F. Time Series Recording

F.1 Overview

The time series (TS) recording feature of the RVP8 provides end-users with the ability to record and playback IQ data. In addition, operators can record time series and then use their own "off-line" programs for processing the data. The time series can be recorded directly on an RVP8 or on a separate archive host via a gigabit network.

The time series recording is built on several software components:

- **RVP8 TS API**- where time series reside in memory in the RVP8.
- **Tsexport**- grabs time series from the TS API and sends them over the network via a UDP broadcast. Typically a gigabit network is used for this.
- **Tsimport**- receives UDP TS packets and recreates the TS API on a local machine.
- **Tsarchive (licensed separately)**- records time series to a local disk. This can be on the RVP8 or a separate networked archive host. Supports both archive and playback.
- **Ascope Utility**- can be used in playback mode to view either raw time series or processed results from the RVP8 processing algorithms.
- **Tsview Utility**- used to see diagnostic print-outs of stored time series files. Note that complete source code is provided for this to assist users with writing their own applications.

Of these components, only the **tsarchive** software is licensed separately. This means that customers are free to write their own TS record/playback software and still take advantage of the the network features such as **tsimport** and **tsexport**.

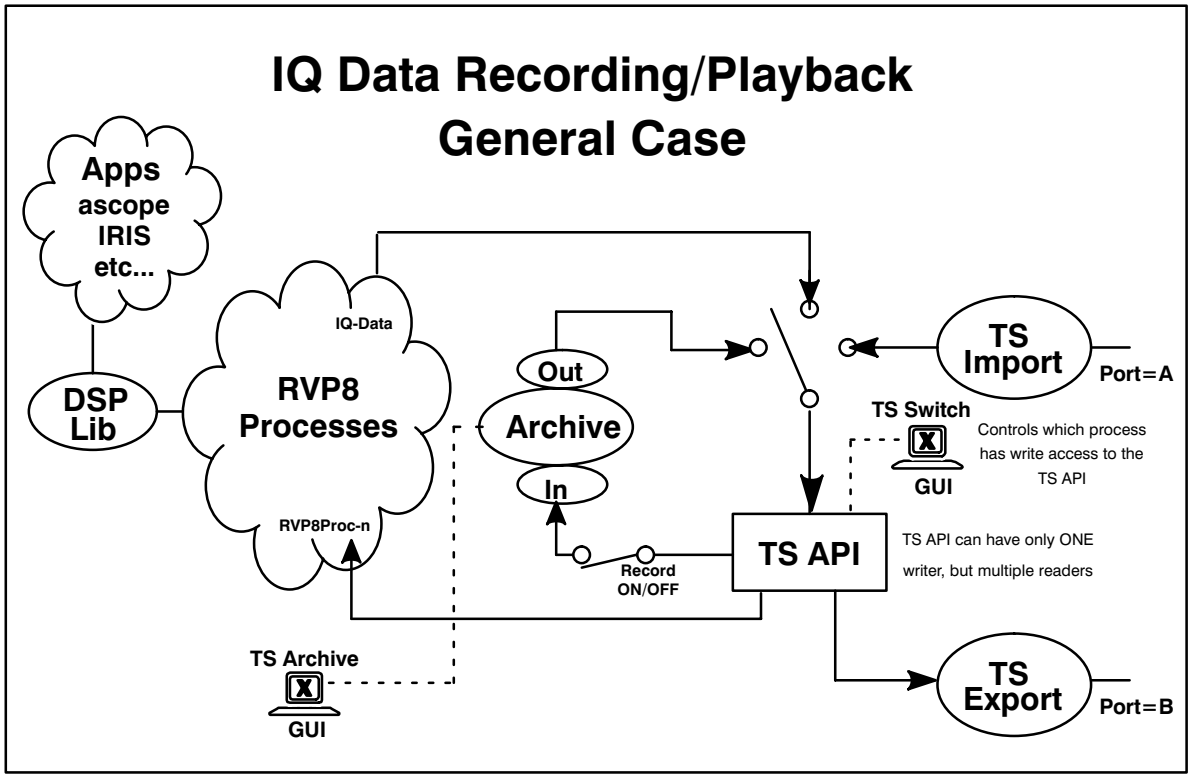
In this appendix:

TS Record/Play Software Architecture	**Section F.2**
Configuration	**Section F.3**
Tsswitch Utility	**Section F.4**
Tsarchive	**Section F.5**
Specific Software Application Examples	**Section F.6**
Ascope TS Playback Features	**Section F.7**
Tsview Utility	**Section F.8**
TS Data Format	**Section F.9**

F.2 TS Record/Playback Software Architecture

F.2.1 General Architecture

The TS record and playback features on a local RVP8 and a remote archive host, share a common software architecture. The most general case is shown below.



