many of which can take several options. These commands are covered in detail in the Command Reference part of this manual. In this section we give an overview of some of the most common `sked` commands. Using just these commands, a novice scheduler should be able to make a schedule.

Useful Commands	
Command	**Description**
`?`	Sked help
`Param`	Set, list parameters
`master`	Check the schedule against the Masterfile. Setup up the schedule using the Masterfile.
`SNR`	Set, list SNR targets.
`Down`	Specify a station is unavailable
`BestSource`	Select the best sources for a given network.
`Auto`	Automatic scheduling
`Whatsup`	What sources are visible at which stations.
`/`	Schedule a scan
`List`	List the schedule
`Check`	Check the schedule
`Summ`	Summarize schedule
`Wr, wc`	Write out a file.
`Quit`	Quit.

Help

The "?" command lists all of the `sked` commands.

```
? ?
 !              Shell to system               /              Insert new scan
 ?              Info for <command>            ^              Previous line
 ABORT          Abandon all changes           ADD            Add station to scan
 ALLOCATION     Set, list tape allocation     ASTROMETRIC    Set desired #obs
. . .
. . .   More Sked output
. . .
 WEIGHT         Set source weight             WHATSUP        Display sources 'up'
 WR             Write sked file               XLIST          Extended listings
 XNEW           New scan extended list
Commands may be abbreviated so long as they are unique
?
```

You can get information about the syntax of a command by entering "**?** *CmdName*". For example, for the list command, we find:

```
? ? list
 LIST [<range> [<source> [<subnet> [<elmin>]]]]
```

```
 <range> is ALL or <start>-<stop> or <start>#<number>
            <start>,<stop> are yydddhhmmss or ^(top), .(current), *(end)
            or first, last, begin, end
?
```

Some commands will give you additional information if you follow the command name by a question mark:

```
? xlist ?
List, Clear, Toggle Extended listings
Usage: Xlist <option>
?         This screen
Clear     Clear all values
List      List values currently set
Off       Turn off extended listing
On        Turn on extended listing
--otions listed below--
AzEl      AzEl
Feet      Tape footage
HA        Hour Angle
Long      Long format for AzEl
Sky       Sky distribution info
SNR       SNR by baseline
Wrap      Include cable wrap
?
```

However, this only works for the newer `sked` commands (commands put in since about 2005). Older `sked` commands will give an error message:

```
? li ?
YDHMS03: Incorrect format in time field:?
 GTDTR02 - Start date/time must be of form YYDDDHHMMSS. YY and DDD optional.
?
```

Eventually, all `sked` commands give provide more information if their first argument is "?".

Param

The **`param`** command is used to list and set various `sked` parameters. To list the current parameters, enter this command without argument:

```
? param
----- Parameter listing ---------------------------------------
 Experiment: RV120                     Description Sixth R&D VLBA session of 2016
 Scheduler:  NASA                      Correlator: VLBA
 Start:      2016-335-18:00:00         End:        2016-336-18:00:00
---------- Scan data parameters-------------------------------
 VScan         Y (Compute scan length)   Duration    120sec (default duration)
 Minslew       0sec (min slew time)
 Minscan       48sec (min scan length)   Maxscan      480sec (max scan length)
 Modscan        1sec (mod scan time)     Modular         83sec (mod start time)
 Calibration  10sec (time before obs)    Early         0sec (start recording)
 Corsync       3sec (pad scan at end)    Idle          0sec (idle after obs)
 Setup        20sec (scan setup)         Mark6_off     0sec (buffer offset)
 Fill_off      0sec (buffer offset)
---------- Procedure parameters ------------------------------
 PRFLAG  YYNN (required procedures)      PREOB  PREOB  (pre-ob procedure)
 MIDOB  MIDOB  (mid-ob procedure)        POSTOB MIDOB  (post-ob procedure)
---------- Timing parameters ---------------------------------
 Parity     100sec (parity check time)   SOURCE       5sec (SOURCE time)
```

```
 Tapetm       1sec (TAPE command time)
---------- General parameters ------------------------------
 MODULAR     1sec (start time mark)      MINIMUM   0sec (time between obs.)
 LOOKAHEAD  20min (for WHATSUP)
 SNR     MAN  (reject for low SNR)       WIDTH 133columns (width of screen)
 CONFIRM     Y (ask before adding obs)    DEBUG      N (display debugging info)
 KEEP_LOG    N (keep log upon exit)       VERBOSE    N (output lots of info)
 CONF_EQUIP  N (update info from cat)
---------- Informational only -------------------------------
 SKED  version:          2018Apr12                          Schedule  file:  /500/ses-
sions/2016/rv120/rv120.skd
 FREQUENCY SX (default freq. code)
 Process ID:  18751                      Printer commands: lj, ljp
 Current yyyyddd:    2016335 (2016.92)( 17723 MJD, WED. 30 NOV.)
 Greenwich sidereal time:   22:40:08 (18:00:00 UT)
 Sun's RA and DEC:   16h 29.1m   -21d 47.5
?
```

The syntax to set a parameter is:

Param *Name Value*

For example, to change the experiment name, you would issue:

```
? param exper R1411
? param li all
----- Parameter listing ---------------------------------------
 Experiment: R1411                       Description IVS-R1
 Scheduler:  GSFC                        Correlator: BONN
 Start:      2009-355-17:00:00           End:        2009-356-17:00:00
...
... more sked output
...
?
```

The meaning of all of the parameters listed is discussed in more detail in the Command Reference part of this manual.

Master

Masterfile and Session Code. The Masterfile is a table that lists all geodetic and astrometric sessions within the IVS. All IVS sessions have a unique experiment code. This is an ASCII string such as RDV76 or R1410. (Currently this string is limited to 6 characters, but this may change.) The Masterfile lists all sessions chronologically. In addition to the session code, it includes the date of the session, the duration, the institution responsible for scheduling the session, and the correlator and other information. By default, the schedule names for IVS sessions use the (lower case) session code followed by ".skd". Hence r1410.skd is the schedule file for IVS session R1410. In addition, the session code is embedded within the schedule.

Setting up a Schedule. The Masterfile is the usual starting point for generating a schedule. Prior to 2008, a scheduler would look at the Masterfile to determine the stations in a session as well as the start and stop times of a schedule. They would then enter this information into the schedule file

'by hand' by issuing the appropriate schedule commands. Besides being time consuming, this approach was prone to error. Several sessions had incorrect stations, or incorrect start and stop times. The `sked` **master** command makes this process unnecessary.

The master command has two modes. **Master get** is used to initialize the schedule file.

```
? master get
 Finding session R1410
 Checking /shared/gemini/ftp/pub/master/master10.txt
 Checking /shared/gemini/ftp/pub/master/master10-int.txt
 Checking /shared/gemini/ftp/pub/master/master09.txt
master_cmd: Initializing experiment.
START: 2009/355-17:00
END:   2009/356-17:00
Stations:
    Station  Rack     Recorder Bnd
  1 NYALES20 Mark4    Mark5A   XS
  2 ONSALA60 Mark4    Mark5A   XS
. . .
  6 WETTZELL Mark4    Mark5A   XS
  7 ZELENCHK VLBA4    Mark5A   XS
Writing out station select file for SKED.
/shared/gemini/ftp/pub/sked/catalogs/equip.cat:   NYALES20   ONSALA60   SESHAN25   TIGO
WESTFORD WETTZELL ZELENCHK
MAKE_MODE_LIST: Found mode 256-16(R1)        GEOSX       8.0   16.0  32-16-2-1
master_cmd: Be sure to check SNR, tape,etc!
?
```

Master get uses the session code in the schedule file. It checks this against the Masterfile until it finds a match. It then uses the information in the Masterfile to setup the stations and the start and stop times in the session. It also tries to set the SNR targets and frequency settings based on the values originally in the file. Occasionally it runs into problems and will notify the user. The most common problem is determining SNR targets. If all of the old X-band SNR targets were 20, it would assume that all the new X-band SNR targets should also be 20. However, if the old X-band targets differ by baseline, the master command cannot figure out what to do.

Master check checks a schedule against the Masterfile and reports if it finds any discrepancies between the two:

```
? master check
 Finding session R1410
 Checking /shared/gemini/ftp/pub/master/master10.txt
 Checking /shared/gemini/ftp/pub/master/master10-int.txt
 Checking /shared/gemini/ftp/pub/master/master09.txt
master_cmd: schedule and master file agree!
?
```

SNR

The **SNR** command sets and list SNR target values. These target values are on a baseline-by-baseline basis. To list the SNR targets, enter the SNR command without an argument:

```
? snr
```

```
 Minimum SNR by baseline for multi-baseline scans
     X-band (margin   0)      S-band (margin   0)
     Ny  On  Sh  Tc  Wf  Wz          Ny  On  Sh  Tc  Wf  Wz
 On  20                      On  15
 Sh  20  20                  Sh  15  15
 Tc  15  15  15              Tc  12  12  12
 Wf  20  20  20  15          Wf  15  15  15  12
 Wz  20  20  20  15  20      Wz  15  15  15  12  15
 Zc  20  20  20  15  20  20  Zc  15  15  15  12  15  15
?
```

The format of the SNR command is:

SNR *Subnet Band Value*

The following commands sets the X-band SNR of all baselines to 25, and then lists the SNRs.

```
? snr _ x 25
? snr
 Minimum SNR by baseline for multi-baseline scans
     X-band (margin   0)      S-band (margin   0)
     Ny  On  Sh  Tc  Wf  Wz          Ny  On  Sh  Tc  Wf  Wz
 On  25                      On  15
 Sh  25  25                  Sh  15  15
 Tc  25  25  25              Tc  12  12  12
 Wf  25  25  25  25          Wf  15  15  15  12
 Wz  25  25  25  25  25      Wz  15  15  15  12  15
 Zc  25  25  25  25  25  25  Zc  15  15  15  12  15  15
?
```

It may happen that you want to change the SNR on all baselines involving a single station, for example for a weak station. This can be done by specifying only this station in the subnet argument. The following command sets the X-band SNR target for baselines involving Tc to 20:

```
? snr Tc x 20
? snr
 Minimum SNR by baseline for multi-baseline scans
     X-band (margin   0)      S-band (margin   0)
     Ny  On  Sh  Tc  Wf  Wz          Ny  On  Sh  Tc  Wf  Wz
 On  25                      On  15
 Sh  25  25                  Sh  15  15
 Tc  20  20  20              Tc  12  12  12
 Wf  25  25  25  20          Wf  15  15  15  12
 Wz  25  25  25  20  25      Wz  15  15  15  12  15
 Zc  25  25  25  20  25  25  Zc  15  15  15  12  15  15
?
```

Down

The **down** command is used to indicate when a station is unavailable for observing during a session. The most common, although not the only, cause of this is that the station is participating in an intensive. Entering the **down** command without an argument will list the stations that are currently down:

```
? down
Wz 2009-355-18:15:00 2009-355-19:45:00
?
```

The syntax for the down command is:

Down *subnet StartTime EndTime*

For example:

```
? down NyOn 20:00:00 21:00:00
? down
Wz 2009-355-18:15:00 2009-355-19:45:00
Ny-On 2009-355-20:00:00 2009-355-21:00:00
?
```

To remove a station from the downtime list, use the syntax:

Down subnet remove

Continuing with the above example:

```
? down wz rem
? down
On 2009-355-20:00:00 2009-355-21:00:00
?
```

BestSource

The best sources for a given session depend on what stations are observing, and the start and stop time of the session. For example, for intensive sessions, which observe for only 1 hour a day, only a small part of the sky is visible. For any session, to generate a schedule with good sky coverage, you want strong sources that are well distributed over the sky.

The **bestsource** command will examine the source catalog and find the best sources for a given set of stations over the duration of the experiment. This command has three arguments:

Best *Number Mode Coverage*

These options will be discussed in more detail under Command Reference. The simplest, and for most cases the best, way of using the command is to ignore the last two arguments and just specify the number of sources:

```
? bestsource 50
BestSource:  NumBest=  50 BestMode  3 NumCover=  3
Reading sources from /shared/gemini/ftp/pub/sked/catalogs/source.cat.geodetic.good
NOTE: IAU name for IIIZW2   should be 0007+106 not IIIZW2
Getting fluxes from file /shared/gemini/ftp/pub/sked/catalogs/flux.cat
Calculating rise/set times:
   1   2   3   4   5   6   7   8   9  10  11  12  13  14  15  16  17  18  19  20
.. more sked output
  Ranking sources
   1   2   3   4   5   6   7   8   9  10  11  12  13  14  15  16  17  18  19  20
.. more sked output
 Calculating rise/set times:
   1   2   3   4   5   6   7   8   9  10  11  12  13  14  15  16  17  18  19  20
  41  42  43  44  45  46  47  48  49  50... done.
?
```

Automatic scheduling

The **auto** command tells sked to automatically schedule scans starting from the current time and ending at some end time. The syntax is:

auto *Subnet EndTime*

The following commands delete all observations, and then schedules scans until 17:15:00:

```
? del ALL
? auto _ 171500
 Auto  T
Fill F Ny-On-Sh-Tc-Wf-Wz-Zc-
 NumObs            0
Total tested:   41  Tested for Minor:  25
. . .
. . . More sked output
. . .
SIMUL02: Inserting | 0400+258  10 SX PREOB  09355171608
?
```

Most scans are scheduled automatically. It is also possible to schedule scans manually.

Manual scheduling

The **/** command is used to schedule a session in manual mode. The syntax is:

/ Src [Start <time>] *[***Sub** *<subnet>] [***Dur** *<duration>* **]**

The terms in [..] are optional arguments. If:

- **start** is not specified, `sked` attempts to schedule the scan as soon after the current time as possible.
- **Sub** is not specified, `sked` will try to use the full subnet (as specified by the **major** command).
- **Dur** is not specified, `sked` will try to adjust the duration to meet the SNR targets.

For example, the following command instructs `sked` to schedule 1611+343 at the current time using as many stations as possible. `Sked` finds that for two of the stations the source is not visible, and hence these stations are dropped. For the remaining stations, it calculates the durations needed to achieve the SNR targets. Lastly, it asks the user if they want to proceed.

```
? / 1611+343
Checking new obs on 1611+343         with Ny On Sh Tc Wf Wz Zc
CHKSRCUP4SCAN: At scan start time 17:00:00 source 1611+343 not visible at SESHAN25:
az, el=   35.5 -13.1
CHKSRCUP4SCAN: At scan start time 17:00:00 source 1611+343 not visible at ZELENCHK:
az, el=  330.3  -5.2
Checking new obs on 1611+343         with Ny On Tc Wf Wz
                    Ny         On         Tc         Wf         Wz
Prev. end:       1F000000   1F000000   1F000000   1F000000   1F000000
New start:       1F000000   1F000000   1F000000   1F000000   1F000000
Spin run (ft):          0          0          0          0          0
        (sec):          0          0          0          0          0
Slewing (min):        0.0        0.0        0.0        0.0        0.0
Idle time (sec):        0          0          0          0          0
Duration (sec):        70        172        172        110         67
Obs start time:  17:00:00
Subnet:          Ny-On-Tc-Wf-Wz
Accept observation (Y/N) ?y
1611+343 09355-170000|  70 172 172 110  67|
?
```

Whatsup

The **whatsup** command tells the user what sources are currently visible.

```
?  whatsup
 WHATSUP display for frequency code SX (GEOSX   )
                              Ny           On           Sh           Tc
      End of current obs:        17:01:10     17:02:52     17:00:00     17:02:52
                              1F000000     1F000000     1F000000     1F000000
  Remaining:                     0s=10000f    0s=10000f*****s=10000f    0s=10000f
  # Source   Scan Last    Obs  Az  El  Sl   Az  El  Sl   Az  El  Sl   Az  El  Sl
  1 0039+230  196            | 166 34 2.0 | 160 55 1.4 | 293  7 0.0 |            |
  2 1746+470  196            | 282 46 0.3 | 301 37 0.5 |            | 356  6 0.1 |
  3 1424+366  196            | 325 28 0.4 | 329  9 0.5 |            |            |
  6 0400+258  196            | 112 31 1.6 |  98 36 1.8 | 275 50 0.0 |            |
. . . more sked output
 51 0035-252  196            |            | 170  7 1.3 |            | 114 10 0.8 |
 55 1432+200  196            | 321 11 0.3 |            |            | 308 14 0.1 |
 58 0544+273  196            |  85 27 1.4 |  76 24 1.9 | 263 73 0.0 |            |
?
```

For each source, `sked` lists the azimuth and elevation and the slew time in minutes. If a source is not visible at any station, it is omitted from the list.

List, Check

The **list** command will list a portion of the schedule. It takes either a single time or a time range. We demonstrate both uses below.

```
? list .
Source      Start      DURATIONS
name     yyddd-hhmmss   Ny  On  Sh  Tc  Wf  Wz  Zc
1324+224 09355-173144|  46      43      46        |
End of listing.
? li beg-171000
Source      Start      DURATIONS
name     yyddd-hhmmss   Ny  On  Sh  Tc  Wf  Wz  Zc
1611+343 09355-170000|  70 172     172 110  67    |
1418+546 09355-170340|  57  99  78      99  48    |
1519-273 09355-170612|              117 117        |
0014+813 09355-170626|  43  43  43          43  43|
2141+175 09355-170915|  44  63          63  43    |
End of listing.
```

The **check** command is very similar to **list** except that it will *check* the schedule while listing. If **check** finds a problem, it will issue a warning or error message.

With a few exceptions that will be discussed later, schedules generated by `sked` should have no warnings or errors. Because of this, in the following example, we first artificially raises the SNR targets above that used in making the schedule, and then run **check**:

```
? snr _ x 30
? ch ^-171000
Source      Start      DURATIONS
name     yyddd-hhmmss   Ny  On  Sh  Tc  Wf  Wz  Zc
1611+343 09355-170000|  70 172     172 110  67    |
SNRAC: SNR of  28 is less than minimum  30 required for On-Wf at X-band
1418+546 09355-170340|  57  99  78      99  48    |
SNRAC: SNR of  15 is less than minimum  30 required for Tc-Wf at X-band
1519-273 09355-170612|              117 117        |
```

```
0014+813 09355-170626|  43  43  43          43  43|
SNRAC: SNR of  25 is less than minimum  30 required for On-Wf at X-band
2141+175 09355-170915|  44  63          63  43    |
SNRAC: SNR of  15 is less than minimum  30 required for Tc-Wf at X-band
1351-018 09355-171129|             161 161        |
 END OF AUTOCHECKING
?
```

It is a good practice to always run **`check`** after generating a schedule.

`Sked` can display much more information about a scan including things like SNR by baseline, pointing information, sky coverage information etc. These options can be turned on and off using the **`xlist`** command, which is described in the command reference part of this manual.

Summary

The summary command gives information about the schedule as a whole. Executed without argument, it displays a screen like the following:

```
? summ
   SKED Summary from file ./r1411.skd for experiment R1411
      (all scans with at least one subnet station)

 Average number of obs. per baseline per source(normalized by up-time) =   9.0
 Min =    0.0  Max =   90.0 (Baseline Sh-Tc on 1958-179)   RMS =  13.4

 Total time:       1440 minutes (24.0 hours).

 Key:     Ma=MATERA     Ny=NYALES20   Sh=SESHAN25   Tc=TIGO       Wf=WESTFORD
          Wz=WETTZELL   Zc=ZELENCHK
                    Ma   Ny   Sh   Tc   Wf   Wz   Zc  Avg
 % obs. time:       42   40   35   17   45   37   25   34
 % cal. time:        5    5    4    1    5    5    5    4
 % slew time:       31   25   30    3   18   14   56   26
 % idle time:       21   28   30   78   31   43   13   35
 total # scans:    412  440  360  123  395  455  423  372
 # scans/hour :     17   18   15    5   16   19   18   16
 Avg scan (sec):   88   79   84  118   98   70   52   83
 # data tracks:     16   16   16   16   16   16   16
 # Mk5 tracks:      16   16   16   16   16   16   16
 Total GBytes:   1311 1252 1086  525 1397 1145  786 1072
 Total GB(M5):   1166 1113  965  466 1242 1018  698  953
 # of tapes :     1.0  1.0  1.0  1.0  1.0  1.0  1.0
 tape change times (hhmm):

Total number of tapes:   7.0  Total GBytes (M5) recorded:  6667.6
      # OF OBSERVATIONS BY BASELINE
  |  Ma   Ny   Sh   Tc   Wf   Wz   Zc  StnTotal
-----------------------------------------------
Ma|      305  262   32  248  373  340    1560
Ny|           296   38  300  374  329    1642
Sh|                1  193  291  298    1341
Tc|                   110   37   20     238
Wf|                        285  222    1358
Wz|                             362    1722
Zc|                                    1571


 Number of  2-station scans:  154
```

```
 Number of  3-station scans:   94
 Number of  4-station scans:  100
 Number of  5-station scans:  146
 Number of  6-station scans:  148
 Number of  7-station scans:    0

 Total # of scans, observations:   642     4716
?
```

In practice, the user would probably use another form of this command: **sum _ _ _ li** which gives more information. The summary command can also be used to generate plots of the sky distribution; when stations are observing, when sources are observed, etc. It is excellent tool to examine many aspects of the schedule.

Wr, Wc

Once the user is satisfied with the schedule, they are ready to write it. The **wr** and **wc** commands write the sked file.

- **Wr** will write out a sked file that already exists. If the file does not exist, it issues a warning message.
- **Wc** will create a sked file if it does not exist.

These are usually almost the last commands a scheduler uses.

```
? wr
Replace ./r1410.skd? (Y/N) y
Replacing file ./r1410.skd
$EXPER R1410
$PARAM
. . . More  sked output
$HEAD
SKED output file ./r1410.skd finished.
Source      Start      DURATIONS
name     yyddd-hhmmss   Ny  On  Sh  Tc  Wf  Wz  Zc
0716+714 09356-165638|  74 117  96     117  65    |
?
```

Quit

The **quit** command exits sked without writing out any files. It returns the user to the command prompt.

```
? quit
bootes: /home/jmg/schedules>>
```

Scheduling an R1

With the above commands it is possible to schedule a simple session in the 11 steps summarized in the table below:

1	**bootes:jmg/schedules> cp r1412.skd r1413.skd**	Copy an old schedule.
2	**bootes:jmg/schedules> sked r1413.skd**	Sked displays lots of information about the schedule.
3	**? param exper r1413**	Change internal session code.
4	**? master get**	Setup schedule based on Masterfile.
5	**? SNR _ X 20**	Set X band SNR to 20.

5	**? SNR _ S 15**	Set S band to 15.
6	**? Best 60**	Get the best 60 sources.
7	**? Auto _ end**	Generate the schedule until the end time.
8	**? summ _ _ _ li**	Do a summary listing of the schedule.
9	**? Wr**	Write the schedule.
10	**? Quit**	Quit.
11	**bootes:jmg/schedules>**	Back to user prompt.

This entire process takes on the order of 15-30 minutes.

Steps 1-3. The following screen shows the effect of doing the first three commands. The user starts with the schedule r1410.skd and copies it to r1411.skd. They then open the schedule using `sked`, and change the session code to r1411.

```
bootes: /home/jmg/schedules>> cp r1410.skd r1411.skd
bootes: /home/jmg/schedules>> sked r1411.skd
sked: Automatic/Interactive VLBI Scheduling Program
      JMG/NRV/AEM HP/Linux SKED 2010Jan27
RDCTL02 - Reading system control file /usr/local/bin/skedf.ctl
RDCTL02 - Reading local control file skedf.ctl
Reading session: R1410
. . .
. . . more sked output
. . .
Source      Start      DURATIONS
name     yyddd-hhmmss   Ny  On  Sh  Tc  Wf  Wz  Zc
1611+343 09355-170000|  70 172     172 110  67    |
End of listing.
? param exper r1411
```

Step 4. The scheduler then uses **`master get`** to setup the schedule. Unfortunately, **`master get`** indicates a problem with determining some of the SNR values.

```
? master get
 Finding session R1411
. . .
. . . more sked output
. . .
  7 ZELENCHK VLBA4    Mark5A   XS
Writing out station select file for SKED.
/shared/gemini/ftp/pub/sked/catalogs/equip.cat:   MATERA   NYALES20   SESHAN25   TIGO
WESTFORD WETTZELL ZELENCHK
MAKE_MODE_LIST: Found mode 256-16(R1)        GEOSX       8.0   16.0  32-16-2-1
Opt est parameters initialized to off.
Following stations are new:
Name      EL  Early   Tape
MATERA    5.0    0 START&STOP
Some baselines have 0 SNR! Please set.
HINT:  SNR Subnet Band Value
 Minimum SNR by baseline for multi-baseline scans
     X-band (margin   0)     S-band (margin   0)
     Ma  Ny  Sh  Tc  Wf  Wz          Ma  Ny  Sh  Tc  Wf  Wz
 Ny   0                       Ny   0
 Sh   0  20                   Sh   0  15
 Tc   0  15  15               Tc   0  12  12
```

```
 Wf   0  20  20  15              Wf   0  15  15  12
 Wz   0  20  20  15  20          Wz   0  15  15  12  15
 Zc   0  20  20  15  20  20      Zc   0  15  15  12  15  15
?
```

In this example, **`master get`** does not know how to set the SNR targets for Ma (Matera). Looking at the other stations, it looks like the X-band SNRs are all 20, except for the baselines involving Tc (Tigo) which are 15. The S-band SNRs are all 15, again except for baselines involving Tc, which are 12.

Step 5. Set the SNRs and then list the SNR to verify they are correct:

```
? snr _ X 20
? snr tc X 15
? snr _ S 15
? snr tc S 12
? snr
 Minimum SNR by baseline for multi-baseline scans
     X-band (margin   0)     S-band (margin   0)
     Ma  Ny  Sh  Tc  Wf  Wz          Ma  Ny  Sh  Tc  Wf  Wz
 Ny  20                      Ny  15
 Sh  20  20                  Sh  15  15
 Tc  15  15  15              Tc  12  12  12
 Wf  20  20  20  15          Wf  15  15  15  12
 Wz  20  20  20  15  20      Wz  15  15  15  12  15
 Zc  20  20  20  15  20  20  Zc  15  15  15  12  15  15
?
```

Step 6. Select the sources.

```
? best 60
BestSource:  NumBest=  60 BestMode  3 NumCover=  3
. . .
. . . more sked output
. . .
Calculating rise/set times:
   1   2   3   4   5   6   7   8   9  10  11  12  13  14  15  16  17  18  19  20
  21  22  23  24  25  26  27  28  29  30  31  32  33  34  35  36  37  38  39  40
  41  42  43  44  45  46  47  48  49  50  51  52  53  54  55  56  57  58  59  60
... done.
?
```

Step 7. Following this we generate the schedule:

```
? auto _ end
. . .
. . . more sked output
. . .
SIMUL02: Inserting | 0710+439  10 SX PREOB  09363165842      45 MIDOB       0 POSTOB
FCAC 1
. . .
No more valid observations found within time.
?
```

Step 8. The next step is to review the schedule. This can be done using the **`summary`** command. This takes many options, and is explained in fuller detail later in this manual. A sample output

using the simplest form of this command follows. The user can also use this command to look at sky distribution, etc.

```
? summ
   SKED Summary from file ./r1411.skd for experiment R1411
      (all scans with at least one subnet station)

 Average number of obs. per baseline per source(normalized by up-time) =   9.0
 Min =    0.0  Max =   90.0 (Baseline Sh-Tc on 1958-179)   RMS =  13.4

 Total time:       1440 minutes (  24.0 hours).

 Key:     Ma=MATERA     Ny=NYALES20   Sh=SESHAN25   Tc=TIGO       Wf=WESTFORD
          Wz=WETTZELL   Zc=ZELENCHK
                   Ma   Ny   Sh   Tc   Wf   Wz   Zc  Avg
 % obs. time:      42   40   35   17   45   37   25   34
 % cal. time:       5    5    4    1    5    5    5    4
 % slew time:      31   25   30    3   18   14   56   26
 % idle time:      21   28   30   78   31   43   13   35
 total # scans:   412  440  360  123  395  455  423  372
 # scans/hour :    17   18   15    5   16   19   18   16
 Avg scan (sec):  88   79   84  118   98   70   52   83
 # data tracks:    16   16   16   16   16   16   16
 # Mk5 tracks:     16   16   16   16   16   16   16
 Total GBytes:  1311 1252 1086  525 1397 1145  786 1072
 Total GB(M5):  1166 1113  965  466 1242 1018  698  953
 # of tapes :     1.0  1.0  1.0  1.0  1.0  1.0  1.0

Total number of tapes:   7.0  Total GBytes (M5) recorded:  6667.6
      # OF OBSERVATIONS BY BASELINE
  |  Ma   Ny   Sh   Tc   Wf   Wz   Zc  StnTotal
-----------------------------------------------
Ma|      305  262   32  248  373  340    1560
Ny|           296   38  300  374  329    1642
Sh|                1  193  291  298    1341
Tc|                   110   37   20     238
Wf|                        285  222    1358
Wz|                             362    1722
Zc|                                    1571

 Number of  2-station scans:  154
 Number of  3-station scans:   94
 Number of  4-station scans:  100
 Number of  5-station scans:  146
 Number of  6-station scans:  148
 Number of  7-station scans:    0

 Total # of scans, observations:   642     4716
?
```

In practice, the user would probably use another form of this command, **`sum _ _ _ li`**, which gives more information.

Steps 9-10. Assuming the schedule looks fine, the last steps are to write the schedule out and quit.

```
? wr
Replace ./r1411.skd? (Y/N) y
Replacing file ./r1411.skd
$EXPER R1411
$PARAM
```

```
$OP
$DOWNTIME
$MINOR
$MAJOR
$ASTROMETRIC
$SOURCES
$STATIONS
$CODES
$HEAD
Unchanged sections from original file:
SKED output file ./r1411.skd finished.
Source      Start      DURATIONS
name     yyddd-hhmmss   Ma  Ny  Sh  Tc  Wf  Wz  Zc
2255-282 09363-165914|  43                  43    |
? q
bootes: /home/jmg/schedules>>
```

Chapter 3 Automatic Scheduling

The vast majority of schedules are generated using automatic scheduling, perhaps augmented with a little manual tweaking. This section describes how `sked` operates in automatic mode. This section is written for those users who are interested in more detail.

Why Automatic Mode?

In 2009, a typical session involves 7 or 8 stations observing 60 sources for 24 hours. A typical schedule will have on the order of 500-1000 scans. Scheduling this manually would require entering a command for each of the scans. Each command requires specifying, at a minimum, the source observed. Optional parameters include the stations, duration, and start time. The scheduler needs to know which sources are visible at which stations at a given time. Generating all but the very simplest schedule manually would probably take days.

In contrast, in automatic mode the user first sets up optimization parameters that govern how `sked` generates the schedule, and then tells `sked` to generate scans until some end time, e.g:

```
Auto_ 19:30:00
```

which will automatically generate scans until the last scan ends past 19:30:00, or

```
Auto _ End
```

which generates scans until the end of the session. (The '_' indicates that we want to schedule all stations. Replacing this with, for example, **`KkWz,`** would mean just schedule Kokee and Wettzell.) Since the optimization parameters typically change very little between similar sessions, setting those up is usually straightforward.

Generating a schedule in automatic mode may be an iterative process. After the initial setup, the user generates a schedule, examines it, and if necessary, tweaks the optimization parameters. This process is repeated until the user is happy with the schedule.

Occasionally the user may schedule part of the schedule in automatic mode, pause the schedule to insert some scans manually, and repeat this process. The most frequent reason for doing this is for astrometry. In this case, the user may want to be certain that `sked` observes some particular source(s). The astrometric mode of `sked`, discussed later, makes this less common than in the past. In astrometric mode the user specifies a list of sources to be observed, together with observing targets. `Sked` will try to fit these observations into the schedule. If it fails, the user can still schedule the sources manually.

Overview of Automatic Mode

Automatic scheduling is governed by two kinds of parameters or options. In `sked` these are called major and minor options. Roughly speaking, the major options determine which scans to consider for the scheduling. The minor options are used to rank the scans. The process of scheduling a scan involves several steps which are summarized below.

1. `Sked` generates a table indicating what sources are up at what stations at the current time. Each row in this table is source, and each column a source. The rows represent possible scans.
2. The table is reduced by a series of filters controlled by the *major options*. These options determine which scans are kept for further consideration. For example, if a source has been observed too recently, it will be removed from the table. If a station takes too long to slew to a source, the source is marked 'down' at the station.
3. For each remaining source in the table, `sked` generates a trial scan using all the stations that can see the source. If all of the baselines in the scan meet the SNR targets, then the trial scan is kept. If all of the baselines to a given station do not meet the targets, the station is eliminated, and a new trial scan generated. This process continues until sked finds a scan that meets the targets, or the source is eliminated. It may also happen that after a station is eliminated, the remaining subnet is too small (as determined by the **major** option *minsubnet*). In this case the source is also eliminated.
4. The set of trial scans is ranked according to either sky-coverage or covariance, and the *best%* kept for further consideration. The *best%* is another major option.
5. Lastly, the sources are ranked according to the minor options. The best scan is inserted in the schedule.
6. If there is more time left, sked will return to step one.

The figure below summarizes the above steps in graphical form.

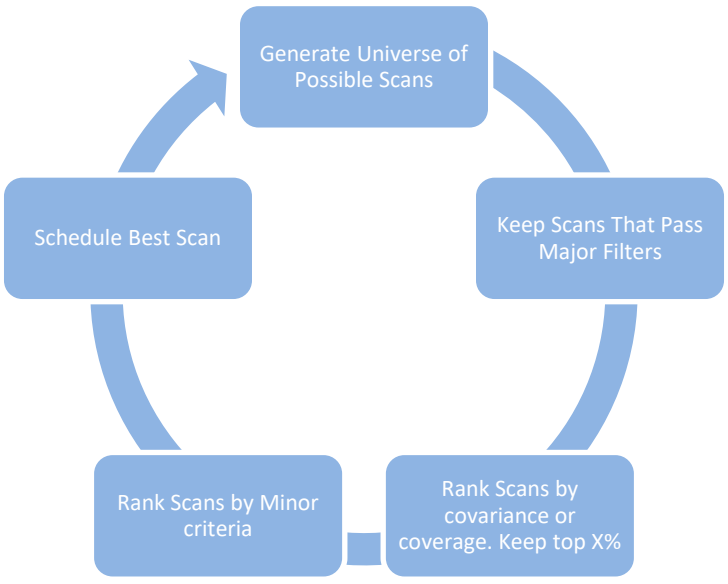


Figure 1. Automatic scheduling of scans.

Major Options

Major options determine what scans are considered for scheduling. Most of the major options serve as filters on the set of all possible scans, and reduce this set to a smaller number. These options are set and listed using the **major** command. This section discusses how to set and list the major options, and briefly describes each option.

The major options are included in the schedule file. The starting point of most schedules is a prior schedule of a similar sort. For example, if you are scheduling an R1, you would start with an earlier R1. Assuming that the major options were set correctly in the original schedule, they should not have to be modified in the new schedule.

Major Options	
Option	Description
Subnet	Current subnet. Only stations in this subnet are scheduled.
SkyCov	Do initial ranking by sky coverage (Yes) or covariance (No).
AllBlGood	Do all baselines in a scan need to meet the target SNR to schedule?
MinAngle	Minimum angular distance between successive observations.
MinBetween	Minimum time (minutes) between observations of the same source.
MinSunDist	Minimum angular distance of a source with respect to the sun. If the distance is less than this, the source will not be considered for scans.
MaxSlewTime	Maximum time to allow an antenna to slew. If the slew time at a station is longer than this, the source is not considered visible at that station.
TimeWindow	Window of time (hours) to consider in computing sky coverage or covariance.
MinSubNet	Only schedule scans if the subnet is at least this size.
NumSubNet	Maximum number of subnets to try to schedule at one time.
Best	Scans are ranked by Sky coverage or covariance, and the top *Best%* of the scans kept for further consideration.
FillIn	Turn on fill in mode.
FillMinSub	Minimum size of fill-in subnet.
FillMinTime	Minimum time a station must be idle to be considered for fill-in mode.
FillBest	This is the same as "Best", but for the fill-in scans. If we are in fill-in mode, the top *FillBest% scans are kept for further consideration.*
Add_ps	Noise to add (in an RSS sense) to the normal observations. This may affect the ranking of scans by covariance. It also affects the formal errors calculated in the *solve* interface.
SNRWts	If yes, weight the observations by SNR. If not, consider all observations the same. This only affects the *solve* interface.
SplitTwins	Manage twin telescopes independently or joined, depending of user choices in the Sked file section $TWIN_TELESCOPES

major ? gives a synopsis of the options:

```
? major ?
 ?                              List major commands and options
```

```
List                            List current values
Subnet              <string>    Observing subnet, e.g: KkWzBr  or Kk-Wz-Br
SkyCov              [Yes|No]    Optimize by sky coverage or covariance
AllBlGood           [Yes|No]    If true, all baselines must meet SNR targets
MaxAngle            <int>       Max angle (degree) between consecutive obs
MinAngle            <int>       Min angle (degree) between consecutive obs
MinBetween          <int>       Min time (minutes) between obs of a source
MinSunDist          <int>       Minimum distance (degrees) of source from sun
MaxSlewTime         <int>       Maximum allowable slew time in seconds
TimeWindow          <real>      Time window used in calculation (hours)
MinSubNetSize       <int>       Minimum subnet size
NumSubNet           <int>       Maximum number of subnets
Best                <int>       % of obs to consider in Normal mode
FillIn              [Yes|No]    Turn on subnet mode
FillMinSub          <int>       Minimum subnet size in FillIn mode
FillMinTime         <int>       Min time (seconds) before we fill in
FillBest            <int>       % of obs to consider in FillIn mode
AddPS               <real>      Amount of noise to add (ps)
SNRWts              [YEs|No]    Use SNR to weight observations
LastHrs             <real>      OBSOLETE! Use TimeWindow
ObsWts              <real>      OBSOLETE! Use SnrWts
SplitTwins          [Yes|No]    Schedule twin telescopes independently
?
```

`Major list` displays the current major options.

```
? major list
Subnet HoKkMaTsWfWz
SkyCov              Yes
AllBlGood           Yes
MinAngle             15
MinBetween           20
MinSunDist           15
MaxSlewTime         300
TimeWindow           24.00
MinSubNetSize         2
NumSubNet             1
Best                 60
FillIn              Yes
FillMinSub            3
FillMinTime         120
FillBest             80
Add_ps               30.0
SNRWts              Yes
SplitTwins           No
?
```

A particular major option can be set using the syntax:

`major` *`Name argument`*

Note that case is ignored in parsing the command. For options that take a number, use the number. For options that take a yes or no, users can enter the values *`Yes`* or *`No`*, or the equivalent synonyms *`Y`*, *`N`*, *`True`*, *`False`*, *`On`*, *`Off`*. For example:

```
? major minangle 20
? major FillIn On
? Major AllBlGood No
?
```

A further discussion of the meaning of each of the major options is given in the command reference part of this manual.

Minor Options

Minor options determine the ranking of scans. There are currently 14 minor options. These are listed below, together with their purpose.

Minor Options	
Option	Description
Astro	Prefer scans with astrometric sources.
BegScan	Prefer scans which start earlier.
EndScan	Prefer scans which end earlier.
LowDec	Prefer scans with low declination sources.
NumLoEl	Prefer scans which involve sources which are low at one or more sites.
NumRiseSet	Prefer scans involving sources which are setting at one or more sites.
NumObs	Prefer scans with more observations.
SkyCov	Prefer scans with better sky coverage.
SrcEvn	Try to even up the distribution of observations by source.
SrcWt	Prefer scans involving certain sources.
StatEvn	Try to even up the distribution of observations by stations.
StatIdle	Prefer scans which minimize station idle time.
StatWt	Prefer scans involving particular stations.
TimeVar	Prefer scans where all stations end close to the same time.

Minor options have the following characteristics associated with them.

Characteristics of Minor Options	
Option	Description
On/Off	If on, include in ranking scans. If off, does not matter.
Normalization: Abs/Rel	Affects the calculation of the minor option score
Weight	Affects how much this option is weighted.
Auxiliary parameters	Influences how the score is calculated.

Absolute versus Relative Normalization. Each option has associated with it an absolute score whose exact formula depends on the option, and is independent of the other scans being considered. In addition, each option has a relative score. The relative score for a particular scan depends on the scores of all of the other scans for this option, and ranges between 1 and 0, with the scan with the highest absolute score being assigned 1, and the scan with the lowest score assigned 0, and other scores of other scans being found by interpolation. The formula for calculating the relative score is:

$$Rel\ Score = \frac{score - score_{min}}{score_{max} - score_{min}}$$

Weight and Total Score. Each scan is assigned a total score which is the weighted sum over all of the minor options:

$$Scan\ Score = \sum_{options} wt_j score_j$$

The scan with the highest score is the scan that is scheduled.

Auxilary Parameters. Some of the minor options take auxiliary parameters. These affect how the score is calculated. The effect of the auxiliary parameters will be discussed with each minor option.

Using the Minor Command

`Minor ?` Gives a synopsis of the minor command:

```
? minor
List      [All]                                  list options in use or ALL options
Astro     [WtMode={Abs|Rel}] [Wt]                weighting of astrometric sources
BegScan   [WtMode={Abs|Rel}] [Wt]                prefer scans that start soon
EndScan   [WtMode={Abs|Rel}] [Wt]                prefer scans that end soon
LowDec    [WtMode={Abs|Rel}] [Wt]                prefer low-dec sources
NumLoEl   [WtMode={Abs|Rel}] [Wt] [El_thres]     prefer scans with el below El_thres
NumRiseSet [WtMode={Abs|Rel}] [Wt]               prefer scans with rising/setting sources
NumObs    [WtMode={Abs|Rel}] [Wt]                prefer scans with more
                                                 observations
SkyCov    [WtMode={Abs|Rel}] [Wt]                prefer scans with better
                                                 sky coverage
SrcEvn    [WtMode={Abs|Rel}] [Wt] [Mode={NONE|EVN|SQRT}]
                                                 modify distribution of obs. of sources
StatEvn   [WtMode={Abs|Rel}] [Wt] [Mode={NONE|EVN|SQRT}]
                                                 modify distribution of obs. of stations
StatIdle  [WtMode={Abs|Rel}] [Wt]               minimize station idle time
StatWT    [WtMode={Abs|Rel}] [Wt] [FFFFT TTFFF ...]
                                                 increase obs of stations with flag=T
TimeVar   [WtMode={Abs|Rel}] [Wt]                prefer scans with equal end time
```

Listing Minor Options. The command **`minor list`** without any argument will list the minor options which are currently on, together with any related information:

```
? minor list
Option      Norm   Wt  Aux_Parm
BegScan     Rel   1.00
EndScan     Rel   1.00
NumObs      Rel   1.00
SkyCov      Rel   1.00
```

The command **`minor list all`** displays the settings of all minor options including the ones that are currently off:

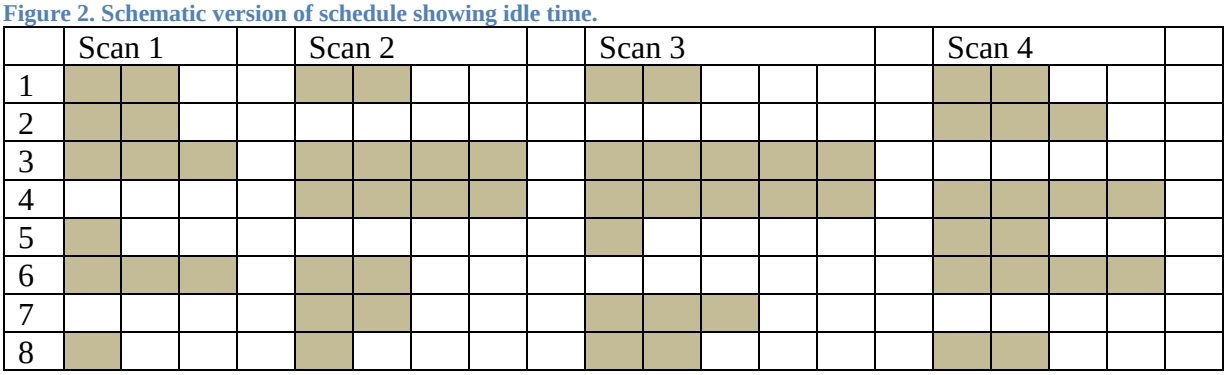
```
? minor list all
Option       On/Off  Norm      Wt   Aux_Parm
Astro           Yes  Abs      3.00
BegScan         Yes  Rel      1.00
EndScan         Yes  Rel      1.00
LowDec          No   Abs      1.00
NumLoEl         No   Rel      1.00    0.00
NumRiseSet      No   Abs      1.00
```

```
NumObs          Yes  Rel      1.00
SkyCov          No   Rel      1.00
SrcEvn          No   Rel      1.00 NONE
SrcWt           No   Rel      1.00
StatEvn         No   Abs      1.00 NONE
StatIdle        Yes  Abs      3.00
StatWt          Yes  Abs      1.00
TimeVar         No   Rel      1.00
```

Subnetting and Fill-In Mode

The default mode of `sked` is to schedule sources sequentially, with each source observed by as many stations as possible. Each station observes the source until all baselines to the station meet their SNR targets and then the station stops observing. Stronger stations will drop out first, weaker stations later. When all of the stations are done observing, `sked` chooses another source. The antennas have to slew to the new source before they can begin observing. Since the slew speed of the antenna varies, as well as the distance the antennas must travel, the total slew time also varies from antenna to antenna. Because of this, the antennas that arrive on source remain idle until the other antennas arrive on source. Once all of the antennas have slewed to the new source, the antennas begin observing, and the process is repeated. A visual representation of the schedule appears below.

Figure 2. Schematic version of schedule showing idle time.



The main problem with this kind of schedule is that there are large blocks of time when several antennas are idle, either waiting for a scan to end, or for the other antennas to arrive on source. The idle time is a function of the geometry of the network and the slew speeds of the antennas.

Subnetting and *Fill-In* mode were introduced as an attempt to reduce the amount of idle time in schedules. These will both be described in this section. Fill-In mode is more general and flexible than subnetting, and hence is preferred.