The structure shown above runs on a single machine. Replicas of this structure, with pieces included or excluded, can be run simultaneously on several machines to handle different scenarios, such as a separate archive host. This modular design does not really make a strong distinction between the RVP8 and a separate archive host operating in record or playback mode.

F.2.2 Description of Processes

The various process shown in the figure are described below.

TS API

Central to the architecture is the **TS API**. This is where the time series data reside in memory. The time series can be written to the **TS API** from any one (but only one) of three sources:

- From a local RVP8
- From a local disk archive
- From a remote network host (via **tsimport**)

Tsswitch

The **tsswitch** GUI, allows the user to select the sole TS writer from among these three possible sources. This GUI is described in **Section F.4**.

Tsarchive

The **tsarchive** process handles both the recording and playback of data. It has its own GUI to select record/playback mode and which directory contains the local disk archive. It also shows an inventory of the TS files and has filter/search capability to locate specific groups of files (e.g., by date and time). The **tsarchive** GUI record and playback features are described in **Sections F.5.**

Tsimport and Tsexport

The **tsimport** and **tsexport** processes provide the ability to receive/send time series over a network. Note that either a 1000 BaseT (gigabit) or 100 BaseT Ethernet can be used depending on the typical mode of operation and the competing network traffic. For example,

1000 bins * 2 parameters/bin/pulse * 16 bits/parameter * 1000 pulses/sec = 32 Mbit/sec

Here the 2 parameters/bin/pulse are the I and Q values which are represented by 16 bits each (floating point). For dual polarization systems with two receiver channels, the data rate would be doubled. The 32 Mbit/sec basic data rate here would fit comfortable on a dedicated 100 BaseT network, i.e., with little or no competing traffic.

The output is via UDP broadcast. This is a very efficient way to transfer data since there is virtually no overhead as compared to standard TCPIP. The socket ports are configured so that the **tsexport** on one system connects to the **tsimport** on another system. This configuration is described in **Section F.3**.

RVP8 Processes

These are a collection of processes that are only present on an actual RVP8 machine. The two important functions indicated in the figure are:

- IQ–Data: writes real time TS to the TS API. These are collected from an RVP8/Rx and IFD.
- RVP8Proc-n: extracts TS from the TS API and processes the data to obtain the various moments.

These processes can be viewed using the v command in dspx. Of course a remote archive host will likely not be an RVP8. In this case these processes do not exist.

F.3 Installation & Configuration

SIGMET recommends the use of TS recording in two configurations. The simplest (but least flexible) configuration is where the RVP8 also serves as the archive host **(NOTE: a separate partition should be created to prevent system CRASHES)**. However, the ideal configuration is to have a separate archive host with an increased amount of disk space and peripherals (i.e. tape drives). The two system configuration should be used in a high bandwidth environment. If this is not possible, then the RVP8 can be equipped with a separate disk for archive operations.

If a two system configuration is used, then the TS IMPORT and TS EXPORT modules have to be turned on at boot time on both systems, and the UDP ports for the sending and receiving system have to be configured as well.

F.3.1 Required Software

The TS archive software is part of the SIGMET's RDA release which is installed by default on all RVP8s and RCP8s, but it is not installed on IRIS systems.

RVP8/RCP8	No additional software required
Archive System (IRIS)	Install RDA (make sure the keep old files button is pressed)
Archive System (w/o IRIS)	Install RDA

F.3.2 Configuring UDP Ports

The UDP ports can be configured by editing the tsimport and tsexport scripts found in /usr/sigmet/config_template/init/linux/. These files should be copied to /etc/rc.d/init.d/. The tsimport and tsexport files must be edited if you plan on using tsarchive with a separate archive host. The export port on the sending system must match up to the import port on the receiving system so that a connection can be made between the two port.

SIGMET RECOMMENDS THE FOLLOWING PORTS:

RVP8:	**ARCHIVE HOST:**
TSEXPORT: 30780	**TSEXPORT: 30781**
TSIMPORT: 30781	**TSIMPORT: 30780**

Each of the scripts contain extensive comments and should be edited depending on your configuration. The scripts are shipped configured for the RVP8 end, so you will need to edit the archive host's files. You also need to edit all tsexport files to explicitly set the target IP address to which it will broadcast the time series. SIGMET recommends that you use a single target host. A broadcast address can be used, but be careful that all recipients can handle the traffic, and that there are no 10baseT network sections.