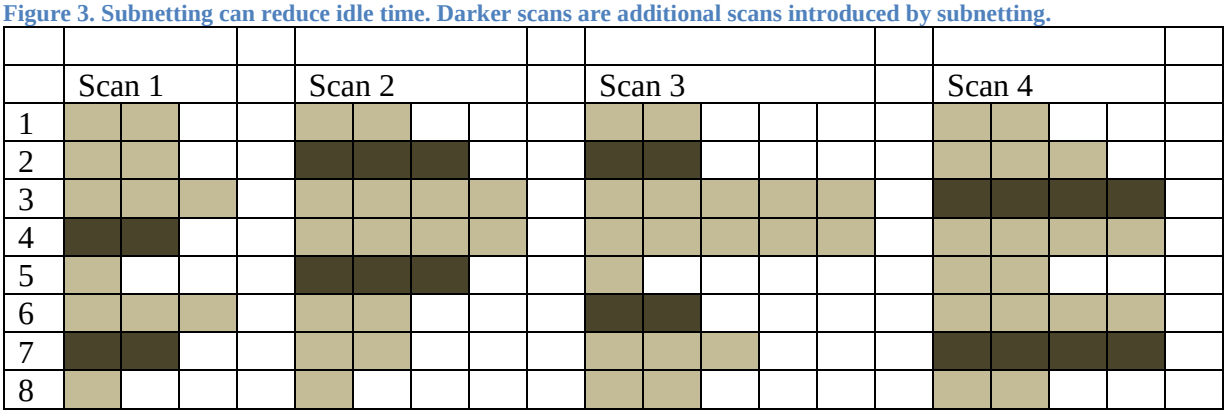
Subnetting

In normal scheduling sked considers one scan at a time. In subnetting sked will consider a set of scans which start at approximately the same time. These scans are considered as a unit, and called a 'trial subnet group' or a 'trial'. `Sked` will generate a list of groups, and schedule the one that it thinks is best. For a given collection of antennas and sources, there are hundreds or thousands of subnet groups. For example, for 6 antennas, you can have:

6 stations observe source A.
6 stations observe source B.
…
5 stations observe source A, 1 station idle.
5 stations observe source B, 1 station idle.
…
2 stations observe A, 4 stations idle.
2 stations observe B, 4 stations idle.
…
4 stations observe source C and 2 stations observe source D
4 stations observe source C and 2 stations observe source E
…

Note that this list contains many subnets that should not be considered because there are better alternatives. If 6 stations can observe a source, there is no reason to schedule a lesser number.

Figure 3. Subnetting can reduce idle time. Darker scans are additional scans introduced by subnetting.



There are two parameters that govern how the subnet-groups are generated. These are both **`major`** options.

1. NumSub is the number of subnets to schedule simultaneously, and ranges from 1 to 4.
2. MinSubNetSize is the smallest subnet that `sked` will schedule.

`Sked` only generates 'reasonable' trial subnet groups. Each subnet group consists of 1-4 scans, each with a non-overlapping subnet, where the upper limit is determine by NumSub. Roughly speaking `sked` does the following:

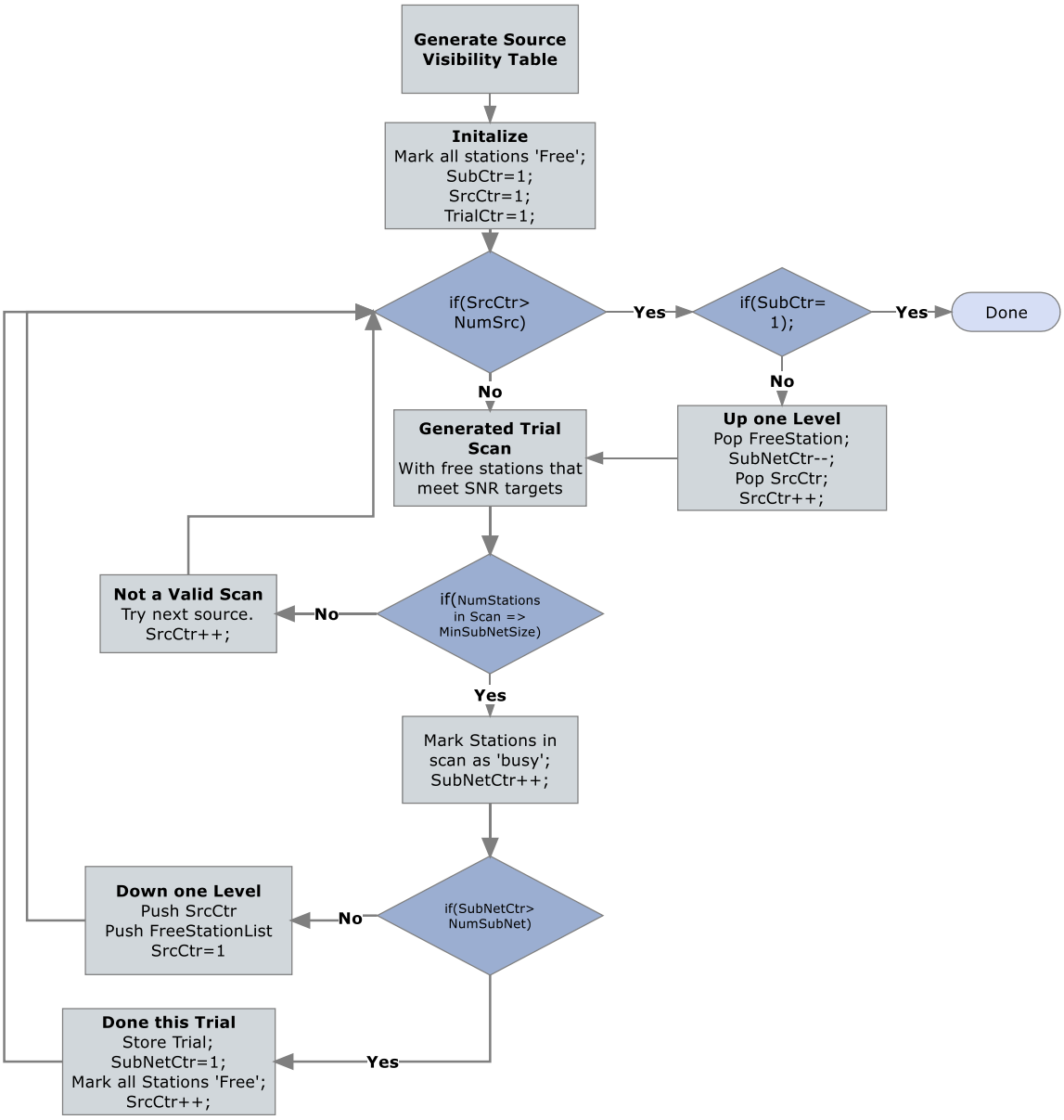
1. Starting with the first source, try to generate a valid scan involving the maximum number of free stations. A scan is valid if it meets the SNR targets, and the number of stations is larger than MinSubNetSize. If we cannot generate a valid scan with this source, try the next one until we can generate a valid scan or the source list is exhausted. In the later case we are done. In the former case we have a valid subnet. Mark these stations as busy.
2. Assuming NumSub is greater than or equal to 2: Try to generate a valid scan with the remaining free stations using a source not used for the first subnet. If we cannot generate a

valid scan, try the next source and so on until we can generate a valid scan or have exhausted the list. In the later case we are done; however, in the first case we have a valid subnet. Mark the stations as busy.

3. Assuming NumSub is greater than or equal to 3: Try to generate a valid scan with the free stations. Etc., etc.

This process continues downwards until either the size of the new subnet is smaller than MinSubNetSize, or the number of subnets reaches NumSub.

Figure 4. Scheduling using subnetting.



Using this algorithm will lead to schedules that look like Figure 3. Note that all of the subnet scans within a given group start at (roughly) the same time. Using subnetting reduces the amount of idle

time, but there can still be a fair amount of idle time left, particularly if a scan involves two weak stations, such as in Stations 3 and 4 of Scan 3 in Figure 2.

Fill-In Mode

Fill-In Mode is an alternative method of reducing idle time. When Fill-In mode is enabled, `sked` alternates back and forth between 'standard' mode and fill-in mode. In standard mode, `sked` schedules scans as it usually does. It then turns to fill in mode, where `sked` tries to schedule additional scans which fill in the idle time in the initial scan. When much of the time as possible has been filled in, `sked` returns to standard mode.

A typical 8 station scan is shown below. The last row of this table indicates the amount of time left until the end of the scan. Station 4, a strong station, stops observing first. This is followed by Stations 5, 8, 7 and 6. The last two stations to observe are 1 and 2.

Figure 5. Typical scan. Shaded areas indicate times when a station is observing, numbers are scan number.

Station																	-
1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	-
2	1	1	1	1	1	1											-
3	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	-
4	1	1	1	1													-
5	1	1	1	1	1	1	1	1	1	1	1						-
6	1	1	1	1	1	1	1	1	1	1	1	1	1	1			-
7	1	1	1	1	1	1	1	1	1	1	1	1					-
8	1	1	1	1	1	1	1	1									-
Time Till Next Scan	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	

There are many possible scans that sked could try to insert. For example, `sked` could try to schedule the first two stations that become idle together, or the first 3, or the first 4. `Sked` will try to schedule a scan that has the potential of reducing as much of the idle time as possible. This is done by finding how many stations are idle at a given instance, and multiplying by amount of time left until the end of the scan. `Sked` selects the set of stations which has the maximum amount of idle time. The process of calculating this is illustrated in Table 1 below.

Table 1. Calculation of maximum idle time.

Idle Stations	# Stations	Time Left	Idle Time
2, 4	2	10	20
2,4,8	3	8	24
2,4,5,8	4	5	20
2,4,5,7,8	5	4	20

In this particular case, scheduling stations (2, 4, 8) has the potential of eliminating 24 units of idle time, whereas scheduling the other combinations has the potential of eliminating only 20 units of idle time. The results of inserting a scan are shown in Figure 6 below.

Figure 6 Result of inserting one fill-in scan.

Station																	-
1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	-
2	1	1	1	1	1	1			2	2	2	2	2	2	2	2	-
3	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	-
4	1	1	1	1					2	2	2	2	2	2	2		-
5	1	1	1	1	1	1	1	1	1	1	1						-
6	1	1	1	1	1	1	1	1	1	1	1	1	1	1			-
7	1	1	1	1	1	1	1	1	1	1	1	1					-
8	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2	-
Time Till Next Scan	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	

After scheduling scan two there is still some idle time left. `Sked` could try to schedule the stations (5, 7), with an idle time of 8, or (5,6,7) with a combined idle time of 6, or (4, 5, 6, 7) with a combined idle time of 4. Since (5, 7) has the most idle time, this network is scheduled. This process is repeated until there is no more idle time, or until the number of remaining stations is too small.

Figure 7. Scan completely filled in.

Station																	-
1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	-
2	1	1	1	1	1	1			2	2	2	2	2	2	2	2	-
3	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	-
4	1	1	1	1					2	2	2	2	2	2	2	4	-
5	1	1	1	1	1	1	1	1	1	1	1		3	3	3	3	-
6	1	1	1	1	1	1	1	1	1	1	1	1	1	1		4	-
7	1	1	1	1	1	1	1	1	1	1	1	1	3	3	3	3	-
8	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2	-
Time Till Next Scan	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	

When a scan is completely filled in, `sked` switches to standard scheduling mode to schedule the next scan, and the process is repeated.

The generation of scans in fill-in mode is controlled by the following major options:

FillIn	Yes or No. Yes enables fill-in-mode.
FillMinSub	Integer. Minimum fill-in subnet.

FillMinTime	Integer seconds. Amount of time a station must be idle before being considered for fill-in mode.
FillBest	Same as best for normal scans. Percentage of scans kept for evaluation by the minor options. This number is generally larger than the standard 'best'. The rationale is that since these scans are free, we don't need to be as picky.

Schedules generated using fill-in mode look somewhat different than normal schedules. They tend to have more scans with smaller subnets.

Chapter 4 Command Reference

This section is a detailed list of all commands. Following a brief introduction, the commands are listed alphabetically, with one command per page.

Sked Command Syntax

Sked has about 80 commands, and many of these commands take arguments. This effectively increases the number of commands and options to several hundred. All commands take the general form:

Command *Argument(s)*

In defining the command syntax, it is useful to introduce the following notation:

|	This is logical "or". This is used when one of several values are possible.
[ ]	This indicates an optional argument.
< >	This indicates a value, for example, duration in seconds.

For example, the syntax for scheduling a new source is:

/ SrcName [*DUR* **<length>] [***SUB* **<subnet>] [***START* **<time>]**

SrcName is a required parameter, while *DUR*, *SUB* and *START* are optional. The three optional parameters all take values.

Case Insensitive

Sked commands and arguments are case insensitive with the exception of file names.

Minimal Matching

For ease of use, the user only needs to specify enough letters of a command to distinguish it from other commands. This principal is called *minimal matching*. Hence **List**, **list**, and **li** are all equivalent.

Minimal matching also applies to many command arguments.

Ambiguous or Unknown Commands

If sked cannot determine the command from the users input, it issues a warning message:

```
? ma
ma command ambiguous
?
```

If sked cannot determine a command, it reports an error:

```
? charm
Command not found: charm
?
```

Since (this version) of sked has no charm command, sked returns with a warning message.

Sked Command Summary

The following is a summary of the `sked` commands. This listing is a direct screen dump of the result of issuing the `sked` **?** command.

```
? ?
!                  Shell to system               /                  Insert new scan
 ?                  Info for <command>            ^                   Previous line
 ABORT              Abandon all changes           ADD                 Add station to scan
 ALLOCATION         Set, list tape allocation     ASTROMETRIC         Set desired #obs limits
 AUTOSKED           Auto generate schedule        BACK                Back up in the schedule
 BESTSOURCE         Find best sources             BROADBAND           Set broadband stations
 CATALOG            List, Set catalogs            CHECK               Check schedule
 COMMENT            only used in scripts          COVERAGE            Report coverage by station
 CURRENT            List current scan             DELETE              Delete scan(s)
 DOWNTIME           Set/list station Downtime     FILL                Fill idle time
 EARLY              Set, list early start         EC                  Create sked file & exit
 ELEVATION          Set, list el limits           ER                  Write sked file & exit
 FLUX               Select or list flux           FREQUENCY           Set,list freq. modes
 GROUP              Handle groups of sources      HELP                List this screen
 LIST               List scans                    MAJOR               List, select major opts
 MAX                List max parameter values     MASTER              Compare schedule, master
 MEDIA              Set, list media types         MINOR               List, select minor opts
 MODIFY             Modify current scan           MONITOR             Get sources to monitor
 MOTION             Set, list tape motion         MUTUALVIS           Display mutual vis.
 NEXT               List next scan                NOW                 Set current time
 OPTIMIZATION       Set, list optimization        PARAMETERS          Set, list parameters
 PID                List Process ID #             PREVIOUS            List previous scan(s)
 PRINTL             Print file - landscape        PRINTP              Print file - portrait
 QUIT               Immediately w/o asking        REMOVE              Remove station
 RESULT             Display fe or matrices        REWRITE             Rewrite scans
 SCAN               Set source scan times         SHIFT               Shift start times
 SITEVIS            Display station vis.          1SNR                Set, list 1-BL SNRs
 SNR                Set, list SNRs                SOLVE               Make output for solve
 SOURCES            Select,list, plot             SRCWT               Select, list SrcWt
 STATIONS           Select, list                  STATWT              Select, list StatWt
 STREAMS            Show processing streams       SUBCON              Set subconfig display
 SUMMARY            Schedule summary              SUMOUT              Write summary file
 TAGALONG           Add station to scans          TAPE                Set, list tape types
 TIMELINE           Set time line display         UNIT                Change output device
 UNTAG              Remove any bad obs.           VCC                 Vex create clean & exit
 VEC                Vex create & exit             VER                 Vex write & exit
 VLBA              Toggle full-obs. mode         VSCAN              Display variable scan lengths
 VWC                Create Vex file               VWR                 Write Vex file
 WC                 Create sked file              WHATSUP             Display sources 'up'
 WR                 Write sked file               DISPLAY_WRAP        Display wraps
 XLIST               Extended listings              XNEW                 New scan extended list
Commands may be abbreviated so long as they are unique
?
```

!

Syntax: !
Synopsis: Shell to operating system.

This command lets you escape to the csh command interpreter while `sked` stops and waits for you to finish. You can exit from the shell and get back into `sked` by typing either ^D or exit.

The following example shells to the OS to do a directory listing and then returns to `sked`.

```
? !
Enter ^D or 'exit' to return
bootes: /home/jmg/schedules>> ls
crf56.skd       iya2009kg.skd  r1416v.skd     r4422.skd      r4422_tc2.skd
crf56v.skd      iya2009kh.skd  r1422.chg      r4422.txt      r4422a.skd
help.scr        k09208.skd     r1422.chg~     r4422.txt~     rd1001.skd
i10004.skd      new.out        r1422.skd      r4422_0.skd    rdv77.skd
i10005.skd      nlist.r1       r1422.txt      r4422_1.skd    skedf.ctl
iy2009kf2.skd   ohig67.skd     r1422.txt~     r4422_2.skd    temp.f
iya.sum         old.out        r1422_6.skd    r4422_3.skd    test.skd
iya09.skd       r1348.skd      r1422_tc2.skd  r4422_4.skd    testnew.skd
iya09.sum       r1410          r1423.skd      r4422_5.skd    testold.skd
iya2009kd.skd   r1410.skd      r1423A_1.skd   r4422_6.skd
iya2009ke.skd   r1412.skd      r4422.chg      r4422_tc.skd
iya2009kf.skd   r1416.skd      r4422.chg~     r4422_tc1.skd
bootes: /home/jmg/schedules>> exit
exit

Exiting shell
?
```

/

Syntax: **[/] SrcName [DUR <length>] [SUB <subnet>] [START <time>] CABLE <wrap> CALIBRATION <integer> IDLE <integer> PREOB <string> MIDOB <string> POSTOB <string> FREQ <string>**

Synopsis: Schedule scan.

This is the "new scan" command.

SrcName may be a source name or number. Minimum matching is done on the source name. If the *SrcName* is specified by a number, the number refers to the position in the source list.

The / is optional if a source number is typed as the command.

The key words DUR, SUB, START, CABLE, CALIBRATION, IDLE, PREOB, MIDOB, POSTOB and FREQ may appear in any order following the *SrcName*. Each keyword takes an argument.

The parameters which pertain to this scan may be specified, in which case they will override, *for this observation only*, the default values set via the **parameters**, **scan**, and **snr** commands. The parameters which may be specified for a single scan are duration, calibration, idle, frequency, preob, midob, postob, and subnet. Refer to the description of the **parameters** command for a description of these parameters.

After you type the command, `sked` displays current and expected footages, tape spin time, idle time, slewing, durations and (if parameter **vscan** is **y**) matrix displays of SNRs, observed flux, projected baseline lengths, and effective SEFDs. An example of the display that might appear when a new source is scheduled is shown at the end of this command description. You can suppress the matrix displays with the command **xnew**.

If the parameter **confirm** is set to **y**, the user must indicate if they want to keep the scan; otherwise the scan is scheduled without asking.

If the parameter **vscan** is set to **y**, scan lengths are calculated using SNRs, source models, and station sensitivities. Matrix displays show predicted SNRs by baseline and observed fluxes by baseline, and the projected baseline lengths. Refer to page SKED- for a discussion of how the observed flux is calculated. If **vscan** is **n**, scan lengths as set with the **scan** command are used. No further displays are shown.

The parameter **vis** set to **sub** indicates that it is acceptable for a subset of the stations to observe the source and then stations are dropped one by one until all remaining can see the source. If **vis** is **all**, all subnet stations must be able to see the source before the scan is acceptable.

If **dur** is specified in this command then that scan duration is used for all stations regardless of what values were set with the **scan** or **snr** commands.

If parameter **snr** is **auto**, stations that cannot meet their snr targets are automatically dropped from the scan. If parameter **snr** is **man**, user approval is requested before dropping stations.

If the specified source will rise at a station within the **lookahead** parameter time, user approval is requested before `sked` will delay the start of the scan until the source rises.

The cable wrap on which a certain telescope should be positioned for this scan may be forced by typing the key word **cable** followed by the station identifier and the code for the wrap (**c** or **w**-) with no spaces between these two characters. If the cable wrap is not specified, the program chooses the shortest move. This feature should be used with caution because there is currently no method for getting the requested cable wrap to most antenna controllers.

The subnet of stations you want to participate in this scan may be specified with the key word **subnet,** followed by a list of station identifiers (no spaces between identifiers). This is the way to schedule a scan with fewer than the full set of stations for which the source is "up". If a subnet is not specified, the stations in the default subnet are scheduled for the scan.

The start time can be explicitly specified with **start**; refer to page SKED- for the format of the time specification. If a start time is specified, *no checks are made* to ensure that adequate time is allowed for tape spin and slewing, although the usual checks for the source being up and adequate SNR are made. If the start time is not specified, the program will automatically compute a start time using the required slewing time, any necessary tape spin or change time, and the default time parameter **modular**. Refer to page SKED- for the algorithm used to compute a new start time.

If a scan with the given parameters is impossible, `sked` will report the reason why, e.g. if the source is not up (i.e. not mutually visible) for the duration of the scan, it will not be scheduled.

The following example demonstrates scheduling 0014+813 specifying the source name and letting `sked` do all the work about figuring out durations and start times.

```
? / 0014+813
Checking new obs on 0014+813         with Kk Ma Ny Tc Ts Wf Wz
CHKSRCUP4SCAN: At scan start time 17:00:00 source 0014+813 not visible at TIGOCONC:
az, el=   10.0 -34.7
Checking new obs on 0014+813         with Kk Ma Ny Ts Wf Wz
                    Kk         Ma         Ny         Ts         Wf         Wz
Prev. end:       1F000000   1F000000   1F000000   1F000000   1F000000   1F000000
```

```
New start:       1F000000   1F000000   1F000000   1F000000   1F000000   1F000000
Spin run (ft):          0          0          0          0          0          0
        (sec):          0          0          0          0          0          0
Slewing (min):        0.0        0.0        0.0        0.0        0.0        0.0
Idle time (sec):        0          0          0          0          0          0
Duration (sec):        47         47         43         43         43         43
Obs start time:  17:00:00
Subnet:          Kk-Ma-Ny-Ts-Wf-Wz
Accept observation (Y/N) ?y
0014+813 10004-170000|  47  47  43  43  43  43|
```

Note that the source is not visible at TIGOCONC, so it is dropped. Note also that the duration of the scan depends on the stations.

The following command schedules source number 2:

```
? 2
Checking new obs on 1348+308         with Kk Ma Ny Tc Ts Wf Wz
CHKSRCUP4SCAN: At scan start time 17:00:47 source 1348+308 not visible at MATERA  :
az, el=  349.4 -18.0
CHKSRCUP4SCAN: At scan start time 17:00:47 source 1348+308 not visible at TIGOCONC:
az, el=  301.1  -9.6
CHKSRCUP4SCAN: At scan start time 17:00:47 source 1348+308 not visible at WETTZELL:
az, el=  346.5  -9.1
Checking new obs on 1348+308         with Kk Ny Ts Wf
SNRAC: SNR of  16 is less than minimum  20 required for Kk-Wf at X-band
SNRAC: SNR of  15 is less than minimum  20 required for Ny-Wf at X-band
SNRAC: SNR of  12 is less than minimum  15 required for Ny-Wf at S-band
NEWOB21: SNR too low on baselines to WESTFORD
Checking new obs on 1348+308         with Kk Ny Ts
                    Kk         Ny         Ts
Prev. end:       1F000000   1F000000   1F000000
New start:       1F000000   1F000000   1F000000
Spin run (ft):          0          0          0
        (sec):          0          0          0
Slewing (min):        0.7        0.7        0.7
Idle time (sec):        0          4          6
Duration (sec):       299        299        129
Obs start time:  17:01:46
Subnet:          Kk-Ny-Ts
Accept observation (Y/N) ?y
1348+308 10004-170146| 299 299 129|
?
```

The following schedules 3C84 to start at 19:00:00 with a duration of 200:

```
? / 0529+483 dur 200 start 19:00:00
Checking new obs on 0529+483         with Kk Ma Ny Tc Ts Wf Wz
CHKSRCUP4SCAN: At scan start time 19:00:00 source 0529+483 not visible at KOKEE   :
az, el=  337.6 -13.2
CHKSRCUP4SCAN: At scan start time 19:00:00 source 0529+483 not visible at TIGOCONC:
az, el=   55.9 -50.4
Checking new obs on 0529+483         with Ma Ny Ts Wf Wz
Station WETTZELL can not participate because of downtime
Checking new obs on 0529+483         with Ma Ny Ts Wf
                    Ma         Ny         Ts         Wf
Prev. end:       1F000000   1F000000   1F000000   1F000000
New start:       1F000000   1F000000   1F000000   1F000000
Spin run (ft):          0          0          0          0
        (sec):          0          0          0          0
Slewing (min):        0.0        0.0        0.0        0.0
Idle time (sec):     7200       7200       7200       7200
```

```
Duration (sec):       200        200        200        200
Obs start time:  19:00:00
Subnet:          Ma-Ny-Ts-Wf
Accept observation (Y/N) ?y
SIMUL02: Inserting | 0529+483  10 SX PREOB  10004190000     200 MIDOB       0 POSTOB
AWB-DW
0529+483 10004-190000| 200 200 200 200|
?
```

?

Syntax	? ? *Command*
Synopsis	Help
Comment	This command is synonymous with **help**.

This is the sked help command. Issued without any arguments, it gives a list of the commands together with a brief description:

```
? ?
   !              Shell to system                /              Insert new scan
 ?              Info for <command>             ^              Previous line
 ABORT          Abandon all changes            ADD            Add station to scan
 ALLOCATION     Set, list tape allocation      ASTROMETRIC    Set desired #obs limits
 AUTOSKED       Auto generate schedule         BACK           Back up in the schedule
 BESTSOURCE     Find best sources              BROADBAND      Set broadband stations
 CATALOG        List, Set catalogs             CHECK          Check schedule
 COMMENT        only used in scripts           COVERAGE       Report coverage by station
 CURRENT        List current scan              DELETE         Delete scan(s)
 DOWNTIME       Set/list station Downtime      EARLY          Set, list early start
 EC             Create sked file & exit        ELEVATION      Set, list el limits
 ER             Write sked file & exit         FLUX           Select or list flux
 FREQUENCY      Set,list freq. modes           HELP           List this screen
 LIST           List scans                     MAJOR          List, select major opts
 MAX            List max parameter values      MASTER         Compare schedule, master
 MEDIA          Set, list media types          MINOR          List, select minor opts
 MODIFY         Modify current scan            MONITOR        Get sources to monitor
 MOTION         Set, list tape motion          MUTUALVIS      Display mutual vis.
 NEXT           List next scan                 NOW            Set current time
 OPTIMIZATION   Set, list optimization         PARAMETERS     Set, list parameters
 PID            List Process ID #              PREVIOUS       List previous scan(s)
 PRINTL         Print file - landscape         PRINTP         Print file - portrait
 QUIT           Immediately w/o asking         REMOVE         Remove station
 RESULT         Display fe or matrices         REWRITE        Rewrite scans
 SCAN           Set source scan times          SHIFT          Shift start times
 SITEVIS        Display station vis.           1SNR           Set, list 1-BL SNRs
 SNR            Set, list SNRs                 SOLVE          Make output for solve
 SOURCES        Select,list, plot              SRCWT          Select, list SrcWt
 STATIONS       Select, list                   STATWT         Select, list StatWt
 STREAMS        Show processing streams        SUBCON         Set subconfig display
 SUMMARY        Schedule summary               SUMOUT         Write summary file
 TAGALONG       Add station to scans           TAPE           Set, list tape types
 TIMELINE       Set time line display          UNIT           Change output device
 UNTAG          Remove any bad obs.            VCC            Vex create clean & exit
 VEC            Vex create & exit              VER            Vex write & exit
 VLBA           Toggle full-obs. mode          VSCAN          Display variable scan lengths
 VWC            Create Vex file                VWR            Write Vex file
 WC             Create sked file               WHATSUP        Display sources 'up'
 WR             Write sked file                XLIST          Extended listings
 XNEW           New scan extended list
Commands may be abbreviated so long as they are unique
?
```

If the command is followed by a command name, it will give a synopsis of the command:

```
? ? quit
 QUIT Command takes no arguments
? ? li
```

```
 LIST [<range> [<source> [<subnet> [<ellim>]]]]
 <range> is ALL or <start>-<stop> or <start>#<number>
             <start>,<stop> are yydddhhmmss or ^(top), .(current), *(end)
             or first, last, begin, end,
?
```

Some commands will give you additional information if you follow the command name by a question mark:

```
? xlist ?
List, Clear, Toggle Extended listings
Usage: Xlist <option>
?         This screen
Clear     Clear all values
List      List values currently set
Off       Turn off extended listing
On        Turn on extended listing
--otions listed below--
AzEl      AzEl
Feet      Tape footage
HA        Hour Angle
Long      Long format for AzEl
Sky       Sky distribution info
SNR       SNR by baseline
Wrap      Include cable wrap
?
```

However, this only works for some of the newer `sked` commands (more recent than 2005). Older `sked` commands will give an error message:

```
? li ?
YDHMS03: Incorrect format in time field:?
 GTDTR02 - Start date/time must be of form YYDDDHHMMSS. YY and DDD optional.
?
```

Eventually, all `sked` commands provide more information if their first argument is "?".

^

Syntax: **^ [Num]**
Synopsis: Move towards the start of the schedule Num scans.
See also: **next**
Comment: This is synonymous with **back.**

This command moves to the previous line of the schedule. If Num is omitted, we space backwards 1 scan.

In the following example we list a part of the schedule, and then space backward 3 scans:

```
? li 171000-173000
Source      Start      DURATIONS
name     yyddd-hhmmss   Kk  Ma  Ny  Tc  Ts  Wf  Wz
2255-282 10004-171300|     161     161         125|
1342+662 10004-171309|  90     110      44 110    |
1128+385 10004-171541| 186     192      78 192    |
0048-097 10004-171633|      43                  43|
0059+581 10004-172058|      43  43      43  43  43|
3C371    10004-172310|  63  99  60      43  99  52|
0716+714 10004-172556|  56  91  64      43  91  54|
0759+183 10004-172752| 162     151      52     162|
1044+719 10004-172811|      43              43    |
1348+308 10004-173139| 101             101        |
End of listing.
? ^ 3
Source      Start      DURATIONS
name     yyddd-hhmmss   Kk  Ma  Ny  Tc  Ts  Wf  Wz
0716+714 10004-172556|  56  91  64      43  91  54|
End of listing.
?
```

Note that after the listing we are left following the scan that ends at 17:31:39. When we space backward 3 scans we are left after the scan that ends at 17:25:56.

abort

Syntax: **abort**
Synopsis: Abort the current schedule.
See also: quit

This command purges the working and scratches files and prepares to exit. The original file which was being edited, if any, is left intact.

If any changes were made in the schedule, you are asked to confirm the abort command.

```
? abort
Changes have been made. Are you sure you want to abort? (Y/N):n
?
```

add

Syntax: **add <range> <station>**
Synopsis: Add a station to the specified scans.
See also: remove,tagalong

This command allows you to add a station to a range of scans, regardless of whether it meets the SNR targets or not. If you want `sked` to check SNR targets, use the tagalong command.

For example, the following part the schedule does not contain NyAlesund:

```
? li 173000
Source      Start      DURATIONS
name     yyddd-hhmmss   Kk  Ma  Ny  Tc  Ts  Wf  Wz
0014+813 10004-170000|  47  47          43  43  43|
3C418    10004-170157|      70              70  57|
1334-127 10004-170240|  43          85  85        |
1636+473 10004-170500| 107              58 107  90|
1348+308 10004-170731| 101             101        |
2255-282 10004-170807|     113     113          87|
2209+236 10004-171110|     300     300      85  69|
0828+493 10004-171326| 186             108     186|
1954-388 10004-171710|              89      89     |
0446+112 10004-171829|      49          49      45|
2008-159 10004-171921|             281     281    |
0219+428 10004-172020|     188         121     188|
0912+029 10004-172333|  43              43        |
1044+719 10004-172521|      45              45  43|
1334-127 10004-172536|  43          88  88        |
1451-375 10004-172740| 217         217            |
3C371    10004-172809|      99          43  99  52|
1244-255 10004-173159|  43              43        |
End of listing
?
```

The following command adds Ny for the interval 17:00:00 through 17:20:00.

```
? ? add ^-172000 ny
Source      Start      DURATIONS
name     yyddd-hhmmss   Kk  Ma  Ny  Tc  Ts  Wf  Wz
0014+813 10004-170000|  47  47  43      43  43  43|
 NOT ENOUGH time between obs
3C418    10004-170157|      70  60          70  57|
CHKSRCUP4SCAN: At scan start time 17:02:40 source 1334-127 not visible at NYALES20: az,
el=  346.3 -23.8
1334-127 10004-170240|  43          85  85        |
1636+473 10004-170500| 107      99      58 107  90|
SNRAC: SNR of  19 is less than minimum  20 required for Ts-Ny at X-band
SNRAC: SNR of  13 is less than minimum  15 required for Ts-Ny at S-band
SNRAC: SNR of  12 is less than minimum  20 required for Kk-Ny at X-band
SNRAC: SNR of   9 is less than minimum  15 required for Kk-Ny at S-band
1348+308 10004-170731| 101     101     101        |
CHKSRCUP4SCAN: At scan start time 17:08:07 source 2255-282 not visible at NYALES20: az,
el=  206.3 -18.1
2255-282 10004-170807|     113     113          87|
2209+236 10004-171110|     300 100 300      85  69|
 NOT ENOUGH time between obs
0828+493 10004-171326| 186     186     108     186|
CHKSRCUP4SCAN: At scan start time 17:17:10 source 1954-388 not visible at NYALES20: az,
el=  247.8 -35.2
```

```
1954-388 10004-171710|              89      89    |
SNRAC: SNR of  16 is less than minimum  20 required for Ma-Ny at X-band
SNRAC: SNR of  14 is less than minimum  15 required for Ma-Ny at S-band
0446+112 10004-171829|      49  49      49      45|
CHKSRCUP4SCAN: At scan start time 17:19:21 source 2008-159 not visible at NYALES20: az,
el=  250.3 -12.3
2008-159 10004-171921|             281     281    |
SNRAC: SNR of  16 is less than minimum  20 required for Ma-Ny at X-band
0219+428 10004-172020|     188 188     121     188|
 END OF AUTOCHECKING
?
```

For some of the scans, e.g., 17:02:40, the source is not up at NyAlesund. For other scans, the source is up but does not meet the SNR targets, e.g., 17:07:31. `Sked` schedules NyAlesund anyway. To verify that NyAlesund is included, we can list the schedule.

```
? li ^-173000
Source      Start      DURATIONS
name     yyddd-hhmmss   Kk  Ma  Ny  Tc  Ts  Wf  Wz
0014+813 10004-170000|  47  47  43      43  43  43|
3C418    10004-170157|      70  60          70  57|
1334-127 10004-170240|  43          85  85        |
1636+473 10004-170500| 107      99      58 107  90|
1348+308 10004-170731| 101     101     101        |
2255-282 10004-170807|     113     113          87|
2209+236 10004-171110|     300 100 300      85  69|
0828+493 10004-171326| 186     186     108     186|
1954-388 10004-171710|              89      89    |
0446+112 10004-171829|      49  49      49      45|
2008-159 10004-171921|             281     281    |
0219+428 10004-172020|     188 188     121     188|
0912+029 10004-172333|  43              43        |
1044+719 10004-172521|      45              45  43|
1334-127 10004-172536|  43          88  88        |
1451-375 10004-172740| 217         217            |
3C371    10004-172809|      99          43  99  52|
1244-255 10004-173159|  43              43        |
End of listing.
?
```

See the same example under **`tagalong`** to see the difference in the effect of add vs tagalong.

allocation

Syntax: **Allocation [Station <auto|scheduled>]**
Synopsis: Allocate tape usage.
See also: **media, motion, tape**
Comment: **Obsolete**

This command determines whether the tape allocation is scheduled or automatically handled. The only stations that allocated tape usage automatically were the VLBA.

Allocation without an argument lists the current argument.

The station argument can be either a two-letter station code or the underscore character "_" which specifies *all* stations. In either case the allocation is changed to the corresponding value. Valid values for allocation are auto or scheduled.

The following example first lists the allocation, then changes the allocation of NyAlesund to Auto, and finally changes the allocation of all stations to auto.

```
? allocation
 ID  Station   Tape allocation
 Ny  NYALES20  SCHEDULED
 On  ONSALA60  SCHEDULED
 Sh  SESHAN25  SCHEDULED
 Tc  TIGOCONC  SCHEDULED
 Wf  WESTFORD  SCHEDULED
 Wz  WETTZELL  SCHEDULED
 Zc  ZELENCHK  SCHEDULED
? allocation Ny Auto
? allocation
 ID  Station   Tape allocation
 Ny  NYALES20  AUTO
 On  ONSALA60  SCHEDULED
 Sh  SESHAN25  SCHEDULED
 Tc  TIGOCONC  SCHEDULED
 Wf  WESTFORD  SCHEDULED
 Wz  WETTZELL  SCHEDULED
 Zc  ZELENCHK  SCHEDULED
? allocation _ auto
? allocation
 ID  Station   Tape allocation
 Ny  NYALES20  AUTO
 On  ONSALA60  AUTO
 Sh  SESHAN25  AUTO
 Tc  TIGOCONC  AUTO
 Wf  WESTFORD  AUTO
 Wz  WETTZELL  AUTO
 Zc  ZELENCHK  AUTO
?
```

astrometric

Syntax: ***Astro [List | Obs | Add Source Min% [Max%]| Set Source Min [Max%]| Delete Source | Cull MinObs]***
Synopsis: List, set delete astrometric sources
See also: **minor**

This command is used to list or set the astrometric sources, or to see how closely the scheduling is achieving the targets. If astrometric mode is turned on (as determined by the **minor** astrometric option), then `sked` tries to make astrometric sources meet their observing targets.

Astrometric sources appear in the $ASTROMETRIC portion of the schedule file.

```
$ASTROMETRIC
0039+230        1.00  1.50
1746+470        1.00  1.50
1424+366        1.00  1.50
…
```

Here the first column is the source name, the second column is the target floor, and the third column is the target ceiling. The target floor, respectively ceiling, are the minimum, respectively maximum, number of observations on the source expressed as a percentage of the total number of observations. Prior to scheduling a scan `sked` calculates the total number of observations scheduled and the number of observations on an astrometric source. If the number of observations is less than the minimum, `sked` will preferentially select scans containing this source. If it is more than the maximum, then `sked` will not schedule this source. Setting the maximum target to 0 is one way of assuring that `sked` will not select the source.

Astrometric Keywords	
Option	Description
List	List astrometric sources and their targets.
Obs	List astrometric sources, targets, and number of observations and scans observed in schedule.
Add Source Min% [Max%]	Add a source to the astrometric list. Must specify minimum value. If maximum value is not specified, assumed to be 100%.
Set Source Min% [Max%]	Set targets for source in astrometric list. If the source is not in the list, it will be added to the list. Must specify minimum value. If maximum value is not specified, assumed to be 100%.
Delete Source	Delete source from astrometric list. Source will not be observed.
Cull MinObs MinRatio	Remove sources from astrometric list if they have fewer than MinObs observations, or for which NumObs/NumScan<MinRatio.

Astrometric without an argument will list the current astrometric sources. This is synonymous with **`ast list.`**

```
? astrometric
SOURCE                    Min%Obs Max%Obs
   1 CL4                  1.00    1.50
   2 1348+308             1.00    1.50
   3 1725+123             1.00    1.50
   4 1013+127             1.00    1.50
   5 0828+493             1.00    1.50
   6 1636+473             1.00    1.50
   7 0219+428             1.00    1.50
   8 1508-055             1.00    1.50
   9 2243+047             1.00    1.50
  10 0436-129             1.00    1.50
   ?
```

The first number on this screen is the position of the source in the list of sources in the schedule file, *not* the position in the astrometric list.

To see how well we are doing in meeting the target, use the **`ast obs`** command.

```
? ast obs
Source      Min     Max    Actual  #Num #Scans
CL4          1.00    1.50    0.28     12   12
1348+308     1.00    1.50    0.24     10   10
1725+123     1.00    1.50    0.19      8    8
1013+127     1.00    1.50    0.14      6    6
0828+493     1.00    1.50    0.92     39   11
1636+473     1.00    1.50    1.63     69   12
0219+428     1.00    1.50    1.32     56   13
1508-055     1.00    1.50    0.14      6    6
2243+047     1.00    1.50    0.73     31   17
0436-129     1.00    1.50    0.14      6    6
Total                        5.74    243  101
?
```

The following command changes the target values for 1616+029, and then verifies it. If the maximum value is omitted, it is set to 100.

```
? ast set 1348+308 2 4
? ast li
SOURCE                    Min%Obs Max%Obs
   1 CL4                  1.00    1.50
   2 1348+308             2.00    4.00
   3 1725+123             1.00    1.50
   4 1013+127             1.00    1.50
   5 0828+493             1.00    1.50
   6 1636+473             1.00    1.50
   7 0219+428             1.00    1.50
   8 1508-055             1.00    1.50
   9 2243+047             1.00    1.50
  10 0436-129             1.00    1.50
?
```

The following command deletes 1636+473 from the astrometric list.

```
? ast del 1636+473
? ast li
SOURCE                    Min%Obs Max%Obs
```

```
   1 CL4                  1.00    1.50
   2 1348+308             2.00    4.00
   3 1725+123             1.00    1.50
   4 1013+127             1.00    1.50
   5 0828+493             1.00    1.50
   7 0219+428             1.00    1.50
   8 1508-055             1.00    1.50
   9 2243+047             1.00    1.50
  10 0436-129             1.00    1.50
?
```

The following adds source 2059+034 to the list with targets of 2.0 and 4.0.

```
? ast add 2059+034
? ast li
SOURCE                    Min%Obs Max%Obs
   1 CL4                  1.00    1.50
   2 1348+308             1.00    1.50
   3 1725+123             1.00    1.50
   4 1013+127             1.00    1.50
   5 0828+493             1.00    1.50
   7 0219+428             1.00    1.50
   8 1508-055             1.00    1.50
   9 2243+047             1.00    1.50
  10 0436-129             1.00    1.50
  46 2059+034             2.00    4.00
?
```

It may happen that after generating a schedule using astrometric mode some sources have too few observations to be useful. You can try to increase the number of the observations on these sources by changing the observing targets, or by increasing the weight of astrometric in the **`minor`** options. If this doesn't work, you may decide to just delete the source. You can do this manually using the *`delete.`*

An alternative is to use the *`cull`* keyword to delete sources. *`Cull`* takes two arguments, *`MinObs`* and *`MinRatio`*, the first of which is required. *`MinObs`* is the minimum number of acceptable observations. The second is *`MinRatio`* which is NumObsPerSrc/NumScansPerSrc. If MinRatio is larger than one, you would cull sources that have just single baseline observations. This might be desirable for source position measurements. The following example gets rid of all sources which have fewer than 7 observatons, or MinRatio under 1.01.

```
? ast cull 7 1.01
Culling sources with numObs <    7
         or  numObs/NumScan <  1.0
 Source      Min     Max    Actual  Num #Scans
CL4          1.00    1.50    0.28    12   12
1348+308     1.00    1.50    0.24    10   10
1725+123     1.00    1.50    0.19     8    8
1013+127     1.00    1.50    0.14     6    6
1508-055     1.00    1.50    0.14     6    6
0436-129     1.00    1.50    0.14     6    6
Total                        1.13    48   48
? ast obs
 Source      Min     Max    Actual  #Num #Scans
0828+493     1.00    1.50    0.92     39   11
1636+473     1.00    1.50    1.63     69   12
0219+428     1.00    1.50    1.32     56   13
2243+047     1.00    1.50    0.73     31   17
```

```
Total                          4.60    195   53
?
```

If the source is specified as "_", then all sources will be made astrometric:

```
? ast set _ 2 3
? ast li
SOURCE                     Min%Obs Max%Obs
   1 CL4                   2.00    3.00
   2 1348+308              2.00    3.00
   3 1725+123              2.00    3.00
   4 1013+127              2.00    3.00
   5 0828+493              2.00    3.00
...more sked output
  51 0920-397              2.00    3.00
  55 0109+224              2.00    3.00
  56 0430+289              2.00    3.00
  57 0925-203              2.00    3.00
  58 1608+243              2.00    3.00
  59 1657-261              2.00    3.00
  60 2000+148              2.00    3.00
?
```

auto

Syntax: **auto [***Subnet EndTime]*
Synopsis: Automatically schedule scans using the stations in *Subnet* until time *EndTime.*
See also: **whatsup, /, major, minor, downtime, astrometric**

Most schedules are generated using automatic scheduling for all or most of the schedule. In automatic mode, sked will generate a schedule using the station specified in *Subnet* until there is a scan that ends past *EndTime*. A special value for the argument is *EndTime* is **END** which is the symbolic name for the end of the session.

Issuing **auto** without an argument will generate a signal scan:

```
? auto
Auto Mode:       T
Fill-In Mode:    F  Subnet: Kk-Ma-Ny-Tc-Ts-Wf-Wz-
Total tested:   47  Tested for Minor:  28
SIMUL02: Inserting | 0014+813  10 SX PREOB  10004170000      47 MIDOB       0 POSTOB KWAWBW
?
```

If the user specifies "_" as the subnet, then **auto** uses the network specified by the **major subnet option**. This is the usual mode. The following example generates a schedule using this network until the first scan that ends after 17:10:00.

```
? auto _ 171000
Auto Mode:       T
Fill-In Mode:    F  Subnet: Kk-Ma-Ny-Tc-Ts-Wf-Wz-
Total tested:   47  Tested for Minor:  28
SIMUL02: Inserting | 0014+813  10 SX PREOB  10004170000      47 MIDOB       0 POSTOB KWAWBW
Fill-In Mode:    F  Subnet: Kk-Ma-Ny-Tc-Ts-Wf-Wz-
Total tested:   44  Tested for Minor:  26
SIMUL02: Inserting | 1334-127  10 SX PREOB  10004170240     131 MIDOB       0 POSTOB K-C-DC
Fill-In Mode:    T  Subnet: Ny-Wf-Wz-Ma-
Total tested:   26  Tested for Minor:  21
SIMUL02: Inserting | 1636+473  10 SX PREOB  10004170147     153 MIDOB       0 POSTOB BWE-FW
. . .
. . . more sked output
. . .
SIMUL02: Inserting | 0446+112  10 SX PREOB  10004170748      74 MIDOB       0 POSTOB A-B-DC
Fill-In Mode:    F  Subnet: Kk-Ma-Ny-Tc-Ts-Wf-Wz-
Turning off:     1636+473
Total tested:   39  Tested for Minor:  31
SIMUL02: Inserting | 0828+493  10 SX PREOB  10004170959     210 MIDOB       0 POSTOB KWBWDC
Fill-In Mode:    T  Subnet: Ma-Tc-Wf-
Turning off:     0828+493 1636+473
Total tested:   10  Tested for Minor:   8
SIMUL02: Inserting | 2255-282  10 SX PREOB  10004171048     161 MIDOB       0 POSTOB A-CW 1
Fill-In Mode:    F  Subnet: Kk-Ma-Ny-Tc-Ts-Wf-Wz-
Turning off:     0828+493 1636+473
Total tested:   35  Tested for Minor:  28
SIMUL02: Inserting | 3C418     10 SX PREOB  10004171536      70 MIDOB       0 POSTOB KWACB-
?
```

Note that the schedule alternates between standard mode and fill-in mode. The source 1636+473 is an astrometric mode, and is turned off because it has met its target. 0828+493 is also an astrometric source, and once this meets its target, it is also turned off.