F.3.3 Configuring automatic start–up of tsimport & tsexport

As root, enter the following commands:

```
#chkconfig ––add tsimport
#chkconfig ––add tsexport
```

Once configured with the chkconfig command, you can start and stop these programs with the commands:

```
#service tsimport start
#service tsimport stop
```

F.3.4 Configuring Network buffering for tsimport

For **tsimport** to successfully read all the pulses of data from the network, the network read buffers must be enlarged. Do this by editing the /etc/rc.d/rc.local file and adding these commands to the end:

```
echo ”1000000” > /proc/sys/net/core/rmem_default
echo “4000000” > /proc/sys/net/core/rmem_max
```

Then reboot for this to take effect.

F.3.5 Tsimport and Tsexport from the command line

Tsimport and **tsexport** can also be run from the command line. Tsimport and tsexport take the following command line options:

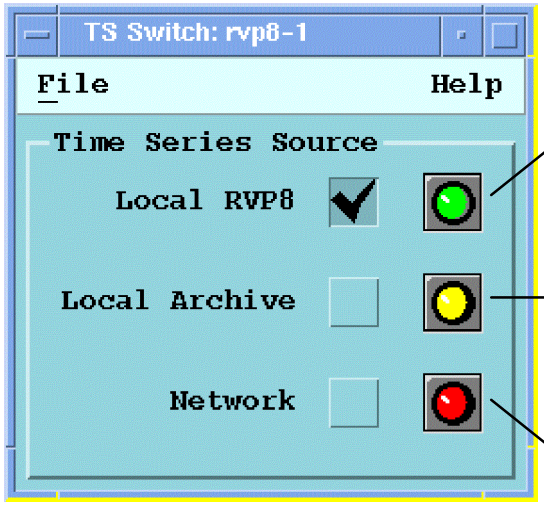
```
$ tsimport –help
tsimport command line options:
   –daemon         – Run as daemon
   –debug          – Print diagnostics
   –help           – Print this list
   –port:<port>    – Specify the port number to use
   All other options ignored

$ tsexport –help
tsexport command line options:
    –broadcast:<broadcast–address>
    –daemon       – Run as daemon
    –debug        – Print diagnostics
    –port:<port>  – Specify the port number to use
    All other options ignored
```

F.4 Tsswitch Utility

To start the tsswitch utility as operator, simply type:

$ tsswitch

In **Section F.2** it is described that only one of three processes may write to the **TS API**. The TS Switch utility, shown below, is used to select among the three possible sources:



Real time IQ from the RVP8/Rx Card. This setting is available only on an RVP8. This would be the choice for normal data processing, local RVP8 archive of real time IQ or export of real time IQ over the network.

Used to extract time series from the local disk archive. On an RVP8 these time series could be processed. On a separate archive host, these time series could be sent to an RVP8 for processing or perhaps a custom user application.

Used to collect time series from a networked RVP8 or archive host, via the TS Import process. This setting can be used either by an RVP8 (for playback) or an archive host (for recording).

The colored lights show the status associated with each of the sources:

- GREEN indicates that the selection of a source has been successful.
- YELLOW indicates that a source is available by not currently selected. If you select this source then it will change to green when the selection is confirmed.
- RED indicates that a source is not available. You may still select the source, but the color of the status indicator will remain red until it is enabled.

In the case of a separate archive host, the "Local RVP8" choice would always show as red, since there is not local RVP8.