The following example schedules the subnet **MaNyWz** until 17:25:00.

```
? auto MaNyWz 172500
Auto Mode:       T
Fill-In Mode:    F  Subnet: Ma-Ny-Wz-
Turning off:     0828+493 1636+473
Total tested:   18  Tested for Minor:  11
SIMUL02: Inserting | 0219+428  10 SX PREOB  10004171846     292 MIDOB       0 POSTOB ACB-FW
Fill-In Mode:    F  Subnet: Ma-Ny-Wz-
Turning off:     0828+493 1636+473 0219+428
Total tested:   22  Tested for Minor:  13
SIMUL02: Inserting | 0759+183  10 SX PREOB  10004172459     188 MIDOB       0 POSTOB ACBWFW
?
```

The following will automatically generate scans until the end of the session:

```
? auto _ end
Auto Mode:       T
Fill-In Mode:    F  Subnet: Kk-Ma-Ny-Tc-Ts-Wf-Wz-
 Optimizing for sky coverage, covariance parameters will be ignored.
Total tested:   47  Tested for Minor:  28
SIMUL02: Inserting | 0014+813  10 SX PREOB  10004170000      47 MIDOB       0 POSTOB KWAWBW
Fill-In Mode:    F  Subnet: Kk-Ma-Ny-Tc-Ts-Wf-Wz-
Total tested:   44  Tested for Minor:  26
SIMUL02: Inserting | 1334-127  10 SX PREOB  10004170240     131 MIDOB       0 POSTOB K-C-DC
Fill-In Mode:    T  Subnet: Ny-Wf-Wz-Ma-
Total tested:   26  Tested for Minor:  21
SIMUL02: Inserting | 1636+473  10 SX PREOB  10004170147     153 MIDOB       0 POSTOB BWE-FW
. . .
. . . more sked output
. . .
Total tested:   28  Tested for Minor:  22
SIMUL02: Inserting | 1219+044  10 SX PREOB  10005165840      43 MIDOB       0 POSTOB K-DC 1
Fill-In Mode:    F  Subnet: Kk-Ma-Ny-Tc-Ts-Wf-Wz-
Turning off:     1636+473
Total tested:   29  Tested for Minor:  23
SIMUL02: Inserting | 0048-097  10 SX PREOB  10005165847      43 MIDOB       0 POSTOB A-F- 1
Fill-In Mode:    F  Subnet: Kk-Ma-Ny-Tc-Ts-Wf-Wz-
Turning off:     1636+473
Total tested:   29  Tested for Minor:  23
 No more valid observations found within time.
?
```

back

Syntax: **back [Num]**
Synopsis: Move towards the start of the schedule Num scans.
See also: current, list, next, previous
Comment: This is synonymous with **^** and previous.

This command moves to the previous line of the schedule. If Num is omitted, we space backwards one scan.

In the following example we list a part of the schedule and then space backward 3 scans:

```
? li 171000-173000
Source      Start      DURATIONS
name     yyddd-hhmmss   Kk  Ma  Ny  Tc  Ts  Wf  Wz
2255-282 10004-171300|     161     161         125|
1342+662 10004-171309|  90     110      44 110    |
1128+385 10004-171541| 186     192      78 192    |
0048-097 10004-171633|      43                  43|
0059+581 10004-172058|      43  43      43  43  43|
3C371    10004-172310|  63  99  60      43  99  52|
0716+714 10004-172556|  56  91  64      43  91  54|
0759+183 10004-172752| 162     151      52     162|
1044+719 10004-172811|      43              43    |
1348+308 10004-173139| 101             101        |
End of listing.
? ^ 3
Source      Start      DURATIONS
name     yyddd-hhmmss   Kk  Ma  Ny  Tc  Ts  Wf  Wz
0716+714 10004-172556|  56  91  64      43  91  54|
End of listing.
?
```

Note that after the listing we are left following the scan that ends at 17:31:39. When we space backward 3 scans we are left after the scan that ends at 17:25:56.

bestsource

Syntax: **`Bestsource NumSrc [Mode [NumCov] ]`**
Synopsis: Find best sources for the current session.
See also: **`Major sub`**

This command finds the best sources for the given session. It uses the default subnet specified in **`major sub`**. It has one required argument, and two optional requirements.

Bestsource arguments	
Option	Description
`NumSrc`	Total number of sources in scheduling. If there are NumAst astrometric sources, then (NumSrc-NumAst) additional sources are chosen.
`Mode`	How the sources are ranked. – Observations. – Source strength. – Combination of observations and source strength. Default value is 3.
`NumCov`	Number of sources to consider in picking best source for coverage. Default value is 3.

The only required argument is NumSrc. This is the total number of sources in the schedule. Note that if there NumAst astrometric sources then the number of additional sources chosen is NumSrc-NumAst.

It may happen that because of station geometry and duration of the schedule it is not possible to find NumSrc sources that are visible during the session. In this case, **`bestsource`** will return as many sources as possible. The most common example of this are the 1-hour intensives, where typically only around 10-15 sources are visible.

Bestsource employs the following algorithm.

1. For each source, schedule a series of pseudo-scans spaced 10 minutes apart for the duration of the experiment.
2. For each pseudo-observation assign a score to the source.
    a. Mode=1. Score = number of observations in scan.
    b. Mode=2. Score = 1/duration.
    c. Mode=3. Score = (number of observations)/duration
3. Find the cumulative score for each source, and then rank them.
4. Pick the source with the highest score, and remove this from the trial list and add it to the BestSource list.
5. Pick the sources with the NumCov highest scores from the trial list. Chose the source that result in the best-sky coverage given the sources already in the BestSource list.

6. Add this to the BestSource list.
7. Go to Step 4 and repeat until we have NumSrc sources.

Here is an example of using BestSource to pick 60 sources.

```
? best 60
BestSource:  NumBest=  60 BestMode  3 NumCover=  3
Reading   sources   from   /shared/gemini/ftp/pub/sked/catalogs/source.cat.geo-
detic.good
NOTE: IAU name for IIIZW2   should be 0007+106 not IIIZW2
NOTE: IAU name for 1746+470 should be 1746+469 not 1746+470
Getting fluxes from file /shared/gemini/ftp/pub/sked/catalogs/flux.cat
Calculating rise/set times:
   1   2   3   4   5   6   7   8   9  10  11  12  13  14  15  16  17  18  19  20
  21  22  23  24  25  26  27  28  29  30  31  32  33  34  35  36  37  38  39  40
  41  42  43  44  45  46  47  48  49  50  51  52  53  54  55  56  57  58  59  60
  61  62  63  64  65  66  67  68  69  70  71  72  73  74  75  76  77  78  79  80
  81  82  83  84  85  86  87  88  89  90  91  92  93  94  95  96  97  98  99 100
 101 102 103 104 105 106 107 108 109 110 111 112 113 114 115 116 117 118 119 120
 121 122 123 124 125 126 127 128 129 130 131 132 133 134 135 136 137 138 139 140
 141 142 143 144 145 146 147 148 149 150 151 152 153 154 155 156 157 158 159 160
 161 162 163 164 165 166 167 168 169 170 171 172 173 174 175 176 177 178 179 180
 181 182 183 184 185 186 187 188 189 190 191 192 193 194 195 196 197 198 199 200
 201 202 203 204 205 206 207 208 209 210 211 212 213 214 215 216 217 218 219 220
 221 222 223 224 225 226 227 228 229 230 231 232 233 234 235 236 237 238 239 240
 241 242 243 244 245 246 247 248 249 250 251 252 253 254 255 256 257 258 259 260
 261 262 263 264 265 266 267 268 269 270 271 272 273 274 275 276 277 278 279 280
 281 282 283 284 285 286 287 288 289 290 291... done.
 Ranking sources
   1   2   3   4   5   6   7   8   9  10  11  12  13  14  15  16  17  18  19  20
  21  22  23  24  25  26  27  28  29  30  31  32  33  34  35  36  37  38  39  40
  41  42  43  44  45  46  47  48  49  50  51  52  53  54  55  56  57  58  59  60
  61  62  63  64  65  66  67  68  69  70  71  72  73  74  75  76  77  78  79  80
  81  82  83  84  85  86  87  88  89  90  91  92  93  94  95  96  97  98  99 100
 101 102 103 104 105 106 107 108 109 110 111 112 113 114 115 116 117 118 119 120
 121 122 123 124 125 126 127 128 129 130 131 132 133 134 135 136 137 138 139 140
 141 142 143 144 145 146 147 148 149 150 151 152 153 154 155 156 157 158 159 160
 161 162 163 164 165 166 167 168 169 170 171 172 173 174 175 176 177 178 179 180
 181 182 183 184 185 186 187 188 189 190 191 192 193 194 195 196 197 198 199 200
 201 202 203 204 205 206 207 208 209 210 211 212 213 214 215 216 217 218 219 220
 221 222 223 224 225 226 227 228 229 230 231 232 233 234 235 236 237 238 239 240
 241 242 243 244 245 246 247 248 249 250 251 252 253 254 255 256 257 258 259 260
 261 262 263 264 265 266 267 268 269 270 271 272 273 274 275 276 277 278 279 280
 281 282 283 284 285 286 287 288 289 290 291 ...done.
Calculating rise/set times:
   1   2   3   4   5   6   7   8   9  10  11  12  13  14  15  16  17  18  19  20
  21  22  23  24  25  26  27  28  29  30  31  32  33  34  35  36  37  38  39  40
  41  42  43  44  45  46  47  48  49  50  51  52  53  54  55  56  57  58  59  60
... done.
?
```

BroadBand

Syntax: **broadband List**
broadband Add <stat> <BW> <DATA> <SINK>
boradband Set <stat> <BW> <DATA> <SINK> |
Delete <stat>
Synopsis: Indicate which stations are BroadBand and the associated bandwidth.
See Also: minor

This command was introduced to allow scheduling of broadband systems. The scheduler can use this command to see which stations are broadband, as well as to 'flag' a station as broadband and set its bandwidth.

The broadband command without an argument lists the broadband stations.

```
? broadband
 # Station     BW (MHz) Data(mbps)  Sink(mbps)
   1 WESTFORD   512.00    8192       4096
   2 GGAO12M    512.00    8192       4096
?
```

Data is how quickly data is acquired and Sink is how quickly the data can be written to disk. In the above example the data rate is twice the sink rate, meaning that it takes twice as long to record the data as it does to take it. The time required to record a scan is given by:

REC_TIME=DURATION*(DATA/SINK)+MARK6_OFF

MARK6_OFF is in the $PARAMETER section.

You can add a station to the list using **Broadband Add**:

```
? broadband add Wn 512  8192 4096
? broadband
# Station     BW (MHz) Data(mbps)  Sink(mbps)
   1 WESTFORD   512.00    8192       4096
   2 GGAO12M    512.00    8192       4096
   3 WETZ12N    512.00    8192       4096
?
```

You can delete a station using the **delete** option.

```
? broadband del wf
? broadband
# Station     BW (MHz) Data(mbps)  Sink(mbps)
   2 GGAO12M    512.00    8192       4096
   3 WETZ12N    512.00    8192       4096
?
```

The broadband command determines how the SNR is calculated. `Sked` uses the following algorithm to calculate the SNRs:

1. If either station is a legacy station, it uses the normal SNR calculation. It does this for both bands. Note that this implicitly assumes that there is a complete overlap between the

the S-band and the Broadband system, and the X-band and the broad system. If this is not the case then the SNR calculation will be too optimistic.

2. If both stations are Broadband, it takes the minimum bandwidth of the two, and calculates the SNR using this. It does this for each band, using the same Bandwidth, but using the sked source flux models at each band.

In auto-`sked` mode `sked` will reject scans unless the meet the SNR targets on each band.

catalog

Syntax: **`Catalog`**
Synopsis: Run Java based catalog program.
See also:

Description:
OBSOLETE

check

Syntax: **Check [*Range [IDLE <value>]*]**
Synopsis: Check the schedule for errors.
See also: **List, Major**

This command checks to make sure that the scheduled scans are valid. It makes no changes to the schedule.

All of the checking performed by **check** is also done when the sked generates the scans, and bad scans will be rejected. Hence, with an exception discussed below, check should return no error messages if the schedule was generated using the automatic mode of sked. **Check** checks such things as:

Do the observations meet SNR targets?
Is there enough slewing time?
Is the source visible for the duration of the scan?
Etc.

Exception. The default mode of sked is that all baselines in a scan must achieve their SNR targets, or the scan is not scheduled. However, if the **major** option **allblgood** is set to No then sked will accept scans where a minority of the baselines do not meet the SNR. For a fuller discussion, see page 87.

In the following example, the SNR target for S-band is raised to 20. We then **check** the scans from the start of the schedule to 19:00:00. (This schedule was originally written with an SNR target of 15. The target is raised to purposefully introduce errors.)

```
? snr _ S 20
? ch ^-190000
Source      Start      DURATIONS
name     yyddd-hhmmss   Ho  Kk  Ma  Tc  Wf  Wz
0133+476 10077-183000|         370 370 155    |
2059+034 10077-183336|  60              60    |
1739+522 10077-183731|         149     149    |
SNRAC: SNR of  13+  3(margin) is less than minimum  20 required for Ho-Tc at S-band
1057-797 10077-183759| 184         184        |
2141+175 10077-184203|             320 320    |
1149-084 10077-184336|  60      60            |
1324+224 10077-184644|  60      60            |
0607-157 10077-184948|          83  83  60    |
SNRAC: SNR of  15+  3(margin) is less than minimum  20 required for Ma-Tc at S-band
0727-115 10077-185202|          60  60        |
1846+322 10077-185210| 124             124    |
0748+126 10077-185521|          60      60    |
1920-211 10077-185645| 306         306        |
CTA26    10077-185816|         179     179    |
SNRAC: SNR of  16+  3(margin) is less than minimum  20 required for Ma-Wf at S-band
0716+714 10077-190301|          60      60    |
 END OF AUTOCHECKING
?
```

If **timeline** is turned on then **check** will display detailed timing information which is useful for debugging purposes.

```
? ch ^-184000
Source      Start      DURATIONS
name     yyddd-hhmmss   Ho  Kk  Ma  Tc  Wf  Wz
0133+476 10077-183000|         370 370 155    |
 STN  START  DUR TAPE IDLE SOURCE MAXSLEW CAL START
 Ho 18:30:00   0    1    0      0       0  10 18:30:00
 MAXSLEW=SLEW *OR* +SETUP+(EARLY-CAL)
           0          20           0
 STN  START  DUR TAPE IDLE SOURCE MAXSLEW CAL START
 Wf 18:32:35   0    1    0      5      45  10 18:33:36
 MAXSLEW=SLEW *OR* +SETUP+(EARLY-CAL)
          44          20           0
2059+034 10077-183336|  60              60    |
 STN  START  DUR TAPE IDLE SOURCE MAXSLEW CAL START
 Wf 18:34:36   0    1    0      5      31  10 18:35:23
 MAXSLEW=SLEW *OR* +SETUP+(EARLY-CAL)
          30          20           0
 STN  START  DUR TAPE IDLE SOURCE MAXSLEW CAL START
 Ma 18:36:10   0    1    0      5      65  10 18:37:31
 MAXSLEW=SLEW *OR* +SETUP+(EARLY-CAL)
          64          20           0
1739+522 10077-183731|         149     149    |
SNRAC: SNR of  13+  3(margin) is less than minimum  20 required for Ho-Tc at S-band
 STN  START  DUR TAPE IDLE SOURCE MAXSLEW CAL START
 Ho 18:34:36   0    1    0      5     187  10 18:37:59
 MAXSLEW=SLEW *OR* +SETUP+(EARLY-CAL)
         187          20           0
 STN  START  DUR TAPE IDLE SOURCE MAXSLEW CAL START
 Tc 18:36:10   0    1    0      5      58  10 18:37:24
 MAXSLEW=SLEW *OR* +SETUP+(EARLY-CAL)
          57          20           0
1057-797 10077-183759| 184         184        |
 STN  START  DUR TAPE IDLE SOURCE MAXSLEW CAL START
 Wf 18:40:00   0    1    0      5      29  10 18:40:45
 MAXSLEW=SLEW *OR* +SETUP+(EARLY-CAL)
          29          20           0
 STN  START  DUR TAPE IDLE SOURCE MAXSLEW CAL START
 Tc 18:41:03   0    1    0      5      44  10 18:42:03
 MAXSLEW=SLEW *OR* +SETUP+(EARLY-CAL)
          43          20           0
2141+175 10077-184203|              320 320    |
 END OF AUTOCHECKING
?
```

comment

Syntax: **`Comment [comment]`**
Synopsis: Display a comment.

This command is typically only used in `sked` scripts. It echos the comment to the output device:

```
? comment hello there
hello there
?
```

coverage

Syntax: **coverage [TimeRange]**
Synopsis: Calculate the sky-coverage

If no time range is specified, coverage will calculate the coverage for the entire session.

Coverage divides the sky into 1692 pixels. For each station, it calculates several different figures having to do with sky-coverage.

Coverage values	
Option	Description
PixVis	Number of pixels above the horizon at a station. This includes the effect of the horizon mask.
PixMut	Number of pixels that are mutually visible by another station.
%MutVis	PixMut/PixVis. This is a measure of how much of the sky can be observed.
PixCvred	Number of pixels which have a scan in them.
Scans	Number of scans.
% Eff	PixCvred/Scans. This is a measure of how efficient we are in sampling the sky.
DistAvg	The average distance of pixels that are sampled from each other.
DistMax	The maximum distance of sampled pixels from each other. This is a measure of the largest hole in the sky.

Below is a sample sky distribution report for an R1.

```
? coverage
 Coverage Summary:
            HOBART26 KOKEE    MATERA   NYALES20 TIGOCONC TSUKUB32 WESTFORD WETTZELL Average
 PixMut      738      781      781      781      756      781      781      781      772
 PixVis      781      781      781      781      781      781      781      781      781
 % MutVis    94.5    100.0    100.0    100.0     96.8    100.0    100.0    100.0     98.9
 PixCvred     229      243      214      250      121      347      222      256      235
 Scans        606      736      618      826      270     1086      712      814      708
 % Eff       37.8     33.0     34.6     30.3     44.8     32.0     31.2     31.4     34.4
 DistAvg      5.1      4.8      5.4      5.1      9.1      3.4      4.9      4.9      5.3
 DistMax     26.2     21.5     17.2     22.1     35.9     10.4     20.4     20.2     21.7
 Number of pixels   1692      Average Pixel radius      2.8 deg
?
```

Here is the report for an Intensive:

```
? coverage
            KOKEE    WETTZELL Average
 PixMut      270      273      271
 PixVis      781      781      781
 % MutVis    34.6     35.0     34.8
 PixCvred      16       20       18
 Scans         30       30       30
 % Eff       53.3     66.7     60.0
 DistAvg     16.4     16.3     16.4
 DistMax     60.4     58.2     59.3
 Number of pixels   1692      Average Pixel radius      2.8 deg
```

```
?
```

For this Intensive session only 35% of the sky is mutually visible between the two stations. The results for Kokee and Wettzell are slightly different because of the granularity of the pixels.

current

Syntax: **current**
Synopsis: Lists the current scan.
See also: back, list, next, previous

This command is equivalent to '**list .**' but is included for convenience.

```
? current
Source      Start      DURATIONS
name     yyddd-hhmmss   Ho  Kk  Ma  Ny  Tc  Ts  Wf  Wz
3C274    10081-171120|  60      64  64      43        |
End of listing.
?
```

delete

Syntax: **delete** *range*
Synopsis: Delete the specified range of scans.
See also: add

This command will delete the specified *range* of scans from the schedule. After the deletion is completed, the current scan becomes the one just before the first deleted scan. This enables the user to start inserting new scans. The **delete** command is the only one for which the *range* does not default to the entire schedule. For this command, a time range must be specified.

The first scan deleted is the one whose start time is equal to or greater than the *range* starting time. The last scan deleted is the next one found after the *range* ending time.

The following example lists the scans between 17:00:00 and 17:30:00 and then deletes the scans between 17:10:00 and 17:20:00, and then lists the scans.

```
? li ^-172000
Source      Start      DURATIONS
name     yyddd-hhmmss   Ho  Kk  Ma  Ny  Tc  Ts  Wf  Wz
0016+731 10081-170000|      76  78  64      43  78  46|
1057-797 10081-170000| 168             168           |
2000+472 10081-170203|      65      43      43  65  43|
1448+762 10081-170356|     183 269 223      69 269 176|
1352-104 10081-170633|  43                  43        |
3C446    10081-170826|      43          43            |
0749+540 10081-170905|              79      77  79  69|
2255-282 10081-170945|     155         155            |
3C274    10081-171120|  60      64  64      43        |
2253+417 10081-171322|     122                 122     |
0955+476 10081-171327|         189 189      94     145|
1124-186 10081-171558|  43                  43        |
1013+054 10081-171845| 263     263 164      98     102|
0602+673 10081-172121|                      60 133 133|
End of listing.
? del 170500-171000
Source      Start      DURATIONS
name     yyddd-hhmmss   Ho  Kk  Ma  Ny  Tc  Ts  Wf  Wz
1448+762 10081-170356|     183 269 223      69 269 176|
 LICMD02 - End of listing.
? li ^-172000
Source      Start      DURATIONS
name     yyddd-hhmmss   Ho  Kk  Ma  Ny  Tc  Ts  Wf  Wz
0016+731 10081-170000|      76  78  64      43  78  46|
1057-797 10081-170000| 168             168           |
2000+472 10081-170203|      65      43      43  65  43|
1448+762 10081-170356|     183 269 223      69 269 176|
2253+417 10081-171322|     122                 122     |
0955+476 10081-171327|         189 189      94     145|
1124-186 10081-171558|  43                  43        |
1013+054 10081-171845| 263     263 164      98     102|
0602+673 10081-172121|                      60 133 133|
End of listing.
?
```

If the time range is ALL, then all the scans will be deleted.

display_wrap

Syntax: **Display_wrap**
Synopsis: Display the current wrap for all stations
See also: --

This command will display the cable wrap for all stations at the current location in the `sked` file.

The following example lists the scans between 17:30:00 and 18:00:00 and then displays the wrap cable wrap of the stations.

```
? li 174500-180000
Source      Start      DURATIONS
name     yyddd-hhmmss   Gs  Ht  Hb  Is  Ke  Ny  On  Yj  Ts  Ww  Wf  Wz  Yg
1424-418 15348-174521|          43      43                  43              |
2008-159 15348-174630|  43  43                          43          43  43  |
1124-186 15348-174652|          96      96                  43  84          81|
2121+053 15348-174810|                          43  43  43              43  |
1034-374 15348-174904|              250 300                      300         |
1243-072 15348-174905|          43                          43              |
2255-282 15348-174929|      43                          43              43  |
0104-408 15348-175108|      54 108                                         108|
0556+238 15348-175109|                      83  83  83  60          65  |
0602+673 15348-175328| 116                 116 116 116  97      116  86  |
1758-651 15348-175332|     139 139                                         |
2126-158 15348-175643|      50                          50              50  |
1030+415 15348-175705| 225         215 225  84 166      43 225  94          |
1156+295 15348-175825|          43                          43              |
2353-686 15348-175831|     154                                         154|
0016+731 15348-180120|              43      43  43  43  43      43  43  |
End of listing.
? display_wrap
GGAO12M  -
HART15M  C
HOBART12 -
ISHIOKA  -
KATH12M  -
NYALES20 -
ONSALA60 W
RAEGYEB  -
TSUKUB32 W
WARK12M  W
WESTFORD -
WETTZELL C
YARRA12M C
?
```

downtime

Syntax: **downtime [? | OFF | <subnet> <start> <end> | <subnet> Rem | <subnet> Off]**
Synopsis: Display, set station downtimes.
See also:

Downtime is a means of specifying when a station will not be available for observing. The most common reasons for this is that station is participating in an intensive.

Downtime without an argument will list the current downtimes:

```
? down
Wz-Kk 2010-074-18:15:00 2010-074-19:45:00
?
```

In this example Kokee and Wettzell are unavailable from 18:15:00 to 19:45:00.

To get more information on the syntax, you can succeed the command with a ?

```
? down help
 DOWNTIME: Set, remove or list downtimes
 DOWNTIME ?                              | This information
 DOWNTIME                                | (No argument) list current downtimes
 DOWNTIME OFF                            | Remove all downtimes
 DOWNTIME Subnet OFF                     | Remove all downtimes for subnet
 DOWNTIME Subnet Start_time End_time     | Insert downtime for subnet
         REM and OFF are synonomous
Wz-Kk 2010-074-18:15:00 2010-074-19:45:00
?
```

In the following example we remove Wettzell and then list the down stations.

```
? down wz off
? down
Kk 2010-074-18:15:00 2010-074-19:45:00
?
```

To add a station (or subnet) you give the station followed by the begining and end times:

```
? down wz 200000 210000
? down
Kk 2010-074-18:15:00 2010-074-19:45:00
Wz 2010-074-20:00:00 2010-074-21:00:00
?
```

A station can have multiple downtimes in a schedule.

early

Syntax: **Early [<station value> <station value>]**
Synopsis: Set, list the early start parameters.

The early start parameter is how early a station starts to record before the data is valid. This option was introduced for tapes which needed time for the correlators to synch up.

If the command is entered without an argument, it lists the current settings:

```
? early
ID  STATION  EARLY START (sec)
 Ho   HOBART26     0
 Kk   KOKEE        0
 Ma   MATERA       0
 Ny   NYALES20     0
 Tc   TIGOCONC     0
 Ts   TSUKUB32     0
 Wf   WESTFORD     0
 Wz   WETTZELL     0
?
```

The following example sets the early start value for Hobart and Matera to 15 seconds, and then verifies that they are set.

```
? early Ho 15 Ma 15
? early
 ID  STATION  EARLY START (sec)
 Ho   HOBART26    15
 Kk   KOKEE        0
 Ma   MATERA      15
 Ny   NYALES20     0
 Tc   TIGOCONC     0
 Ts   TSUKUB32     0
 Wf   WESTFORD     0
 Wz   WETTZELL     0
?
```

To set all of the stations to the same value, use '_' as the station identifier:

```
? early _ 20
? early
 ID  STATION  EARLY START (sec)
 Ho   HOBART26    20
 Kk   KOKEE       20
 Ma   MATERA      20
 Ny   NYALES20    20
 Tc   TIGOCONC    20
 Ts   TSUKUB32    20
 Wf   WESTFORD    20
 Wz   WETTZELL    20
?
```

The early start values are written into the `$PARAM` section of the schedule file when the **er**, **ec**, **wr**, or **wc** command is executed and the limits are then automatically set when the same schedule file is accessed again. The values appear on lines that begin with `EARLY_START`.

ec, er

Syntax: **ec** *filename*
er *[filename]*
Synopsis: Write out schedule file and exit.
See also: wc, wr, vwc, vwr

This is a standard exit command. With the **ec** command (exit, create), a new file is created with the name supplied, and the file being edited is left as it was. With the **er** command (exit, replace), the file being edited (or the file named in this command) is replaced by the edited version just produced in this `sked` session.

Before exiting, `sked` reads through the schedule file and checks that all of the sources and stations you have scheduled are currently selected. If not, an error message is printed and you will be asked whether you wish to exit anyway, saving the schedule file as is. If possible, you should complete selections before exiting. You can always exit using **abort**.

For the **er** command, you are asked if you want to replace the file. Only a **y** or **n** is accepted as a response, *i.e.* there is no default.

The current parameter values for the quantities in the `$EXPER` and `$PARAM` sections are always written into the output file. Other sections are re-written from `sked`'s scratch files only if a change has been made, that is, selection has been done or new scans have been added. Unchanged sections are copied in their entirety from the original file.

With both **er** and **ec**, valid access to the file is checked. The path given in the control file, if any, is pre-pended to the file name you specify in this command. Refer to page SKED- for a discussion of control files.

To save intermediate versions of a scheduling session without exiting from the current schedule, use the **wc** or **wr** command.

elevation

Syntax: **elevation [<station limit> <station limit> …]**
Synopsis: List, set the elevation limits for a station.

The elevation limit sets the minimum observing elevation for the stations. If the command is entered without an argument, it lists the current settings:

```
? elevation
 ID  STATION  EL LIMIT(deg)
 Ho  HOBART26   5.0
 Kk  KOKEE      5.0
 Ma  MATERA     5.0
 Ny  NYALES20   5.0
 Tc  TIGOCONC   5.0
 Ts  TSUKUB32   5.0
 Wf  WESTFORD   5.0
 Wz  WETTZELL   5.0
?
```

The following example sets the elevation limit for Hobart to 7 and Westford to 8, and then verifies that the values were set.

```
? elevation Ho 7 wf 8
? el
 ID  STATION  EL LIMIT(deg)
 Ho  HOBART26   7.0
 Kk  KOKEE      5.0
 Ma  MATERA     5.0
 Ny  NYALES20   5.0
 Tc  TIGOCONC   5.0
 Ts  TSUKUB32   5.0
 Wf  WESTFORD   8.0
 Wz  WETTZELL   5.0
?
```

To set all of the stations to the same value, use '_' as the station identifier:

```
? elevation _ 10
? el
 ID  STATION  EL LIMIT(deg)
 Ho  HOBART26  10.0
 Kk  KOKEE     10.0
 Ma  MATERA    10.0
 Ny  NYALES20  10.0
 Tc  TIGOCONC  10.0
 Ts  TSUKUB32  10.0
 Wf  WESTFORD  10.0
 Wz  WETTZELL  10.0
?
```

The elevation values are written into the `$PARAM` section of the schedule file when the **er**, **ec**, **wr**, or **wc** command is executed and the limits are then automatically set when the same schedule file is accessed again.

fill

Syntax: **`Fill [TimeRange [SourceList [Subnet]]]`**
Synopsis: Checks a schedule for idle time that can used to observe longer previous scans and increase the length of the scans if possible.
See also: Parameter fill_off

If the command is entered without an argument (default), it will work on the entire schedule. It can be restricted to a certain time range with TimeRange, to scans on a single source or on all sources in the ASTRO section with SourceList, and/or to scans in which a subnet of stations participate. The specifications for time, source, and stations must appear in the order listed above. The place-holder character _ (underline) can be used to specify "all" if, for example, you want to apply the command to all scans, sources and stations.

The following command applies FILL to scans from the start time to 18:30:00.

```
? li ^-183000
Source       Start       DURATIONS
name     yyddd-hhmmss   Br  Fd  Hh  Hn  Kk  Kp  La  Mk  Nl  Ny  On  Ov  Pt  Sc  Wz
1726+455 16335-180000| 300 300     300 300 300 300 300 300 300 300 300 300 300 300|
0718+793 16335-180659|  72          72  72  72      72              72              |
2059+034 16335-180754|     300 300             300     300 300 300     300 300 300|
1300+580 16335-180927|  98          98  98  98      98              98              |
1440-220 16335-181437| 360 360     360     360 360 360 360         360 360 360     |
2318+049 16335-181521|         260                             144 260             |
1334-127 16335-182126|  48  48              48  48  48  48          48  48  48     |
2150+173 16335-182218|         382 164                         312 382             |
1511-100 16335-182315|  48  48              48  48  48  48          48  48  48     |
1656-075 16335-182504|  48  48              48  48  48  48          48  48  48     |
1717+178 16335-182659|  48  48      48      48  48  48  48          48  48  48     |
0212+735 16335-183038|  48  48      48      48  48      48  48  48  48  48  48     |
End of listing.
? fill ^-183000
 1726+455  10 SX PREOB  16335180000
 0718+793  10 SX PREOB  16335180659
 …
 1656-075  10 SX PREOB  16336175734
 End of FILL command.
? li ^-183000
Source       Start       DURATIONS
name     yyddd-hhmmss   Br  Fd  Hh  Hn  Kk  Kp  La  Mk  Nl  Ny  On  Ov  Pt  Sc  Wz
1726+455 16335-180000| 340 351     300 357 332 343 363 338 300 373 348 344 373 363|
0718+793 16335-180659|  76          102 102  74      73              72              |
2059+034 16335-180754|     315 300             317     316 404 394     318 300 404|
1300+580 16335-180927| 139          113 204 144     204             148             |
1440-220 16335-181437| 379 378     360     378 379 360 379         379 378 372     |
2318+049 16335-181521|         299                             367 367             |
1334-127 16335-182126|  73  65              71  69  68  64          73  70  48     |
2150+173 16335-182218|         419 192                         419 382             |
1511-100 16335-182315|  72  66              67  69  51  72          70  68  48     |
1656-075 16335-182504|  58  59              64  57  67  48          64  60  67     |
1717+178 16335-182659| 120  95      92      109 114 127  97         127 111  88     |
0212+735 16335-183038|  48  48      48      48  48      48  48  48  48  48  48     |
End of listing.
?
```

The observations for the first scan (source 1726+455 at 16335-180000) were initially of 300 seconds. After using fill, these scans were increased when possible. The Maxscan parameter for this schedule was set at 480 seconds. The fill command keeps this value and will not increase the scans beyond the Maxscan value.

We introduced a parameter Fill_off that is a safety feature to absorb possible differences between slewing time models and real values. This parameter is user settable (see parameters section).

```
? param fill_off 5
? fill
 …
  1656-075  10 SX PREOB  16336175734
 End of FILL command.
? li ^-183000
Source      Start      DURATIONS
name     yyddd-hhmmss   Br  Fd  Hh  Hn  Kk  Kp  La  Mk  Nl  Ny  On  Ov  Pt  Sc  Wz
1726+455 16335-180000| 335 346     300 352 327 338 358 333 300 368 343 339 368 358|
0718+793 16335-180659|  72          97  97  72       72              72            |
2059+034 16335-180754|     310 300              312      311 399 389     313 300 399|
1300+580 16335-180927| 134          108 200 139      200             143           |
1440-220 16335-181437| 374 373     360      373 374 360 374          374 373 367    |
2318+049 16335-181521|         294                                362 362           |
1334-127 16335-182126|  68  60              67  64  63  59          68  65  48    |
2150+173 16335-182218|         414 187                          414 382           |
1511-100 16335-182315|  67  61              62  64  48  67          65  63  48    |
1656-075 16335-182504|  53  54              59  52  62  48          59  55  62    |
1717+178 16335-182659| 115  90      87      104 109 123  93         123 107  83    |
0212+735 16335-183038|  48  48      48       48  48      48  48  48  48  48  48    |
End of listing.
?
```

In the first scan, all the observations that were filled have an offset of 5 seconds.

The following command applies the command to all scans on sources in the ASTRO section. The keyword ASTRO is case insensivite.

```
? fill _ ASTRO _
 …
1656-075  10 SX PREOB  16336175734
End of FILL command.
? li ^-183000
Source      Start      DURATIONS
name     yyddd-hhmmss   Br  Fd  Hh  Hn  Kk  Kp  La  Mk  Nl  Ny  On  Ov  Pt  Sc  Wz
1726+455 16335-180000| 300 300     300 300 300 300 300 300 300 300 300 300 300 300|
0718+793 16335-180659|  72          72  72  72       72              72            |
2059+034 16335-180754|     300 300              300      300 300 300     300 300 300|
1300+580 16335-180927|  98          98  98  98       98              98            |
1440-220 16335-181437| 360 360     360      360 360 360 360          360 360 360    |
2318+049 16335-181521|         260                                144 260           |
1334-127 16335-182126|  48  48              48  48  48  48          48  48  48    |
2150+173 16335-182218|         419 192                          419 382           |
1511-100 16335-182315|  72  66              67  69  51  72          70  68  48    |
1656-075 16335-182504|  48  48              48  48  48  48          48  48  48    |
1717+178 16335-182659| 120  95      92      109 114 120  48          48  48  88    |
0212+735 16335-183038|  64  71      70       72  70      68  53  48  67  71  72    |
End of listing.
?
```

NOTE: The command fill is going to increase the amount of data required to record. This is an example for an RDV session before using fill:

```
         Br   Fd   Hh   Hn   Kk   Kp   La   Mk   Nl   Ny   On   Ov   Pt   Sc   Wz  Avg
% obs. time:
         56   58   42   55   35   58   58   48   58   51   55   56   58   53   46   52
% cal. time:
          4    5    3    4    3    5    5    4    4    3    3    5    5    4    4    4
% slew time:
         22   22   36   21   16   23   22   22   23   15   17   23   22   20   11   21
% idle time:
         16   15   18   19   45   14   15   25   14   30   23   15   14   22   39   22
total # scans:
       382  401  219  348  269  418  407  359  381  287  302  413  411  328  327  350
# scans/hour :
         16   17    9   15   11   17   17   15   16   12   13   17   17   14   14   15
Avg scan (sec):
       127  124  167  137  112  120  122  117  131  153  158  117  122  140  122  130
# data tracks:
         16   16   16   16   16   16   16   16   16   16   16   16   16   16   16
# Mk5 tracks:
         16   16   16   16   16   16   16   16   16   16   16   16   16   16   16
Total TB(M5):
       1.6  1.6  1.2  1.5  1.0  1.6  1.6  1.3  1.6  1.4  1.5  1.5  1.6  1.5  1.3  1.5
```

After using fill:

```
         Br   Fd   Hh   Hn   Kk   Kp   La   Mk   Nl   Ny   On   Ov   Pt   Sc   Wz  Avg
% obs. time:
         68   69   46   69   50   69   69   65   69   70   71   67   69   66   71   66
% cal. time:
          4    5    3    4    3    5    5    4    4    3    3    5    5    4    4    4
% slew time:
         22   22   36   21   16   23   22   22   23   15   17   23   22   20   11   21
% idle time:
          5    3   14    5   30    3    3    8    3   11    7    4    3    9   13    9
total # scans:
       382  401  219  348  269  418  407  359  381  287  302  413  411  328  327  350
# scans/hour :
         16   17    9   15   11   17   17   15   16   12   13   17   17   14   14   15
Avg scan (sec):
       153  149  183  170  160  142  147  156  156  210  203  140  146  174  188  164
# data tracks:
         16   16   16   16   16   16   16   16   16   16   16   16   16   16   16
# Mk5 tracks:
         16   16   16   16   16   16   16   16   16   16   16   16   16   16   16
Total TB(M5):
       1.9  1.9  1.3  1.9  1.4  1.9  1.9  1.8  1.9  1.9  2.0  1.9  1.9  1.8  2.0  1.8
```

The observation time percentage average increase from 52% to 66% and the idle time percentage average decreased from 22% to 9%. The average data recorded increases from 1.5 TB to 1.8 TB.

flux

Syntax: **Flux Select <catalog> | List | Check | Fix]**
Synopsis: Display, set fluxes.
See also:

This command allows the user to read in fluxes, list the fluxes, check to see if there are missing values for the fluxes, and to fix them.

Use flux select to update the fluxes in the sked catalog:

```
? flux sel
Getting fluxes from file /home/ftp/pub/sked/catalogs/flux.cat
?
```

Flux list will list the flux models on the output device:

```
? flux li
#   Source     Band Type Base Flux  Base   Flux  Base   Flux  Base   Flux
                        Flux MajAx Ratio  PA    Off1    Off2
   1 1  1236-684  X  B  0.0  2.56    900.  2.56   1530.  2.48   2600.  2.46   4420.
2.46   7520.  2.39  10400.  2.35  12800.
        1236-684  S  B  0.0  1.13    900.  0.88   1530.  0.81   2600.  0.85   4420.
0.72   7520.  0.72  10400.  0.71  12800.
   2 2  0047-579  X  B  0.0  0.36    900.  0.34   1530.  0.34   2600.  0.34   4420.
0.34   7520.  0.34  10400.  0.34  12800.
        0047-579  S  B  0.0  0.42    900.  0.41   1530.  0.40   2600.  0.35   4420.
0.31   7520.  0.31  10400.  0.31  12800.
. .
. . more sked output
. .
  22 l  1300+580  X  M   0.88  0.35  0.50   30.0   0.00   0.00
        1300+580  S  M   0.48  0.70  1.00    0.0   0.00   0.00
  23 m  1424-418  X  M   0.85  0.50  1.00    0.0   0.00   0.00
        1424-418  S  M   0.62  1.50  1.00    0.0   0.00   0.00
. . .
. . .
  60 X  1502+036  X  B  0.0  0.59   1000.  0.59   2000.  0.59   3000.  0.56   4000.
0.55   5000.  0.52   6000.  0.52   7000.  0.52   8000.  0.51   9000.  0.48  10000.  0.48
11000.  0.47  12000.  0.45  13000.
        1502+036  S  B  0.0  0.62   1000.  0.61   2000.  0.61   3000.  0.58   4000.
0.56   5000.  0.53   6000.  0.53   7000.  0.53   8000.  0.52   9000.  0.52  10000.  0.50
11000.  0.47  12000.  0.45  13000.
?
```

For each source, sked lists the X-band flux followed by the S-band flux. On the first line for each source the first token is the source number, the second the source symbol, the third the source name, the fourth the band, and the fifth the kind of flux model. This is followed by model parameters. Sked currently uses two kinds of flux models. In *Baseline* models (indicated by "B") the flux is modeled as a series of step functions. In elliptical models (indicated by "M"), the source is modeled as a sum of ellipses. For more details on the modeling see the chapter on algorithms.

For example, the 60th source is 1502+036, its symbol is "X", and sked uses a baseline model. It may happen that some of the sources are missing fluxes. In this case, sked will indicate this by typing ****MISSING**** instead of the model:

```
? flux li
#   Source     Band Type Base Flux  Base   Flux  Base   Flux  Base   Flux
                        Flux MajAx Ratio  PA    Off1    Off2
   1 1  1236-684  X  B  0.0  2.56    900.  2.56   1530.  2.48   2600.  2.46   4420.  2.46
7520.  2.39  10400.  2.35  12800.
        1236-684  S  B  0.0  1.13    900.  0.88   1530.  0.81   2600.  0.85   4420.  0.72
7520.  0.72  10400.  0.71  12800.
   2 2  0047-579  X  B  0.0  0.36    900.  0.34   1530.  0.34   2600.  0.34   4420.  0.34
7520.  0.34  10400.  0.34  12800.
        0047-579  S  B  0.0  0.42    900.  0.41   1530.  0.40   2600.  0.35   4420.  0.31
7520.  0.31  10400.  0.31  12800.
   3 3  2142+110  X  B  0.0  0.36   1000.  0.36   2000.  0.35   3000.  0.35   4000.  0.33
5000.  0.32   6000.  0.31   7000.  0.31   8000.  0.30   9000.  0.30  10000.  0.30  11000.
0.30  12000.  0.30  13000.
        2142+110  S  *****MISSING*****
.. .
?
```

Although this correctly indicates that the S-band flux is missing for source 2142+110, it may be hard to find this information if the schedule has 60 or more sources.

The **`flux check`** command will display all missing fluxes:

```
? flux check
WARNING!  Following sources have missing fluxes:
Source    Band
2142+110  S
1435+638  X
1435+638  S
?
```

The user can use this information to fix the missing values. For example, they could edit the $FLUX portion of the schedule file.

A simple fix is to use the **`flux fix`** command:

```
? flux fix
Source    Band
   3 2142+110  S copied from X
   7 1435+638  X
   7 1435+638  S
?
```

This will do the following:

- If one of the bands has a flux model, it will use the same model for the other band.
- If both bands are missing the flux model, it assumes that the source is weak, and that the flux is 0.25 mJy on all baselines.

We recognize that this is not an optimal solution.
Sources without fluxes can still be scheduled if the user specifies the duration manually.

frequency

Syntax: **Freq <select|list>**
Synopsis: List or select the observing mode.
See also: source , station

Frequency list will display information about the current frequency sequence:

```
? freq li
  Name  Code
VGEOSX   SX
Recording mode setup for:
  BR-VLBA  FD-VLBA  HN-VLBA  KP-VLBA  LA-VLBA  MK-VLBA  NL-VLBA  OV-VLBA
  PIETOWN  SC-VLBA
  Mode      Tot.Rate      Tot.BandW  #chan #bits  Barrel
 VLBA1:2   253.184 Mbits  126.592 MHz    8   2     NONE
  Chan.BW  #Subpasses  Tracks(*fan)  Tot.tracks  Speed
  8.00 MHz      1         16(*2)        32       0.00
  X-band spanned bw=   490.0 MHz       rms spanned bw=   206.1 MHz
  S-band spanned bw=   140.0 MHz       rms spanned bw=    58.9 MHz
  Effective number of channels recorded per sub-pass
          X         S         Total
          7.912     7.912    15.824
Recording mode setup for:
  HOBART26 KOKEE    NYALES20 TSUKUB32 WETTZELL
  Mode      Tot.Rate      Tot.BandW  #chan #bits  Barrel
 Mk341:2   253.184 Mbits  126.592 MHz    8   2     NONE
  Chan.BW  #Subpasses  Tracks(*fan)  Tot.tracks  Speed
  8.00 MHz      1         16(*2)        32       0.00
  X-band spanned bw=   490.0 MHz       rms spanned bw=   206.1 MHz
  S-band spanned bw=   140.0 MHz       rms spanned bw=    58.9 MHz
  Effective number of channels recorded per sub-pass
          X         S         Total
          7.912     7.912    15.824
?
```

In the above example, since the VLBA stations use a different, but compatible, observing mode, they are listed separately from the Mark4 stations.