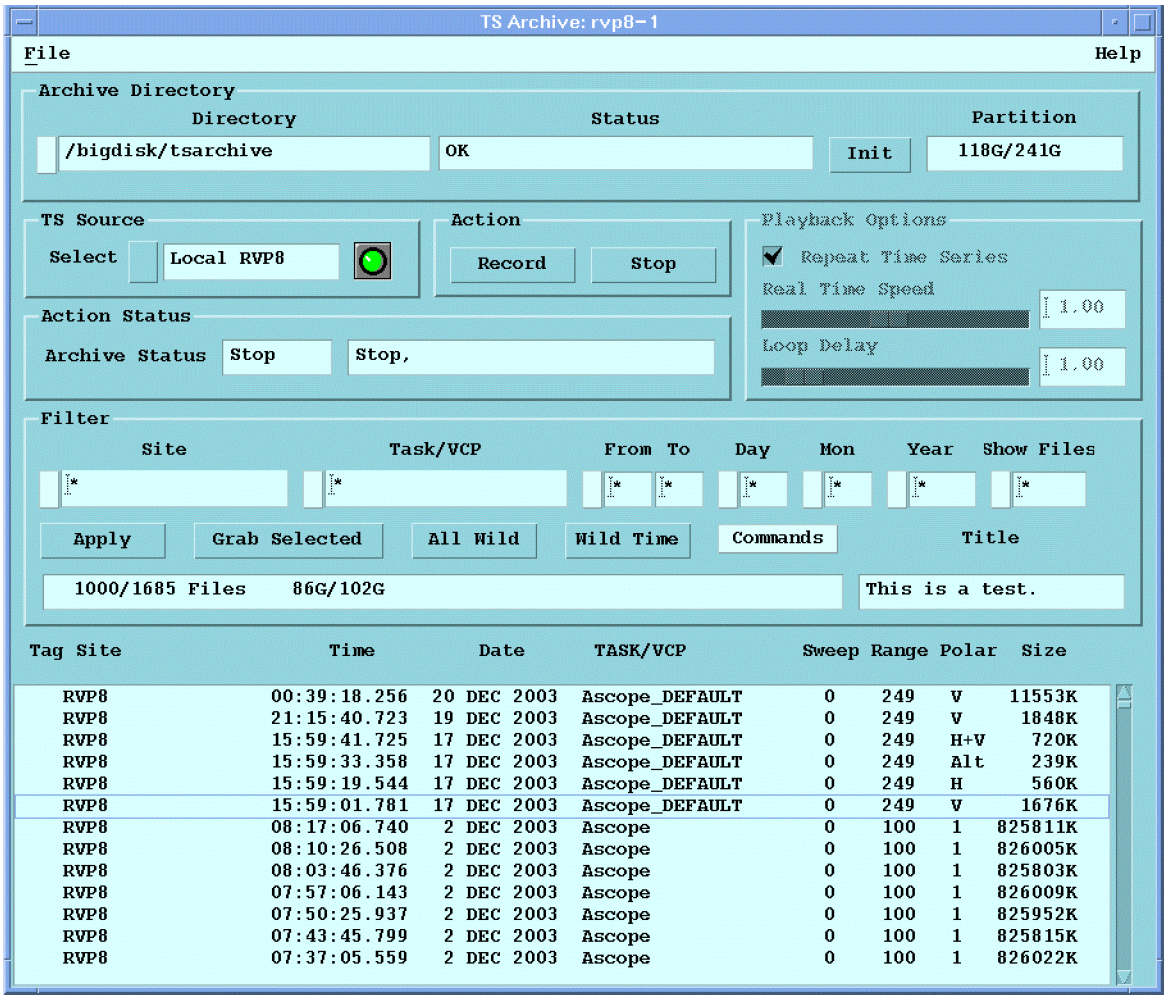
The "Local Archive" case and the "Network" case are possible for both an RVP8 and a separate archive host.

F.5 Tsarchive Utility

To start the utility, simply type (as operator):

```
$tsarchive
```

The **tsarchive** utility enables the end user to record and playback archived data. The utility provides a graphical user interface (GUI) including access to the TS switch utility, playback and record modes, and a complete archive file inventory for managing disk space.



F.5.1 Archive Directory Area

Directory

The directory section is used for selecting which archive directory to use, or to add another directory. It is recommended that you first create the directory from the command prompt.

```
$mkdir /bigdisk/tsarchive
```

Status

The Status section displays information about the chosen archive directory.

Init

The Init button initializes the directory by prompting the user for a title for the directory and also verifying the contents of the directory. Initialization requires that the directory be empty, or that it contains ONLY TS archive files. If a directory contains TS archive files, then the user will be prompted for permission to delete them. The initialization feature can ONLY delete TS data files for system security reasons. Note that if there are other non TS archive files in the directory, then these must be manually deleted using the UNIX "rm" command.

Partition

The Partition field displays the ratio of used disk space over total disk space for the selected archive directory partition. For example, if the selected archive directory is /bigdisk/tsarchive, the Partition field will show the used/total disk space for /bigdisk/. The values displayed here are for all types of files in the partition, not just the TS archive files. The filter area provides information on the amount of storage used for just the TS archive files alone.

F.5.2 TS Source

The TS Source area is used to select which source is used to record data. This button executes the TS switch utility. For more information, please see section **F.4**.

Action & Action Status

Once the source has been selected, data can be recorded or played back. Pushing the record button begins the data recording. The inventory at the bottom of the screen will update with TS file information. The Playback button is only displayed when the Local Archive source is selected. The Stop button terminates all recording or playback operations. The "Action Status" displays the current mode of the utility and provides information on what data are being recorded or played back.

Playback Options

The Playback Options section will only be enabled when Local Archive has been selected from the TS Source Area.

- **Repeat Time Series** (if selected) will repeat the selected files.
- **Real Time Speed** controls the speed at which the files are played back.
- **Loop Delay** controls the length of the pause in between each repetition.

F.5.3 Filter

The filter area of the utility provides end users with the ability to manage the files that are stored on disk. In particular, the filter functions are used to display data for a certain Site, Task and time .

Site

Enter a site ID in this field to select data from only one site, or enter the wildcard character to select data from all sites.

Task

Here Task refers to either an IRIS TASK name (sometimes called a VCP or volume control procedure) or an ascope saved configuration file name. Enter the name of a TASK in this field to narrow the list down to only those products generated by a specific TASK. You can include wildcard characters in the TASK name. A question mark (?) matches any single character; an asterisk (*) matches any sequence of zero or more characters. For example, entering a TASK name of *PPI*_? selects all hybrid TASKS that have PPI somewhere in their names.

From, To

Enter a range of hours in these two fields to narrow the list of products by time of day. You can pop up a list of ranges to choose from.

Day, Month, Year

Enter a day, month. or year to narrow the list of products by date. You can pop up a list of values to choose from.

Show Files

The Show files field lets you control how many files to include in the list.

Apply

Click on the Apply button to update the file list, based on your selection criteria. The Apply button is enabled only if the Filter button is pushed in. If the Apply button is grayed out, click on the Filter button.

Grab

If a product is selected, the Grab button inserts a selected file's information into the filter fields.

All Wild

Click on the All Wild button to return all the fields to the wildcard character.

Wild Time

Click on the Wild Time button to change only the hours, month, day and year fields to the wildcard character.

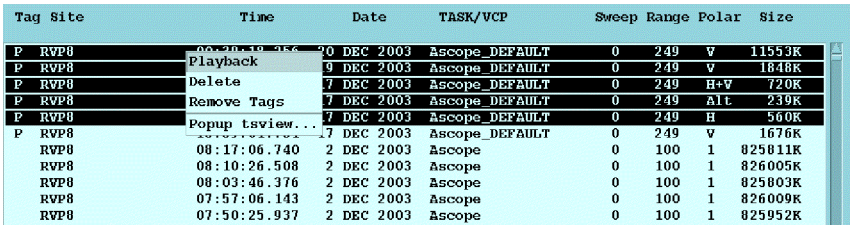
Commands

Pops up the following list of operations that you can perform on the TS archive files selected by the Filter menu.

Playback	Tags files for playback. A "P" shows in the left column
Delete	Deletes files. A "D" shows in the left column.
Remove Tags	Untags any delete or Playback tags.

CAUTION: The commands apply to all of the TS archive files that match the filter. If you put in wildcards everywhere and command "Delete", then every TS archive file could be deleted- that is why there is an "Are you sure" prompt.

F.5.4 TS Archive Log Area



Tag & Right–Click Menu

When you right–click on any selected file or group of files (as shown in the above picture), you are prompted with 4 commands: Playback, Delete, Remove Tags, and Popup Tsview.

- **Playback** marks the files with a P in the Tag Column and when the playback button is pressed, only the tagged files will be played.
- **Delete** marks the files with a D in the Tag Column and then the files are deleted. This is helpful when a large list of files has been selected for deletion.
- **Remove Tags** clears the D or P tags
- **Popup tsview** provides easy access to file information in another window. For more information see section ...

Site

The Site field displays which TS site was used to create the data.

Time & Date

The time & date fields display the UTC time & date when the data were acquired.

Task/VCP

This field displays the name of the associated tasks or ASCOPE file used for controlling the RVP8.

Sweep

This field displays the number of sweeps (e.g., 360 degrees) in the Task/VCP.

Range & Polar

These fields display the range and polarization of the TS data.

Size

This field displays the size of the file.