Frequency select enables the user to change the frequency mode. This command reads the `sked` frequency catalogs, and then displays a screen that looks like this:

```
Mode name          Frq.Code    BW    Sample  Recorder Code
256-16(R1)         GEOSX        8.0   16.0  32-16-2-1
128-16(INT)        NEOS-WB      4.0    8.0  32-16-2-1
256-16(INT2)       GEOSX4F      8.0   16.0  32-16-2-1
128-16(R4)         GEOSXR4      4.0    8.0  32-16-2-1
256-16(OHIG)       EUR2-SX      4.0    8.0  32-16-2-2
64-32(APSG)        CDP-SX       4.0    8.0  32-16-2-1
64-16(EU-T2)       EUR2-SX      4.0    8.0  32-16-2-1
128-8(RDV)         VGEOSX       8.0   16.0  32-8-4-1
256-8(RDV)         VGEOSX       8.0   16.0  32-8U-2-2
512-8(RDV)         VGEOSX      32.0   64.0  32-8-4-1
1024-8(RDV)        VGEOSX      64.0  128.0  32-8-4-1
1024-16(R&D)       GEOSX8N     16.0   32.0  64-16-2-2
56-14(CRF)         CDP-SX       4.0    8.0  28-14-2-1
128-16             GEOSX        4.0    8.0  32-16-2-1
512-16             GEOSX       16.0   32.0  32-16-2-1

Cursor key or ijkl            <E>nd     <F>irst   <N>ext    <P>rev
<R>efresh
```

You use the cursor keys to navigate around. Highlighted modes are selected. In this example the current frequency mode is 256-8 (RDV). Hitting the space bar toggles if a frequency is selected or not. When you are satisfied with your selection, type "E". This presents you with a menu:

```
> se
 SE - select entries for SKED
 LI - list selected entries so far
 AB - abort and return to SKED
 :: - return to sked with new information
>
```

LI gives you a chance to review your selection.

SE allows you to modify your selection.

AB lets you return to `sked`, keeping the old selection.

:: lets you return with the new mode.

In principle `sked` can handle several frequency modes in the schedule. In practice, all geodetic schedules use a single frequency mode.

For the frequency mode to be valid, it must be defined for all the stations in the schedule. If the user selects an invalid mode, `sked` will issue warning messages. Expert users can use these messages to modify the catalogs so that the mode is defined correctly for the stations that had problems.

In the past the user had to select the frequency mode if they changed the stations in a schedule. You no longer need to do this. `Sked` will try to figure out the appropriate mode from the schedule. If it runs into problems, it will let the user know.

group

Syntax: ***GROUP [List | Obs | Add Src Group# | Set Src Group# | Delete Src | Cull Group# | / Group# [START <time>] [SUBNET <subnet>] [DUR <duration>]]***

Synopsis: List, add, delete and schedule source groups

This command is used to list, add, delete or schedule sources classified in groups.

Sources in groups appear in the $GROUP portion of the schedule file.

```
$GROUP
1143-332  01
1151-324  01
1922-341  02
1938-302  02
1939-316  02
0235-266  03
0240-217  03
0633-211  04
0637-216  04
```

Here the first column is the source name and the second column is the group number.

Group Keywords	
Option	Description
List	List sources in groups
Obs	List sources in groups, group numbers, and number of observations and scans observed in schedule.
Add Source Group#	Add a source to a given group. Must specify group#.
Set Source Group#	Read sources in group list.
Delete Source	Delete source from group list. Source will not be observed.
Cull MinObs MinRatio	Remove sources from group list if they have fewer than MinObs observations, or for which NumObs/NumScan<MinRatio.
/ Group# [START <time>] [SUBNET <subnet>] [DUR <duration>]	Schedule sources from a given group using the regular manual scheduling called by "/". The options are the same (see chapter 4 for command "/").

Group without an argument will list the current sources in groups. This is synonymous with **group list.**

```
? group li
#    SrcName Group #
   1 1143-332    1
   2 1151-324    1
   3 1922-341    2
```

```
   4 1938-302    2
   5 1939-316    2
   6 0235-266    3
   7 0240-217    3
   8 0633-211    4
   9 0637-216    4
?
```

The first number on this screen is the position of the source in the group list.

To see how well we are doing in meeting the target, use the **`group obs`** command.

```
? group obs
 Source   Gr#   Actual  #Num #Scans
1143-332   1     0.04      6    2
1151-324   1     0.05      8    3
1922-341   2     0.07     12    2
1938-302   2     0.07     12    2
1939-316   2     0.07     12    2
0235-266   3     0.00      0    0
0240-217   3     0.01      1    1
0633-211   4     0.00      0    0
0637-216   4     0.00      0    0
Total            0.31     51   12
?
```

The following command deletes 0633-211 from the group list. The user must specify the group number.

```
? group del 0633-211 4
? group li
#    SrcName Group #
   1 1143-332    1
   2 1151-324    1
   3 1922-341    2
   4 1938-302    2
   5 1939-316    2
   6 0235-266    3
   7 0240-217    3
   8 0637-216    4
?
```

The following adds source 1152-308 in the group 4.

```
? group add 1908-201 4
? group li
#    SrcName Group #
   1 1143-332    1
   2 1151-324    1
   3 1922-341    2
   4 1938-302    2
   5 1939-316    2
   6 0235-266    3
   7 0240-217    3
   8 0637-216    4
   9 1908-201    4
?
```

It may happen that after generating a schedule some sources have too few observations to be useful. You may decide to just delete the source. You can do this manually using the *`delete`*.

To schedule a source group, the command is ‘group / group# OPTIONS’. The OPTIONS are the same than for the Sked manual schedule command (see details for command ‘/’).

The command ‘param confirm off’ to remove all questions asking the user to confirm the addition of the scan. ‘param vscan off’ allows the user to schedule a scan without taking into account the SNRs and schedule on a given duration. The following command allows the user to schedule consecutively all sources of group 4 on a duration of 120 seconds.

```
? param confirm off
? param vscan off
? group / 1 dur 120
Checking new obs on 1143-332          with Br Fd Hh Hn Kk Kp La Mk Nl Ny On Ov Pt Sc
Wz
…
Checking new obs on 1143-332          with Kk Mk
                     Kk          Mk
Slewing (min):         1.6         1.6
Idle time (sec):         4           0
Duration (sec):        120         120
Obs start time:  18:01:22
Subnet:           Kk-Mk
1143-332 16336-180122| 120 120|
Checking new obs on 1151-324          with Br Fd Hh Hn Kk Kp La Mk Nl Ny On Ov Pt Sc
Wz
…
Checking new obs on 1151-324          with Kk Kp Mk
                     Kk          Kp          Mk
Slewing (min):         0.3         1.1         0.0
Idle time (sec):       516           0         534
Duration (sec):        120         120         120
Obs start time:  18:12:34
Subnet:           Kk-Kp-Mk
1151-324 16336-181234| 120 120 120|
?
```

help

Syntax: **help [***Command***]**
Synopsis: Move towards the start of the schedule Num scans.
Comment: This is synonymous with the '**?**' command.

Typing help without an argument; lists the command together with a brief description:

```
? help
 !              Shell to system                /              Insert new scan
 ?              Info for <command>             ^              Previous line
 ABORT          Abandon all changes            ADD            Add station to scan
 ALLOCATION     Set, list tape allocation      ASTROMETRIC    Set desired #obs limits
 AUTOSKED       Auto generate schedule         BACK           Back up in the schedule
 BASELINE       Listings by baseline           BESTSOURCE     Find best sources
 CATALOG        Start/get catalog info         CHECK          Check schedule
 COMMENT        only used in scripts           COVERAGE       Report coverage by station
 CURRENT        List current scan              DELETE         Delete scan(s)
 DOWNTIME       Set/list Stat  Downtime        EARLY          Set, list early start
 EC             Create sked file & exit        ELEVATION      Set, list el limits
 ER             Write sked file & exit         FLUX           Select or list flux
 FREQUENCIES    Set,list freq. modes           HELP           List this screen
 INIT           Initialize tape data           LIST           List scans
 MAJOR          List, select minor opts        MAX            List max parameter values
 MASTER         Compare schedule, master       MEDIA          Set, list media types
 MINOR          List, select minor opts        MODIFY         Modify current scan
 MONITOR        Get sources to monitor         MOTION         Set, list tape motion
 MUTUALVIS      Display mutual vis.            NEXT           List next scan
 OPTIMIZATION   Set, list optimization         PARAMETERS     Set, list parameters
 PID            List Process ID #              PREVIOUS       List previous scan(s)
 PRINTL         Print file - landscape         PRINTP         Print file - portrait
 QUIT           Immediately w/o asking         REMOVE         Remove station
 RESULT         Display fe or matrices         REWRITE        Rewrite scans
 SCAN           Set source scan times          SHIFT          Shift start times
 SITEVIS        Display station vis.           1SNR           Set, list 1-BL SNRs
 SNR            Set, list SNRs                 SOLVE          Make output for solve
 SOURCES        Select                         STATIONS       Select
 STREAMS        Show processing streams        SUBCON         Set subconfig display
 SUMMARY        Print                          SUMOUT         Write summary file
 TAGALONG       Add station to scans           TAPE           Set, list tape types
 TIMELINE       Set time line display          UNIT           Change output device
 UNTAG          Remove any bad obs.            VEC            Vex create & exit
 VER            Vex write & exit               VLBA           Toggle full-obs. mode
 VSCAN          Display variable scan lengths  VWC            Create Vex file
 VWR            Write Vex file                 WC             Create sked file
 WEIGHT         Set source weight              WHATSUP        Display sources 'up'
 WR             Write sked file                XLIST          Extended listings
 XNEW           New scan extended list
Commands may be abbreviated so long as they are unique
?
```

If the '**?**' command is followed by a command name, it will give a synopsis of the command:

```
? ? quit
 QUIT Command takes no arguments
? ? li
 LIST [<range> [<source> [<subnet> [<ellim>]]]]
 <range> is ALL or <start>-<stop> or <start>#<number>
             <start>,<stop> are yydddhhmmss or ^(top), .(current), *(end)
             or first, last, begin, end,
?
```

Some commands will give you additional information if you follow the command name by a question mark:

```
? xlist ?
List, Clear, Toggle Extended listings
Usage: Xlist <option>
?         This screen
Clear     Clear all values
List      List values currently set
Off       Turn off extended listing
On        Turn on extended listing
--otions listed below--
AzEl      AzEl
Feet      Tape footage
HA        Hour Angle
Long      Long format for AzEl
Sky       Sky distribution info
SNR       SNR by baseline
Wrap      Include cable wrap
?
```

However, this only works for some of the newer `sked` commands (more recent than 2005). Older `sked` commands will give an error message:

```
? li ?
YDHMS03: Incorrect format in time field:?
 GTDTR02 - Start date/time must be of form YYDDDHHMMSS. YY and
DDD optional.
?
```

Eventually, all `sked` commands give provide more information if their first argument is "?".

list

Syntax: **List [Range [source [subnet [max_el]]]**
Synopsis: Move towards the start of the schedule Num scans.
See also: back,current,next

This is the basic schedule listing command and also the standard way to make a scan be the "current" one. The listing can be restricted to a certain time range with *range*, to scans on a single source with *source*, and/or to scans in which a *subnet* of stations participate. If *max_el* is specified, only observations with elevations lower than *value* will be listed.

The default for each of the specifications is to list "all". Hence, **list** without any arguments will list all the scans in the schedule.

The specifications for time, source, and stations must appear in the order listed above. The place-holder character _ (underline) can be used to specify "all" if, for example, you want to list all times for a single source. Refer to page SKED- for the syntax of *range*, *source*, and *subnet*.

If only the time range is specified, a listing of the scans scheduled for all stations in the default subnet (as determined by the **major subnet** option) will be displayed on the display unit. If a source name or number is specified, only scans for that source will be listed.

To insert a new scan into the schedule, use the list command to establish the preceding scan as the current one by listing it.

The new scan command (/ or *source*) as well as list, next, back, current, and previous produce listings of scheduled observations on the display unit, as specified with the unit command. The listing includes the items specified with the xlist command.

The following command lists the schedule from the start time to 18:50:00.

```
? li ^-190000
Source      Start      DURATIONS
name     yyddd-hhmmss   Ho  Kk  Ma  Tc  Wf  Wz
0133+476 10077-183000|         370 370 155    |
2059+034 10077-183336|  60              60    |
1739+522 10077-183731|         149     149    |
1057-797 10077-183759| 184         184        |
2141+175 10077-184203|             320 320    |
1149-084 10077-184336|  60      60            |
1324+224 10077-184644|  60      60            |
0607-157 10077-184948|          83  83  60    |
0727-115 10077-185202|          60  60        |
END OF AUTOCHECKING
?
```

To list scans involving Hobart in this interval, use the following:

```
? li ^-190000 _ ho
Source      Start      DURATIONS
name     yyddd-hhmmss   Ho
2059+034 10077-183336|  60|
1057-797 10077-183759| 184|
1149-084 10077-184336|  60|
1324+224 10077-184644|  60|
1846+322 10077-185210| 124|
1920-211 10077-185645| 306|
End of listing.
?
```

The following list all scans involving 0133+476 from the start of the session until 23:00:00.

```
? li ^-230000 0133+476
Source      Start      DURATIONS
name     yyddd-hhmmss   Ho  Kk  Ma  Tc  Wf  Wz
0133+476 10077-183000|         370 370 155    |
0133+476 10077-194021|      60  60      60  60|
0133+476 10077-201319|      60  60      60  60|
0133+476 10077-204706|      60  60      60  60|
0133+476 10077-211947|          60      60    |
0133+476 10077-215431|      60  60      60  60|
0133+476 10077-222642|      60          60  60|
0133+476 10077-230113|      60          60  60|
End of listing.
?
```

The following three commands 1) Turn on the listing of elevation; 2) Display the scan involving Matera between the start of the session and 19:00:00; and 3) Same as 2, but only display scans where the elevation at Matera is below 20 degrees.

```
? xl azel
? li ^-190000 _ ma
Source      Start      AZ  EL  DURATIONS
name     yyddd-hhmmss     Ma    Ma
0133+476 10077-183000| 309 31| 370|
1739+522 10077-183731|  16  6| 149|
1149-084 10077-184336| 114 13|  60|
1324+224 10077-184644|  74 16|  60|
0607-157 10077-184948| 205 30|  83|
0727-115 10077-185202| 184 38|  60|
0748+126 10077-185521| 178 62|  60|
CTA26    10077-185816| 250 19| 179|
0716+714 10077-190301| 355 59|  60|
End of listing.
? li ^-190000 _ ma 20
Source      Start      AZ  EL  DURATIONS
name     yyddd-hhmmss     Ma    Ma
1739+522 10077-183731|  16  6| 149|
1149-084 10077-184336| 114 13|  60|
1324+224 10077-184644|  74 16|  60|
CTA26    10077-185816| 250 19| 179|
End of listing.
?
```

If the second part of the range argument is a number, **list** will list this many scans:

```
? li 193000-#5
```

```
Source      Start      AZ  EL  AZ  EL  AZ  EL  AZ  EL  AZ  EL  AZ  EL  DURATIONS
name     yyddd-hhmmss     Ho      Kk      Ma      Tc      Wf      Wz    Ho  Kk  Ma  Tc  Wf  Wz
1739+522 10077-193324|       | 323 45|  24  9|       | 333 13|  23 16|     257 257     161  60|
1324+224 10077-193500| 310  7|       |       |       |       |  83 24|  60                 60|
2000+472 10077-193818|       | 344 63|       |       | 312 25|   2  7|      65         65  60|
2052-474 10077-193920| 116 51|       |       | 231 30|       |       | 784         784     |
0133+476 10077-194021|       |  46 28| 316 21|       | 301 78| 311 29|      60  60      60  60|
End of listing.
```

To display the SNRs by baseline, you must first turn this option on using the Xlist command. The following commands do this, and then list the scans for Tc-Wf baseline for the first 30 minutes.

```
? xl snr
? li ^-190000 _ tcwf
Source      Start      DURATIONS SNR by baseline for X , S
name     yyddd-hhmmss   Tc  Wf  Tc-Wf  Tc-Wf
0133+476 10077-183000| 370 155|   33 |   12 |
2059+034 10077-183336|      60|      |      |
1739+522 10077-183731|     149|      |      |
1057-797 10077-183759| 184    |      |      |
2141+175 10077-184203| 320 320|   15 |   17 |
0607-157 10077-184948|  83  60|   28 |   20 |
0727-115 10077-185202|  60    |      |      |
1846+322 10077-185210|     124|      |      |
0748+126 10077-185521|      60|      |      |
1920-211 10077-185645| 306    |      |      |
CTA26    10077-185816|     179|      |      |
0716+714 10077-190301|      60|      |      |
End of listing.
?
```

Scans with missing values for the SNR are scans where only one of Tc of Westford participated.

The following command displays the observed flux for Ma-Tc-Wf. The first xlist command toggles the SNR, the second turns on the display of flux.

```
? xl snr
? xl flux
? li ^-190000 _ matcwf
Source      Start      DURATIONS   Observed flux by baseline for X , S
name     yyddd-hhmmss   Ma  Tc  Wf  Ma-Tc Ma-Wf Tc-Wf  Ma-Tc Ma-Wf Tc-Wf
0133+476 10077-183000| 370 370 155|  1.7   2.2   2.0 |  0.6   1.1   0.8 |
2059+034 10077-183336|          60|                   |                   |
1739+522 10077-183731| 149     149|        0.6        |        0.7        |
1057-797 10077-183759|     184    |                   |                   |
2141+175 10077-184203|     320 320|               0.6 |               0.8 |
1149-084 10077-184336|  60        |                   |                   |
1324+224 10077-184644|  60        |                   |                   |
0607-157 10077-184948|  83  83  60|  1.9   4.3   3.4 |  2.3   2.5   2.4 |
0727-115 10077-185202|  60  60    |  3.6              |  1.9              |
1846+322 10077-185210|         124|                   |                   |
0748+126 10077-185521|  60      60|        3.2        |        2.2        |
1920-211 10077-185645|     306    |                   |                   |
CTA26    10077-185816| 179     179|        0.5        |        0.8        |
0716+714 10077-190301|  60      60|        2.2        |        0.6        |
End of listing.
?
```

major

Syntax: **Major [list | Name value]**
Synopsis: Set or list the major options
See also: **minor**

Description:
The major options determine which scans are generated for further consideration. For a fuller discussion see the chapter on automatic scheduling.

Entering **major** without an argument lists the current settings of the major options:

```
? major
 ?                              List major commands and options
List                            List current values
Subnet                <string>  Observing subnet, e.g: KkWzBr  or Kk-Wz-Br
SkyCov                [Yes|No]  Optimize by sky coverage or covariance
AllBlGood             [Yes|No]  If true, all baselines must meet SNR targets
MaxAngle              <int>     Max angle (degree) between consecutive obs
MinAngle              <int>     Min angle (degree) between consecutive obs
MinBetween            <int>     Min time (minutes) between obs of a source
MinSunDist            <int>     Minimum distance (degrees) of source from sun
MaxSlewTime           <int>     Maximum allowable slew time in seconds
TimeWindow            <real>    Time window used in calculation (hours)
MinSubNetSize         <int>     Minimum subnet size
NumSubNet             <int>     Maximum number of subnets
Best                  <int>     % of obs to consider in Normal mode
FillIn                [Yes|No]  Turn on subnet mode
FillMinSub            <int>     Minimum subnet size in FillIn mode
FillMinTime           <int>     Min time (seconds) before we fill in
FillBest              <int>     % of obs to consider in FillIn mode
AddPS                 <real>    Amount of noise to add (ps)
SNRWts                [YEs|No]  Use SNR to weight observations
LastHrs               <real>    OBSOLETE! Use TimeWindow
ObsWts                <real>    OBSOLETE! Use SnrWts
SplitTwins            [Yes|No]  Schedule twin telescopes independently
?
```

The following table presents an overview of each of the major options.

Major Options	
Option	Description
Subnet	Current subnet. Only stations in this subnet are scheduled, listed, or used in calculations.
SkyCov	Do initial ranking by sky coverage (Yes) or covariance (No).
AllBlGood	Do all baselines in a scan need to meet the target SNR to schedule?
MaxAngle	Minimum angular distance between successive observations.
MinAngle	Minimum angular distance between successive observations.
MinBetween	Minimum time (minutes) between observations of the same source.
MinSunDist	Minimum angular distance of a source with respect to the sun. If the distance is less than this, the source will not be considered for scans.
MaxSlewTime	Maximum time to allow an antenna to slew. If the slew time at a station is longer than this, the source is not considered visible at that station.

TimeWindow	Window of time (hours) to consider in computing sky coverage or covariance.
MinSubNet	Only schedule scans if the subnet is at least this size.
NumSubNet	Maximum number of subnets to try to schedule at one time.
Best	Scans are ranked by Sky coverage or covariance, and the top *Best%* of the scans kept for further consideration.
FillIn	Turn on fill in mode.
FillMinSub	Minimum size of fill-in subnet.
FillMinTime	Minimum time a station must be idle to be considered for fill-in mode.
FillBest	This is the same as "Best", but for the fill-in scans. If we are in fill-in mode, the top *FillBest% scans are kept for further consideration.*
Add_ps	Noise to add (in an RSS sense) to the normal observations. This may affect the ranking of scans by covariance. It also affects the formal errors calculated in the the `solve` interface.
SNRWts	If yes, weight the observations by SNR. If not, consider all observations the same. This only affects the `solve` interface.
SplitTwins	If yes, the twin telescopes listed in the sked file section $TWIN_TELESCOPES will be treated as indicated in the section (independently, joined, either. See $TWIN_TELESCOPES section in this documentation). If no, the two telescopes are treated as regular stations.

In the following we discuss each of the major options.

Subnet

The subnet option determines what stations are considered for scheduling. To set the subnet, issue a command like:

```
? major subnet KkNyWz
?
```

This command sets the subnet to Kokee, NyAlesund, and Wettzell. The subnet remains in effect until it is changed. The subnet command is a useful way of turning stations on and off. For example, if you want to consider scans involving only the VLBA, you enter:

```
? major subnet BrFdKHnKpLaMkNlOvPtSc
?
```

The subnet remains in effect until it is changed. The underscore character '_' is a special subnet indicating all stations. To turn on all the stations, you would issue:

```
? major subnet _
?
```

One use of the subnet option is in tag-along mode. Sometimes there are stations whose performance is unclear, either because the station is new, or because there may be problems. Because of this you don't want the station to unduly influence the schedule. In this case you first generate a schedule excluding the problematic one. This is done by problematic on, and then generating a

schedule as you normally would. When you are done you then instruct sked to 'tag' the station along. Sked will insert the station into the schedule in all scans where the source is visible, and the station has a shot of achieving its SNR targets.

The subnet option effects not only scheduling but also various displays. If a station is not in the subnet, it will not appear in listings or in the summary information.

SkyCov

Purpose	Do initial ranking by sky coverage (YES) or covariance (NO).
Argument Type	String
Valid Values	Yes/No , On/Off, True/False
Comments	The Yes/No pair have many synonyms. See also Best and FillBest below.

After generating a list of possible scan, sked ranks the scans according to either sky coverage or covariance:

SkyCov=YES. Roughly speaking, scans are ranked by the angular distance of the source from all sources within some previous time-window. The larger the value, the larger the score. Effectively, sked is finding the largest hole that the observation fills.

SkyCov=NO. Rank scans by their effect on the covariance matrix. Use of the covariance optimization is discussed in further detail below.

Once the scans are ranked, only a subset is kept for later evaluation. The percentage of scans which are kept is determined by the *Best* and *FillBest* parameters described below. Note that the smaller the value of Best, the more important the initial ranking.

AllBlGood

Purpose	Determines if all baselines in a scan must meet SNR targets. If the argument is YES, then all baselines must meet SNR targets. If NO, the maximum number of bad SNRs per station is N/2, where N is the number of stations in the scan.
Argument Type	String
Valid Values	Yes/No, On/Off, True/False
Comments	The Yes/No pair have many synonyms.

The rationale for setting AllBlGood to NO is that allows sked to keep scans which are good, but not perfect. Generating possible scans is an iterative possible. Sked will first attempt to generate a scan using all stations that can see a given source. It will then go evaluate each station to see how well it did, and eliminate the worst station if necessary. This is summarized below.

1. Start with list of stations.
2. Generate scan.
3. For each station, evaluate how many baselines fail to meet SNR targets.
4. Rank stations by number of failures.

5. If the number of failures is greater than threshold for failure, remove worst station from list and start over.
6. Continue until we have a scan that meets SNR target (up to threshold), or the subnet is too small.

The threshold for determining how many SNR failures are too many is set by AllBlGood.

AllBlGood=yes. Threshold is 1. Any station that does not meet all SNR targets will be eliminated.

AllBlGood=no. Threshold is (num stations in scan)/2. A station must link to at least half of the stations in the subnet.

MaxAngle

Purpose	Set the maximum sky-angle between successive observations. This is designed to limit antenna motion between scans.
Argument Type	Integer degrees
Valid Values	0-90
Comments	Reasonable values are in the 30-180 degree range.

MinAngle

Purpose	Set the minimum sky-angle between successive observations. This is designed to improve the sky-distribution.
Argument Type	Integer degrees
Valid Values	0-90
Comments	Reasonable values are in the 15-30 degree range.

MinBetween

Purpose	Set the minimum time between observations. This keeps sked from scheduling the same source too frequently.
Argument Type	Integer minutes
Valid Values	Positive
Comments	10 minutes is the recommended minimum value unless the schedule has very few sources. This only affects automatic scheduling.

MinSunDist

Purpose	Set the minimum angular distance to the sun. This is designed to improve the sky-distribution.
Argument Type	Integer degrees
Valid Values	All
Comments	Most schedules use 15 degrees. As this angle gets smaller, you lose coherence.

MaxSlewTime

Purpose	Set the maximum slew time.

	Sources with longer slew times are marked s “down” at the station.
Argument Type	Integer seconds.
Valid Values	All
Comments	The maximum value for this should be no more than 600 seconds.

TimeWindow

Purpose	Set the time window used in computing sky-coverage and covariance.
Argument Type	Integer hours
Valid Values	All
Comments	None

MinSubNetSize

Purpose	Set the smallest subnet that will be considered for scheduling. If the subnet for a given source is smaller than this, the scan will not be scheduled.
Argument Type	Integer
Valid Values	All
Comments	This is usually set to 2, allowing single baseline scans.

NumSubNet

Purpose	Set the maximum number of subnets that will be scheduled simultaneously.
Argument Type	Integer
Valid Values	4
Comments	The advent of fill-in mode makes this option largely irrelevant.

Given an N-station subnet there are many ways of scheduling the stations. For example, for N=6

All 6 stations.
5 stations, with one station idle
4 stations + 2 stations
4 stations + 2 stations idle
3 stations + 3 stations
3 stations + 2 stations + 1 station idle
…

If NumSubNet is >1, then `sked` will attempt to schedule up to NumSubNet simultaneously.

Best

Purpose	Set the percentage of scans that are kept for further consideration.
Argument Type	Integer
Valid Values	1-100
Comments	The smaller this number, the more effect the initial ranking has. The larger the number, the less effect this ranking has.

FillIn

Purpose	Turn on fill in mode.

Argument Type	String
Valid Values	Yes/No , On/Off, True/False
Comments	The Yes/No pair have many synonyms.

Fillin mode is discussed in more detail below. When `sked` is in Fillin mode, it will attempt to schedule scans using subsets of the stations that are idle.

FillMinSub

Purpose	Smallest subnet to consider in fillin mode. If there are fewer than FillMinSub idle stations, `sked` will not attempt to schedule them.
Argument Type	Integer
Valid Values	2-Number of stations in schedule.
Comments	2 or 3 is a reasonable number.

FillMinTime

Purpose	Set the minimum length of time a station must be idle to be available for fillin mode.
Argument Type	Integer seconds.
Valid Values	All
Comments	A reasonable value is 120 seconds.

FillBest

Purpose	Same meaning as "Best" in non-fill in mode. Percentage of candidate fillin scans kept for later consideration.
Argument Type	Integer
Valid Values	1-100
Comments	Since in some sense the Fillin scans are free, it is reasonable to have a larger value for *`FillBest`* than *`Best`*.

Add_ps

Purpose	Amount of noise to add to calculated sigma. This primarily affects the solve interface, but will also affect the initial ranking of scans if covariance mode is on.
Argument Type	Integer picoseconds
Valid Values	All
Comments	Reasonable values are 15 ps to 30 ps.

SNRWts

Purpose	Yes: Calculate the formal errors using the SNR. No: Assume that all observations have the same formal errors. This primarily effects the initial ranking of the scans and also the *`solve`* interface.
Argument Type	String
Valid Values	Yes/No, On/Off, True/False

Comments	The Yes/No pair have many synonyms.

SplitTwins

Purpose	Yes: The twin telescopes listed in the section $TWIN_TELESCOPES will be treated in the schedule as indicated by the chosen options of the section (in different subnets, joined, or as two different stations). No: No effect. The twin telescopes will be treated as independent stations.
Argument Type	String
Valid Values	Yes/No, On/Off, True/False
Comments	The Yes/No pair have many synonyms.

master

Syntax: **master [Check | Get]**

Synopsis: Checks a schedule against the master file. Initializes the schedule using the master file.

Each IVS session has a session or experiment code associated with it. This session code is embedded in the schedule file. It can be changed using **param exper** option. This experiment code also appears in the IVS Master File. For each session the masterfile lists what stations are involved, the start and stop times, the scheduler and the correlator.

The master command has two modes. **Master get** initializes the schedule file. It uses the session code in the schedule file. It checks this against the masterfile until it finds a match. It then uses the information in the masterfile to setup the stations and the start and stop times in the session. It also tries to set the SNR targets and frequency settings based on the values originally in the file. Occasionally it runs into problems and will notify the user. The most common problem is determining SNR targets. If all of the old X-band SNR targets were 20, it would assume that all the new X-band SNR targets should also be 20. However, if the old X-band targets differ by baseline, the master command cannot figure out what to do.

```
? master get
 Finding session R1411
 Checking /shared/gemini/ftp/pub/master/master10.txt
 Checking /shared/gemini/ftp/pub/master/master10-int.txt
 Checking /shared/gemini/ftp/pub/master/master09.txt
master_cmd: Initializing experiment.
START: 2009/362-17:00
END:   2009/363-17:00
Stations:
    Station  Rack     Recorder Bnd
  1 MATERA   Mark4    Mark5A   XS
  2 NYALES20 Mark4    Mark5A   XS
  3 SESHAN25 VLBA4    Mark5A   XS
  4 TIGO     VLBA4    Mark5A   XS
  5 WESTFORD Mark4    Mark5A   XS
  6 WETTZELL Mark4    Mark5A   XS
  7 ZELENCHK VLBA4    Mark5A   XS
Writing out station select file for SKED.
/shared/gemini/ftp/pub/sked/catalogs/equip.cat:   MATERA   NYALES20   SESHAN25   TIGO
WESTFORD WETTZELL ZELENCHK
MAKE_MODE_LIST: Found mode 256-16(R1)        GEOSX       8.0   16.0  32-16-2-1
Opt est parameters initialized to off.
Following stations are new:
Name      EL  Early   Tape
NYALES20  5.0   10 START&STOP
SESHAN25  5.0   10 START&STOP
ZELENCHK  5.0   10 START&STOP
Some baselines have 0 SNR! Please set.
HINT:  SNR Subnet Band Value
 Minimum SNR by baseline for multi-baseline scans
     X-band (margin   5)     S-band (margin   3)
     Ma  Ny  Sh  Tc  Wf  Wz          Ma  Ny  Sh  Tc  Wf  Wz
 Ny   0                         Ny   0
```

```
 Sh   0   0                      Sh   0   0
 Tc  15   0   0                  Tc  12   0   0
 Wf  20   0   0  15              Wf  15   0   0  12
 Wz  20   0   0  15  20          Wz  15   0   0  12  15
 Zc   0   0   0   0   0   0      Zc   0   0   0   0   0   0
?
```

In this example, **`master get`** could not determine the SNRs and issued a warning message.

`Master check` checks a schedule against the masterfile and reports if it finds any discrepancies between the two:

```
? master check
 Finding session R1410
 Checking /shared/gemini/ftp/pub/master/master10.txt
 Checking /shared/gemini/ftp/pub/master/master10-int.txt
 Checking /shared/gemini/ftp/pub/master/master09.txt
master_cmd: schedule and master file agree!
?
```

max

Syntax: **max**
Synopsis: This displays the maximum values of various sked parameters.

The **max** command does not take an argument. To change the parameters you would need to edit the include files in the directory `skdrincl`.

```
? max
Maximum array sizes currently set in sked and drudg
 Maximum number of sources    1000     (  990 celestial,    10 satellite)
 Maximum source name length    16 characters
 Maximum number of source names in catalog  1000
 Maximum number of stations     40
 Maximum number of horizon mask pairs     60
 Maximum number of station names in catalog   300
 Maximum number of observing modes     20
 Maximum number of subpasses per head position     36
 Maximum number of observing mode names in catalog    50
 Maximum number of bands (e.g. X, S)     2
 Maximum number of observations 20000
 Maximum number of parameters that can be optimized    100
 Maximum number of sources positions that can be optimized     10
 Maximum number of configurations considered for optimization   100
?
```

media

Syntax: **Media <station> [Mark5A | Mark5B | K5 | <thick|think> [high|low]]**
Synopsis: List, set media.
See also: tape
Comment: This is synonymous with the tape. The syntax is identical.

This command lists or sets the media for the station. Media without an argument lists the current media at each site:

```
? media
 ID  Station   Tape length         Density         Passes
 Hb  HOBART12 Mark5B
 Ho  HOBART26 Mark5A
 Kk  KOKEE    Mark5A
 Ma  MATERA   Mark5A
 Ny  NYALES20 Mark5A
 Pa  PARKES   Mark5A
 Tc  TIGOCONC Mark5A
 Ts  TSUKUB32 K5
 Wf  WESTFORD Mark5A
 Wz  WETTZELL Mark5A
?
```

Users can change the media at a station by specifying the station name followed by the media type. In the following we change Kokee to a Mark5B recorder, and then verify this:

```
? media kk Mark5B
? media
 ID  Station   Tape length         Density         Passes
 Hb  HOBART12 Mark5B
 Ho  HOBART26 Mark5A
 Kk  KOKEE    Mark5B
 Ma  MATERA   Mark5A
 Ny  NYALES20 Mark5A
 Pa  PARKES   Mark5A
 Tc  TIGOCONC Mark5A
 Ts  TSUKUB32 K5
 Wf  WESTFORD Mark5A
 Wz  WETTZELL Mark5A
?
```

You can set all of the stations to the same media type by using "_" as the station name.

```
? med _ mark5A
? med
 ID  Station   Tape length         Density         Passes
 Hb  HOBART12 Mark5A
 Ho  HOBART26 Mark5A
 Kk  KOKEE    Mark5A
 Ma  MATERA   Mark5A
 Ny  NYALES20 Mark5A
 Pa  PARKES   Mark5A
 Tc  TIGOCONC Mark5A
 Ts  TSUKUB32 Mark5A
 Wf  WESTFORD Mark5A
 Wz  WETTZELL Mark5A
```

```
? 
```

All current schedules use disk-based recording. Prior to around 2003, all stations used tape, and the media listing would give something like this:

```
? media
 ID  Station   Tape length         Density         Passes
 Gc  GILCREEK  17400feet (Thin  )     56700 (HIGH  )    14
 Ma  MATERA    17400feet (Thin  )     56250 (HIGH  )    14
 Ny  NYALES20  17400feet (Thin  )     56250 (HIGH  )    14
 On  ONSALA60  17400feet (Thin  )     56250 (HIGH  )    14
 Wf  WESTFORD  17400feet (Thin  )     56250 (HIGH  )    14
 Wz  WETTZELL  17400feet (Thin  )     56250 (HIGH  )    14
?
```

Between 2003 and 2007 some stations used tape, and some disks, and the listing would be mixed.

The syntax of the media command for tapes depends on the kind of tapes, as summarized below. (Note that we are using the standard "**? CmdName**" syntax to get help about a command.)

```
? media
 Mk3/4 : MEDIA [<station> <THICK|THIN> [<HIGH|LOW>]]
 S2,K4 : MEDIA [<station> <length in minutes>
 MARK5A: MEDIA [<station> MARK5A]
 K5:     MEDIA [<station> K5]
?
```

Occasionally you will run into a schedule that was scheduled assuming that the stations recorded on tapes. You can change the media to one of the valid disk types, write the schedule out, and the schedule will perform fine. However, it is always better to specify disk recording for stations that have disks. This is because tape-based recording has extra gaps in the schedule for fast-forwarding to the end of pass, or for rewinding the tape.

minor

Syntax: **Minor [list [All] | name [on|off] [Norm Weight AuxValue]]**

Synopsis: List or set the minor options.

See also: **Astro, major, srcwt, statwt**

Description: This command lists or sets the minor option. These options determine how scans are ranked. Note that `sked` does not rank all possible scans—only those generated according to the major options.

Issuing **minor** without an argument lists the minor options together with a short synopsis:

```
? minor
List       [All]                                                 list options in use or ALL
Astro      [WtMode={Abs|Rel}] [Wt]                               weighting of astrometric sources
BegScan    [WtMode={Abs|Rel}] [Wt]                               prefer scans that start soon
EndScan    [WtMode={Abs|Rel}] [Wt]                               prefer scans that end soon
LowDec     [WtMode={Abs|Rel}] [Wt]                               prefer low-dec sources
NumLoEl    [WtMode={Abs|Rel}] [Wt] [El_thres]                    prefer scans with elevation below El_thres
NumRiseSet [WtMode={Abs|Rel}] [Wt]                               prefer scans with rising/setting sources
NumObs     [WtMode={Abs|Rel}] [Wt]                               prefer scans with more observations
SkyCov     [WtMode={Abs|Rel}] [Wt]                               prefer scans with better sky coverage
SrcEvn     [WtMode={Abs|Rel}] [Wt] [Mode={NONE|EVN|SQRT}]   modify distribution of observations of sources
SrcWT      [WtMode={abs|Rel}] [Wt]                               prefer scans involving certain sources
StatEvn    [WtMode={Abs|Rel}] [Wt] [Mode={NONE|EVN|SQRT}]   modify distribution of observations of stations
StatIdle   [WtMode={Abs|Rel}] [Wt]                               minimize sation idle time
StatWT     [WtMode={Abs|Rel}] [Wt] [FFFFT TTFFF ...]             prefer scans including some stations
TimeVar    [WtMode={Abs|Rel}] [Wt]                               prefer scans with equal end time
```

Executing **minor list** displays the current minor options which are turned on:

```
? minor li
 Option          Norm      Wt   Aux_Parm
Astro            Abs     3.00
BegScan          Rel     1.00
EndScan          Rel     1.00
NumObs           Rel     1.00
StatIdle         Abs     3.00
StatWt           Abs     1.00
?
```

Minor options have the following characteristics associated with them.

Characteristics of Minor Options	
Option	Description
On/Off	If on, include in ranking scans. If off, does not matter.
Normalization:Abs/Rel	Affects the calculation of the minor option score.
Weight	Affects how much this option is weighted.
Auxiliary parameters	Influences how the score is calculated.

Setting Minor Options.

The syntax to set a minor option is

Minor *Option [On|Off] [Abs|Rel] [Wt] [Auxiliary Parameters]*

The arguments in brackets are optional, and, to some extent, the order is not important. Case is ignored. The string is parsed using the following rules:

If a string argument of On, Off, Ab or Rel is found the following happens:

On: the option is turned on.

Off: the option is turned off.

Abs: absolute weighting is used.

Rel: relative weighting is used.

String arguments not of this form are assumed to be optional arguments. If the option does not take an auxiliary string argument, an error message is issued.

The first numeric value found is assumed to be the option weight.

Remaining numeric values are assumed to be auxiliary arguments. If the option does not take an auxiliary numeric value, an error message is issued.

This example changes the weighting of BegScan to Abs and changes the weighing to 4:

```
? minor begscan 4 rel
? minor li
Option     Norm   Wt  Aux_Parm
BegScan    Rel   4.00
EndScan    Rel   1.00
NumObs     Rel   1.00
SkyCov     Rel   1.00
StatWt     Abs   1.00
?
```

Detailed Description of Minor Options

In this section we describe each of the minor options.

Astro

Purpose	Put limits on minimum and maximum % of observations of astrometric sources.
Score	*(%lower - %observed*) *%lower* is the lower target for a given source. *%observed* is the *%* observations so far on the source. If *%observed > %upper*, then the source is not considered scheduling. *%upper* is the upper observation target for the source
Recommended normalization	Absolute
Auxiliary	NONE
Example	**Minor Astro Abs 1** Turn on astrometric mode with absolute normalization and a weight of 1.

Comment	Only sources specified in the astrometric command contribute to the scoring. Weighting of individual sources is set using the astrometric command, described later.

This option affects only scans containing astrometric sources. These sources appear in the `$ASTRO` section of the schedule, which looks like:

```
$ASTROMETRIC
2106-413        1.00  1.50
0516-621        1.00  1.50
1313-333        1.00  1.50
1354+195        1.00  1.50
…
```

Here the first column is the source name, the second column is the target floor, and the third column is the target ceiling. Listing and setting the astrometric sources and their targets is done using the **`astro`** command, and is discussed elsewhere.

Scoring. A scan will receive an ASTRO score only if it contains a source which is in the astrometric list. `Sked` calculates the total number of observations on this source and expresses it as a percentage of the total number of observations scheduled.

1. If *`%observed`* is greater than the target upper bound, than the scan will not be scheduled.
2. If *`%observed`* is less than the target upper bound, the score is: *`(%lower - %observed`*). The score is positive if the source is below the lower target, and negative if it is above it. `Sked` will preferentially select astrometric sources until they meet their target floor.

BegScan

Purpose	Preferentially select scans which start soon after the current scan.
Score	*`-(TimeScanStarts-TimePrevScanEnds)`* expressed in minutes
Recommended normalization	Relative
Comment	The score is always negative. The later the scan starts, the more negative.

EndScan

Purpose	Preferentially select scans which start soon after the current scan.
Score	*`-(TimeScanEnds-TimePrevScanEnds)` expressed in minutes*
Recommended normalization	Relative
Comment	Note that the score is always negative. The later the scan ends, the more negative.

LowDec

Purpose	Preferentially select scans with low declination.

Score	-Abs(declination in degrees)/10.
Recommended normalization	Relative
Comment	The score is always negative. The higher the declination, the more negative.

NumLowEl

Purpose	Preferentially select scans which are low in elevation at some sites.
Score	+1 for each station in the scan where the elevation is lower than *el_thres*
Recommended normalization	Relative
Auxiliary Parameter	*El_thres*. This parameter is expressed in degrees.
Comment	The score is positive, and equal to the number of stations where the elevation of the source is below the target.

NumRiseSet

Purpose	Preferentially select scans where a source is rising or setting at a site.
Score	+1 for each station where the source has risen within 20 minutes or will set within 20 minutes. The effect is similar to NumLoEl.
Recommended normalization	Relative
Comment	The score is always positive.

NumObs

Purpose	Preferentially select scans with more observations.
Score	NumStat*(NumStat-1)/2=number of observations in this scan.
Recommended normalization	Relative
Comment	The score is always positive.

SkyCov

Purpose	Preferentially select scans with better sky coverage.
Score	This score is the same as the sky coverage score used in the initial ranking of the scans. The algorithm used to calculate this score is discussed elsewhere.
Recommended normalization	Relative
Comment	The score is always positive.

SrcEvn

Purpose	Try to make the number of observations more uniform across the sources.
Score	*%target- %observed*
Recommended normalization	Relative

Auxiliary parameter	ASCII flag which is one of NONE, EVEN, SQRT, UPTIME. If the flag is set to NONE, this is equivalent to turning this option off.
Comment	The score is always positive. If this setting is used, the recommended setting is SQRT. EVEN tends to overweight the weaker sources too much.

One issue with `sked` is that, all things being equal, it prefers to schedule strong sources. This will lead to a few strong sources being observed very often and weaker sources scarcely at all. The SrcEvn mode attempts to mitigate this.

For each source, `sked` calculates a target observing percentage for the source. The score for a given scan is found by taking the difference between the target and the number of times the source is observed:

%target- %observed

If this number is positive, the source is under observed with respect to the target, and `sked` will preferentially select these scans. If the number is negative, the source is over observed with respect to the target, and these scans will not be selected as often.

The formula for the target depends on the auxiliary parameter.

1. If the auxiliary parameter is EVEN, then the target is the same for all sources.
2. If the auxiliary parameter is SQRT or UPTIME, then `sked` first calculates the total integrated uptime for each source. This is found by calculating the sum of the times that the source is visible at each station, and adding these all up.
    a. If the auxiliary parameter is UPTIME, then the target for the source is:
    TARGET= UPTIME for Source/(Sum of All UPTIMES)
    b. If the auxiliary parameter is SQRT, then the target for the source is: TARGET = SQRT(UPTIME for Source/(Sum of All UPTIMES))

SrcWt

Purpose	Preferentially select scans involving given sources.
Score	Multiply the weight of the source by the weight of the minor SrcWt option.
Recommended normalization	Absolute
Auxiliary Parameter	Logical array with number of elements equal to the number of stations. If an element is positive, preferentially select scans involving this station.
Comment	The score is always positive.

`Sked` tends to prefer strong sources with good mutual visibility. SrcWt gives one way of increasing the preference for other sources. Each source is assigned a weight (the weight of most sources is zero). The contribution of the SrcWt minor option for a particular scan is:

SrcWt*(weight of individual source)

For example, if:

The weight of SrcWt minor option is 2.

1044+719 has a weight of 3.
1639-062 has a weight of 4.

Then the contribution of SrcWt to the total score for a scan involving 1044+719 is 6 =2*3 while for a scan involving 1639-062 it would be 8=2*4.

StatEvn

Purpose	Try to make the number of observations per station more uniform.
Score	$\sum_{stations}(\%target - \%observed)$
Recommended normalization	Relative
Auxiliary parameter	ASCII flag which is one of NONE, EVEN, SQRT, UPTIME. If the flag is set to NONE, this is equivalent to turning this option off.
Comment	The score is always positive. This option is rarely used.

This option is similar for SrcEvn, but for applies to stations instead of sources.

For each station `sked` calculates a target observing percentage. The score for a given scan is found by taking the sum of the differences between the target number of observations and the actual number of observations:

$\sum_{stations}(\%target - \%observed)$

The formula for the target depends on the auxiliary parameter.

If the auxiliary parameter is EVEN, then the target is the same for all stations.

If the auxiliary parameter is SQRT or UPTIME, then `sked` first calculates the total integrated uptime for each station. This is found by calculating the sum of the times that some source is visible at each station, and adding these all up.

If the auxiliary parameter is UPTIME, then the target is:

TARGET= (UPTIME for Source)/(Sum of All UPTIMES)

If the auxiliary parameter is SQRT, then the target is:

TARGET = SQRT(UPTIME for Source/(Sum of All UPTIMES))

StatIdle

Purpose	Preferentially select scans which minimize station idle time.
Score	Sum of idle time (expressed in minutes) for each station in the scan.
Recommended normalization	Absolute
Comment	The score is always positive. Hence scans with more idle time are preferred.

StatWt

Purpose	Preferentially select scans involving given stations.
Score	Add up the individual weights of all the stations in the scan, and then multiply by the overall weight of this minor option.
Recommended normalization	Absolute

Auxiliary Parameter	Logical array with number of elements equal to the number of stations. If an element is positive, preferentially select scans involving this station.
Comment	The score is always positive.

`Sked` tends to have fewer scans for smaller stations, or for stations that are poorly connected. StatWt tries to address this issue by giving a means of preferentially selecting scans involving these stations. In previous versions of `sked` you could only turn station "on" or "off" for the purposes of StatWt. In this version of sked you can determine how much weight to give each station. For example, suppose that:

The weight of the StatWt minor option is 2.
The weight of Tsukuba is 1.
The weight of Tigo is 3.

Then a scan involving:

Tsukuba, but not Tigo, will have a StatWt score of 2 = 2*1.
Tigo, but nut Tsukuba, will have a StatWt score of 6=2*3.
Both Tigo and Tsukuba 8= 2*(3+1).

For a description of how to set the weights of individual stations, see the StatWt section.

TimeVar

Purpose	Preferentially select scans where all stations stop at about the same time.
Score	Standard deviation of the ending time, expressed in minutes.
Recommended normalization	Absolute
Auxiliary Parameter	Logical array with number of elements equal to the number of stations. If an element is positive, preferentially select scans involving this station.
Comment	The score is always positive.

modify

Syntax: **Modify**
Synopsis: Modify a scan
Comment: This command should only be used in rare circumstances.

This is a way of modifying a scan. `Sked` will print out the current scan followed by the ">" prompt immediately below. The user can modify the scan by typing in characters below. If the character is a blank, nothing is changed. Non-blank characters replace the corresponding characters in the scan.

In the following example the user changes the scan length from 43 to 50.

```
? mod .
Source      Start
name     yyddd-hhmmss  STATIONS
 0552+398  10 SX PREOB  10264162109      43 MIDOB       0 POSTOB NWTWE- 1F000000 . .
.
>                                       50
 0552+398  10 SX PREOB  10264162109      50 MIDOB       0 POSTOB NWTWE- 1F000000 . .
.
OK (Y/N)?y
? li .
Source      Start      DURATIONS
name     yyddd-hhmmss   Hh  Hb  Ho  Ny  On  Tc  Wf
0552+398 10264-162109|             50  50      50|
End of listing.
?
```

This command should be used with great care. `Sked` scores scans internally as ASCII strings. When you use the modify command you are modifying the string that corresponds to a scan.
It is much better to delete the scan and then insert a new one using, for example, the "/" new-scan command.

monitor

Syntax: **Monitor [num]**
Synopsis: Select sources to monitor.
See also:

The monitor command is used to schedule sources that have been under-observed with respect to their observing targets. This is done by extracting information from the Goddard VLBI database, or VDB for short. VDB contains information about all of the IVS VLBI sessions including what stations participated, what sources were scheduled, number of observations scheduled per source, number correlated per source, and number used in the solution. VDB also has information on the observing targets per source. Currently sources are divided into the three categories of 1) geodetic, 2) astrometric and other 3) sources. The observing target for geodetic sources is 12 times over the prior year, while for astrometric sources it is 2 times over the prior year.

The monitor command queries the VDB to find a list of underobserved sources. It will then see if these sources can be observed in the current session. If so it will pick num of these to include in the schedule. If num is not specified it is assumed to be 10. It will read the flux information from the flux catalog specified in skedf.ctl. If the sources have no flux information, it assumes that the flux is 0.25 mJy over all baselines.

```
? monitor
 MonitorSources: # not specified. Using 10
 Getting number of obs over last year
 Getting number of obs over last qtr
 Getting position
 Got position
 Converting to epoch
Getting fluxes from file /shared/gemini/ftp/pub/sked/catalogs/flux.cat
Calculating rise/set times:
   1   2   3   4   5   6   7   8   9  10  11  12  13  14  15  16  17  18  19  20
  21  22  23  24  25  26  27  28  29  30  31  32  33  34  35  36  37  38  39  40
  41  42  43  44  45  46  47  48  49  50  51  52  53  54  55  56  57  58  59  60
  61  62  63... done.
 Ranking sources
   1   2   3   4   5   6   7   8   9  10  11  12  13  14  15  16  17  18  19  20
  21  22  23  24  25  26  27  28  29  30  31  32  33  34  35  36  37  38  39  40
  41  42  43  44  45  46  47  48  49  50  51  52  53  54  55  56  57  58  59  60
  61  62  63 ...done.
Getting fluxes from file /shared/gemini/ftp/pub/sked/catalogs/flux.cat
   # Source        RA    Dec   FluxX    FluxS
   1 1642+690    16.70   68.92 Found    Found
   2 0454-810     4.82  -81.00 Found    Found
   3 0506+101     5.17   10.21 Found    Found
   4 IIIZW2       0.18   11.03 Found    Found
   5 1013+127    10.27   12.40 Found    Found
   6 2000+148    20.05   15.05 Found    Found
   7 1615+029    16.31    2.75 Found    Found
   8 1349-439    13.89  -44.26 Found    Found
   9 1424+366    14.45   36.37 Found    Found
  10 0729+259     7.56   25.79 Found    Found
?
```

For the monitor command to work correctly you need to do the following:

1. Install MySQL on your system.
2. Link `sked` using MySQL.
3. Setup a chron job to download and update the latest version of the VDB database on a nightly basis.

Currently the only scheduling centers that use Monitor are GSFC and USNO.

motion

Syntax: **`Motion [<station> <type> [<gaptime>] <station> <type> … ]`**

Synopsis: Previously modified how tapes were recorded. Now modifies how data is recorded.

See also:

There are three kinds of motion:

START&STOP	Record data only when we have valid data. Start at the start of a scan, and stop when the scan is done.
CONTINUOUS	Continuously record data
ADAPTIVE [gap]	Use START&STOP unless the gap between two consecutive observations is under [gap] seconds. In this later case, do not stop recording between them.

This command was introduced for the RDV sessions. The default mode for geodetic schedules processed on Mark4 correlators is START&STOP. However, initially the NRAO correlator could only handle continuous observation. Once this was fixed there was still the problem that it took the hardware correlator a certain amount of time to sync up. Hence the ADAPTIVE mode was introduced.

mutualvis

Syntax: **Mutualvis [<source> [<subnet> [TOTAL|XYAZEL|POLAZEL]]]**
Synopsis: Generate a list showing which sources are mutual visible.
See also:

Without any argument mutualvis will display a listing of the sources and then indicate for how many stations they are visible at different times. This is useful if you are trying to figure out which source to schedule next.

```
? mu
 Source Visibility on 2010 32
   for stations  HOBART12  HOBART26  KOKEE     MATERA    NYALES20  PARKES
 TSUKUB32  WESTFORD  WETTZELL
                RISE   SET    |0     3     6     9     12    15    18    21    |
               hh:mm  hh:mm   |------|-----|-----|-----|-----|-----|-----|-----|
   1 1237-101   0: 0   0: 0   |3222222333333333  22222334455555555555544456554|
   2 2216+178   0: 0   0: 0   |66666666666876666444434444444444444555433344466|
   3 1601+112   0: 0   0: 0   |76666444433344444444444543333233555555555556666|
   4 2030+547   0: 0   0: 0   |66666666666655555555555444455556666666666666666|
   5 1903-802   0: 0   0: 0   |33333333333333322222222222222222223333333333333|
. . . Rest of the sources
```

Specifying a source will give the mutual visibility for the source:

```
? mu 2335-027
 Source Visibility on 2010 32
   for stations  HOBART12  HOBART26  KOKEE     MATERA    NYALES20  PARKES    TSUKUB32
WESTFORD  WETTZELL

                RISE   SET    |0     3     6     9     12    15    18    21    |
               hh:mm  hh:mm   |------|-----|-----|-----|-----|-----|-----|-----|
  60 2335-027   0: 0   0: 0   |55655555555555545655554332223333333333222222233|
?
```

Specifying a subnet will display the visibility for only the subnet:

```
? mu _ kkma
 Source Visibility on 2010 32
   for stations  KOKEE     MATERA

                RISE   SET    |0     3     6     9     12    15    18    21    |
               hh:mm  hh:mm   |------|-----|-----|-----|-----|-----|-----|-----|
   1 1237-101   0: 0   0: 0   |                                                 |
   2 2216+178   5:51   6:21   |           22                        222         |
   3 1601+112  12: 1  12:23   |                         2                       |
   4 2030+547  14:46   6: 4   |2222222222222                2222222222222222222|
   5 1903-802   0: 0   0: 0   |                                                 |
   6 0833+585   2:38  18:25   |     22222222222222222222222222222222            |
   . . . rest of sources
```

Specifying the options XYAZEL or POLAZEL will generate plots of the sources at each station over the course of the day either in XY or polar coordinates.

Specifying TOTAL will list only those times when a source is visible by the entire network:

```
? mu _ _   total
 Source Visibility on 2010  8
   for stations  FORTLEZA  KOKEE     MATERA    NYALES20  TIGOCONC  WETTZELL

               RISE   SET   |0     3     6     9     12    15    18    21    |
              hh:mm  hh:mm  |------|-----|-----|-----|-----|-----|-----|-----|
   1 0003-066   0: 0   0: 0  |                                                 |
   2 0104-408   0: 0   0: 0  |                                                 |
   3 0106+013   0: 0   0: 0  |                                                 |
   4 0133+476  21:31   0:33  |66                                         66666|
   5 0208-512   0: 0   0: 0  |                                                 |
   6 0235+164  23:46   1: 0  |666                                           6|
   7 CTA26      0: 0   0: 0  |                                                 |
   8 0405-385   0: 0   0: 0  |                                                 |
   9 0454-234   0: 0   0: 0  |                                                 |
  10 0458-020   0: 0   0: 0  |                                                 |
  11 0454+844   0: 0   0: 0  |                                                 |
  12 0528+134   2:47   3:41  |     666                                         |
  13 0537-441   0: 0   0: 0  |                                                 |
  14 0602+673   0: 0   0: 0  |                                                 |
  15 0607-157   0: 0   0: 0  |                                                 |
  16 0656+082   0: 0   0: 0  |        6                                        |
  17 0637-752   0: 0   0: 0  |                                                 |
  18 0642+449   2:54   5:37  |     6666666                                     |
  19 0727-115   0: 0   0: 0  |                                                 |
  20 0743+259   4:40   6:43  |         66666                                   |
  21 0749+540   0: 0   0: 0  |                                                 |
  22 0805+410   4:28   7:46  |        66666666                                 |
  23 0823+033   0: 0   0: 0  |                                                 |
  24 OJ287      5:59   7:28  |           6666                                  |
  . . . rest of sources
```

It may happen that no sources are ever visible by the entire network—for example, if we have stations in both the Southern and Northern Hemispheres, sources which are far north will not be visible by the southern stations.

next

Syntax: **next [***Num***]**
Synopsis: Move towards the end of the schedule *Num* scans.
See also: back, current, list, next, previous

This command positions the scan pointer Num scans toward the end of the schedule.

```
Source      Start      DURATIONS
name     yyddd-hhmmss   Ny  On  Sh  Tc  Wf  Wz  Zc
1611+343 09355-170000|  70 172     172 110  67    |
End of listing.
? next 10
Source      Start      DURATIONS
name     yyddd-hhmmss   Ny  On  Sh  Tc  Wf  Wz  Zc
1418+546 09355-170340|  57  99  78      99  48    |
1519-273 09355-170612|             117 117        |
0014+813 09355-170626|  43  43  43          43  43|
2141+175 09355-170915|  44  63          63  43    |
1351-018 09355-171129|             161 161        |
0400+258 09355-171211|  43  43  43          43  43|
0039+230 09355-171357| 188 188              71    |
0716+714 09355-171507|          56      56        |
0059+581 09355-171819|  43  43  43      43  43  43|
0955+476 09355-172043|  43  97  97      79  43    |
End of listing.
?
```

In this example the pointer is positioned immediately *after* the scan on 0955+476 at 17:20:43.

now

Syntax: **now [<subnet> <time>]**
Synopsis: Set the current time in the schedule to *time*.
See also:

Sked keeps track of the state of each antenna. One of the variables it tracks is the current time at the end. This command is used to set the current time at the specified subnet to time.

Now without an argument will list the current time.

```
Source      Start      DURATIONS
name     yyddd-hhmmss   Ny  On  Sh  Tc  Wf  Wz  Zc
1611+343 09355-170000|  70 172     172 110  67    |
End of listing.
? next 10
Source      Start      DURATIONS
name     yyddd-hhmmss   Ny  On  Sh  Tc  Wf  Wz  Zc
1418+546 09355-170340|  57  99  78      99  48    |
1519-273 09355-170612|              117 117        |
0014+813 09355-170626|  43  43  43          43  43|
2141+175 09355-170915|  44  63          63  43    |
1351-018 09355-171129|              161 161        |
0400+258 09355-171211|  43  43  43          43  43|
0039+230 09355-171357| 188 188              71    |
0716+714 09355-171507|          56      56        |
0059+581 09355-171819|  43  43  43      43  43  43|
0955+476 09355-172043|  43  97  97      79  43    |
End of listing.
?
```

In this example the pointer is positioned immediately *after* the scan on 0955+476 at 17:20:43.

optimization

Syntax: **`Optimization [go | set | list]`**
Synopsis: Set up optimization criteria for covariance optimization
See also:

This command is used to setup the optimization criteria for covariance optimization. The command **`op set`** brings up a screen that looks like:

```
  Optimize          XP      YP     DUT     PSI     EPS
FORTLEZA AtmOffs AtmRate ClkOffs ClkRat1 ClkRat2    U       E       N
KOKEE    AtmOffs AtmRate ClkOffs ClkRat1 ClkRat2    U       E       N
MATERA   AtmOffs AtmRate ClkOffs ClkRat1 ClkRat2    U       E       N
NYALES20 AtmOffs AtmRate ClkOffs ClkRat1 ClkRat2    U       E       N
TIGOCONC AtmOffs AtmRate ClkOffs ClkRat1 ClkRat2    U       E       N
WETTZELL AtmOffs AtmRate ClkOffs ClkRat1 ClkRat2    U       E       N
  Estimate          XP      YP     DUT     PSI     EPS
FORTLEZA AtmOffs AtmRate ClkOffs ClkRat1 ClkRat2    U       E       N
KOKEE    AtmOffs AtmRate ClkOffs ClkRat1 ClkRat2    U       E       N
MATERA   AtmOffs AtmRate ClkOffs ClkRat1 ClkRat2    U       E       N
NYALES20 AtmOffs AtmRate ClkOffs ClkRat1 ClkRat2    U       E       N
TIGOCONC AtmOffs AtmRate ClkOffs ClkRat1 ClkRat2    U       E       N
WETTZELL AtmOffs AtmRate ClkOffs ClkRat1 ClkRat2    U       E       N

<E>nd   <U>=<X> toggle between UEN/XYZ   Cursor or h,j,k,l
```

Users can move around the screen using the cursor keys. The space bar serves as a toggle to turn on or off optimization or estimation. Note that if you want to optimize a parameter you must also estimate it. If you leave the screen without turning on the estimation of the parameter you are optimizing for, `sked` will turn it on for you. In the above (unrealistic) example we are optimizing for FORTLEZA atmosphere (offset and rate) and clock (second degree polynomial), and we are estimating an atmosphere and clock offset and rate at WETTZELL.

Upon exiting from screen the user is presented with the following options:

```
  PA - display station parameters for selection
  SO - display source parameters for selection
  GO - return to SKED, create new normal equations
  EN - return to SKED, do not create new normal equations
>
```

Entering in SO brings up a screen that allows you to optimize for source positions:

```
Optimize
0003-066 0104-408 0106+013 0133+476 0208-512 0235+164 CTA26    0405-385
0454-234 0458-020 0454+844 0528+134 0537-441 0602+673 0607-157 0656+082
0637-752 0642+449 0727-115 0743+259 0749+540 0805+410 0823+033 OJ287
4C39.25  OK290    1034-293 1044+719 1057-797 1124-186 1128+385 1144-379
3C274    1308+326 1334-127 1357+769 OQ208    1418+546 1424-418 1606+106
1611+343 1622-253 1739+522 1741-038 1749+096 1803+784 1815-553 1921-293
1923+210 1958-179 3C418    2052-474 2113+293 2121+053 2126-158 2234+282
2243-123 2255-282 2318+049 2356+385
  Estimate
0003-066 0104-408 0106+013 0133+476 0208-512 0235+164 CTA26    0405-385
0454-234 0458-020 0454+844 0528+134 0537-441 0602+673 0607-157 0656+082
```

```
0637-752 0642+449 0727-115 0743+259 0749+540 0805+410 0823+033 OJ287
4C39.25  OK290    1034-293 1044+719 1057-797 1124-186 1128+385 1144-379
3C274    1308+326 1334-127 1357+769 OQ208    1418+546 1424-418 1606+106
1611+343 1622-253 1739+522 1741-038 1749+096 1803+784 1815-553 1921-293
1923+210 1958-179 3C418    2052-474 2113+293 2121+053 2126-158 2234+282
2243-123 2255-282 2318+049 2356+385

<E>nd   <U>=<X> toggle between UEN/XYZ   Cursor or h,j,k,l
```

Similar to the station parameters, if you optimize for a source you must also estimate it. If you don't specify this, `sked` will automatically turn on estimation.

`Op list` lists the current parameters that are estimated or optimized.

```
? op li
Optimization parameters for experiment R4412       from schedule file /500/ses-
sions/2010/r4412/r4412.skd
  OPTIMIZE:
FORTLEZA AtmOffs  AtmRate  ClkOffs  ClkRat1  ClkRat2
KOKEE
MATERA
NYALES20
TIGOCONC
WETTZELL
  ESTIMATE:
FORTLEZA AtmOffs  AtmRate  ClkOffs  ClkRat1  ClkRat2
KOKEE
MATERA
NYALES20
TIGOCONC
WETTZELL AtmOffs  AtmRate  ClkOffs  ClkRat1

 Number of parameters to estimate:   9
 Number of parameters to optimize:   5
?
```

Lastly, **`Op Go`** generates the normal equations based on the currently scheduled scans.

parameters

Syntax: **parameters [List [All |General | Note | Procedure | SNR |] | ParamName Value]**
Synopsis: List, set the parameters
See also:

This command is used to list and set the parameters in the $PARAM section that take a single argument.

The command **param** without an argument will list all of the parameters:

```
? param
----- Parameter listing ----------------------------------------
 Experiment: RV120                      Description Sixth R&D VLBA session of 2016
 Scheduler:  NASA                       Correlator: VLBA
 Start:      2016-335-18:00:00          End:        2016-336-18:00:00
---------- Scan data parameters-------------------------------
 VScan         Y (Compute scan length)   Duration    120sec (default duration)
 Minslew       0sec (min slew time)
 Minscan       48sec (min scan length)   Maxscan      480sec (max scan length)
 Modscan        1sec (mod scan time)     Modular         83sec (mod start time)
 Calibration  10sec (time before obs)    Early         0sec (start recording)
 Corsync       3sec (pad scan at end)    Idle          0sec (idle after obs)
 Setup        20sec (scan setup)         Mark6_off     0sec (buffer offset)
 Fill_off      0sec (buffer offset)
---------- Procedure parameters ------------------------------
 PRFLAG  YYNN (required procedures)      PREOB  PREOB  (pre-ob procedure)
 MIDOB  MIDOB  (mid-ob procedure)        POSTOB MIDOB  (post-ob procedure)
---------- Timing parameters ---------------------------------
 Parity     100sec (parity check time)   SOURCE       5sec (SOURCE time)
 Tapetm       1sec (TAPE command time)
---------- General parameters --------------------------------
 MODULAR     1sec (start time mark)      MINIMUM   0sec (time between obs.)
 LOOKAHEAD  20min (for WHATSUP)
 SNR     MAN  (reject for low SNR)       WIDTH 133columns (width of screen)
 CONFIRM     Y (ask before adding obs)    DEBUG      N (display debugging info)
 KEEP_LOG    N (keep log upon exit)       VERBOSE    N (output lots of info)
 CONF_EQUIP  N (update info from cat)
---------- Informational only --------------------------------
 SKED  version:          2018Apr12                        Schedule  file:  /500/ses-
sions/2016/rv120/rv120.skd
 FREQUENCY SX (default freq. code)
 Process ID:  18751                      Printer commands: lj, ljp
 Current yyyyddd:    2016335 (2016.92)( 17723 MJD, WED. 30 NOV.)
 Greenwich sidereal time:   22:40:08 (18:00:00 UT)
 Sun's RA and DEC:   16h 29.1m   -21d 47.5
?
```

There are different options for listing, e.g., ‘param li notes’, ‘param li general’ which display subsets of the above information.

You can set the parameters using the syntax “param ParamName Value” syntax. For example:

```
? param debug y
```

Turns on the display of debugging information.

All of the parameters appear near the top of the schedule file.

What follows is a brief description of the parameters that can be set using the **`param`** command in the order they appear in the $PARAM section. Some of these parameters are obsolete and are no longer used (e.g., MIDTP) or have no effect (e.g., IDLE). These will soon be removed. They are included here because many schedules still include them.

Name	Type	Description
Miscellaneous Global Parameters		
DESCRIPTION	Text	Brief description of session.
SOFTWARE_VERSION	Text	Release date of software. **NOT USER settable.**
SCHEDULE_CRE-ATE_DATE	Text	When was the schedule created or saved. **NOT USER settable.**
SCHEDULER	Text	Institution responsible for scheduling. This should agree with the master file. If you use "Master Get" to setup the schedule this will be updated automatically.
CORRELATOR	Text	Instititution responsible for correlating. This should agree with the master file. If you use "Master Get" to setup the schedule this will be updated automatically.
START	Time	Start of session in format YYYYdddHHmmSS. Here ddd is the day of year.
END	Time	End of session in format YYYYdddHHmmSS
Parameters that Take Integer Arguments		
CALIBRATION	Int	Time in seconds for calibration.
CORSYNCH	Int	Extra time in seconds to record data. If the calculated scan length is 40 seconds, and CORSYNCH=3, then we will record 43 seconds of data. This was put in to give time for correlators to synchronize.
DURATION	Int	Default duration in seconds. Only used if VSCAN is N.
EARLY	Int	Recorders start recording EARLY seconds before data is valid.
FILL_OFF	Int	Seconds to take off from a "filled" scan when using the FILL command. This is a safety feature to absorb possible differences in between slewing time models and real slewing speed.
IDLE	Int	Originally, time a station is idle at the end of an observation. This currently has no effect. **OBSOLETE**
LOOKAHEAD	Int	Time in minutes that `sked` will look ahead to see if a source is rising.

MAXSCAN	Int	Maximum scheduled scan in seconds
MINSCAN	Int	Minimum Scan length in seconds.
MINSLEW	Int	Minimum time between scan (seconds).
MARK6_OFF	Int	Extra time to allocate for recording on Mark6 recorders
MIDTP	Int	Extra time for mid-tape procedure. **OBSOLETE**
MODULAR	Int	Seconds. Let SEC_NOW be the time since the beginning of the day. If MODULAR is non-zero, then Mod(SEC_NOW,MODULAR)=0
MODSCAN	Int	If MODSCAN<>0, then all scan lengths will be multiples of MODSCAN.
PARITY	Int	Time in seconds for PARITY command. OBSOLETE
SETUP	Int	Time in seconds for source command. This is added to the slew time for an antenna.
TAPETM	Int	Time in seconds for the TAPE command.
WIDTH	Int	Width of display screen to be used in scheduling. OBSOLETE
Parameters that take Y/N arguments		
CONFIRM	Y/N	If yes, confirm scans that are entered manually. If no, schedule scans without confirmation.
DEBUG	Y/N	Print debugging information when writing schedule
VERBOSE	Y/N	Print verbose debugging information.
VSCAN	Y/N	If yes, compute variable scan length. If no use default scan lengths. The default is determined by DURATION (see above) and SCAN (see the SCAN command) which is source dependent.
KEEP_LOG	Y/N	Sked generates a log of all commands executed during a session. By default this file is removed on exit. If Keep_log=Y this is kept. This is useful for debugging.
CONF_EQUIP	Y/N	If yes, Sked will automatically update any catalog modifications when necessary. If no, Sked will ask the use: “use catalog equipment?”
Miscellaneous Text Parameters		
PRFLAG	Text	CHAR*4 of the form XXXX where each X is either Y or N depending on whether or not to do a procedure. The procedures are: SETUP PARITY PREPASS --unused— The PRLAG should be set to YNNN for current schedules
SNR	Text	Valid values are “AUTO” or “MAN”. This is used in checking scans. If set to “MAN” will include a station even if it does meet the SNR targets.

FREQUENCY	Text	Current frequeny sequence. Only makes sense if the schedule file has several different frequency sequences which does not happen in geodesy schedules.
PREOB	Text	Name of PreOb procedure. Default is PREOB
MIDOB	Text	Name of MidOb procedure Default is MIDOB
POSTOB	Text	Name of PostOb procedure. Default is POSTOB

The remaining parameters in the $PARAM section are set using other commands. These should be easy to find. For example, to set the target SNR, use the **SNR** command. To set the default source Scan length, use the **SCAN** command.

pid

Syntax: **pid**
Synopsis: Display the Process ID (PID) of the program. This is useful in identifying scratch and log files associated with this schedule.
See also: parameters

This command lists the process ID. It does not take an argument:

```
? pid
Process ID = 09029
?
```

The process ID is embedded in the names of various `sked` scratch files.

The process ID is also displayed if you type the **param** command.

previous

Syntax: **previous [Num]**
Synopsis: Move towards the start of the schedule Num scans.
See also: ^, back, current, next
Comment: This is a synonym for back and ^

This command moves to the previous line of the schedule. If Num is omitted, we space back-wards one scan.

In the following example we list a part of the schedule, and then space backward 3 scans:

```
? li 171000-173000
Source      Start      DURATIONS
name     yyddd-hhmmss   Kk  Ma  Ny  Tc  Ts  Wf  Wz
2255-282 10004-171300|     161     161         125|
1342+662 10004-171309|  90     110      44 110    |
1128+385 10004-171541| 186     192      78 192    |
0048-097 10004-171633|      43                  43|
0059+581 10004-172058|      43  43      43  43  43|
3C371    10004-172310|  63  99  60      43  99  52|
0716+714 10004-172556|  56  91  64      43  91  54|
0759+183 10004-172752| 162     151      52     162|
1044+719 10004-172811|      43              43    |
1348+308 10004-173139| 101             101        |
End of listing.
? prev 3
Source      Start      DURATIONS
name     yyddd-hhmmss   Kk  Ma  Ny  Tc  Ts  Wf  Wz
0716+714 10004-172556|  56  91  64      43  91  54|
End of listing.
?
```

Note that after the listing we are left following the scan that ends at 17:31:39. When we space backward 3 scans we are left after the scan that ends at 17:25:56.

printl, printp

Syntax: **`Printl <file> | PRINT`**
Synopsis: Print the specified file, or the file opened by the **`unit`** command.
See also:

This program can be used to print an arbitrary file (if the filename is specified), or to print the file last opened by the **`unit`** command.

`printp` prints in portrait
`printl` in landscape.

CAUTION: These routines call the shell scripts *ljp* and *lj* which print to the laser printer. If these scripts are absent or not in the path, then these commands will not work.

quit

Syntax: **quit**
Synopsis: Quits the current schedule.
See also: Abort

This command purges the working and scratch files and exits.

No checking is done to see if changes were made to the schedule. All work done will be lost unless the schedule was written out.

The following example quits `sked` and the user is left at the operating system prompt.

```
? quit
bootes: /home/jmg/schedules>>
```

remove

Syntax: **Remove <range> <station>**
Synopsis: Remove a station from a set of scans.
See also: add, delete

This command will remove a station from a set of scans. In the following example, we first list the scans from the start of the session to 17:15. We then remove Tsukuba from the scans from the start to 17:10:00, and then list the scans to 17:15 again:

```
? li ^-171500
Source      Start      DURATIONS
name     yyddd-hhmmss   Ho  Kk  Ma  Tc  Ts  Wf  Wz
0133+476 10074-170000|          43          43  43|
1657-261 10074-170000|  43  43          43        |
2008-159 10074-170139|     251     251            |
1800+440 10074-170146|                 43  43     |
1725+044 10074-170316|  99             99         |
0420+022 10074-170419|          94          94  43|
1617+229 10074-170617|  43              43        |
2243-123 10074-170630|     277     277            |
0607-157 10074-170655|          43              43|
0710+439 10074-170840|                  53 150 150|
1034-293 10074-171033|  43              43        |
1435+638 10074-171242|     300 300      93 298 180|
1013+054 10074-171523|  43              43        |
End of listing.
? rem ^-171000 ts
Source      Start      DURATIONS
name     yyddd-hhmmss   Ho  Kk  Ma  Tc  Ts  Wf  Wz
0133+476 10074-170000|          43          43  43|
1657-261 10074-170000|  43  43                    |
2008-159 10074-170139|     251     251            |
 Deleting 1800+440  10 SX PREOB  10074170146      43 MIDOB       0 POS
1800+440 10074-170146|                 43         |
 Deleting 1725+044  10 SX PREOB  10074170316      99 MIDOB       0 POS
1725+044 10074-170316|  99                        |
0420+022 10074-170419|          94          94  43|
 Deleting 1617+229  10 SX PREOB  10074170617      43 MIDOB       0 POS
1617+229 10074-170617|  43                        |
2243-123 10074-170630|     277     277            |
0607-157 10074-170655|          43              43|
0710+439 10074-170840|                      150 150|
 Deleting 1034-293  10 SX PREOB  10074171033      43 MIDOB       0 POS
1034-293 10074-171033|  43                        |
 END OF AUTOCHECKING
? li ^-171500
Source      Start      DURATIONS
name     yyddd-hhmmss   Ho  Kk  Ma  Tc  Ts  Wf  Wz
0133+476 10074-170000|          43          43  43|
1657-261 10074-170000|  43  43                    |
2008-159 10074-170139|     251     251            |
0420+022 10074-170419|          94          94  43|
2243-123 10074-170630|     277     277            |
0607-157 10074-170655|          43              43|
0710+439 10074-170840|                      150 150|
1435+638 10074-171242|     300 300      93 298 180|
1013+054 10074-171523|  43              43        |
End of listing.
?
```

Note that `sked` deletes several scans which are only single baseline scans.

result

Syntax: **result [FE | COVARIANCE | CORRELATION]**
Synopsis: Display formal errors, covariance or correlation.
See also: optimization, coverage

Result without an argument will display the coverage for the session as well as the formal errors.

```
? res

   SKED results from file ./r1449.skd for experiment R1449
 Coverage Summary:
            HARTRAO  HOBART12 HOBART26 NYALES20 ONSALA60 TIGOCONC WESTFORD Average
 PixMut      780       781       781       781       781       781       781       780
 PixVis      781       781       781       781       781       781       781       781
 % MutVis   99.9     100.0     100.0     100.0     100.0     100.0     100.0     100.0
 PixCvred    225        55       126       314       320       181       335       222
 Scans       275        63       159       429       440       195       435       285
 % Eff      81.8      87.3      79.2      73.2      72.7      92.8      77.0      80.6
 DistAvg     5.7      20.6      10.0       3.7       3.7       8.9       3.4       8.0
 DistMax    25.2      58.8      34.9      14.8      14.5      40.0      13.4      28.8
 Number of pixels   1692      Average Pixel radius      2.8 deg


WARNING: Sky coverage only optimization is specified!!


Condition number:0.1115E-08

Standard deviations of the unknown parameters:
      XPOL                18.62     uas
      YPOL                18.24     uas
      UT1                 1.273     us
      HARTRAO  ATM0       2.934     ps
      HARTRAO  ATM1      0.2024     ps/D
      HOBART12 ATM0       2.124     ps
      HOBART12 ATM1      0.6829E-01 ps/D
      HOBART26 ATM0       1.892     ps
      HOBART26 ATM1      0.6821E-01 ps/D
      NYALES20 ATM0      0.7424     ps
      NYALES20 ATM1      0.3680E-01 ps/D
      ONSALA60 ATM0      0.7419     ps
      ONSALA60 ATM1      0.3201E-01 ps/D
      TIGOCONC ATM0       1.725     ps
. . .
```

You can also print the correlation matrix and covariance matrix.

rewrite

Syntax: **rewrite**
Synopsis: Rewrite the schedule
See also: **Obsolete**

This command is used to rewrite a schedule. It was used to convert from one `sked` format to another, and is no longer used.

scan

Syntax: **Scan [Src scanLength Src Scanlength …]**
Synopsis: List, set default scan length for sources

This command sets the default scan length for sources. This only has an effect if the parameter VSCAN is set to NO. If VSCAN is set to yest, then `sked` will adjust the scan lengths to meet the SNR targets.

SCAN without an argument will list the current default lengths:

```
? scan
  #  SOURCE   DURATION(sec)
   1 0710+439           196
   2 0047+023           196
   3 2142+110           196
   4 1059+282           196
   5 0420+022           196
   6 2320+506           196
   7 1435+638           196
   8 1354+195           196
   9 1004-500           196
  10 1725+044           196
. . . more sked output
  57 0925-203           196
  58 1555+001           196
  59 1657-261           196
  60 2357-318           196
?
```

The following commands 1) Change the default scan length for source number 4 to 50 seconds; 2) Change the default scan length for soruce 1657-261 to 60 seconds; and 3) Display the result.

```
? scan 4 50
? scan 1657-261  60
? scan
  #  SOURCE   DURATION(sec)
   1 0710+439           196
   2 0047+023           196
   3 2142+110           196
   4 1059+282           50
   5 0420+022           196
   6 2320+506           196
   7 1435+638           196
   8 1354+195           196
   9 1004-500           196
  10 1725+044           196
. . . more sked output
  57 0925-203           196
  58 1555+001           196
  59 1657-261           60
  60 2357-318           196
?
```

`Sked` stores the source scan length parameters in the $PARAM section of the `sked` file.

shift

Syntax: **Shift [range [tape [station | time]**
Synopsis: Used to shift a schedule if scans are introduced.
Comment: This command is rarely used.

This command is identical in function to the **check** command except that it automatically shifts the start time and/or tape status of each scan as necessary to optimize the schedule. If a scan was inserted or deleted, this command can be used to adjust all the times and/or tape usage after the editing. Refer to the timeline on page SKED- for how `sked` computes the new start time.

When beginning the time and tape calculations, `sked` assumes that the first scan it encounters for each station is acceptable and that those following are to be edited if needed. If a non-valid scan is encountered, for example if a source ends up not being mutually visible due to the time shifting, then the shifting process is terminated. The user must decide what to do about these situations. .

If nothing is specified after the *range*, then both start times and tape usage are adjusted as necessary. If **tape** is specified, then only the tape usage is adjusted and the start times are left alone. Tape usage is adjusted for the specified station, or for all stations if none is specified. Adjusting the tapes for a subnet is not implemented.

If **time** is specified, then only the start times will be adjusted and the tape usage will remain as it was. Note that you could end up with an impossible schedule by shifting only the time or tape use: caution is advised.

If shifting ends because of an error, such as a source not being up at a station, the last scan listed before the message `END OF AUTOCHECKING` is not a valid scan. The time of this scan is the time that would be appropriate for all stations except for the one in error. `Sked` backs up to the previous scan and lists it as the most recent valid scan.

Messages detailing the problems which may occur are typed out before the offending scan is displayed. During **check**ing, **shift**ing and **tag**ing the assumption is made that the previous scan which was listed has passed inspection and is problem-free. This will be true with **autoshift** since it will adjust the start time and tape usage as required for a “correct” scan, and it will quit if it cannot handle a problem.

sitevis

Syntax: **Sitevis [<source> [<subnet> [LINE|XYAXEL|POLAZEL]]]**
Synopsis: Move towards the start of the schedule Num scans.
See also: mutualvis

This displays the visibility of sources at each site. If no arguments are specified, it lists the visibility of all sources at all sites. This is equivalent to **sitevis _ _ line.**

```
? sitevis
 Source Visibility on 2010 74
   for stations  HOBART26  KOKEE     MATERA    TIGOCONC  TSUKUB32  WESTFORD  WETTZELL

   1 0710+439 RISE  SET  MAX |0     3     6     9     12    15    18    21    |
              hh:mm hh:mm  EL |------|-----|-----|-----|-----|-----|-----|-----|
 Ho HOBART26  0: 0  0: 0   3 |                                                 |
 Kk KOKEE    23:20 13:22  68 |-------------------------|                   |-|
 Ma MATERA    9:50  3:24  87 |------|            |------------------------------|
 Tc TIGOCONC 22:35  1:43   9 |---|                                         |--|
 Ts TSUKUB32  2:11 18:35  82 |    |---------------------------------|          |
 Wf WESTFORD 15:55  9:33  89 |--------------------|          |----------------|
 Wz WETTZELL  8:22  5:23  85 |----------|     |-------------------------------|
 All stat'ns  0: 0  0: 0     |555555544443333344454444444333344444443333333455|

   2 0047+023 RISE  SET  MAX |0     3     6     9     12    15    18    21    |
              hh:mm hh:mm  EL |------|-----|-----|-----|-----|-----|-----|-----|
 Ho HOBART26 22:30  8:27  45 |----------------|                          |--|
 Kk KOKEE    18:14  5:41  71 |-----------|                         |-----------|
 Ma MATERA    6:30 17:54  52 |             |---------------------|             |
 Tc TIGOCONC 12:59 23:21  50 |                         |---------------------| |
 Ts TSUKUB32 22:14  9:42  57 |-------------------|                       |---|
 Wf WESTFORD 12:22 23:46  50 |                         |----------------------||
 Wz WETTZELL  6:46 18: 8  44 |             |----------------------|            |
 All stat'ns  0: 0  0: 0     |333333333333244443332222344444444444433333334554|
... rest of sources
  60 2357-318 RISE  SET  MAX |0     3     6     9     12    15    18    21    |
              hh:mm hh:mm  EL |------|-----|-----|-----|-----|-----|-----|-----|
 Ho HOBART26 18:57 10:20  79 |--------------------|                |----------|
 Kk KOKEE    18:31  3:44  36 |-------|                              |----------|
 Ma MATERA    8: 8 14:36  18 |                 |------------|                   |
 Tc TIGOCONC 10:27  0:40  85 |-|                  |---------------------------|
 Ts TSUKUB32 23:26  6:49  22 |-------------|                             |-|
 Wf WESTFORD 14:13 20:15  16 |                           |------------|       |
 Wz WETTZELL  9:37 13:37   9 |                      |-------|                  |
 All stat'ns  0: 0  0: 0     |44333333222222  222343333333332222222444433334 4|
?
```

Specifying XYAZEL or POLAZEL will produce sky charts of the source(s) over 24 hours at each site.

SNR, 1SNR

Syntax: **SNR [<subnet> <band> <value>**
SNR MARGIN <band> <value>
SNR AST_MARGIN <band> <value>
1SNR [<subnet> <band> <value>
SNR MARGIN <band> <value>
Synopsis: Set or display SNR targets and values
See Also: **Param MaxScan**

The SNR and the 1SNR are identical in syntax and similar in effect. The SNR command sets or lists the minimum SNR targets by baseline and band. This applies to scans with more than 3 or more stations. The 1SNR command sets the minimum targets for single baseline observations.

You can exclude a subnet from influencing the SNR calculations by specifying an SNR of 0. The default value for all baselines is an SNR of 0. Refer to the equations starting on page 180 to see how `sked` calculates SNRs and scan length. Refer to page 7 for the syntax of *subnet*.

SNR without an argument lists the current SNR targets and margins.

```
? SNR
 Minimum SNR by baseline for multi-baseline scans
     X-band (margin   5)      S-band (margin   3)
     Ho  Kk  Ma  Tc  Wf           Ho  Kk  Ma  Tc  Wf
 Kk  20                       Kk  15
 Ma  20  20                   Ma  15  15
 Tc  15  15  15               Tc  12  12  12
 Wf  20  20  20  15           Wf  15  15  15  12
 Wz  20  20  20  15  20       Wz  15  15  15  12  15
?
```

The **margin** parameter is a means of reducing SNR requirements for weak sources and/or stations. In scheduling a scan `sked` calculates duration required to achieve the SNR targets. If this duration is greater than **maxscan**, `sked` will calculate what the SNRs would be if the duration were set to **maxscan**. If the calculated SNR value is at least as large as the (SNR target – margin) then the scan is acceptable for scheduling. For example, suppose that the required scan-length to achieve an SNR of 20 is 400 seconds, but **maxscan** is 300 and margin is 5. The actual SNR achieved at 300 seconds is 17. Since 20 - 5 >17 this scan would be OK.

The **ast_margin** parameter is similar to the **margin** parameter but is used only for sources in the $ASTROMETRIC section.

The following commands sets the X-band SNR of all baselines to 25, and then lists the SNRs.

```
? snr _ x 25
? snr
 Minimum SNR by baseline for multi-baseline scans
     X-band (margin   0)      S-band (margin   0)
     Ny  On  Sh  Tc  Wf  Wz          Ny  On  Sh  Tc  Wf  Wz
```

```
 On  25                          On  15
 Sh  25  25                      Sh  15  15
 Tc  25  25  25                  Tc  12  12  12
 Wf  25  25  25  25              Wf  15  15  15  12
 Wz  25  25  25  25  25          Wz  15  15  15  12  15
 Zc  25  25  25  25  25  25      Zc  15  15  15  12  15  15
?
```

It sometimes happens that there is a weaker station in the schedule. In this case, you might want to lower the SNR targets of baselines involving this station. This can be done by specifying only this station in the subnet argument. For example, the following command sets the X-band SNR target for baselines involving Tc to 20:

```
? snr Tc x 20
? snr
 Minimum SNR by baseline for multi-baseline scans
     X-band (margin   0)      S-band (margin   0)
     Ny  On  Sh  Tc  Wf  Wz          Ny  On  Sh  Tc  Wf  Wz
 On  25                          On  15
 Sh  25  25                      Sh  15  15
 Tc  20  20  20                  Tc  12  12  12
 Wf  25  25  25  20              Wf  15  15  15  12
 Wz  25  25  25  20  25          Wz  15  15  15  12  15
 Zc  25  25  25  20  25  25      Zc  15  15  15  12  15  15
?
```

The SNR and 1SNR targets for each baseline are written into the `$PARAMETERS` section of the schedule file and are automatically read back into `sked` when you pick up the same schedule.

solve

Syntax: **Solve [filename**
Synopsis: Create solve simulation file.

This command creates an output file with lists of the sources and stations for this schedule and the partial derivatives for each observation.

```
? solve dum
SOLVE02: Opened output file dum
insert    1  insert    2  insert    3  insert    4  insert    5  insert    6  insert
7  insert    8  insert    9  insert   10  insert   11  insert   12  insert   13  insert
14   insert    15   insert    16   insert    17   insert    18   insert    19   insert    20
insert
... more sked output
?
```

If no output file name is specified, the output file is given the default name of *experiment*`.solve` where *experiment* is the name in the parameter command display, taken from the name on the `$EXPER` line in the schedule file.

```
? solve
SOLVE02: Opened output file r1422
insert    1  insert    2  insert    3  insert    4  insert    5  insert    6  insert
7  insert    8  insert    9  insert   10  insert   11  insert   12  insert   13  insert
14   insert    15   insert    16   insert    17   insert    18   insert    19   insert    20
insert
... more sked output
?
```

The output file is the `sked` side of the interface to `solve`. The other side of the interface is implemented in a program called `sskedh` (written by Karen Baver) which loads the information from the file into a set of `solve` work files or creates a superfile. You then run `solve` to set up parameterization and start the least squares processing, or set up a `batch` run.

source

Syntax: **Source List | Select**
Synopsis: List current sources, or select sources
See also: bestsource, **Error! Not a valid result for table.**, station

Source list displays a list of the current sources:

```
  #     SOURCE      RA(hms) 2000 DEC(dms)      RA(hms) DATE DEC(dms)     RA(hms) 1950 DEC(dms)
   1 1  CL4          20 50 51.1  +31 27 27.    20 51 15.2  +31 29 50.    20 48 47.4  +31 16 11.
   2 2  1348+308     13 50 52.7  +30 34 54.    13 51 20.4  +30 31 37.    13 48 37.3  +30 49 43.
   3 3  1725+123     17 28  7.1  +12 15 39.    17 28 34.6  +12 15  4.    17 25 47.7  +12 18  3.
   4 4  1013+127     10 15 44.0  +12 27  7.    10 16 18.1  +12 23 57.    10 13  3.6  +12 42  5.
   5 5  0828+493      8 32 23.2  +49 13 21.     8 33  9.7  +49 11  7.     8 28 47.9  +49 23 33.
   6 6  1636+473     16 37 45.1  +47 17 34.    16 38  1.3  +47 16  9.    16 36 19.2  +47 23 29.
   7 7  0219+428      2 22 39.6  +43  2  8.     2 23 19.5  +43  5  9.     2 19 30.0  +42 48 30.
   8 8  1508-055     15 10 53.6  - 5 43  7.    15 11 25.6  - 5 45 29.    15  8 15.0  - 5 31 49.
   9 9  2243+047     22 45 53.7  + 5  0 57.    22 46 24.3  + 5  4 12.    22 43 21.7  + 4 45  8.
  10 0  0436-129      4 38 35.0  -12 51  3.     4 39  5.1  -12 49 53.     4 36 15.6  -12 56 57.
  11 a  0014+813      0 17  8.5  +81 35  8.     0 17 44.7  +81 38 55.     0 14  4.5  +81 18 28.
  12 b  0048-097      0 50 41.3  - 9 29  5.     0 51 12.6  - 9 25 48.     0 48 10.0  - 9 45 24.
  13 c  0059+581      1  2 45.8  +58 24 11.     1  3 23.5  +58 27 48.     0 59 43.5  +58  8  4.
  14 d  0104-408      1  6 45.1  -40 34 20.     1  7 13.8  -40 31 16.     1  4 27.6  -40 50 21.
  15 e  CTA26         3 39 30.9  - 1 46 36.     3 40  3.3  - 1 44 37.     3 36 58.9  - 1 56 17.
  16 f  0537-441      5 38 50.4  -44  5  9.     5 39 10.7  -44  4 53.     5 37 21.1  -44  6 45.
  17 g  0556+238      5 59 32.0  +23 53 54.     6  0 11.4  +23 53 57.     5 56 28.7  +23 53 45.
  18 h  0656+082      6 59 18.0  + 8 13 31.     6 59 53.1  + 8 12 38.     6 56 34.8  + 8 17 42.
  19 i  0727-115      7 30 19.1  -11 41 13.     7 30 49.7  -11 42 31.     7 27 58.1  -11 34 53.
  20 j  1044+719     10 48 27.6  +71 43 36.    10 49 15.0  +71 40  2.    10 44 49.7  +71 59 27.
  21 k  1124-186     11 27  4.4  -18 57 17.    11 27 36.0  -19  0 38.    11 24 34.0  -18 40 46.
  22 l  1128+385     11 30 53.3  +38 15 19.    11 31 27.2  +38 11 40.    11 28 12.5  +38 31 52.
  23 m  1144-379     11 47  1.4  -38 12 11.    11 47 32.9  -38 15 27.    11 44 30.9  -37 55 31.
...
?
```

The first column is the source number. The second a symbol used for the source when plotted. This is followed by the source name and coordinates.