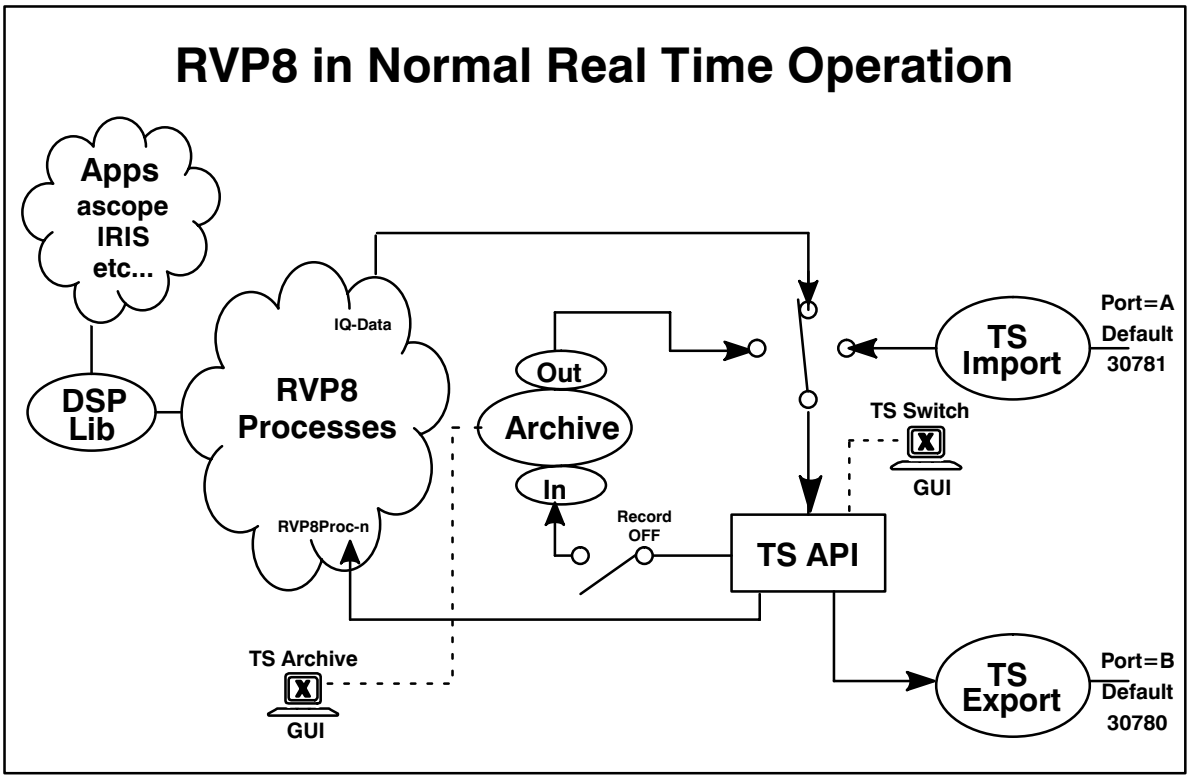
F.6 Specific Software Application Examples

There are four specific example applications described here:

1 – TS recording on a local RVP8, see F.6.1
2 – TS recording on a separate archive host, see F.6.2
3 – TS playback on a local RVP8, see F.6.3
4 – TS playback from a separate archive host to an RVP8, see F.6.4

These are the only applications that are supported. In the example descriptions, unused processes are omitted for clarity.

For reference, the case of an RVP8 in normal operation, is shown below.