Source select allows you to select the source. After the command is entered you are presented with a window that looks something like this:

```
Source    Grade     Source    Grade     Source    Grade     Source    Grade
0003-066  (B-)      0014+813  ( )       0048-097  (A )      0059+581  (A )
0104-408  (A-)      0106+013  (B-)      0111+021  (  )      0119+115  (B )
0119+041  (B )      0133+476  (C+)      0201+113  (C )      0202+149  (  )
0208-512  (B )      0229+131  (B )      0235+164  (B+)      CTA26     (B )
0402-362  (B )      0405-385  (B )      0434-188  (C )      0454-234  (B )
0458-020  (B-)      0454+844  (B )      0530-727  (C-)      0528+134  (B-)
0537-441  (C )      0552+398  (A )      0556+238  (B )      0602+673  (C )
0607-157  (B )      0656+082  (C-)      0637-752  (B-)      0718+793  (C-)
0727-115  (B+)      0743+259  (B-)      0749+540  (C )      0804+499  (A-)
0805+410  (C )      0808+019  (B )      0823+033  (B )      OJ287     (C )
4C39.25   (A-)      OK290     (C )      0955+476  (A )      1034-293  (B-)
1044+719  (A )      1053+815  (C )      1057-797  (C )      1101+384  (  )
1104-445  (C )      1124-186  (B )      1128+385  (B )      1144-379  (B )
1156+295  (C-)      3C274     (  )      1255-316  (C+)      1300+580  (B-)
. . .
Cursor key or ijkl            <E>nd     <F>irst   <N>ext    <P>rev    <R>efresh
```

The user can use the cursor keys to navigate around. Highlighted sources are selected. To select/deselect a source, use the spacebar. Once you are satisfied with your selection, type “E”. This presents you with a menu:

```
> se
 SE - select entries for SKED
 LI - list selected entries so far
 AB - abort and return to SKED
 :: - return to sked with new information
>
```

LI gives you a chance to review your selection.

SE allows you to modify your selection.

AB lets you return to `sked`, keeping the old sources.

:: lets you return to `sked` with new sources.

After you are done selecting

For most purposes, a better way of selecting sources is to let `sked` do it using the **bestsource** command.

After you are done selecting the sources you should use **flux select** to update the fluxes.

Note: It sometimes happens that there are sources in the schedule that are not present in the catalogs. In this case, `sked` will issue warning messages and ask if you want to proceed.

SrcWt

Syntax: **srcwt List | Add <src> <wt> | Set <src> <wt> | Delete <src>**
Synopsis: List or set sources used in the SrcWt minor option.
See Also: minor

This command lists or sets the weights of sources. By increasing the weight of a source you may be able to increase the number of scans using the source. This is analogous to the StatWt command. This command will have an effect *only* if the SrcWt minor option is on and has a non-zero weight.

All sources have a weight associated with them. By default, the weight is 0. You can use SrcWt to change or list the weights of sources. Executing SrcWt without an argument lists the non-zero source weights:

```
? srcwt
   # Source       Wt
  53 2008-159             2.00
  59 1657-261             3.00
?
```

The first argument is the source number, followed by the source name and then the weight.

You can add a source to the list using **SrcWt Add**:

```
? srcwt add 0215+015 5.5
? srcwt
   # Source       Wt
  39 0215+015             5.50
  53 2008-159             2.00
  59 1657-261             3.00
?
```

You can delete a source using the **delete** option (this is equivalent to setting the weight to 0):

```
? Srcwt delete 2008-159
? srcwt
   # Source       Wt
  39 0215+015             5.50
  59 1657-261             3.00
?
```

You can set the weight of a source using the **set** option:

```
? srcwt set 1657-261 3.4
? srcwt
   # Source       Wt
  39 0215+015             5.50
  59 1657-261             3.40
?
```

station

Syntax: **`Stations list | select | add | delete`**
Synopsis: List, select the stations.
See also: frequenc,source

`Station list` will display information about the current stations:

```
? stati li
     STATION     AXIS  SLEW RATES   SLEW CONST  LIMIT STOPS
  1 B Bd BADARY   AZEL  60.0  30.0     40   40    278.0    802.0     12.0     80.0
     Position    -102.23 WEST          51.77 NORTH   Occupation code: 00000000
     Horizon    0.  7.0  10.  5.0  20.  4.0  50.  2.0  60.  1.0 100.  2.0 130.  3.0
              230.  2.0 260.  4.0 270.  5.0 280.  6.0 290.  7.0 300.  8.0 310.  9.0
              340.  8.0 350.  7.0 360.  7.0
  2 F Ft FORTLEZA AZEL  48.0  20.0     7   10    171.0    709.0      5.0     88.0
     Position      38.43 WEST          -3.88 NORTH   Occupation code: 72974801
  3 I Is ISHIOKA  AZEL 720.0 360.0     10   10    290.0    790.0      5.0     89.0
     Position    -140.22 WEST          36.21 NORTH   Occupation code: 00000000
  4 K Kk KOKEE    AZEL 127.0 136.0     12   12    270.0    810.0      0.0     89.7
     Position     159.67 WEST          22.13 NORTH   Occupation code: 72983001
     Horizon    0.  5.0 107. 25.0 153.  5.0 360.  5.0
  5 A Ma MATERA   AZEL 105.0 139.0     33   33    277.0    803.0      4.0     88.0
     Position     -16.70 WEST          40.65 NORTH   Occupation code: 72435701
  6 N Ny NYALES20 AZEL 130.0 135.0     10    9    271.0    809.0      0.0     89.7
     Position     -11.87 WEST          78.93 NORTH   Occupation code: 73313301
     Horizon    0.  2.0  10.  4.0  60.  4.0  65.  2.0 120.  2.0 128.  5.0 150.  5.0
              152.  7.0 162.  9.0 176. 12.0 190.  5.0 226.  8.0 230.  6.0 250.  6.0
              256.  7.0 266. 12.0 270. 12.0 290.  4.0 310.  2.0 360.  2.0
  7 U Ur URUMQI   AZEL  60.0  32.0     9    9    280.0    800.0      5.0     88.0
     Position     -87.18 WEST          43.47 NORTH   Occupation code: 73303201
  8 C Wn WETTZ13N AZEL 720.0 360.0     0    0      0.0    540.0      0.0     90.0
     Position     -12.88 WEST          49.14 NORTH   Occupation code: 73870000
  9 V Wz WETTZELL AZEL 180.0  90.0     0    0    251.5    831.0      2.0     89.0
     Position     -12.88 WEST          49.15 NORTH   Occupation code: 72247801
     Horizon    0.  5.0 360.  5.0

 Baseline lengths (km):
          Bd     Ft     Is     Kk     Ma     Ny     Ur     Wn
    Ft  11154.
    Is   3407. 12249.
    Kk   7997. 11064.  5744.
    Ma   6073.  7038.  8818. 10894.
    Ny   4334.  8744.  6490.  8103.  4190.
    Ur   1452. 10925.  4439.  9052.  5480.  4861.
    Wn   5726.  7215.  8442. 10358.   990.  3283.  5356.
    Wz   5726.  7215.  8442. 10357.   990.  3283.  5356.     0.

 Average total baeline length =  6535. km
 Average X-Y component length =  6012. km
 Average X-Z component length =  5374. km
 Average Y-Z component length =  4033. km
Baselines sorted by length:
 WETTZELL - WETTZ13N        0.
 WETTZ13N - MATERA        990.
 WETTZELL - MATERA        990. . . .
More sked output
. . .
KOKEE    - FORTLEZA    11064.
 FORTLEZA - BADARY      11154.
 ISHIOKA  - FORTLEZA    12249.
```

```
 #   ID  STATION   Band SEFD   Band SEFD   DAT_name ID   Rack                Recorder
 1 B Bd  BADARY     X    400    S    600    BADARY   BD   none                Mark5B
 2 F Ft  FORTLEZA   X   5000    S   5000    OVRO_130 01   Mark4               Mark5A
 3 I Is  ISHIOKA    X   1950    S   1750    ISHIOKA  Is   K4-2                K5
 4 K Kk  KOKEE      X   2000    S    750    KO-VLBA  102  VLBA5               Mark5B
 5 A Ma  MATERA     X   1600    S   2200    MATERA   119  Mark5               Mark5B
 6 N Ny  NYALES20   X   1000    S   1500    RICHMOND 66   DBBC_DDC            Mark5B
 7 U Ur  URUMQI     X   1500    S   1500    URUMQI   67   Mark5               Mark5B
 8 C Wn  WETTZ13N   X   1400    S   1050    WETTZ13N Wn   DBBC_DDC            Mark5B
 9 V Wz  WETTZELL   X    750    S   1115    WETTZELL 33   Mark4               Mark5A
?
```

`Station select` will bring up a screen which allows you to select stations:

```
Station  Rack     Recorder Bnds     Station  Rack     Recorder Bnds
AIRA     K4-1     K5       XS       ALGOPARK VLBA4    Mark5A   XS
ALGOPARK none     S2       XS       ARECIBO  unknown  unknown  XS
ARIES_4M unknown  unknown  XS       ARIES_9M Mark3A   Mark3A   XS
ARIES_9M none     S2       XS       ATCA     Mark4    Mark5A   KK
. . .
KASHIM34 K4-1     K5       XS       KASHIM11 K4-2     K5       XS
KATH12M  VLBA4    Mark5A   XS       KAUAI    unknown  unknown  XS
KOKEE    VLBA4    Mark5A   XS       KOKEE    none     S2       XS
KP-VLBA  VLBA     Mark5A   XS       KOGANEI  K4-2     K5       XS
LA-VLBA  VLBA     Mark5A   XS       MADRID64 unknown  unknown  XS
MARCUS   unknown  unknown  XS       MATERA   Mark4    Mark5A   XS
MCMURDO  unknown  unknown  XS       MEDICINA Mark4    Mark5A   XS
MEDICINA Mark4    Mark5A   CC       METSAHOV VLBA     Mark5A   XS
MIAMI20  unknown  unknown  XS       MIURA    K4-2     K4-2     XS
. . .
NOTO     VLBA4    Mark5A   XS       NOTO     VLBA4    Mark5A   CC
NRAO85_3 unknown  unknown  XS       NRAO_13  unknown  unknown  XS
NRAO_140 unknown  unknown  XS       GBT_VLBA VLBA     Mark5A   XX
NRAO20   VLBA     Mark5A   XS       NYALES20 Mark4    Mark5A   XS
OHIGGINS VLBA4    Mark5A   XS       ONSALA60 Mark4    Mark5A   XS
ONSALA85 Mark4    Mark5A   CC       ORION_5M Mark4    Mark5A   XS
OV-VLBA  VLBA     Mark5A   XS       OVRO_130 unknown  unknown  XS
. . .
WESTFORD Mark4    Mark5A   XS       WSTRBORK Mark4    Mark5A   CC
WSTRBORK Mark4    Mark5A   XX       WETTZELL Mark4    Mark5A   XS
WETTZELL Mark4    K5       XS       YARRA12M VLBA4    Mark5A   XS
YEBES40M VLBA4    Mark5A   XS       ZELENCHK VLBA4    Mark5A   XS
ZELENCHK none     S2       XS

Cursor key or ijkl            <E>nd     <F>irst   <N>ext    <P>rev    <R>efresh
```

The user can use the cursor keys to navigate around. Highlighted sources are selected. To select/ deselect a source, use the spacebar. Once you are satisfied with your selection, type “E”. This presents you with a menu:

```
> se
 SE - select entries for SKED
 LI - list selected entries so far
 AB - abort and return to SKED
 :: - return to sked with new information
>
```

`LI` gives you a chance to review your selection.

`SE` allows you to modify your selection.

`AB` lets you return to `sked`, keeping the old stations.

`::` lets you return to `sked` with new stations.

Note: It sometimes happens that there are stations in the schedule that are not present in the catalogs, or there is a discrepancy between hardware in the schedule and that in the station catalog. In this case sked will issue warning messages and ask if you want to proceed.

In the past the user had to select the frequency mode if they changed the stations in a schedule. You no longer need to do this. `Sked` will try to figure out the appropriate mode from the schedule. If it runs into problems, it will let the user know.

`Station add` will add the given station in the current set of stations. If the station is already in the experiment network, sked will send a message.

```
? stati add Hh
   1 Bd B
   2 Ft F
   3 Hh J
   4 Is I
   5 Kk K
   6 Ma A
   7 Ny N
   8 Ur U
   9 Wz V
  10 Wn C
Writing out station select file for SKED: Antenna Position Equipment Mask
MAKE_MODE_LIST: Found mode 256-16(R1-R4)     GEOSX       8.0   16.0  00-16-0-1
Opt est parameters initialized to off.
Following stations are new:
Name      EL  Early   Tape
HARTRAO   2.0    0 START&STOP
 Searching for rx: SX_WIDE
?
? stati add Hh
 Stcmd: Station already in the network:HH
?
```

`Station del` will delete the given station from the current set of stations. To do so, it will delete all the scans containing the station first and then remove the station from the list of stations.

```
? station del bd
Source      Start      DURATIONS
name     yyddd-hhmmss   Wz  Ma  Ny  Kk  Is  Bd  Ft  Ur  Wn  Hh
2229+695 17362-183000|     271 250     291     291 250 177    |
OJ287    17362-183658|      60  60      60          60  60    |
1538+149 17362-183909|          98      98                    |
0454-234 17362-183949|      60                      60  60    |
2255-282 17362-184225|      60                          60    |
0202+319 17362-184231|          71              71  71        |
0420+022 17362-184516|      60  60                  60  60    |
0727-115 17362-184806|                  60          60        |
2318+049 17362-184806|     116  89             116      84    |
0834-201 17362-185019|                  60          60        |
.................
More sked listing
.................
Deleting 0606-223  10 SX PREOB  17363181208      60 MIDOB       0 POS
```

```
0606-223 17363-181208|                       60                |
0400-319 17363-181405|     278                        278 133    |
0955+476 17363-181558|  60      60  60  60                       |
1502+036 17363-181857|             178 178                       |
 Deleting 1504+377  10 SX PREOB  17363181934      63 MIDOB       0 POS
1504+377 17363-181934|                       63                |
2128-123 17363-182025|  60  60                          60      |
1351-018 17363-182246|              77  77                       |
0202+319 17363-182337|  60 103  71             103  71  60      |
0716+714 17363-182738|  64 123  76  60 123          82  60      |
 END OF AUTOCHECKING
   1 Ft F
   2 Hh J
   3 Is I
   4 Kk K
   5 Ma A
   6 Ny N
   7 Ur U
   8 Wz V
   9 Wn C
Writing out station select file for SKED: Antenna Position Equipment Mask
MAKE_MODE_LIST: Found mode 256-16(R1-R4)     GEOSX       8.0   16.0  00-16-0-1
 Searching for rx: SX_WIDE
?
```

StatWt

Syntax: **statwt List | Add <stat> <wt> | Set <stat> <wt> | Delete <stat>**
Synopsis: List or delete stations used in the StatWt minor option.
See Also: minor

This command lists or sets the weights of stations. By increasing the weight of a station you may be able to increase the number of scans using the station. This is analogous to the SrcWt command. This command will have an effect *only* if the StatWt minor option is on and has a non-zero weight.

All stations have a weight associated with them. By default, the weight is 0. You can use StatWt to change or list the weights. Executing StatWt without an argument lists the non-zero station weights:

```
? statwt
# Station      Wt
   4 TIGOCONC     3.00    # Source       Wt
  ?
```

The first argument is the station number, followed by the name and then the weight.

You can add a station to the list using **StatWt Add**:

```
? statwt add tsuk 2
? statwt
   # Station      Wt
   4 TIGOCONC     3.00
   5 TSUKUB32     2.00
?
```

You can delete a station using the **delete** option (this is equivalent to setting the weight to 0):

```
? Statwt delete tc
? statwt
   # Station       Wt
   5 TSUKUB32      2.00
?
```

You can set the weight of a station using the **set** option:

```
? statwt set Ts 3.5
? statwt
   # Station      Wt
   5 TSUKUB32     3.50
?
```

streams

Syntax: **`streams [Expand]`**
Synopsis: Calculate and display number of correlator streams.
See also:

This command calculates the number of Mark4 correlator streams. Each stream corresponds to a set of observations which are independent. If you have two streams, you could process them simultaneously.

Streams without an argument will list the number of streams and the duration of each:

```
? stream
Number of streams used:     3
Stream:    1  Scans:       690 Time:     53957 (14 hr 59 min)
Stream:    2  Scans:       490 Time:     43283 (12 hr  1 min)
Stream:    3  Scans:       184 Time:     16353 ( 4 hr 32 min)
End of streams analysis.
?
```

If you give the argument **`EXPAND`** then `sked` will list the scans in each stream:

```
? stream expand
Number of streams used:     3
Stream:    1  Scans:       690 Time:     53957 (14 hr 59 min)
Stream:    2  Scans:       490 Time:     43283 (12 hr  1 min)
Stream:    3  Scans:       184 Time:     16353 ( 4 hr 32 min)
    1 074-1700a     1 074-1700b     1 074-1704
    2 074-1701a     2 074-1701b     2 074-1706c
    3 074-1706a     3 074-1703      3 074-1710
    4 074-1708      4 074-1706b     4 074-1721c
    5 074-1712      5 074-1715      5 074-1801
. . . More sked output
  182 074-2328    182 075-0230a   182 075-1644
  183 074-2330    183 075-0231    183 075-1648
  184 074-2333b   184 075-0233b   184 075-1656c
  185 074-2335a   185 075-0238b
  186 074-2338a   186 075-0241b
  187 074-2340    187 075-0243
. . . More sked ouutput
  488 075-1004    488 075-1652b
  489 075-1006    489 075-1654b
  490 075-1010a   490 075-1656b
  491 075-1011
  492 075-1012
. . . More sked output
  688 075-1654a
  689 075-1656a
  690 075-1658
End of streams analysis.
?
```

subcon

Syntax: **Subcon [on| off]**
Synopsis: Display sub-configuration information during scheduling.
See also: **Next**

This command specifies whether subconfigurations are displayed as they are being evaluated during the **whatsup** or **auto** command.

If **subcon** is **off** (initial default setting) then no display is made.

If **subcon** is **on** then each subconfiguration is listed on the display device just before it is evaluated during automatic scan selection. For each scan, `sked` displays the scan number, the initial score (sky-coverage or covariance optimization), followed by the first 80 characters of the scan.

```
? subcon on
? auto
? auto
Auto Mode:       T
Fill-In Mode:    F  Subnet: Hb-Ho-Kk-Ny-Ts-Wf-
   1   12.57  | 2353-686  10 SX PREOB  10277170000     213 MIDOB       0 POSTOB H-A- 1F000000 1F
   2    9.77  | 0524-485  10 SX PREOB  10277170307      97 MIDOB       0 POSTOB H-A-K- 1F000000
   3    2.28  | 1758+388  10 SX PREOB  10277170211     151 MIDOB       0 POSTOB N-E- 1F000000 1F
   4    2.58  | 0723+219  10 SX PREOB  10277170214     179 MIDOB       0 POSTOB K-NWTC 1F000000
   5   12.57  | 0003-066  10 SX PREOB  10277170000      43 MIDOB       0 POSTOB HWA- 1F000000 1F
   6    9.16  | CTA26     10 SX PREOB  10277170206      89 MIDOB       0 POSTOB HWA-TW 1F000000
   7    8.09  | 0405-385  10 SX PREOB  10277170317     213 MIDOB       0 POSTOB HWA-K-TW 1F00000
   8    7.61  | 0458-020  10 SX PREOB  10277170328     164 MIDOB       0 POSTOB HWA-K-TC 1F00000
   9   12.57  | 0530-727  10 SX PREOB  10277170000     221 MIDOB       0 POSTOB H-A- 1F000000 1F
  10    1.19  | 0718+793  10 SX PREOB  10277170145      67 MIDOB       0 POSTOB KWNWTC 1F000000
  11    3.01  | OJ287     10 SX PREOB  10277170212      43 MIDOB
0 POSTOB K-E- 1F000000 1F
?
```

For debugging purposes an alternative is to turn on Debug using the parameter command.

summary

Syntax: **Summary [range [source [subnet [stats | line | baseline| hist | snr | xy| pol| el |az |cov|file [xmin xmax ymin ymax]]]]]**
Synopsis: Display summary information about the schedule
See also:

A summary of the specified observations is displayed on the display unit. The summary can be restricted to a certain time range, to a single source, and/or to a subnet of stations. The default is to summarize all observations. The specifications for time, source, and stations must appear in order as shown in the syntax above. The place-holder character _ (underline) can be used to indicate "all" if, for example, you want to summarize all observations for a single source. The output produced by each of the key words is described next.

Note: In displaying the output of the summary command we will use small font so that we can display everything that appears on the screen.

Printed displays. The **stats** option (default) displays the statistics of time spent in observing, calibration, slewing, and the total number of tapes required. The observations for each baseline in the subnet are summarized. The number of observations using 2, 3, 4, *etc.* stations is listed. A sample display follows:

```
? summ
   SKED Summary from file ./r1451.skd for experiment R1451

       (all scans with at least one subnet station)


 Average number of obs. per baseline per source(normalized by up-time) =   8.4
 Min =    0.0  Max =   60.4 (Baseline Ho-Kk on 1324+224)   RMS =  13.6

 Total time:       1440 minutes (  24.0 hours).

 Key:      Hb=HOBART12   Ho=HOBART26   Kk=KOKEE      Ny=NYALES20   Ts=TSUKUB32
           Wf=WESTFORD
                     Hb   Ho   Kk   Ny   Ts   Wf  Avg
 % obs. time:         2   17   52   45   38   50   34
 % cal. time:         1    2    5    5    7    5    4
 % slew time:         1   27   22   25   27   14   20
 % idle time:        95   53   20   24   28   30   42
 total # scans:      47  205  434  462  572  410  355
 # scans/hour :       2    9   18   19   24   17   15
 Avg scan (sec):     43   73  104   84   57  105   77
 # data tracks:      16   16   16   16   16   16
 # Mk5 tracks:       16   16   16   16   16   16
 Total GBytes:       73  541 1618 1405 1167 1550 1059
 Total GB(M5):       65  481 1438 1249 1037 1378  941
 # of tapes :      1.0  1.0  1.0  1.0  1.0  1.0
 tape change times (hhmm):

Total number of tapes:   6.0  Total GBytes (M5) recorded:  5648.0
      # OF OBSERVATIONS BY BASELINE
  |  Hb   Ho   Kk   Ny   Ts   Wf  StnTotal
---------------------------------------
Hb|       45   16   10   44    1     116
```

```
Ho|           93   39  183    6     366
Kk|               346  365  291    1111
Ny|                    387  366    1148
Ts|                         326    1305
Wf|                                 990


 Number of  2-station scans:  198
 Number of  3-station scans:  204
 Number of  4-station scans:  268
 Number of  5-station scans:   10
 Number of  6-station scans:    0

 Total # of scans, observations:   680     2518
?
```

This command can present a wealth of information. A more extended option is shown below. (The font size has been reduced so that we can print the whole width.) The top of the screen shows each time a source has been observed within 15 minute blocks. This is followed by a chart showing every time a station has observed. Notice that two of the stations - Kokee and NyAlesund - have a 1- hour gap. This is during an Intensive. Hobart12, a new station, was tagged along in this schedule, which is why its observation is so sporadic.

```
? sum _ _ _ li

SKED Summary from file ./r1451.skd for experiment R1451

      (all scans with at least one subnet station)

          4 chars/hour
  SOURCE | 0           3           6           9          12          15          18          21          | #SCANS #OBS #Obs/bl
 2353-686|                                                                                                |     0     0   0.0
 0524-485|                                                       x  xx x x xx  x  x     x                 |    10    10   8.3
 1601+112|        x                                                                                       |     1     1   0.2
 1806-458|                          x  x      x                                                           |     3     5   7.0
 1758+388|  x          x             x             x                x x       x   x           x  x        |    10    35   8.6
 1049+215|      x                x x                                                     xR   x S     x   |     6     6   1.3
 0723+219|                                                 x      x  x    x R   x S        x       x      |     7    27   4.6
 2000+148|                    x   x      x                                                                |     3     3   0.6
 2245-328|                                    x x x x x  x x x     x    x x                               |    11    11   4.1
 0221+067|                                          x x   x x xx xx x    x x xx     x                     |    14    14   2.4

. . . More Sked output. . .
 0347-211|                                                       x x x          x x x xx                  |     8     8   2.4
 0544+273|                                           x    x x  x x x    R    S             x              |     7    33   5.6
 0847-120|                                                               x                                |     1     1   0.6
 Total scans, obs:                                                                                            680  2518

          4 chars/hour
  STATN  | 0           3           6           9          12          15          18          21          | #SCANS #OBS %OBS
 HOBART12| x xxx xxx  x     x x   xxxx x xx     xxxx x   x  xx x                    xxx x     x xxx   xxxx|    47   116   4.6
 HOBART26|xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx xxxxxxxxxxxxxxxx|   205   366  14.5
 KOKEE   |xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx      xxxxxxxxxxxxxxxxx|   434  1111  44.1
 NYALES20|xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx      xxxxxxxxxxxxxxxxx|   462  1148  45.6
 TSUKUB32|xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx|   572  1305  51.8
 WESTFORD|xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx|   410   990  39.3

 Average number of obs. per baseline per source(normalized by up-time) =   8.4
 Min =    0.0  Max =   60.4 (Baseline Ho-Kk on 1324+224)   RMS =  13.6

 Total time:       1440 minutes (  24.0 hours).

 Key:     Hb=HOBART12   Ho=HOBART26   Kk=KOKEE      Ny=NYALES20   Ts=TSUKUB32
          Wf=WESTFORD
                     Hb    Ho    Kk    Ny    Ts    Wf   Avg
 % obs. time:         2    17    52    45    38    50    34
 % cal. time:         1     2     5     5     7     5     4
 % slew time:         1    27    22    25    27    14    20
 % idle time:        95    53    20    24    28    30    42
 total # scans:      47   205   434   462   572   410   355
 # scans/hour :       2     9    18    19    24    17    15
 Avg scan (sec):     43    73   104    84    57   105    77
 # data tracks:      16    16    16    16    16    16
 # Mk5 tracks:       16    16    16    16    16    16
 Total GBytes:       73   541  1618  1405  1167  1550  1059
 Total GB(M5):       65   481  1438  1249  1037  1378   941
 # of tapes :       1.0   1.0   1.0   1.0   1.0   1.0
 tape change times (hhmm):
```

```
Total number of tapes:   6.0  Total GBytes (M5) recorded:  5648.0
      # OF OBSERVATIONS BY BASELINE
  |  Hb   Ho   Kk   Ny   Ts   Wf  StnTotal
-----------------------------------------
Hb|       45   16   10   44    1     116
Ho|            93   39  183    6     366
Kk|                346  365  291    1111
Ny|                     387  366    1148
Ts|                          326    1305
Wf|                                  990


 Number of  2-station scans:  198
 Number of  3-station scans:  204
 Number of  4-station scans:  268
 Number of  5-station scans:   10
 Number of  6-station scans:    0

 Total # of scans, observations:   680     2518

?
```

The following command will produce a histogram:

```
? summary _ _ _ hist
SKED Summary from file ./r1451.skd for experiment R1451
      (all scans with at least one subnet station)
Elevation histogram
 Distribution of elevations, for each station
    Elev:  0   5  10  15  20  25  30  35  40  45  50  55  60  65  70  75  80  85  90
HOBART12:    0   1   5   4   4   5   5   6   1   1   3   4   5   0   2   0   0   1
HOBART26:    0   6  15  17  20  20  15  22  10  10  10  11  18   8  11   6   3   3
KOKEE   :    0  31  45  45  35  33  38  40  40  32  25  18  16   9  11   8   5   3
NYALES20:    0   9  30  25  33  26  20  23  42  44  31  41  42  40  16  12  17  11
TSUKUB32:    0  50  32  50  43  53  47  39  42  42  40  35  27  24  28  11   7   2
WESTFORD:    0  27  33  35  42  34  32  32  22  33  26  25  20  18  14   9   6   2
   Total:    0 124 160 176 177 171 157 162 157 162 135 134 128  99  82  46  38  22
Total number of station scans:  2130

    Elev:  0   1   2   3   4   5   6   7   8   9  10
HOBART12:    0   0   0   0   0   0   0   0   0   1
HOBART26:    0   0   0   0   0   0   2   1   2   1
KOKEE   :    0   0   0   0   0   3   8   4   5  11
NYALES20:    0   0   0   0   0   2   2   2   1   2
TSUKUB32:    0   0   0   0   0  15  11   9   8   7
WESTFORD:    0   0   0   0   0   4   4   6   8   5
   Total:    0   0   0   0   0  24  27  22  24  27
Total number of station scans:   124

Distribution of observations (one or both stations are observing at low elevation)
Elev:  0    1    2    3    4    5    6    7    8    9   10   Total
          0    0    0    0    0   51   58   40   50   58      257
                  0>>|      0>>|    109>>|
                   0%        0%        4%                     10%
?
```

The following command produces information about the sky coverage (font size has been reduced to capture the entire screen).

```
? summary _ _ _ hist
SKED Summary from file ./r1451.skd for experiment R1451
         (all scans with at least one subnet station)
Sky coverage histogram
            NE  SE  SW  NW  UP   Total  Avg   Rms
HOBART12:    8   1   3  22  13     47.    9.    8.
HOBART26:   67  10   6  59  63    205.   41.   27.
KOKEE   :  126  25  44 157  82    434.   87.   49.
```

```
NYALES20:  120  30  22 102 188    462.   92.   61.
TSUKUB32:  164  82  60 116 150    572.  114.   39.
WESTFORD:  110   7  29 160 104    410.   82.   56.
 Overall      Avg=   71.  Rms=   56.

                NE                  SE                  SW                  NW          Avg Rms
  El bin:  0  11  23  36  53  | 0  11  23  36  53  | 0  11  23  36  53  | 0  11  23  36  53  |
HOBART12:    0   3   4   1   5|  0   1   0   0   2|  0   2   1   0   0|  1   6   8   7   6| 2.  3.
HOBART26:    5  18  26  18  20|  1   2   3   4  13|  0   2   2   2   3|  2  20  18  19  27| 10.  9.
KOKEE   :   16  30  43  37  32|  1   7   3  14   6|  6  16  10  12  12|  26  41  44  46  32| 22. 15.
NYALES20:   10  30  28  52  71|  0   5   8  17  30|  3   3   6  10  26|  6  35  17  44  61| 23. 20.
TSUKUB32:   27  38  45  54  51|  14  22  22  24  28|  9  16  20  15  30|  11  23  42  40  41| 29. 13.
WESTFORD:   16  29  33  32  27|  1   3   1   2   6|  3   6   7  13  18|  19  42  56  43  53| 20. 17.
     Avg:   12  24  29  32  34|  2   6   6  10  14|  3   7   7   8  14|  10  27  30  33  36|
 Overall      Avg=   18.  Rms=   17.
?
```

Summary can be used to extract an SNR summary from the schedule:

```
? summary _ _ _ snr
    SKED Summary from file ./r1451.skd for experiment R1451
      (all scans with at least one subnet station)
SNR histogram
 Distribution of X-band SNRs, for each baseline
 SNR:     0     5    10    15    20    25    30    35    40    45    50    55    60    65    70    75    80    85  >>
 Distribution of Z-band SNRs, for each baseline
 SNR:    95
 Hb-Ho:     0     0     0     0     2     8     2     3     0     1     2     6     7     0     0     0     0    14
 Hb-Kk:     0     0     0     0     9     1     1     2     3     0     0     0     0     0     0     0     0     0
 Hb-Ny:     0     0     0     0     1     0     1     1     0     0     0     0     0     1     0     1     0     5
 Hb-Ts:     0     0     0     0     3     0     0     0     0    10     0     0    11     6     0     0     0    14
 Hb-Wf:     0     0     0     0     0     0     1     0     0     0     0     0     0     0     0     0     0     0
 Ho-Kk:     0     0     0     0    61    21     5     1     0     2     3     0     0     0     0     0     0     0
 Ho-Ny:     0     0     0     0     8     0    20     1     0     0     1     1     0     1     0     0     1     6
 Ho-Ts:     0     0     0     0    69     5    11     7     5     1     4    29    10     1     3     2    18    18
 Ho-Wf:     0     0     0     0     6     0     0     0     0     0     0     0     0     0     0     0     0     0
 Kk-Ny:     0     0     0     0   212    41    36    38     1     1     0     0     5     0     0     0     1    11
 Kk-Ts:     0     0     0     0    60    97    65     8     9     6     4    24    52     5     2     3     4    26
 Kk-Wf:     0     0     0     0   242    37     0     3     1     1     4     1     1     0     0     1     0     0
 Ny-Ts:     0     0     0     0     8    20    20    84    44    80     7     2     5     3     0     3     1   110
 Ny-Wf:     0     0     0     0   112   105    29    10    80     4     3     5     1     1     5     0     0    11
 Ts-Wf:     0     0     0     0    50    93    73    19     4    13    25    15     9    18     3     0     0     4
 Total:     0     0     0     0   843   428   264   177   147   119    53    83   101    36    13    10    25   219
 Total number of obs:  2518  Average SNR:   44.8   Median SNR bin:   30
 Distribution of S-band SNRs, for each baseline
 SNR:     0     5    10    15    20    25    30    35    40    45    50    55    60    65    70    75    80    85  >>
 Distribution of Z-band SNRs, for each baseline
 SNR:    95
 Hb-Ho:     0     0     0     0    18     9     0     6     9     3     0     0     0     0     0     0     0     0
 Hb-Kk:     0     0     0     2     0     8     2     2     2     0     0     0     0     0     0     0     0     0
 Hb-Ny:     0     0     0     3     7     0     0     0     0     0     0     0     0     0     0     0     0     0
 Hb-Ts:     0     0     0     0     4     0     0    13     4    19     1     0     0     0     0     3     0     0
 Hb-Wf:     0     0     0     1     0     0     0     0     0     0     0     0     0     0     0     0     0     0
 Ho-Kk:     0     0     0    21    18     3    20    12     8     3     1     4     0     0     0     0     0     3
 Ho-Ny:     0     0     0     7    22    10     0     0     0     0     0     0     0     0     0     0     0     0
 Ho-Ts:     0     0     0    66     5    16    14     2     9    10    18     9    25     0     1     2     0     6
 Ho-Wf:     0     0     0     3     3     0     0     0     0     0     0     0     0     0     0     0     0     0
 Kk-Ny:     0     0     0    91   145    40     7    25     8    25     5     0     0     0     0     0     0     0
 Kk-Ts:     0     0     0     6    48    54    43    95     2     3    30     9     3     4    34     3     0    31
 Kk-Wf:     0     0     0    79    85    63    31    13     3     0     0    15     1     0     0     0     1     0
 Ny-Ts:     0     0     0    63    54   115    45    20    12     8    29    19     4     3     1     6     8     0
 Ny-Wf:     0     0     0   238    64    23    15    16     8     0     0     0     0     1     0     1     0     0
 Ts-Wf:     0     0     0   110    79    98     2     0    14    11     3     9     0     0     0     0     0     0
 Total:     0     0     0   690   552   439   179   204    79    82    87    65    33     8    36    15     9    40
 Total number of obs:  2518  Average SNR:   30.0   Median SNR bin:   30
?
```

The following examble calculates the average spherical distance between pairs of observations:

```
? summary _ _ _ dist
SKED Summary from file ./r1451.skd for experiment R1451
      (all scans with at least one subnet station)
Histogram of distances between pairs of observations
Values are percentages of the total number of pairs

 Degrees:  0   10   20   30   40   50   60   70   80   90  100  110  120  130  140  150  160  170  180  #pairs
HOBART12:   1.3  9.8  9.0 11.7 14.6 15.1 10.6  9.8  8.5  5.2  3.8  2.7  2.2  1.8  1.1  0.8  0.5  0.5    1081
HOBART26:   1.1  6.0  9.5 12.0 14.2 14.3 13.6 11.2  8.4  6.1  4.2  2.8  2.0  1.3  0.8  0.6  0.5  0.5   20910
KOKEE   :   1.3  5.2  9.1 12.0 12.0 12.4 11.0  9.8  8.8  6.8  5.9  4.6  3.8  2.5  1.5  1.1  0.6  0.5   93961
NYALES20:   1.3  5.5  9.9 13.2 13.9 14.3 12.8 10.8  8.6  6.0  4.4  2.8  1.9  1.2  0.8  0.6  0.5  0.5  106491
TSUKUB32:   1.1  4.5  7.8 10.5 11.2 12.0 11.2 10.4  9.2  8.0  6.8  5.1  4.1  2.9  1.8  1.1  0.7  0.5  163306
WESTFORD:   1.4  6.2 11.0 14.4 14.6 14.5 12.4 10.0  7.4  5.3  3.8  2.5  1.7  1.2  0.9  0.7  0.5  0.5   83845
-------------------------------------------------------------------------------------------------------------
Random5 :   1.6  4.5  6.8  8.6  9.8 10.4 10.5 10.1  9.2  8.1  6.7  5.3  3.8  2.5  1.4  0.6  0.1  0.0 (5d min. el)
Random10:   1.7  4.9  7.4  9.3 10.5 11.0 10.9 10.3  9.2  7.9  6.3  4.7  3.2  1.8  0.8  0.1  0.0  0.0 (10d min. el)
?
```

Summary has many options and I encourage the scheduler to ‘play around’ with them. Many of these produce graphical output which is difficult to capture and incorporate in this manual.

sumout

Syntax: **Sumout [filename]**
Synopsis: Output a brief summary.
Comment: Obsolete

Sumout outputs some information to the file specified by *Filename*. If *Filename* is not specified then sumout appends "-sksum.txt" to the experiment name specified in the PARAMETER section of the schedule file.

The following example opens a schedule file and uses sumout to put some information in the file "r1422-sksum.txt".

```
bootes: /home/jmg/schedules>>  sked r1422.skd
sked: Automatic/Interactive VLBI Scheduling Program
      JMG/NRV/AEM HP/Linux SKED 2010Sep16
RDCTL02 - Reading system control file /usr/local/bin/skedf.ctl
RDCTL02 - Reading local control file skedf.ctl
Reading session: R1422
$OP
Minor_cmd: This usage of minor statwt is obsolete.
    Please use new StatWt command to set station weights.
$SKED         1364 scans
$SOURCES        60 sources
$STATIONS        7 stations
$CODES
$HEAD
$FLUX
Re-reading CODES.     (1 frequency codes)
Re-reading HEAD.
Re-reading FLUX.
Re-reading $OP section
$PARAM
PRSET22 - Initializing schedule starting time to 2010-074-17:00:00
Source      Start      DURATIONS
name     yyddd-hhmmss   Ho  Kk  Ma  Tc  Ts  Wf  Wz
0133+476 10074-170000|          43          43  43|
End of listing.
? sumout
? q
```

The file r1422-sksum.txt contains the following:

```
Session R1422
Start 2010-074 17:00:00 MAR. 15
End   2010-075 16:58:27 MAR. 16
Stations     7
Ho  HOBART26  H
Kk  KOKEE     A
Ma  MATERA    B
Tc  TIGOCONC  C
Ts  TSUKUB32  D
Wf  WESTFORD  E
Wz  WETTZELL  F
```

The functionality of sumout is usually replaced by using shell scripts that: 1) start `sked`; 2) use the unit command to specify a file; 3) execute various `sked` command; and 4) quit.

tagalong

Syntax: **tagalong <range> <station>**
Synopsis: Add a station to a set of scans if it meets the SNR targets.
See also: add,delete,remove

Sometimes we are not sure if a station will be available to participate. Because of this we may want to include it in a schedule from the start. Instead we generate the schedule without the station, and then let it participate when it can. This is called letting the stationg **tagalong**. When a station is tagged-along, sked checks to see that it meets the SNR targets, and that the station can slew to the source.

Tagalong is similar to **add** except that in **add** sked does not checks SNR targets, whereas in **tagalong** it will check SNR limits.

NOTE: By default the scanlength will be the minimum scan length that meets the SNR targets. Sometimes you might want to schedule a station for the maximum scan-length in a scan. This can be done by setting VSCAN to off. This is illustrated at the end of this section.

For example, the following part the schedule does not contain NyAlesund:

```
? li ^-172500
Source      Start      DURATIONS
name     yyddd-hhmmss   Kk  Ma  Ny  Tc  Ts  Wf  Wz
0014+813 10004-170000|  47  47          43  43  43|
3C418    10004-170157|      70              70  57|
1334-127 10004-170240|  43          85  85        |
1636+473 10004-170500| 107              58 107  90|
1348+308 10004-170731| 101             101        |
2255-282 10004-170807|     113     113          87|
2209+236 10004-171110|     300     300      85  69|
0828+493 10004-171326| 186             108     186|
1954-388 10004-171710|              89      89    |
0446+112 10004-171829|      49          49      45|
2008-159 10004-171921|             281     281    |
0219+428 10004-172020|     188         121     188|
0912+029 10004-172333|  43              43        |
1044+719 10004-172521|      45              45  43|
End of listing
?
```

We can tag along NyAlesund to the first 20 minutes:

```
? tag ^-172000 ny
Source      Start      DURATIONS
name     yyddd-hhmmss   Kk  Ma  Ny  Tc  Ts  Wf  Wz
0014+813 10004-170000|  47  47  43      43  43  43|
 NOT ENOUGH time between obs
3C418    10004-170157|      70              70  57|
CHKSRCUP4SCAN: At scan start time 17:02:40 source 1334-127 not visible at NYALES20:
az, el=  346.3 -23.8
1334-127 10004-170240|  43          85  85        |
1636+473 10004-170500| 107      99      58 107  90|
SNRAC: SNR of  19 is less than minimum  20 required for Ts-Ny at X-band
```

```
SNRAC: SNR of  13 is less than minimum  15 required for Ts-Ny at S-band
SNRAC: SNR of  12 is less than minimum  20 required for Kk-Ny at X-band
SNRAC: SNR of   9 is less than minimum  15 required for Kk-Ny at S-band
1348+308 10004-170731| 101            101        |
CHKSRCUP4SCAN: At scan start time 17:08:07 source 2255-282 not visible at NYALES20:
az, el=  206.3 -18.1
2255-282 10004-170807|     113     113          87|
2209+236 10004-171110|     300 100 300      85  69|
SNRAC: SNR of  19 is less than minimum  20 required for Kk-Ny at X-band
0828+493 10004-171326| 186            108     186|
CHKSRCUP4SCAN: At scan start time 17:17:10 source 1954-388 not visible at NYALES20:
az, el=  247.8 -35.2
1954-388 10004-171710|              89      89    |
SNRAC: SNR of  16 is less than minimum  20 required for Ma-Ny at X-band
SNRAC: SNR of  14 is less than minimum  15 required for Ma-Ny at S-band
0446+112 10004-171829|      49          49      45|
CHKSRCUP4SCAN: At scan start time 17:19:21 source 2008-159 not visible at NYALES20:
az, el=  250.3 -12.3
2008-159 10004-171921|             281     281    |
SNRAC: SNR of  16 is less than minimum  20 required for Ma-Ny at X-band
0219+428 10004-172020|     188         121     188|
 END OF AUTOCHECKING
?
```

Listing the schedule we see that NyAlesund is included in some of the scans. For other scans it is excluded because it is not visible (the scan at 17:02:40), or it does not meet the SNR targets (the scan at17:07:31).

```
? li ^-172500
Source      Start      DURATIONS
name     yyddd-hhmmss   Kk  Ma  Ny  Tc  Ts  Wf  Wz
0014+813 10004-170000|  47  47  43      43  43  43|
3C418    10004-170157|      70              70  57|
1334-127 10004-170240|  43          85  85        |
1636+473 10004-170500| 107      99      58 107  90|
1348+308 10004-170731| 101             101        |
2255-282 10004-170807|     113     113          87|
2209+236 10004-171110|     300 100 300      85  69|
0828+493 10004-171326| 186             108     186|
1954-388 10004-171710|              89      89    |
0446+112 10004-171829|      49          49      45|
2008-159 10004-171921|             281     281    |
0219+428 10004-172020|     188         121     188|
0912+029 10004-172333|  43              43        |
1044+719 10004-172521|      45              45  43|
End of listing.
?
```

To see the difference between tagalong and add, see the corresponding example under add.

If we want to schedule the tag-along station to observe for the maximum scan-length, then we need to turn the parameter vscan-off. This is illustrated below:
We can tag along NyAlesund to the first 20 minutes:

```
? param Vscan off
? tag ^-172000 ny
Source      Start      DURATIONS
name     yyddd-hhmmss   Kk  Ma  Ny  Tc  Ts  Wf  Wz
0014+813 10004-170000|  47  47  47      43  43  43|
```

```
 NOT ENOUGH time between obs
3C418    10004-170157|      70             70  57|
CHKSRCUP4SCAN: At scan start time 17:02:40 source 1334-127 not visible at NYALES20:
az, el=  346.3 -23.8
1334-127 10004-170240|  43          85  85        |
1636+473 10004-170500| 107     107      58 107  90|
SNRAC: SNR of  19 is less than minimum  20 required for Ts-Ny at X-band
SNRAC: SNR of  13 is less than minimum  15 required for Ts-Ny at S-band
SNRAC: SNR of  12 is less than minimum  20 required for Kk-Ny at X-band
SNRAC: SNR of   9 is less than minimum  15 required for Kk-Ny at S-band
1348+308 10004-170731| 101            101        |
CHKSRCUP4SCAN: At scan start time 17:08:07 source 2255-282 not visible at NYALES20:
az, el=  206.3 -18.1
2255-282 10004-170807|     113     113          87|
2209+236 10004-171110|     300 300 300      85  69|
SNRAC: SNR of  19 is less than minimum  20 required for Kk-Ny at X-band
0828+493 10004-171326| 186             108     186|
CHKSRCUP4SCAN: At scan start time 17:17:10 source 1954-388 not visible at NYALES20:
az, el=  247.8 -35.2
1954-388 10004-171710|              89      89    |
SNRAC: SNR of  16 is less than minimum  20 required for Ma-Ny at X-band
SNRAC: SNR of  14 is less than minimum  15 required for Ma-Ny at S-band
0446+112 10004-171829|      49          49      45|
CHKSRCUP4SCAN: At scan start time 17:19:21 source 2008-159 not visible at NYALES20:
az, el=  250.3 -12.3
2008-159 10004-171921|             281     281    |
SNRAC: SNR of  16 is less than minimum  20 required for Ma-Ny at X-band
0219+428 10004-172020|     188         121     188|
 END OF AUTOCHECKING
?
```

The resulting schedule looks like:

```
? li ^-172500
Source      Start      DURATIONS
name     yyddd-hhmmss   Kk  Ma  Ny  Tc  Ts  Wf  Wz
0014+813 10004-170000|  47  47  47      43  43  43|
3C418    10004-170157|      70              70  57|
1334-127 10004-170240|  43          85  85        |
1636+473 10004-170500| 107      107     58 107  90|
1348+308 10004-170731| 101             101        |
2255-282 10004-170807|     113     113          87|
2209+236 10004-171110|     300 300 300      85  69|
0828+493 10004-171326| 186             108     186|
1954-388 10004-171710|              89      89    |
0446+112 10004-171829|      49          49      45|
2008-159 10004-171921|             281     281    |
0219+428 10004-172020|     188         121     188|
0912+029 10004-172333|  43              43        |
1044+719 10004-172521|      45              45  43|
End of listing.
?
```

Note that in all of the scans, NyAlesund is scheduled for the maximum scan length.

tape

Syntax:	**tape <station> [Mark5A | Mark5B | K5 | <thick|think> [high|low]]**
Synopsis:	List, set media.
See also:	mediaError! Not a valid result for table.
Comment:	This is synonymous with the media. This command is included for compatibility with older schedules.

This command lists or sets the recording media for the station. **Tape** without an argument lists the current media at each site:

```
? media
 ID  Station   Tape length          Density          Passes
 Gc  GILCREEK  17400feet (Thin  )     56700 (HIGH  )     14
 Ma  MATERA    17400feet (Thin  )     56250 (HIGH  )     14
 Ny  NYALES20  17400feet (Thin  )     56250 (HIGH  )     14
 On  ONSALA60  17400feet (Thin  )     56250 (HIGH  )     14
 Wf  WESTFORD  17400feet (Thin  )     56250 (HIGH  )     14
 Wz  WETTZELL  17400feet (Thin  )     56250 (HIGH  )     14
?
```

Since all current schedules are disk-based, we recommend that you use the **media** command.

The syntax for setting the media depends on the kind of media, as summarized below. (Note that we are using the standard "**? CmdName**" syntax to get help about a command.)

```
? media
 Mk3/4 : MEDIA [<station> <THICK|THIN> [<HIGH|LOW>]]
 S2,K4 : MEDIA [<station> <length in minutes>
 MARK5A: MEDIA [<station> MARK5A]
 K5:     MEDIA [<station> K5]
?
```

Occaisonally you will run into a schedule that was scheduled assuming that the stations recorded on tapes. You can change the media to one of the valid disk types, write the schedule out, and the schedule will perform fine. However, it is always better to specify disk recording for stations that have disks. This is because tape-based recording has extra gaps in the schedule for fast-forwarding to the end of pass, or for rewinding the tape.

timeline

Syntax: **timeline [On|Off]**
Synopsis: Display detailed information about timing. This only affects the **check** command.
See also: **check**

If **timeline** is turned on, sked will display detailed information about a station when running the check command. This can be useful for debugging purposes. The default is off.

The following example **checks** several scans from the start of a session with **timeline off**, and then with **timeline on**.

```
? timeline off
? ch ^-170500
Source      Start      DURATIONS
name     yyddd-hhmmss   Gs  Ht  Hb  Is  Ke  Ny  On  Yj  Ts  Ww  Wf  Wz  Yg
0332-403 15348-170000|      43  43                          43           |
0650+371 15348-170000|             295 300 115 211       43         100 300|
0506+101 15348-170236|      93              93            43          75    |
0202+319 15348-170456|      43              43  43  43  43            43    |
0906+015 15348-170658|          46  43  48                43  57          57|
 END OF AUTOCHECKING
? timeline on
? ch ^-170500
Source      Start      DURATIONS
name     yyddd-hhmmss   Gs  Ht  Hb  Is  Ke  Ny  On  Yj  Ts  Ww  Wf  Wz  Yg
0332-403 15348-170000|      43  43                          43           |
 STN  PREV   Wraps  AzBeg  AzEnd  DUR  TAPE SRC  SLEW CAL   START    SLEW -or- SETUP
 Ke 17:00:00 -  -     0.0    0.0   48    1    0    0   10 17:00:48 |       0    20
 Ny 17:00:00 -  W     0.0    0.0   43    1    0    0   10 17:00:43 |       0    20
 On 17:00:00 -  -     0.0    0.0   43    1    0    0   10 17:00:43 |       0    20
 Ts 17:00:00 W  W     0.0    0.0   43    1    0    0   10 17:00:43 |       0    20
 Wz 17:00:00 W  W     0.0    0.0   43    1    0    0   10 17:00:43 |       0    20
 Yg 17:00:00 -  -     0.0    0.0   57    1    0    0   10 17:00:57 |       0    20
 Is 17:00:00 -  -     0.0    0.0   43    1    0    0   10 17:00:43 |       0    20
0650+371 15348-170000|             295 300 115 211       43         100 300|
 STN  PREV   Wraps  AzBeg  AzEnd  DUR  TAPE SRC  SLEW CAL   START    SLEW -or- SETUP
 Ht 17:00:00 -  -   482.1  432.4   43    1    5   40   10 17:01:39 |      40    20
 Ts 17:00:00 W  W   279.1  245.3   43    1    5   26   10 17:01:25 |      26    20
 Wz 17:00:00 W  W   409.7  446.1  100    1    5   20   10 17:02:16 |      13    20
 Ny 17:00:00 W  -   419.8  450.9  115    1    5   25   10 17:02:36 |      25    20
0506+101 15348-170236|      93              93            43          75    |
 STN  PREV   Wraps  AzBeg  AzEnd  DUR  TAPE SRC  SLEW CAL   START    SLEW -or- SETUP
 Ht 17:02:36 -  -   432.1  383.3   93    1    5   28   10 17:04:53 |      28    20
 Ny 17:02:36 -  -   451.3  494.0   93    1    5   31   10 17:04:56 |      31    20
 On 17:00:00 -  -   411.4  474.8  211    1    5   47   10 17:04:34 |      47    20
 Ts 17:02:36 W  W   245.8  295.9   43    1    5   31   10 17:04:06 |      31    20
 Wz 17:02:36 W  W   446.5  465.0   75    1    5   31   10 17:04:38 |      31    20
 Yj 17:00:00 -  -   446.5  465.0   43    1    0    0   10 17:00:43 |       0    20
0202+319 15348-170456|      43              43  43  43  43            43    |
 STN  PREV   Wraps  AzBeg  AzEnd  DUR  TAPE SRC  SLEW CAL   START    SLEW -or- SETUP
 Hb 17:00:00 W  -   246.8  376.6   43    1    5   29   10 17:01:28 |      29    20
 Ke 17:00:00 -  -   352.2  420.8  300    1    5   21   10 17:05:37 |      21    20
 Ts 17:04:56 W  W   296.1  150.8   43    1    5   63   10 17:06:58 |      63    20
 Ww 17:00:00 W  W   232.0  335.6   43    1    5   35   10 17:01:34 |      35    20
 Yg 17:00:00 -  -   367.9  421.0  300    1    5   20   10 17:05:36 |      16    20
 Is 17:00:00 -  -   638.6  510.5  295    1    5   21   10 17:05:32 |      21    20
0906+015 15348-170658|          46  43  48                43  57          57|
```

```
 END OF AUTOCHECKING
??

ch ^-183800
|
 STN  START  DUR TAPE IDLE SOURCE MAXSLEW CAL START
 Wf 18:40:00   0    1    0      5      29  10 18:40:45
 MAXSLEW=SLEW *OR* +SETUP+(EARLY-CAL)
          29          20           0
?
```

twin_telescopes (work in progress, no impact on scheduling)

Syntax: ***Twin_telescopes [List | Add Stat1 Stat2 [SPLIT|JOIN] | Set Stat1 Stat2 [SPLIT|JOIN|-] | Delete Stat1 Stat2]***

Synopsis: List, set delete twin_telescopes

See also: **major**

This command is used to list or set twin telescopes. If the major option SplitTwins is turned on then `sked` schedules the two stations as indicated by the user:

- If SPLIT, the two stations will be scheduled on different subnets, different observations.
- If JOIN, the two stations will be scheduled on the same observations.
- If "-", sked will schedule the two stations normally, as two independent stations.

Twin telescopes appear in the $TWIN_TELESCOPES portion of the schedule file.

```
$TWIN_TELESCOPES
TWINA1    TWINA2    JOIN
TWINB1    TWINB2    SPLIT
TWINC1    TWINC2    -
…
```

Here the first column is the first twin telescope name, the second column is the second twin telescope name, and the third column is the option for scheduling.

Astrometric Keywords	
Option	Description
List	List twin telescopes and their scheduling option.
Add Twin1 Twin2 [JOIN|SPLIT|-]	Add a set of twin telescopes to the twin_telescope list.
Add Twin1 Twin2 [JOIN|SPLIT|-]	Set scheduling option for twin telescopes pair in twin_telescopes list.
Delete Twin1 Twin 2 Option	Delete pair of twin telescopes from twin telescope list.

Twin_telescope li will list the current twin telescopes and their scheduling option.

```
? twin_telescope li
#      Stat1    Stat2  Action
   1 TWINA1    TWINA2   JOIN
   2 TWINB1    TWINB2   SPLIT
   3 TWINC1    TWINC2   -
```

The following command changes the scheduling option for twina1 twina2.

```
? twin_telescope set twina1 twina2 split
 Twin_cmd: WARNING stations already in the list but different action.
 The action will be changed.
? twin_telescope li
#      Stat1    Stat2  Action
```

```
   1 TWINA1   TWINA2   SPLIT
   2 TWINB1   TWINB2   SPLIT
   3 TWINC1   TWINC2   -
?
```

The following command deletes twina1 twina2 from the twin telescopes list.

```
? twin_telescope del twina1 twina2 split
? twin_telescope li
#      Stat1    Stat2  Action
   1 TWINB1   TWINB2   SPLIT
   2 TWINC1   TWINC2   -
?
```

The following adds twina1 twina2 to the list with the scheduling option “JOIN”.

```
? twin_telescope add twina1 twina2 join
 Twin_cmd: warning! Value is JOIN: the two stations will be scheduled together.
? twin_telescope li
#      Stat1    Stat2  Action
   1 TWINA1   TWINA2   JOIN
   2 TWINA1   TWINA2   SPLIT
   3 TWINA1   TWINA2   -
?
```

unit

Syntax: **Unit [print | screen | file [append| overwrite] | saveps]**
Synopsis: Set display unit.
See also:

This command sets the display unit for listings and other displays. Information messages, error messages, and help messages are always written to the screen. The default unit for display is the user's terminal. If the unit command is given with no parameters, the current display unit is shown.

To save output to be sent to a printer, type the command unit print. This will save all standard output (except command error messages) to a temporary file named `/tmp/SKP`*nnnnn* where *nnnnn* is the process ID. When you are finished saving output, type unit screen. This restores screen output but does not close the temporary file. The temporary print file can be added to any time prior to its being printed by using unit print append. You can start the print file over again (without printing it) by specifying overwrite instead of append. The append option is the default. If you attempt to exit from `sked` without closing the temporary file you will be asked whether to abandon it or not.

Output to a permanent *file* works the same way as temporary output. An error is produced if you don't have permission to write to *file*. If you exit from `sked` before closing this file, you will be asked whether to ignore it or not.

To print the output, refer to **`printl`** and **`printp`** commands.

A session of saving output might look like this:

```
? unit print
 Saving to /tmp/SKP01177
? mutual
? unit screen
 Closing file /tmp/SKP01177
 Output returning to the screen
? printp
 request ID is laser-160
Deleting file /tmp/SKP01177
?
```

The output from the mutual command will now be sent to the laser printer. The temporary print file is deleted.

If `sked` is interfaced to the pgplot graphics library, you can save graphical output such as source visibility plots to a postscript file by setting the unit to **`printps.`** This will generate postscript files of the graphical output. You must rename the files.

untag

Syntax: **untag [<range>]**
Synopsis: Remove bad stations from schedule.
See also: add,
check, delete, remove, tagalong

Remove stations that would have problems in scans. This includes:

Arriving late on source
Having too low SNRs.
Source being down.

Having stations that don't work in a scan is usually do to putting in the stations "by-hand", as opposed to letting `sked` do it.

In the example below, a **check** of the schedule from 17:00 to 17:20 and finds several problems.

```
? ch ^-172000
Source      Start      DURATIONS
name     yyddd-hhmmss
0014+813 10004-170000|  47  47  43      43  43  43|
 Following obs occurs   1mins 29secs too early for station Ny
 CHECK99 - Not enough time between these observations
3C418    10004-170157|      70  60          70  57|
1334-127 10004-170240|  43          85  85        |
1636+473 10004-170500| 107      99      58 107  90|
ERROR:  For source: 1348+308
SNRAC: SNR of  19 is less than minimum  20 required for Ts-Ny at X-band
SNRAC: SNR of  13 is less than minimum  15 required for Ts-Ny at S-band
SNRAC: SNR of  12 is less than minimum  20 required for Kk-Ny at X-band
SNRAC: SNR of   9 is less than minimum  15 required for Kk-Ny at S-band
1348+308 10004-170731| 101     101     101        |
2255-282 10004-170807|     113     113          87|
2209+236 10004-171110|     300 100 300      85  69|
ERROR:  For source: 0828+493
SNRAC: SNR of  19 is less than minimum  20 required for Kk-Ny at X-band
 Following obs occurs   1mins 14secs too early for station Ny
 CHECK99 - Not enough time between these observations
0828+493 10004-171326| 186     186     108     186|
1954-388 10004-171710|              89      89    |
ERROR:  For source: 0446+112
SNRAC: SNR of  16 is less than minimum  20 required for Ma-Ny at X-band
SNRAC: SNR of  14 is less than minimum  15 required for Ma-Ny at S-band
0446+112 10004-171829|      49  49      49      45|
2008-159 10004-171921|             281     281    |
ERROR:  For source: 0219+428
SNRAC: SNR of  16 is less than minimum  20 required for Ma-Ny at X-band
0219+428 10004-172020|     188 188     121     188|
 END OF AUTOCHECKING
?
```

We use untag to fix these problems:

```
? untag ^-172000
Source      Start      DURATIONS
name     yyddd-hhmmss   Kk
 Removing
0014+813 10004-170000|  47  47  43      43  43  43|
```

```
 Following obs occurs   1mins 29secs too early for station Ny
CHCMD05 - NYALES20 removed from this scan.
3C418    10004-170157|      70              70  57|
1334-127 10004-170240|  43          85  85        |
1636+473 10004-170500| 107      99      58 107  90|
ERROR:  For source: 1348+308
SNRAC: SNR of  19 is less than minimum  20 required for Ts-Ny at X-band
SNRAC: SNR of  13 is less than minimum  15 required for Ts-Ny at S-band
SNRAC: SNR of  12 is less than minimum  20 required for Kk-Ny at X-band
SNRAC: SNR of   9 is less than minimum  15 required for Kk-Ny at S-band
 Removing station NYALES20 because of low SNR:
1348+308 10004-170731| 101             101        |
2255-282 10004-170807|     113     113          87|
2209+236 10004-171110|     300 100 300      85  69|
ERROR:  For source: 0828+493
SNRAC: SNR of  19 is less than minimum  20 required for Kk-Ny at X-band
 Following obs occurs   1mins 14secs too early for station Ny
CHCMD05 - NYALES20 removed from this scan.
0828+493 10004-171326| 186             108     186|
1954-388 10004-171710|              89      89    |
ERROR:  For source: 0446+112
SNRAC: SNR of  16 is less than minimum  20 required for Ma-Ny at X-band
SNRAC: SNR of  14 is less than minimum  15 required for Ma-Ny at S-band
 Removing station NYALES20 because of low SNR:
0446+112 10004-171829|      49          49      45|
2008-159 10004-171921|             281     281    |
ERROR:  For source: 0219+428
SNRAC: SNR of  16 is less than minimum  20 required for Ma-Ny at X-band
 Removing station NYALES20 because of low SNR:
0219+428 10004-172020|     188         121     188|
 END OF AUTOCHECKING
?
```

A check of the schedule now reveals no problems.

```
? ch ^-172000
Source      Start      DURATIONS
name     yyddd-hhmmss   Kk
0014+813 10004-170000|  47  47  43      43  43  43|
3C418    10004-170157|      70              70  57|
1334-127 10004-170240|  43          85  85        |
1636+473 10004-170500| 107      99      58 107  90|
1348+308 10004-170731| 101             101        |
2255-282 10004-170807|     113     113          87|
2209+236 10004-171110|     300 100 300      85  69|
0828+493 10004-171326| 186             108     186|
1954-388 10004-171710|              89      89    |
0446+112 10004-171829|      49          49      45|
2008-159 10004-171921|             281     281    |
0219+428 10004-172020|     188         121     188|
 END OF AUTOCHECKING
?
```

This example was generated using the **add** command to add NyAlesund to this schedule.

vec, ver,vcc

Syntax: **vec filename**
vcc filename
ver [filename]
Synopsis: Write out vex files.
See also: ec, er, wc, wr, vwc, vwr

This is a standard exit command for vex files. With the **vec** command (**v**ex, **e**xit, **c**reate), a new file is created with the name supplied, and the file being edited is left as it was. With the **ver** command (**v**ex, **e**xit, **r**eplace), the file being edited (or the file named in this command) is replaced by the edited version just produced in this `sked` session.

The **vcc** command is similar to **vec** except that the vex file does not include some sections in the sked file. This was put in at the request at of the Bonn correlator group who found the extra information 'distracting'.

Before exiting, `sked` reads through the schedule file and checks that all of the sources and stations you have scheduled are currently selected. If not, an error message is printed and you will be asked whether you wish to exit anyway, saving the schedule file as is. If possible, you should complete selections before exiting. You can always exit using **abort**.

For the **ver** command, you are asked if you want to replace the file. Only a **y** or **n** is accepted as a response, *i.e.* there is no default.

The current parameter values for the quantities in the `$EXPER` and `$PARAM` sections are always written into the output file. Other sections are re-written from *sked*' s scratch files only if a change has been made, that is, selection has been done or new scans have been added. Unchanged sections are copied in their entirety from the original file.

With both **ver** and **vec**, valid access to the file is checked. The path given in the control file, if any, is pre-pended to the file name you specify in this command. Refer to page SKED- for a discussion of control files.

To save intermediate versions of a scheduling session without exiting from the current schedule, use the **vwc** or **vwr** command.

vlba

Syntax: **VLBA [ON | OFF]**
Synopsis: Turn on or off VLBA mode.
Comment: **Obsolete**

This command was introduced in 1995 when the VLBA first came on line. For the VLBA correlator to function correctly, all of the stations had to be able to observe the source. If VLBA mode is no, `sked` will only schedule scans where the source is up at all stations.

The command without an argument will toggle VLBA mode:

```
?
? vlba

VLBA full-observe mode is being turned ON

?
```

Alternately, you can explicitly turn the mode on or off:

```
? vlba off
?
```

vscan

Syntax: **Vscan [<source> [<subnet>]]**

Synopsis: This command displays the scan length and SNR by baselines for a set of sources at the current time. If source is _ then it will list this for all sources.

See also:

The example below lists the durations and SNR for the Hobart-Kokee-NyAlesund baseline for all sources. Under duration a dash indicates that the source is not visible, or it is impossible to meet the SNR targets. Under SNR a dash indicates that the station does meet the targets.

```
? vscan _ hokkny
 Variable scan info for SX (GEOSX   )
 Durations & SNRs for X-band
   Source    | Durations       | Baseline SNRS
             |   Ho   Kk   Ny  |   H-K  H-N  K-N
 1 1237-101  |   77   77   48  |    20   24   20
 2 2216+178  |   -    -    -   |    -    -    -
 3 1601+112  |   -    -    -   |    -    -    -
 4 2030+547  |   -    -    -   |    -    -    -
 5 1903-802  |   46   50   50  |    21   32   20
 6 0833+585  |   61   58   61  |    23   37   20
 7 1622-297  |   43   49   49  |    21   31   20
 8 0602+673  |  105   -   105  |    -    20   -
 . . .
 Durations & SNRs for S-band
   Source    | Durations       | Baseline SNRS
             |   Ho   Kk   Ny  |   H-K  H-N  K-N
 1 1237-101  |   77   77   48  |    54   34   39
 2 2216+178  |   -    -    -   |    -    -    -
 3 1601+112  |   -    -    -   |    -    -    -
 4 2030+547  |   -    -    -   |    -    -    -
 5 1903-802  |   46   50   50  |    19   15   17
 6 0833+585  |   61   58   61  |    21   15   18
 7 1622-297  |   43   49   49  |    31   25   29
 8 0602+673  |  105   -   105  |    -    29   -
. . .
?
```

vwc, vwr

Syntax:	**vwc filename,**
	vwr [filename]
Synopsis:	Write out vex files.
See also:	vwc, vwr, ec, er, wc, wr

Similar to the **vec** and **ver** commands, the v**wc** command (**v**ex **w**rite, **c**reate) creates a new file with the name supplied, and the **vwr** command (**v**ex, **w**rite, **r**eplace) replaces the file being edited (or the file named) with the edited version just produced in this sked session. The difference in the v**ec**, v**er**, and v**wc**, v**wr** commands is that you end the edit session with the former commands whereas you return to where you were in the scheduling with the latter.

With the **vwr** command, you are asked to confirm replacement of the file. With both commands, valid access to the file is checked.

Before saving, sked reads through the schedule and checks that all of the sources and stations you have scheduled are currently selected. If not, an error message is printed and you will be asked whether you wish to continue anyway, saving the schedule file as is.

For the v**wr** command, the current values for the $EXPER and $PARAM sections are always written into the output file. Other sections are re-written from sked's scratch files only if a change has been made, that is, selection has been done or new observations have been added. Unchanged sections are copied in their entirety from the original file.

If you do a **vwc** command, the newly-created filename becomes current and further saves can be accomplished with **vwr** or **ver.**

Sked writes out the $EXPER, $PARAM, and unchanged file sections first, followed by the sections that have been modified in this scheduling session. Thus the order of the sections within the schedule file may change depending on what changes you make in your schedule.

The path specified in the control file, if any, is pre-pended to the file name specified with this command.

wc, wr

Syntax:	**wc** *filename* **wr** **[***filename***]**
Synopsis:	Write out a file.
See also:	ec, er

Similar to the **ec** and **er** commands, the **wc** command (**w**rite, **c**reate) creates a new file with the name supplied, and the **wr** command (**w**rite, **r**eplace) replaces the file being edited (or the file named) with the edited version just produced in this `sked` session. The difference in the **ec**, **er**, and **wc**, **wr** commands is that you end the edit session with the former commands whereas you return to where you were in the scheduling with the latter.

With the **wr** command, you are asked to confirm replacement of the file. With both commands, valid access to the file is checked.

Before saving, `sked` reads through the schedule and checks that all of the sources and stations you have scheduled are currently selected. If not, an error message is printed and you will be asked whether you wish to continue anyway, saving the schedule file as is.

For the **wr** command, the current values for the `$EXPER` and `$PARAM` sections are always written into the output file. Other sections are re-written from `sked`'s scratch files only if a change has been made, that is, selection has been done or new observations have been added. Unchanged sections are copied in their entirety from the original file.

If you do a **wc** command, the newly-created filename becomes current and further saves can be accomplished with **wr** or **er**.

`Sked` writes out the `$EXPER, $PARAM,` and unchanged file sections first, followed by the sections that have been modified in this scheduling session. Thus the order of the sections within the schedule file may change depending on what changes you make in your schedule.

The path specified in the control file, if any, is pre-pended to the file name specified with this command.

whatsup

Syntax: **whatsup [[<subnet> [Full|Min|No [<time>]]]**
Synopsis: Display sources that are currently visible.
See also: auto

This command displays a list of sources which are up and available for the next scan. The telescope pointing position and slewing time required are displayed for each station in the *subnet* specified, or for the stations in the default subnet if nothing is specified. The pointing positions are listed as of the end of the slewing time, *i.e.* when the new scan could begin. The tape and time status at the end of the current scan at each station is also displayed. The program also looks ahead by the amount indicated in the parameter **lookahead** and will print a message if any source will rise or set within this amount of time in the future. Lookahead is done in steps of 1/20th of **lookahead** parameter. A source is displayed if it is visible at more than one station in the subnet, or if it is visible at one station and will rise at one or more stations during the lookahead time.

The standard display consists of azimuth, elevation, and slewing time for each station. This is also the **min** display. The **full** display includes hour angle as well. The **no** option will not make any display; this is useful in auto-select mode if you are only interested in the chart of the "best" observations.

The parameter **width** determines how many stations can fit across the screen or a page. The fixed part of the display is 25 characters and each station needs 16 characters for **full** and 12 characters for **min**. If you have 10 stations, a **width** of 145 will display all 10 in landscape orientation on a printed page. An example display is shown below.

```
?  wh _ full
Auto Mode:       F
Fill-In Mode:    T  Subnet: Hb-Ho-Kk-Ny-Ts-Wf-
 WHATSUP display for frequency code SX (GEOSX   )
                           Hb(HOBART12)      Ho(HOBART26)      Kk(KOKEE   )
      End of current obs:     17:00:00 1F00000 17:00:00 1F00000 17:02:02 1F00000
  Remaining:                 *****s=010000ft  *****s=010000ft      0s=010000ft
  # Source   Scan Last    Obs  H.A. Az El  Sl   H.A. Az El  Sl   H.A. Az El  Sl
  1 2353-686  196            | 3.8 210 51 0.0 | 3.8 210 51 0.0 | 7.4 203-27 2.2 |
  2 0524-485  196            |-1.7 117 71 0.0 |-1.7 117 71 0.0 | 1.9 199 15 2.1 |
  3 1601+112  196            |11.6 190-57 0.0 |11.6 190-57 0.0 |-8.8  60-31 0.9 |
  4 1806-458  196            | 9.5 205  5 0.0 | 9.5 205  5 0.0 |-11. 154-62 1.7 |
  5 1758+388  196            | 9.7 273-63 0.0 | 9.7 273-63 0.0 |-11.  17-25 0.6 |
  6 1049+215  196            |-7.2  85-26 0.0 |-7.2  85-26 0.0 |-3.6  80 40 1.1 |
  7 0723+219  196            |-3.7  51  7 0.0 |-3.7  51  7 0.0 |-0.2  97 88 1.3 |
  8 2000+148  196            | 7.7 264-27 0.0 | 7.7 264-27 0.0 |11.2 342-50 0.3 |
  9 2245-328  196            | 4.9 254 33 0.0 | 4.9 254 33 0.0 | 8.5 245-42 2.5 |
 10 0221+067  196            | 1.3 336 37 0.0 | 1.3 336 37 0.0 | 4.9 270 18 0.6 |
 11 0003-066  196            | 3.6 291 30 0.0 | 3.6 291 30 0.0 | 7.2 271-18 0.6 |
 12 0059+581  196 00:00:43  2| 2.7 340-16 0.0 | 2.7 340-16 0.0 | 6.2 327 17 *** |
 13 CTA26     196            | 0.0 359 49 0.0 | 0.0 359 49 0.0 | 3.6 253 32 2.6 |
 14 0405-385  196            |-0.4  49 84 0.0 |-0.4  49 84 0.0 | 3.2 217 15 2.3 |

. . . more sked output
```

```
Total tested:   57  Tested for Minor:  34
Source   Dur: |0059+581     43   |1424-418    269   |0800+618    285   |
Stations:     |B HWA- 1F000000   |B H-A-K-TC 1F000  |B HWA-TC 1F00000  |
Start time:     | 10277170000         | 10277170350         | 10277170255         |
================================================================================
==
Source   Dur: |1741-038    136   |1049+215    235   |1057-797    100   |
Stations:     |B H-A-KWTW 1F000  |B A-TC 1F000000   |B H-A-K-N-TWE- 1  |
Start time:     | 10277170312         | 10277170303         | 10277170412         |
================================================================================
=
. . .
?
```

The start of the display is a summary of what sources are up at what station. This is followed by a list of some of the best scans using the algorithm employed in automatic scheduling. A fuller description of the display follows.

On the display, the first line lists the station IDs. The second line shows the ending time of the current observation and the pass number, direction, and footage count of the tape at that station. The `Remaining` line shows how much footage remains on this pass of the tape and how many seconds of recording time this footage corresponds to.

`Scan` is the scan length for this source, which will be used only if parameter **vscan** is **n**. `Last` is the time since this source was last observed, on any subnet, in hours and minutes. The current time is taken as the time of the first station displayed by this command. `Obs` is the number of scans so far in the schedule on this source.

`Az` and `El` give the azimuth and elevation of the source at the time the new observation could begin at that station, in integer degrees. `Sl` is the time in decimal minutes that the antenna requires to slew from the current source to the listed source. The current source being observed at each site is indicated by `**` in place of the slewing time.

If parameter **snr** is **auto**, then information is not displayed for stations for which the source cannot be observed due to low SNR. Because the SNR calculations depend on the actual subnet used to schedule, the display may not be exactly consistent with the results you will see in scheduling a source if you specify a subnet. **whatsup** considers that if the SNR is too low on any of the baselines to a station, it will drop that station from the display.

The *time* field specifies the ending time of the automatic schedule generation. *time* is in standard `sked` time format. `Sked` will automatically select scans to fill up the schedule from the time of the current scan, stopping when *time* is reached. You can generate one new automatically selected subconfiguration if you use the period, **.**, which means the current time. If no *time* is given then only a display is shown and no observations are added to the schedule.

Selection of subconfigurations for evaluation is performed during the execution of the **whatsup** command.
If the command **subcon on** was issued, then each subconfiguration that is evaluated is also displayed on the screen. The display is the full schedule entry as it would appear in the `$SKED` section of the schedule file.

If the normal equations have been set up with the **op go** command or if the sky coverage option is turned on, then a chart of 15 highest ranked subconfigurations are displayed. Ranking is done according to how much each new subconfiguration would improve the schedule. For each optimized parameter the relative improvement in the matrix of normal equations is displayed. The criterion for ranking the subconfigurations is the sum of these values.

xlist

Syntax: **Xlist [?|list|clear|on|off|feet|azel|wrap|dur|snr|max |flux|freq|sky|long]**
Synopsis: Turn on extended listing options.
See also: list

By default `sked` lists the source, start time, and durations of stations. For example:

```
? li ^-170500
Source      Start      DURATIONS
name     yyddd-hhmmss   Ho  Kk  Ma  Tc  Ts  Wf  Wz
0133+476 10074-170000|          43          43  43|
1657-261 10074-170000|  43  43          43        |
2008-159 10074-170139|     251     251            |
1800+440 10074-170146|                 43  43     |
1725+044 10074-170316|  99              99        |
0420+022 10074-170419|          94          94  43|
1617+229 10074-170617|  43              43        |
End of listing.
?
```

There are frequently times when you want more information about the scans. The **xlist** command controls which additional information is displayed.

The xlist? Command displays information about the command:

```
? xl ?
List, Clear, Toggle Extended listings
Usage: Xlist <option>
?         This screen
Clear     Clear all values
List      List values currently set
Off       Turn off extended listing
On        Turn on extended listing
--otions listed below--
AzEl      AzEl
Dur       Duration
Flux      Fluxes by baseline
Freq      2-letter freq code
Feet      Tape footage
HA        Hour Angle
Long      Long format for AzEl
Max       Include cal time, procedures
Sky       Sky distribution info
SNR       SNR by baseline
Wrap      Include cable wrap
? xl max
```

All of the **xlist** options are toggles. If they are off, typing **xlist option** will turn them off. If they are off, it will turn them on. To clear all of the **xlist** options, use the **clear** parameter. For example, to turn on information about the pointing if it is currently off, you would enter:

```
? xl azel
? li ^-170500
Source      Start      AZ  EL  AZ  EL  AZ  EL  AZ  EL  AZ  EL  AZ  EL  AZ  EL  DURATIONS
name     yyddd-hhmmss     Ho      Kk      Ma      Tc      Ts      Wf      Wz    Ho  Kk  Ma  Tc  Ts  Wf  Wz
0133+476 10074-170000|       |       | 301 47|       |       |  65 70| 290 53|          43          43  43|
1657-261 10074-170000|  76 54| 195 40|       |       | 137 13|       |       |  43  43          43        |
```

```
2008-159 10074-170139|       | 136 40|       | 280 39|       |       |       |     251     251             |
1800+440 10074-170146|       |       |       |       |  60 43| 304 30|       |       |                43  43    |
1725+044 10074-170316|  53 27|       |       |       | 110 32|       |       |  99             99            |
0420+022 10074-170419|       |       | 211 48|       |       | 103 18| 202 41|          94          94  43|
1617+229 10074-170617|  27 20|       |       |       | 104 57|       |       |  43             43            |
End of listing.
?
```

Some of the information, such as durations and pointing info is given on a station-by-station basis. Other information, such as fluxes or SNRs is given by baseline and by flux. This can make the output lines very long.

If a program uses extended `sked` output generated in batch mode, we recommend that you use **`xlist clear`** to clear all of the toggles, and then turn on the options you want.

xnew

Syntax:	**XNEW [On | OFF [SNR|FLUX|BASE|SEFD]**
Synopsis:	Display more information when a scan is scheduled.
See also:	xlist

This is similar in some ways to xlist which allows you to display more information when listing a schedule. Xnew displays more information when scheduling a scan manually.

Xnew by-itself will toggle it on or off.

Here is an example of scheduling a scan manual for 0059+581:

```
? / 0059+581
Checking new obs on 0059+581         with Hb Ho Kk Ny Ts Wf
CHKSRCUP4SCAN: At scan start time 17:00:43 source 0059+581 not visible at HOBART12:
az, el=  339.5 -16.6
CHKSRCUP4SCAN: At scan start time 17:00:43 source 0059+581 not visible at HOBART26:
az, el=  339.5 -16.6
Checking new obs on 0059+581         with Kk Ny Ts Wf
                     Kk         Ny         Ts         Wf
Prev. end:       1F000000   1F000000   1F000000   1F000000
New start:       1F000000   1F000000   1F000000   1F000000
Spin run (ft):          0          0          0          0
        (sec):          0          0          0          0
Slewing (min):        0.2        0.2        0.2        0.2
Idle time (sec):        0          0          0          0
Duration (sec):        43         43         43         43
Obs start time:  17:01:19
Subnet:          Kk-Ny-Ts-Wf
Accept observation (Y/N) y
SIMUL02: Inserting | 0059+581  10 SX PREOB  10277170119      43 MIDOB       0 POSTOB
KWNWTW
0059+581 10277-170119|  43  43  43  43|
?
```

Here is the result of issuing the same command when xnew is on:

```
? xnew on
? / 0059+581
Checking new obs on 0059+581         with Hb Ho Kk Ny Ts Wf
```

```
CHKSRCUP4SCAN: At scan start time 17:00:43 source 0059+581 not visible at HOBART12:
az, el=  339.5 -16.6
CHKSRCUP4SCAN: At scan start time 17:00:43 source 0059+581 not visible at HOBART26:
az, el=  339.5 -16.6
Checking new obs on 0059+581         with Kk Ny Ts Wf
                    Kk         Ny         Ts         Wf
Prev. end:       1F000000   1F000000   1F000000   1F000000
New start:       1F000000   1F000000   1F000000   1F000000
Spin run (ft):          0          0          0          0
        (sec):          0          0          0          0
Slewing (min):        0.2        0.2        0.2        0.2
Idle time (sec):        0          0          0          0
Duration (sec):        43         43         43         43
Obs start time:  17:01:19
 SNR by baseline:
          X-band               S-band
     Kk  Ny  Ts           Kk  Ny  Ts
 Ny  30               Ny  22
 Ts  62  86           Ts  59  38
 Wf  20  43  49       Wf  18  25  23
 Observed flux by baseline:
          X-band                    S-band
       Kk   Ny   Ts             Kk   Ny   Ts
  Ny  0.9                 Ny  0.6
  Ts  1.2  1.0            Ts  0.9  0.7
  Wf  0.9  1.2  0.8       Wf  0.6  1.0  0.5
 Projected baseline lengths (km):
        Kk    Ny    Ts
  Ny  7361.
  Ts  4503.  6495.
  Wf  7647.  3102.  8503.
SEFDs (* = adjusted for elevation):
           Kk       Ny       Ts       Wf
Elevation  17.2     55.8     59.0     11.1
X-band   2261.3*   907.2*   320.0   1883.0*
S-band    804.6*  1205.3*   360.0   1626.5*
Subnet:          Kk-Ny-Ts-Wf
Accept observation (Y/N) ?y
SIMUL02: Inserting | 0059+581  10 SX PREOB  10277170119      43 MIDOB       0 POSTOB
KWNWTW
0059+581 10277-170119|  43  43  43  43|
?
```

Chapter 5 Algorithms Used in Sked

This section describes the algorithms, definitions, and equations used by `sked` for critical processes and calculations. References to subsections are made throughout the command descriptions.

This section does not discuss the algorithms used in automatic scheduling which are described in a separate chapter.

Definition of a Valid Scan

There are several criteria which must be met in order for a scan to be valid. The following things are checked when a new observation is scheduled and during **`check`**, **`autoshift`**, or **`tagalong`**.

1. The new source must be within antenna limits within one hour after the end of the previous scan. This allows for the case when the source has not yet risen at the beginning of the slew, but may still be up for the start of the next scan.
2. The source must be within antenna limits at the start of the scan and at the end of the scan.
3. At antennas with az-el mounts, the continuity of the scan is checked to ensure that it begins and ends on the same cable wrap.
4. At antennas with az-el mounts, the slew to the new source is checked for convergence. This problem could arise if the source is on one portion of the cable wrap at the beginning of the slew, but by the end of the slew, it has moved onto the other portion of the wrap.
5. When automatic scan length calculations are enabled, the source strength and antenna sensitivity must be sufficient to achieve the specified minimum SNR on all baselines to the antenna.
6. The antenna must not be down during any part of the scan.

Subnetting

Immediately after station selection, a default subnet is initialized to hold all of the stations just selected. Thereafter, `sked` attempts to schedule each station in the default subnet to participate in each observation if no particular subnet is specified. The stations in the default subnet may be changed at any time via the parameters subnet command.

You can schedule an observation in which fewer than the total number of stations in the default subnet participate. This is accomplished either by specifying a subnet in the new observation command, which overrides the default subnet for that observation, or letting `sked` eliminate stations automatically when it finds that a source is not up at a particular station or that a source has insufficient SNR at a station.

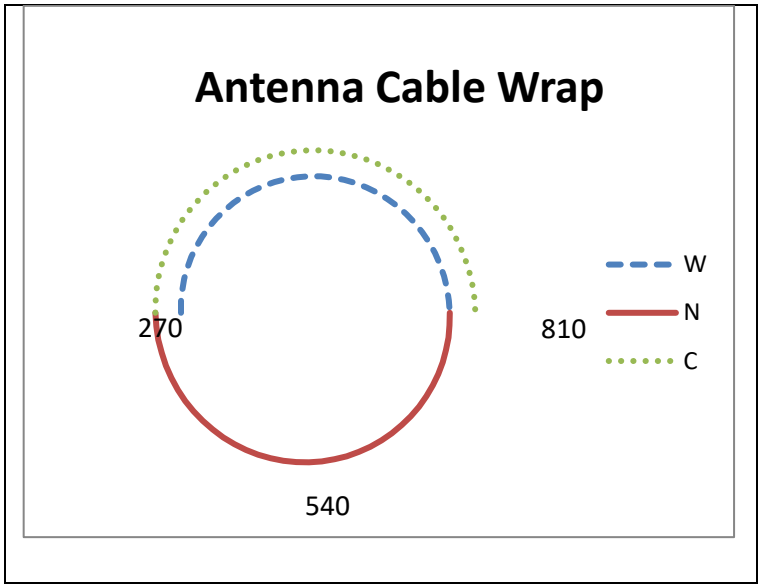
When the observation is scheduled, the slewing times for only the subnet stations are taken into account in calculating the start time and the tape footage count is advanced for the subnet stations only. Subsequent observations have slewing times and tape footage calculated from the last observation in which a station participated. Observations are written into the schedule such that all observations appear in increasing time order.

Antenna Models

This section describes various models related to the antenna.

Cable Wrap

Cable wrap is only a concern for az-el antennas. The entire cable is viewed as a single continuous wrap which begins at a certain (positive) azimuth and proceeds clockwise through ever-increasing azimuths to the end of the cable. Negative values for azimuth cable limits are not understood by `sked`. An antenna that can move between -90° azimuth and +450° azimuth is specified as having a cable wrap range between 270° and 810°.



The total angular range typically depends on the antenna, and varies from 360° at Westford, which has no overlap, to 710° at Tsukuba. If ther angular range is greater than 360°, there are some azimuths that correspond to two values of the cable wrap.

The so-called “neutral point” is located halfway between the azimuth travel limits of the telescope. The two parts of the cable, one on either side of the neutral point, are designated by the letters “C” (clockwise) and “W” (counter-clockwise), where clockwise and counter-clockwise are the direction of travel from the neutral point looking down on the antenna.

The azimuth limits displayed by the station list command show the full range for the az-el telescopes. In listings, azimuths are displayed in the range 0° to 360° degrees. If a telescope azimuth falls in a non-unique portion of the cable, it is tagged by a letter indicating on which wrap (C or W) the telescope is positioned. The letters “W” and “C” are used to request that an observation be scheduled such that the telescope moves to that wrap for the observation.

You can display the cable wrap by using the “Xlist Wrap” command.

For each observation an az-el antenna is in, sked specifies the azimuth position at the start of a scan in terms of a number (the azimuth) and a letter which is either "-", "C", or "W" for neutral, clockwise and counter-clockwise. It is important to emphasize that the wrap is the position at the *start* of the scan, and may not be the wrap at the end of the scan, or at the starting time of the next scan. This is particularly true if a scan starts near the edge of a boundary. In this case it can sometimes happen that the scan ends on another cable-wrap, or that by the time the next scan starts the antenna (which continues to track the source) has drifted to another cable wrap.

In calculating how to slew the antenna to get to the next source, sked has to determine what the current cable wrap is at the start of the source. It uses the following algorithm. Let az_cur be the current position and cwrap_cur the associated cable wrap of the previous observation. Let az_new be the azimuth of the new observation. The azimuth (including cable-wrap) are given by the following Fortran code snippet:

```
      if (az_cur.LT.STNLIM(1,1,ISTN)) az_cur=az_cur+TwoPi
      if(cwrap_cur .eq.'C ' .and.
     &   az_cur+twopi .lt. stnlim(2,1,istn)) az_cur=az_cur+TwoPi

      if (az_new.lt.stnlim(1,1,istn)) az_new=az_new+TwoPi
```

The second line takes care of the problem where the antenna may have drifted from one wrap region to another.

As part of scheduling an observation, sked needs to calculate the slew time. This depends on the time required to move the antenna in both azimuth and elevation.

1. Because some ranges of azimuth are in two cable-wrap regions (the region -90° do +90° in the above example, there may be two ways of moving from a given azimuth point to the next azimuth point. Sked always chooses the shorter distance.
    a. Suppose that the first point is in the neutral region at, say Az=100° (460° Cable-wrap), and the next point is also in the neutral region, Az=120° (or 480° cablewrap). There is only one way of moving from point one to point two.
    b. Suppose that the first point is in the neutral region at, say Az=100° (360° Cable-wrap), and the next point is in the overlap region at Az=10°**.** There are two possible values of cablewrap: 370° or 630°. One of these involves traveling 170°**,** while the other involves traveling 530°. Sked will choose the shortest distance.
    c. If both points are in the overlap region, then there will be two ways of traveling. Sked will choose the shortest**.** For example, if there is a point at Az=10° and the next observation is at Az=20°, there are two ways of moving. The shortest distance is 10° while the other paths involve moving either 350° or 370°, depending on the cable wrap of the first point.