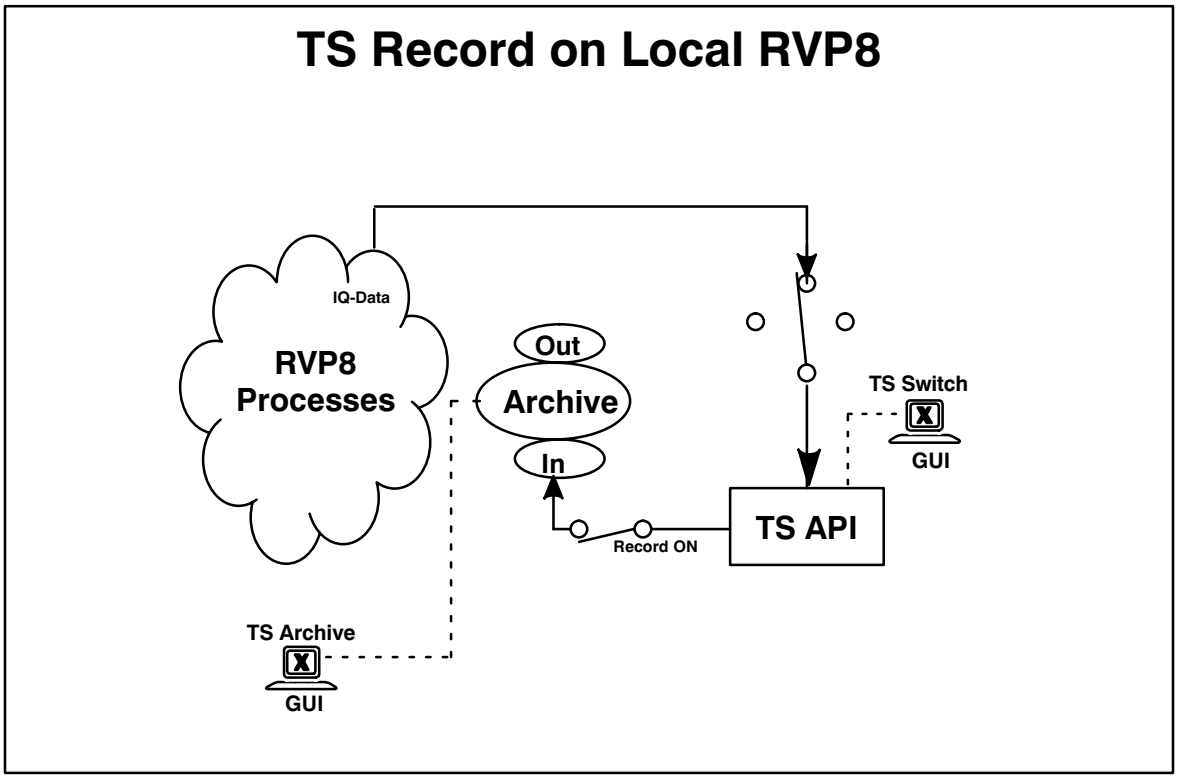


In this case, the TS Switch is set to write real time data from the IQ-Data process to the TS API. The RVP8Proc-n then extract time series data and process it. Configuration information is obtained from and data are passed to the various user applications via the DSP Lib functions. Note that the TS Export process, if started, can extract data simultaneously from the TS API.

Utility Settings:

TS Switch:	Local RVP8
TS Archive:	N/A

F.6.1 Case 1: TS recording on a local RVP8



In this case, the TS Switch is set to place the real time IQ values from the IQ-Data Process into the TS API. These are extracted and recorded to local disk by the TS Archive process. Note that the RVP8 may still do its normal data processing tasks, as shown on the previous page, while TS data are being recorded.

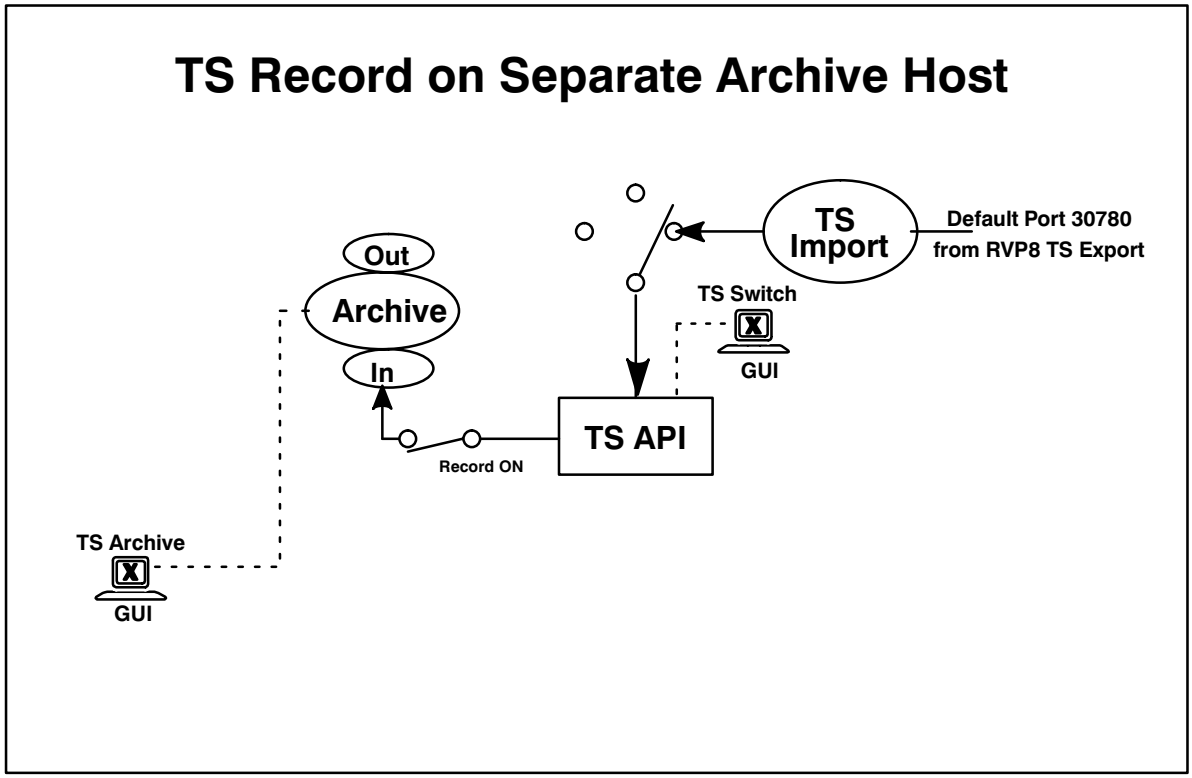
Utility Settings:

TS Switch: Local RVP8
TS Archive: Record

This configuration records to a local disk on the RVP8. Typically only a 20 GB disk is provided with a standard RVP8 so recording capability is limited unless a large custom disk is added. In either case, the recording should be done to a dedicated data partition, NOT the "/" partition. The reason for this is that if the "/" partition fills-up, the system will crash. However, if the separate data partition fills-up, then the system will stop recording, but otherwise function normally.