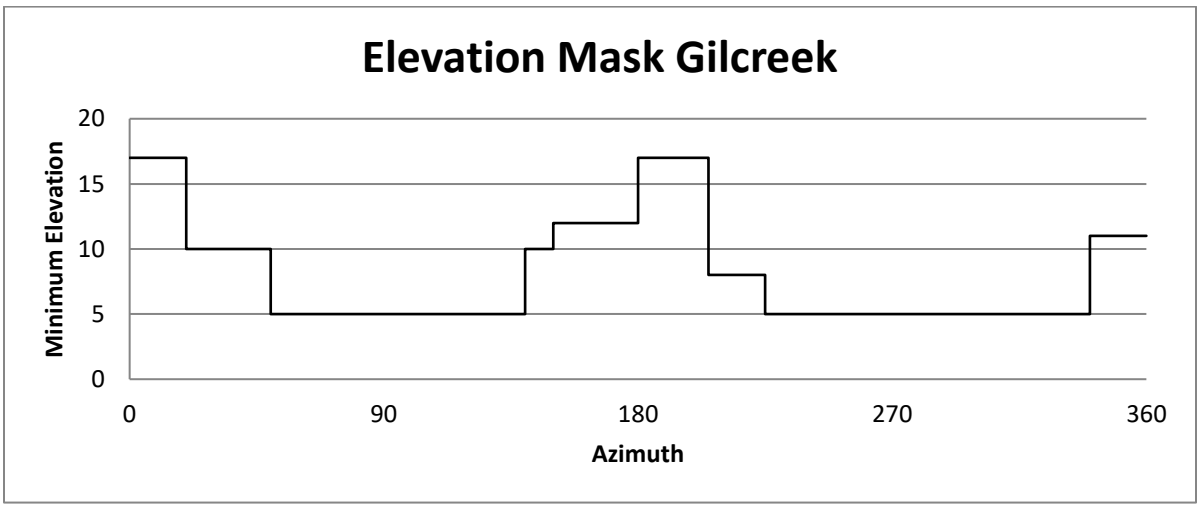
2. If the distance between two successive azimuth points differs by exactly 180 degrees, then the two paths have the same slew time. `Sked` tries to avoid these points because it cannot predict which direction the antenna will move in, and will not schedule such points in automatic mode.
3. Because of imperfections in the cablewrap model at the egdges, `sked` avoids scheduling observations which occur close to the edge of a cable wrap. For example, `sked` may think the upper limit is 810°. If the upper limit is really 805° and an observation is scheduled for 808°, the antenna will move to the cablewrap position of 548°, which differs by 360°. Because of this possible problem, in automatic mode, `sked` will not schedule observations in the last 5° of cablewrap.

Horizon Mask

`Sked` models the horizon mask as a series of step functions. The "H" lines in the schedule file describe the elevation mask. As a concrete example, the horizon mask at Gilcreek is:

```
H GILCREEK AL 0 17 20 10 50 5 90 5 140 10 150 12 160 12 180
17  205 8 225 5 290 5 340 11 360 17
```

The numbers following the two letter station code "AL" give the mask. `Sked` alternates azimuths and minimum elevations. The minimum elevation is assumed to be constant between azimuths. In the above example the minimum elevation is 17 degrees between 0 and 20. Betwenn 20 and 50 it is 10 degrees. Between 50 and 90 it is 5 degrees, etc. The figure below is a graphical representation of the elevation mask.



Elevation-dependent Sensitivity

`Sked` calculates and applies an elevation-dependent reduction in sensitivity that is due to the atmosphere's addition to system temperature. In addition, some antennas have an elevation-dependent sensitivity due to changes in the amount of ground pickup caused by feed spillover. The formulation in `sked` accounts only for the system temperature contribution to an antenna's sensitivity

and ignores actual gain effects. The dependence of sensitivity on elevation has been determined from system temperature data recorded at the stations and is applied in `sked` when you use automatic calculation of scan lengths to achieve a minimum SNR.

The program uses an algorithm developed by Dave Shaffer that scales the zenith SEFD to compute an elevation dependent SEFD:

$$SEFD(el) = SEFD_{zenith} \times f(el)$$

Where $f(el)$ is a function of the elevation involving powers of 1/sin(el):

$$f(el) = \sum_{i=0}^{n} \frac{c_i}{\left(\sin el^{y}\right)^{i}}$$

where

n = number of terms, usually 1 to 3

el = elevation of the source

c_i = coefficient for the ith term

y = power of the sin(el) term, generally $0 < y \leq 1$

Refer to the `sked`'s catalogs manual for the way the values of c_i and *y* are entered into the equip.cat catalog file. Adjusted values of SEFDs are displayed when you schedule an observation interactively.

Recording Options.

`Sked` supports three types of recording known as "start&stop", "continuous", and "adaptive". These recording options were developed in the days when tapes were used to record data. To change the recording option use the TAPE commaon for each station. (The name is an arftifact of when recording was done using tapes.

1. Start&Stop Motion. This is the default recording type. Data starts recording at the beginning of a scan, and stops at the end of a scan.
2. Continous motion. (Obsolete) Data is taken continuously from the start of the session to the end. This mode was introduced because some correlators could not handle Start&Stop.
3. Adaptive. (Obsolete) This mode is similar to Start&Stop unless the time between adjacent scans is under some threshold. If the gap between scans is under this threshold, the recorder will continue recording through the gap. Adaptive mode was introduced because some correlators took extra time to "synch-up". On the one hand, with continuous observing you only have to synch-up once but you record more data than is used. On the other hand, if you use Start&Stop mode the correlator speds a lot of time synching up. Hence this is a compromise between minimizing recording media and synch time.

Tape Speed

As all recording is now done using disks this section is obsolete and is included for historical reference.

Tape speed is calculated with the following equation:

speed = ohfac × r /(bitdens × n)

where

ohfac = 9/8 for Mark III/IV data-replacement (DR) format
= 9.072/8 for VLBA non-data-replacement (NDR) format

n = fanout factor, either 1, 2, or
r = sample rate in bits/sec
bitdens = bit density in bpi

33333 for Mark III/IV data-replacement format (thick tape).
34020 for VLBA non-data-replacement format (thick tape).
56250 for Mark III/IV data-replacement format (thin tape).
56700 for VLBA non-data-replacement format (thin tape).

Note that bit density depends on the recording mode, not on the station equipment, but remember that Mark IV equipment can only record in data-replacement modes while VLBA equipment can do either mode. The high density modes require thin tape to be used.

Source Modeling

This section describes the various models sked uses in describing the sources.

Rise/Set Calculations

`Sked` needs to know whether a source is "up" at a given station at the current time many, many times during the generation of the schedule. One approach would be to calculate the source's whenever it is needed, and then test to see whether it is visible at a station. A more efficient procedure is to calculate when a source rises and sets at each station and then to store this. When we need to know if a source is up, we just check to see if the current time is between the rising and setting times. This approach reduces the total calculations in the program by 30%.

One complication in this approach is that `sked` keeps time internally as UT, but sources rise and set at the same sidereal time each day. Therefore, it is necessary to store the rise and set times as sidereal times. When it is needed to know whether a source is up at a certain station, the appropriate time conversion must be made.

`Sked` indicates the first time it calculates the rise and set times, and counts the source numbers off as they are completed. This process can take many seconds to complete.

Multiple Rises/Sets

The simplicity of this approach is complicated by the station horizon mask that effectively lets a source "rise" and "set" multiple times. A source's path across the sky may go behind an obstruction after it rises, then emerge from behind the obstruction later. For example, this effect occurs for a few sources at Fairbanks and at Fort Davis where there are mountain peaks on the horizon. `Sked` finds all of the risings and settings for each source and stores them all, then checks the appropriate one to decide whether a source is up. Currently, `sked` can handle up to 4 rise and set times per source per station. If a source rises and sets more than 4 times in a day, an error message is issued and `sked` stops. None of the source/station combinations used has more than 4 rise/set values.

Another example occurs when a source passes directly overhead at a station with an az-el mount. The source will appear to "set" during the time it transits the keyhole at zenith.

In such cases, the *sitevis* display will show only the initial rise and first "setting" of the source. This is due to the algorithm used for mutual visibility displays. A different algorithm is used for the whatsup display and the new scan calculations are always correct. The source's position for a new scan is checked at the current time and at the end of the proposed observation. If the scan is possible, it will be displayed by `whatsup` and scheduled if requested. `Sked` will not let you schedule an impossible observation.

There is one case for which `sked` will not do the right thing. This is the case when the scan happens to begin before the source "sets" into the obstruction or keyhole and ends after the source has "risen" out of the obstruction or keyhole. Since only the beginning and end of the scan are checked, `sked` would think this is a valid scan.

Source Structure Models

Source structure models are used in `sked` to calculate the predicted observed flux on each baseline of a scan. The current implementation uses elliptical gaussian models. Parameters for the source models are found in the $FLUX section of the schedule file.

The effect of having sources with extended structure is that they are partially resolved on long baselines, thus reducing the observed flux. The baseline length that is appropriate is the projected baseline. For example, when a source is rising at Mojave, the baseline to Westford is foreshortened and therefore generally more of the source's flux would be observed than when the source is more nearly overhead at both stations.

The equations below are used in `sked` to compute the observed flux density for a given scan. All angles are in radians, uv components are in wavelengths, and flux density is in Jy. The observed flux for all components is added to obtain the total observed flux for a given scan. As of this release of SKED, offsets of components from a centroid is NOT implemented. Separate calculations are done for X- and S-band.

The observed flux for one model component is calculated from the following equation:

$$obsflux = flux \times \exp \frac{-(\pi\theta\ell)^2}{4\ln 2}$$

Where

obsflux = predicted flux density that will be seen for this observation, for this component.
flux = total flux density of the component.
θ = size of the major axis of the component.
ℓ = effective baseline length, taking into account the baseline projection and the position angle of the component. For a circular source, ℓ is the projected baseline:

$$l^2 = (v\cos pa + u\sin pa)^2 + R^2(u\cos pa - v\sin pa)^2$$

$$u = b_x \sin GHA + b_y \cos GHA$$

$$v = b_z + \sin\delta(-b_x \cos GHA + b_y \sin GHA)$$

Where:

bx, by, bz = components of the baseline.
R = axial ratio of the component (1.0 for circular).
ba = position angle of the component major axis with respect to the origin.
GHA = Greenwich hour angle of the source.
δ = source declination.

The observed fluxes by baseline are displayed in matrix form when a new scan is scheduled interactively.

The projected baselines that are displayed in matrix form when a new scan is scheduled interactively are calculated from the u and v components:

$$projectedbaseline = \sqrt{u^2 + v^2}$$

The calculations of observed flux for the vscan command are slightly different because there is no epoch associated with the calculations. The equations are identical except for the calculation of u and v. For the vscan command:

$$u = \sqrt{b_x^2 + b_y^2}$$
$$v = b_z \cos\delta$$
$$projectedbaseline = \sqrt{b_x^2 + b_y^2 + b_z^2}$$

SNR Calculations

Basic Equations

`Sked` will attemptto schedule scans to meet the minimum SNR targets. The SNR depends on the source strength, antenna SEFD, and the total number of bits recorded. Increasing the source strength increases the SNR, as does increasing the number of channels or the integration time, both of which increase the number of bits. The fundamental equations relating these quantities are displayed below.

$$SNR = \eta\rho\sqrt{NumSamples}$$

$$\rho = \frac{F}{\sqrt{SEFD_2 \times SEFD_1}}$$

F= correlated (observed) flux density

$$NumSamples = SampleRate \times NumChannels \times Scanlength$$

SampleRate= recording rate = $2 \times Bandwidth$ (per channel)

$$\eta = bit_{eff} \times corr_{eff}$$

Here bit_{eff} is the degradation in SNR due to digital sampling. The values are given below:

Bit-efficiency compared to analog sampling	
1-bit	0.5715
2-bit	0.6366

Here $corr_{eff}$ is a correction factor due to approximations made in the correlation process.

Correlator Efficiency	
Mark4 Correlator	0.8995
DiFX	0.97

The number of channels is the total number of tracks recorded (excluding fan-out) and corresponds to the sum of the upper- and lower-sidebands recorded. Combining all of these equations together we get:

$$SNR = \eta \frac{F}{\sqrt{SEFD_1 \times SEFD_2}} \sqrt{SampleRate \times NumChannels \times Scanlength)}$$

Which can be inverted to yield:

$$scanlength = \left(\frac{SNR}{\eta F} \right)^2 \times \left(\frac{SEFD_1 \times SEFD_2}{SampleRate \times NumChannels} \right)$$

Example calculation of SNR.

As a simple example, assume that we are observing a 'weak' source with flux of 0.25, have two good antennas with SEFDs of 1,500. Further assume that we are using the R1 observing mode. At the time this is written this observing mode uses 1-bit sampling, records 16 channels, with each channel having a bandwidth of 8 MHz. Assume that the scan length is 240 seconds (4 minutes). Then the calculated SNR is 22.

Table. SNR calculation for a weak source with the R1 observing sequence	
1-bit sampling	0.5715
Mark4 Correlator	0.8995
Flux of source	0.25
$SEFD_1$ = $SEFD_2$	1,500
Channel Bandwidth	8 MHz
Number of Channels	16
Scan length	240 seconds
SNR	22.1

Calculation of Scan lengths.

Individual station scan lengths (durations) and baseline SNRs achieved are calculated as follows.

1. All calculations are done for both bands (S and X).
2. For each baseline, calculate number of seconds required to achieve the required SNR, using the observed flux density on that baseline, SEFD for each antenna, number of channels, bandwidth, and SNR.
    a. Flux density applicable to the observed flux for the baseline length is used to calculate the scan durations by baseline.
        i. Refer to section Source Structure Models on page 178 for the equations used to calculated observed flux, F.
        ii. If the source has no flux model, it will not be scheduled.
    b. Antenna SEFDs are adjusted for the elevation of the source at each station.
        i. See the section Elevation-dependent Sensitivity on page 174.
        ii. If the station has no SEFDs it will not be scheduled.

3. For each station, find the longest duration, for both bands, of all baselines the station participates in. This is the duration assigned to the station.
4. For each baseline (station pair), use the shortest duration of the two stations to calculate the actual SNR achieved. This is the time both stations observe together.
5. If the calculated SNR is lower than the minimum required on any of the subnet baselines to a station, the station is dropped automatically if parameter SNR is set to auto. If SNR is set to manual, you are asked each time if you want to schedule it anyway.

The actual scan-length scheduled is

$$scan(\text{sec}) = \left(\frac{SNR}{\eta F} \right)^2 \times \left(\frac{SEFD_1 \times SEFD_2}{SampleRate \times NumChannels} \right) + CORSYNCH$$

The CORSYNCH parameter gives the correlators extra time to synch up.

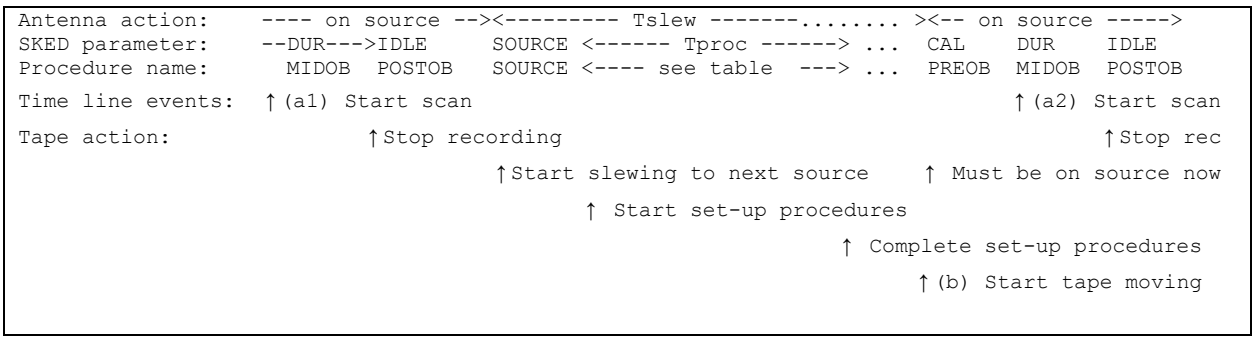
New Scan

When a new scan is requested is requested manually, `sked` takes the following steps and makes these calculations to determine if the scan is valid.

1. Calculate slewing time to the new source.
    a. If source will rise within the lookahead time, then set slewing time equal to the time remaining until the source rises, and mark it as rising.
    b. For each station:
        i. If the new source is not up at the end of the previous observation and:
            1. VIS=SUB then drop this station.
            2. VIS=ALL then quit.
        ii. If the source is marked as rising, ask if user wants to delay start of observation until source rises.
2. Calculate scan lengths, calculate predicted SNRs, check SNRs against minimum required.
    a. For each station: If the station had any baselines with 'low SNR' or 'no flux'
        i. If SNR=AUTO, then drop the station.
        ii. If SNR=MAN, ask the user if they want to schedule anyway.
3. (Now obsolete): Determine best tape footage at each station including tape spin time.
4. Calculate start time of the observation, if required. (See sked Timeline below.)
5. If the source is too close to the sun at the start time then don't schedule it.
6. For each station:
    a. Calculate source position at the start and end of the observation.
    b. If the source is not up at the start or end:
        i. If VIS=SUB then eliminate the station.
        ii. If VIS=ALL then quit.
7. Display observation parameters and ask for confirmation.

Sked Timeline

There are many things that influence when a scan is started, among them the time required to slew to the antenna, the time required to perform various commands, etc. This section describes the `sked` timeline.




```
Tslew = time required to slew to the next source
Tproc = MIDTAPE + CHANGE + PREPASS + PARITY + spin + SETUP + HEAD
Tmax  = MAX (Tslew, Tproc + MAX(EARLY-CAL,0), MINIMUM)
T(a2) = T(a1) + DUR + TAPE + IDLE + SOURCE + Tmax + CAL + TAPE
```

The start time for a new scan, T(a2), is determined by the equations above. The words used in the equations are the SKED parameter names found in the first column of the table. The times for each of the parameters given in the equations are actually used only when the conditions listed under the Comments column are met. For example, the time specified for CHANGE is only added in when a new tape is called for, otherwise it has a zero value in the equation.

SKED paramter	Procedure name	Comments
DUR	MIDOB	Duration of scan
IDLE	POSTOB	Post-scan calibration
TAPE	ET, TAPE	Stop tape, record footage
SOURCE	SOURCE	Set up for new source and begin slewing
MIDTAPE	MIDTP	Used when tape changes direction.
CHANGE	UNLOD, READY	Used when changing tape.
PREPASS	PREPASS	Used to prepass the tape before recording.
(P3)	CHECK2C1,2	Check parity on first scan of a pass.
PARITY	FASTF,FASTR	Spin tape at high speed to new footage. Used when needed to position the tape.
(P2)	SX2C1,2	Used to set up modules before every scan.
spin time	HEAD	Used only when the heads move to a new pass.
	n/a	
SETUP (P1)	n/a	
HEAD	PREOB	

PRFLAG	n/a	If flags P1, P2, P3 are "Y" the corresponding procedures are used as noted. If flags are "N" the corresponding procedure is never used.
EARLY		Start tape moving before scan start, EARLY = T(a2) - T(b).
CAL		Pre-scan calibration.
MINIMUM		Minimum time between scans.

You can use the **timeline** command to see how sked calculates when the next scan starts.

Catalog Access

sked Selection

The following procedures are used by `sked` for accessing and selecting catalog information: `sked` initially creates scratch files and writes into them any information it finds in the schedule file sections $SOURCES, $STATIONS, $HEAD, $FLUX, and $CODES. Any comments within these sections are preserved in the scratch files.

The select option on the source, station, and frequency commands accesses catalog files. All entries in the catalog are displayed by name, and you select the ones you want for your schedule. When source, station, or frequency selection is done interactively, `sked` puts the names of the entries into a list of "selected entries". During the process of selection you add to or remove from this list. For sources, the common names are used for selection; for stations, antenna names; for frequency codes, the name of the observing mode.

When you exit from selection, `sked` will read the information it requires from all relevant catalog files and create the appropriate format for the sked file section(s). New scratch file(s) are written with the new information you have just selected.

Information from the catalog files is always retrieved unless you specify the OR option (only available for sources) which will retain (some of) the information from your original schedule file. This is not recommended because you should normally get fresh data from the catalogs for scheduling.

When the **`er`** or **`wr`** command is executed, `sked` copies the scratch files directly into the schedule file if selection has been done. If selection has not been done for any of the three types of information, then the corresponding section of the original file is copied in its entirety into the output file. This latter procedure preserves any comments which might have been added to the schedule file.

Access Logic

The following detailed steps are followed by `sked` in collecting catalog information:

Sources

1. Original scan lengths and fluxes are saved by source name.
2. Names from the source catalog file, source.cat file, or specified file, are read in and checked for duplicates.
3. Grades from flux.cat.comments file are read in.
4. Source common names and grades are displayed.

5. The user selects the soureces.
6. For each selected name, `sked` gets position and epoch from the catalog file.
7. Write/re-write the SKXnnnnn scratch file ($SOURCES section).
8. Restore scan lengths and fluxes for same-named sources.
9. Set scan lengths to default for sources not in the save list.

Stations

1. All user-specified values and parameters are saved by station name.
2. Names and 1-letter codes from antenna.cat are displayed.
3. User selects stations, optionally changing the 1-letter station ID code.
4. For each selected name:
    a. get antenna information from antenna.cat
    b. if the 1-letter ID code for antenna is the same as another, change subsequent ids.
    c. get positions from matching position code in position.cat.
    d. get information from matching antenna name in equip.cat.
    e. get horizon or coordinate mask from matching antenna name in mask.cat.
    f. write/re-write the SKYnnnnn scratch file ($STATIONS section).
    g. restore user-specified values and parameters for same-named stations.
    h. set defaults for elevation limit, SNR, tape motion, early start, and optimization parameters for stations not in the save list.

Frequencies

Note: Stations must be selected prior to selecting frequencies.

1. Display the names from modes.cat.
2. User selects the modes.
3. For each selected mode get the following information:
    a. RF frequencies and channel references from freq.cat.
    b. Receiver setups from rx.cat
    c. LO and channel assignments from loif.cat.
    d. Recording mode information from rec.cat.
    e. Head positions from hdpos.cat and track assignments from tracks.cat
4. write/re-write the SKZnnnnn scratch file ($CODES section).
5. write/re-write the SKHnnnnn scratch file ($HEAD section).

Fluxes

Sources must have been selected first.

1. For each source and frequency band, retrieve fluxes from the flux catalog.

Selection Error Conditions

In the following we describe some error conditions and indicate what `sked` does or the limitations imposed.

1. Sources: If no flux is available for a given source, you will not be able to use the automatic scan length calculation features.
2. Stations:
    a. If no position is found for an antenna, or if no slewing rates are present, `sked` cannot continue and resets the stations to "none selected".
    b. If no equipment entry is found for an antenna, sked uses the default values for tape length and number of passes so that you can continue scheduling. These default values are set in the sked parameter file.
    c. If no SEFD values are found, you will not be able to use the automatic scan length calculation features.
    d. If a horizon mask is found but there is no matching code from the A line, `sked` checks for a matching code from the P line. This check is done so that information in old schedules without mask codes on the A lines will be read properly.
3. Frequencies: If no LO information is found for a station, `sked` will continue with a warning message.
4. Modes: The consistency of the number of tracks, subpasses, and channels is checked thoroughly and any problems are reported.

Chapter 6 Sked File Format

This section describes the format of the schedule file and how you can use `sked` commands to modify them.

The schedule file is an ASCII file that broken into various sections. Each section starts with a $string command, e.g., $PARAM, $BROADBAND, $SKED, $FLUX etc. A section contains until the next $string is encountered. The order of the sections within a `sked` file does not matter. For many sections ($STATION, $SOURCE, $FLUX, $CODES) the sections contain (almost) verbatim the relevant portions of the `sked` catalogs.

We will discuss each section in turn and give brief snippets of what you find in them.

Some of this chapter will become obsolete when `sked` uses VEX as its native format.

$EXPER

This section consists of a single line, and is the only section that contains an argument. The argument is the schedule ID. This is usually the first line in a schedule. A sample follows:

```
$EXPER R1718
```

$PARAM

The $PARAM section contains information that affects the session as a whole. It is a 'catch-all' section. The start of the file consists of a series of `KEYWORD ARGUMENT` pairs. There can be more than one of these per line. The `SCHEDULING_SOFTWARE, SOFTWARE_VERSION, and SCHEDULE_CREATE_DATE` are all updated by `sked`. The remaining parameters are user settable. Many of these are set using the `param` command (see page 116). The remainder are generally set using the format `KEYWORD VALUE(S)` where `KEYWORD` is something like `SNR`, `TAPE_TYPE`, etc. The start of the $PARAM section is shown below:

```
$PARAM
DESCRIPTION Sixth R&D VLBA session of 2016
SCHEDULING_SOFTWARE SKED
SOFTWARE_VERSION 2016Apr19
SCHEDULE_CREATE_DATE 2016/12/08 10:40:10
SCHEDULER  NASA   CORRELATOR VLBA START 2016335180000 END   2016336180000
CALIBRATION    10 CORSYNCH        3 DURATION      120
EARLY           0 IDLE            0 LOOKAHEAD      20
MAXSCAN       480 MINSCAN        48 MINSLEW          0 MARK6_OFF       0
FILL_OFF        0
MIDTP          10 MODULAR         1 MODSCAN          1 PARITY        100
SETUP          20 SOURCE          5 TAPETM           1 WIDTH           0
CONFIRM         Y VSCAN           Y
DEBUG           N   KEEP_LOG      N VERBOSE          N
PRFLAG       YYNN SNR          AUTO
FREQUENCY   SX PREOB      PREOB  MIDOB     MIDOB  POSTOB     POSTOB
ELEVATION _   5.0
TAPE_MOTION _  START&STOP
TAPE_TYPE Br Mark5A Fd Mark5A Hh Mark5B Hn Mark5A Kk Mark5B Kp Mark5A
```

```
TAPE_TYPE La Mark5A Mk Mark5A Nl Mark5A Ny Mark5B On Mark5B Ov Mark5A
TAPE_TYPE Pt Mark5A Sc Mark5A Wz Mark5A
TAPE_ALLOCATION Br AUTO Fd AUTO Hh SCHEDULED Hn AUTO Kk SCHEDULED Kp AUTO
TAPE_ALLOCATION La AUTO Mk AUTO Nl AUTO Ny SCHEDULED On SCHEDULED Ov AUTO
TAPE_ALLOCATION Pt AUTO Sc AUTO Wz SCHEDULED
SNR Br-Fd X   20 Br-Fd S   15 Br-Hh X   20 Br-Hh S   15 Br-Hn X   20 Br-Hn S   15
SNR Br-Kk X   20 Br-Kk S   15 Br-Kp X   20 Br-Kp S   15 Br-La X   20 Br-La S   15
SNR Br-Mk X   20 Br-Mk S   15 Br-Nl X   20 Br-Nl S   15 Br-Ny X   20 Br-Ny S   15
…
```

$OP

This section is used in the covariance optimization routines in sked and determines what paramters are estimated, and which are optimized. The values in this section are set within *sked* using the `OP` command.

The $OP section contains two blocks of text which are indentical in form. The first block are the parameters that are optimized for, which is followed by the parameters that are estimated. The general format of the lines are "`PARAM1 T/F PARAM2 T/F …`" The first line in each block corresponds to the EOP parameters in the order X-pole, Y-pole, UT1, Nutation Psi, Nutation Epsilon. This is followed by one line for each station, which contain the one letter station code followed by the parameters: atmosphere offset, atmosphere rate, clock offset, clock rate, clock quadratic, and X, Y, Z (or U, E, N). This is then followed by source-position parameters, which are numbered in order of the sources in the $SOURCE section.

A $OP block for an IVS INT01 session looks like:

```
$OP
XP F YP F DUT T PSI F EPS F
K AOFF F ARAT F COFF F CRT1 F CRT2 F X F Y F Z F
V AOFF F ARAT F COFF F CRT1 F CRT2 F X F Y F Z F
  1 F    2 F    3 F    4 F    5 F    6 F    7 F    8 F    9 F   10 F
 11 F   12 F   13 F   14 F   15 F   16 F   17 F   18 F   19 F   20 F
 …
XP F YP F DUT T PSI F EPS F
K AOFF T ARAT F COFF F CRT1 F CRT2 F X F Y F Z F
V AOFF T ARAT F COFF T CRT1 T CRT2 T X F Y F Z F
  1 F    2 F    3 F    4 F    5 F    6 F    7 F    8 F    9 F   10 F
 11 F   12 F   13 F   14 F   15 F   16 F   17 F   18 F   19 F   20 F
```

Note that based on the above we are optimizing UT1, but estimating UT1, atmospheres for the K (=Kokee) and V (=Wettzell) stations, and a quadratic clock for the V station.

$DOWNTIME

This section contains information about which stations are down (that is, unavailable) and for which periods. It looks something like this:

```
$DOWNTIME
Wz 2015-348-18:15:00 2015-348-19:45:00
```

You can have downtimes for different stations, and each station can have many downtimes as long as the total number of downtimes is less than 2,000.

$MAJOR

The parameters in this section determines which scans are considered for scheduling. Stated another way, this section limits the universe of possible scans. It is set using `MAJOR` command.

```
$MAJOR
Subnet GsHtHbIsKeNyOnYjTsWwWfWzYg
SkyCov              Yes
AllBlGood           Yes
MaxAngle         180.00
MinAngle          15.00
MinBetween           20
MinSunDist         4.00
MaxSlewTime         300
TimeWindow            4.00
MinSubNetSize         2
NumSubNet             1
Best                 60
FillIn              Yes
FillMinSub            3
FillMinTime         120
FillBest             80
Add_ps               30.0
SNRWts              Yes
```

$MINOR

The parameters in this section determines which characteristics are used to rank a scan and the weight of each characteristic. In automatic mode, the parameter that has the highest weighted score is selected. Within `sked`, this section is modified using the `MINOR` command.

```
$MINOR
Astro           Yes  Abs          3.00
BegScan         Yes  Rel          1.00
Covar           No   Abs          1.00
EndScan         Yes  Rel          1.00
LowDec          No   Abs          1.00
NumLoEl         No   Rel          1.00         0.00
NumRiseSet      No   Abs          1.00
NumObs          Yes  Rel          1.00
SkyCov          No   Rel          1.00
SrcEvn          No   Rel          1.00 NONE
SrcWt           No   Abs          0.00
StatEvn         No   Abs          1.00 NONE
StatIdle        Yes  Abs          3.00
StatWt          Yes  Abs          2.00
TimeVar         No   Rel          1.00
```

$ASTROMETRIC

This section lists the ‘astrometric sources’. Each source is followed by desired minimum and maximum targets expressed as a percentage of the total number of observations in a session.

```
$ASTROMETRIC
3C286               1.00    1.50
0906+015            1.00    1.50
0650+371            1.00    1.50
1511-100            1.00    1.50
0306+102            1.00    1.50
0528-250            1.00    1.50
1448+762            1.00    1.50
2353-686            1.00    1.50
1034-374            1.00    1.50
2121+053            1.00    1.50
```

In the above example, the observing targets for the sources have minimum and maximum values of 1.0% to 1.5%. This section can be modified using the ASTRO command. This section is only important if the `MINOR ASTRO` parameter is turned on.

$TWIN_TELESCOPES (work in progress, no effect on scheduling yet)

This section lists the twin telescopes of the experiment. Each set of twin telescopes is followed by the action chosen by the user: JOIN means the two telescopes will be treated as one station (scheduled on same observations), SPLIT means the two telescopes will be treated in different subnets (Scheduled on different observations), "-" means sked will schedule the two telescopes as two different stations. Attention! The twin telescopes need to be part of the network before being added in the TWIN_TELESCOPES section.

```
? TWIN_TELESCOPES li
#      Stat1    Stat2  Action
   1 TWINA1   TWINA2   JOIN
   2 TWINB1   TWINB2   SPLIT
   3 TWINC1   TWINC2   -
?
```

This section can be modified using the TWIN_TELESCOPE command. This section is only important if the `MAJOR SplitTwins` parameter is turned on.

$GROUP

This section lists sources classified in groups. Each group number is indicated in the second column.

```
$GROUP
0008-421  01
0022-423  01
0027-426  01
0130-447  01
2315-404  02
2322-411  02
2327-459  02
2329-415  02
0615-365  03
0625-354  03
0635-355  03
```

In the above example, the first four sources are in group 1. This section can be modified using the GROUP command. This section is only important if you intend to schedule group of sources at a time.

$STATWT, $SRCWT

These sections are used to preferentially select scans involving particular stations or sources. They have an effect on the schedule generation only if the `MINOR STATWT` or `SRCWT` options are turned on. These sections can be modified within `sked` using the `STATWT` and `SRCWT` commands. These sections look like:

```
$STATWT
YARRA12M     3.00
```

$CATALOG_USED

This section is generated by the sked program and lists all of the catalogs used in generating the schedule. It looks like this:

```
$CATALOGS_USED
SOURCE 13Sep23_iGSFC    /shared/gemini/ftp/pub/sked/catalogs/source.cat.geodetic.good
FLUX       15NOV20_iGSFC     /shared/gemini/ftp/pub/sked/catalogs/flux.cat
ANTENNA    15Mar30_iGSFC     /shared/gemini/ftp/pub/sked/catalogs/antenna.cat
POSITION   15Nov18_iGSFC     /shared/gemini/ftp/pub/sked/catalogs/position.cat
EQUIP      16Jun17_iGSFC     /shared/gemini/ftp/pub/sked/catalogs/equip.cat
MASK       15Feb12_iGSFC     /shared/gemini/ftp/pub/sked/catalogs/mask.cat
MODES      15Sep22_iGSFC     /shared/gemini/ftp/pub/sked/catalogs/modes.cat
FREQ       15Feb23_iGSFC     /shared/gemini/ftp/pub/sked/catalogs/freq.cat
REC        15SEP23_iGSFC     /shared/gemini/ftp/pub/sked/catalogs/rec.cat
RX         15Jun29_iGSFC     /shared/gemini/ftp/pub/sked/catalogs/rx.cat
LOIF       15Jun29_iGSFC     /shared/gemini/ftp/pub/sked/catalogs/loif.cat
TRACKS     14Oct29_iGSFC     /shared/gemini/ftp/pub/sked/catalogs/tracks.cat
HDPOS      05DEC04_iGSFC     /shared/gemini/ftp/pub/sked/catalogs/hdpos.cat
```

This section is modified only if new catalog information is read in. For example, if you take a schedule and change the start and stop times, and generate a new schedule, this section will not be modified. However if you update the source fluxes, than FLUX catalog entry will be modified to indicate which catalog was used. If you choose new sources, the SOURCE catalog will be updated. If you select new stations, then the catalog entries related to stations (ANTENNA, POSITION, EQUIP, and MASK) will be updated.

$BROADBAND

This section is a temporary 'kludge' to allow sked to schedule broadband sessions. The contents can be listed and modified using the BROADBAND command. It looks something like this:

```
$BROADBAND
WESTFORD    512.00    8192       4096
GGAO12M     512.00    8192       4096
```

There is one line for each broadband station. The first entry is the bandwidth per band in MHz, and is used in calculating the SNR. The second and third entries are the Data Rate and Sink Rate in Mbps—that is, how fast data is taken, and how quickly it is written to disk. This is used in calculating how much extra time to allocate to an observation in order to write out all of the data that is taken. The formula for the time required to write out the data for a scan is given by:

```
WRITE_TIME=(DATA_RATE/SINK_RATE)*DURATION+MARK6_OFF
```

Where DURATION is the length of the scan, and MARK6_OFF is an offset parameter contained in the $PARAM section.

$SOURCES

This section lists the positions of the sources. These section will change if you select new sources using the SOURCE command or BEST N command. These lines are images of the lines in the source catalog—that is, if you select a given source from the source catalog, sked copies the corresponding line into this section.

```
$SOURCES
 0048-097 $          00 50 41.317388     -09 29 05.21027 2000.0 0.0  ICRF2 def
 0059+581 $          01 02 45.762382     +58 24 11.13660 2000.0 0.0  ICRF2 def
 0119+115 $          01 21 41.595043     +11 49 50.41310 2000.0 0.0  ICRF2 def
 0133+476 $          01 36 58.594806     +47 51 29.10004 2000.0 0.0  ICRF2 def
 0229+131 $          02 31 45.894054     +13 22 54.71627 2000.0 0.0  ICRF2 def
 0336-019 CTA26      03 39 30.937787     -01 46 35.80411 2000.0 0.0  2010a glob
 0454-234 $          04 57 03.179229     -23 24 52.02014 2000.0 0.0  ICRF2 def
…
```

The first column is the IAU name. The second column is the IVS name if there is one. For example, 0336-019 has an IVS name of CTA26. This is followed by the position in Right Ascenion in hours, minutes and seconds, and the Declination in degrees, minutes, and seconds. This is followed by the epoch and the literal "0.0" which is unused, and the line ends with where the source positons come from.

$STATIONS

This section describes the stations in a schedule. This section will change if select new stations using the `STATION` command or the `MASTER GET` command. All of the lines come from station-related copies and are prefaced by a single character indicating what kind of information they contain. For a two-station experiment this might look something like this:

```
$STATIONS
A  E WESTFORD AZEL 0.31800 200.0 18  100.0  460.0 120.0 15    4.0   87.2  18.0 Wf 07   WF
A  G GGAO12M  AZEL 0.00000 300.0  0  180.0  720.0  60.0  0    6.5   88.0  12.0 Gs Gs   Gs
P  Wf WESTFORD  1492206.59964 -4458130.50737  4296015.53210   72097301  71.49   42.61 GLB1069
P  Gs GGAO12M   1130729.3     -4831242.4      3994225.1       71085301  76.83   39.02 bec120130
T  07  WESTFORD 2x4096  16192  X  3500  S 1500 S 1.0 0.962 0.0384 X 1.0 0.939 0.0608 RDBE Mark6
T    Gs  GGAO12M   2x4096  18192   X  2000   S  2000 RDBE Mark6
H WF  0 5  15 5 16 6  26 8 60 8 61 5 75 5 76 6.5 85 6.5 86 5 95 5 96 6.5 106 5 116 4 360 4
H Gs 0 6 15 5.5 58 3.5 90 4.5 130 3 154 28 162 33 167 36 172 40 212 36 222. 33 227 28 232 6 360
```

The 'A' lines come *antenna.cat*, and describe the antenna. The 'P' lines come from *position.cat* and give the position of the antenna. The 'T' (for terminal) lines come from *equip.cat* and describe the equipment at a station. The 'H' (for horizon) come from *mask.cat*, and give information about the horizon mask.

Note that the 'A' lines also contain the single station code for a station as the argument following "A", and the two-letter code as the 15th argument. In the above example, the 1-letter and 2-letter codes for Westford are "E" and "Wf". For GGAO12M they are "G" and "Gs".

$SKED

This section contains the scheduled observations. Each line corresponds to a single observation. This section is generated by `sked` in the process of making the schedule. Each line begins with the sorce being observed. The argument following PREOB is the epoch of the observation in format YYDDDHHMMSS followed by the duration of the scan in seconds. The argument following POSTOB gives the stations involved in a scan and the cable wrap. Each station has a unique single letter code.

```
$SKED
0332-403   10 8F PREOB   15348170000        43 MIDOB         0 POSTOB WWJ-HW 1F000000
1F000000 1F000000 YNNN     43     43     43
```

```
0650+371  10 8F PREOB  15348170000     300 MIDOB       0 POSTOB K-NWT-AWVWY-I- 1F000000
1F000000 1F000000 1F000000 1F0000
00 1F000000 1F000000 YNNN   300   115   211    43   100   300   295
0506+101   10 8F PREOB   15348170236       93 MIDOB        0 POSTOB J-AWVWN- 1F000000
1F000000 1F000000 1F000000 YNNN    93
  43    75    93
0202+319  10 8F PREOB  15348170456      43 MIDOB       0 POSTOB J-N-T-AWVWR- 1F000000
1F000000 1F000000 1F000000 1F000000
 1F000000 YNNN    43    43    43    43    43    43
```

$SOURCES

This section lists the positions of the sources. These section will change if you select new sources using the `SOURCE` command or `BEST N` command. These lines are images of the lines in the source catalog—that is, if you select a given source from the source catalog, `sked` copies the corresponding line into this section.

```
$SOURCES
 0048-097 $          00 50 41.317388     -09 29 05.21027 2000.0 0.0  ICRF2 def
 0059+581 $          01 02 45.762382     +58 24 11.13660 2000.0 0.0  ICRF2 def
 0119+115 $          01 21 41.595043     +11 49 50.41310 2000.0 0.0  ICRF2 def
 0133+476 $          01 36 58.594806     +47 51 29.10004 2000.0 0.0  ICRF2 def
 0229+131 $          02 31 45.894054     +13 22 54.71627 2000.0 0.0  ICRF2 def
 0336-019 CTA26      03 39 30.937787     -01 46 35.80411 2000.0 0.0  2010a glob
 0454-234 $          04 57 03.179229     -23 24 52.02014 2000.0 0.0  ICRF2 def
…
```

The first column is the IAU name. The second column is the IVS name if there is one. For example, 0336-019 has an IVS name of CTA26. This is followed by the position in Right Ascenion in hours, minutes and seconds, and the Declination in degrees, minutes, and seconds. This is followed by the epoch and the literal "0.0" which is unused, and the line ends with where the source positons come from.

$FLUX

This section contains the flux models used in scheduling. These lines are copied directly from the flux catalog. This section is updated if you use the `FLUX SEL` command to update the `sked` file from the flux catalog. There are two kinds of flux models. Lines that have "B" as the third argument are baseline models. Lines that have "M" as the third argument use elliptical models.

```
$FLUX
3C286  X  B 0.00   0.41   900.0  0.28  1530.0  0.27  2600.0  0.31  4420.0  0.32  7520.0
0.21 10400.0  0.26 12800.0
3C286  S  B 0.00   1.82   900.0  1.04  1530.0  0.36  2600.0  0.50  4420.0  0.57  7520.0
0.64 10400.0  0.64 12800.0
   2. 0906+015  X  B 0.00   2.32   900.0  2.02  1530.0  1.82  2600.0  1.41  4420.0
      1.31  7520.0  1.41 10400.0  1.31 12800.0
   3. 0906+015  S  B 0.00   2.16   900.0  2.02  1530.0  1.93  2600.0  1.60  4420.0
      1.46  7520.0  1.46 10400.0  1.36 12800.0
0650+371  X  B 0.00   0.69 13000.0
0650+371  S  B 0.00   0.46 13000.0
1511-100  X  B 0.00   0.66 14000.0
…
1424-418  S  M   3.52  1.50 1.00    0.0   0.00   0.00
1741-038  X  M   6.96  0.65 0.65  178.0   0.00   0.00
1741-038  S  M   3.12  1.10 1.00    0.0   0.00   0.00
```

Chapter 7 Installation

This section gives an overview of how to install `sked`. The current version of `sked` is designed to run under Linux. It may also work under other operating systems.

Required libraries

1. curses screen library.
2. pc8 graphics library.
3. blas and ATLAS linear algebra libraries.
4. flex and bison.

Optional libraries

1. mysql. This is used internally at GSFC and at USNO for source monitoring. If you don't want to link to mysql, you must edit the file *set_misc*, discussed below.

Compilers

1. Intel Fortran compiler or gfortran.
2. Intel C compiler **or** gcc.

Installation

1. Create a directory for the `sked` source code. For my purposes I call this *sked_source*.
2. Obtain the latest `sked` release from https://vlbi.gsfc.nasa.gov/software/sked/ . The `sked` source should have a name like skedall_2010Jan29.tgz. Put this in *sked_source*
3. Unzip and extract all the files, eg.:
   gzip –d skedall_2010Jan29.tgz
   tar –xvf skedall_2010Jan29.tar
4. Unzip and extract all the files from this file. This should create the following directories:
   a. *sked* This has the `sked` code.
   b. *drudg* Source code for `drudg`.
   c. *skdrut* Utilities (also used by `drudg`).
   d. *skdrincl* Include files.
   e. *lnfch* Hollerith character routines. Uggh.
   f. *curses* Fortran interface to curses library.
   g. *matrix* Some matrix routines.
   h. *vex* Vex libraries.
5. The file *sked_source/set_misc* sets environment variables that point to compilers and libraries. Edit this for your installation.
6. In the *sked_source* directory, execute the command: `make_sked`. This should make all of the required libraries and finally make sked. The executable will be placed in the directory `sked_source/sked/sked`. You can leave it there, or copy it to or some other directory in your path, for example, `/usr/local/bin`.

Skedf.ctl

The file *skedf.ctl* is a configuration file for `sked` (and the Field System program `drudg`). This contains information about where the catalogs are located, where to put temporary files, etc. `Sked` actually attempts to read two versions of this file. The default global copy should be in */usr/local/bin/skedf.ctl*. The local copy is in the user's current directory. The values in the local copy

over-ride the values in the global copy. Hence users can have several different copies in different directories. Stated another way, upon starting up:

1. `Sked` will search for the file */usr/local/bin/skedf.ctl*. If this file is present, it will read it and set up some internal parameters.
2. `Sked` will then search for the file *skedf.ctl* in the local directory. If present, it will read it and set up internal parameters. The local copy over-rides the global copy.

There should be a copy of *skedf.ctl* in the directory *sked_source/sked*. If there is not, you can download https://vlbi.gsfc.nasa.gov/software/sked/sked.ctl .

Catalogs etc.

To be able to pick stations, sources, and frequency sequences you need to use the catalogs. There was a major overhaul of the frequency part of the catalog in 2006. Catalogs prior to 2006 will not work with the current version of `sked`.

The latest copy of the `sked` catalogs are available at https://vlbi.gsfc.nasa.gov/software/sked/catalogs/. Copy all of the catalog files to your local installation. You need to tell `sked` where the files are. This can be done by modifying *skedf.ctl*.

Troubleshooting

If you run into trouble, please contact me. Here are some hints.

1. Make sure all of the compilers and libraries specified in *sked_source/set_misc* are correct.
2. The most common problem seems to be making the vex library, vex/vex.a. A default version of this library comes with `sked` installation. Try using this file.
3. Make the libraries one at a time and see where `sked` is failing. To make the curses library do the following:

   source sked_source/set_misc
   cd sked_source/curses
   make

These steps should make a working copy of `sked`. If you run into problems, please contact me and I will help you work through it.

If anything in these notes is unclear, please contact me. My goal is to make the installation as pain-free as possible.

HP-UX Installation

The above steps may work for installing `sked` on HP-UX machines. I do not know of any institution that still uses HP-UX.