F.6.2 Case 2: TS recording on separate archive host

This is the recommended recording configuration for TS recording.



In this case TS Switch is set to write IQ data from the TS Import network source. Typically this is a 100 or 1000 Base T LAN connection. The time series are placed on the network via UDP broadcast by the TS Export process on a networked RVP8.

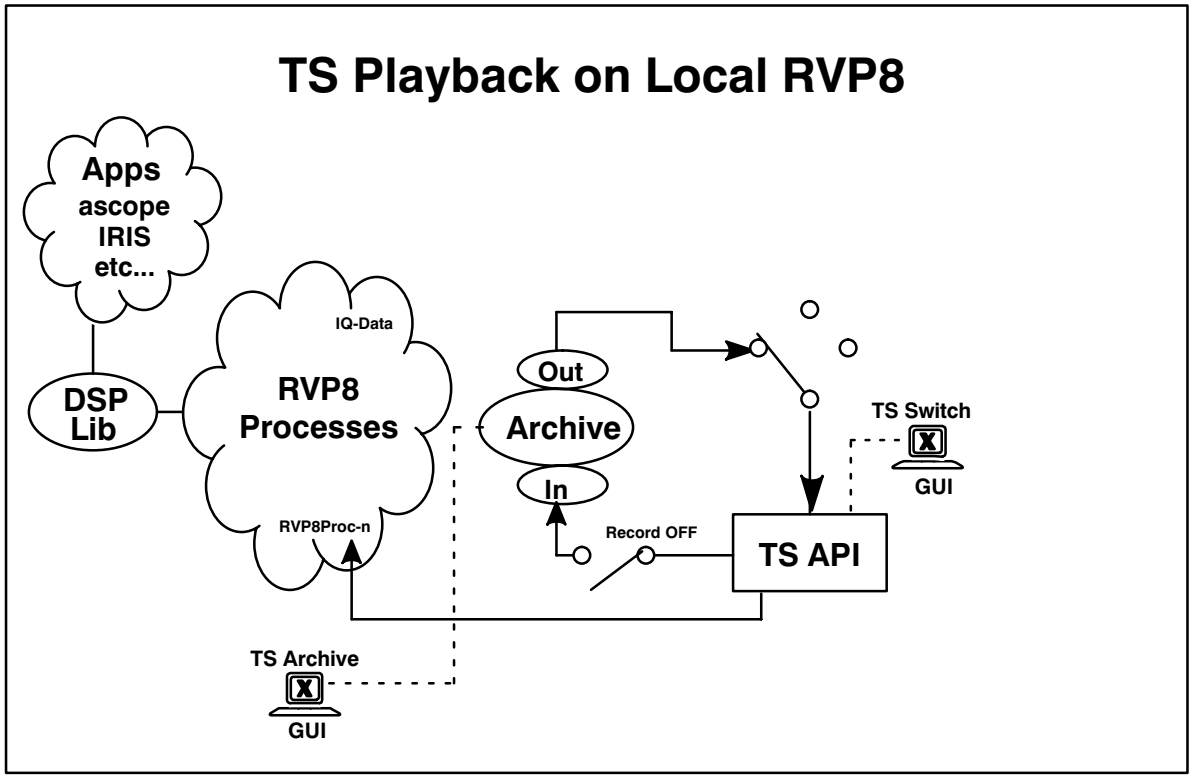
Utility Settings:

RVP8
TS Switch: Local RVP8
TS Archive: N/A

Archive Host:
TS Switch: Network
TS Archive: Record

The advantage of having a separate archive host is that it is easy to install a large disk that is dedicated to time series recording without having record/playback/backup operations interfere with the normal operation of an RVP8. Note that there can be multiple archive hosts on the network.

F.6.3 Case 3: TS playback on a local RVP8



Here, the TS Switch is set to write data from the TS Archive to the TS API. The RVP8Proc-n process(es) then read the time series data from the API. Note that this is essentially identical to the real time normal operation case shown at the beginning of this section except that the archive is the source rather than the real time operation.

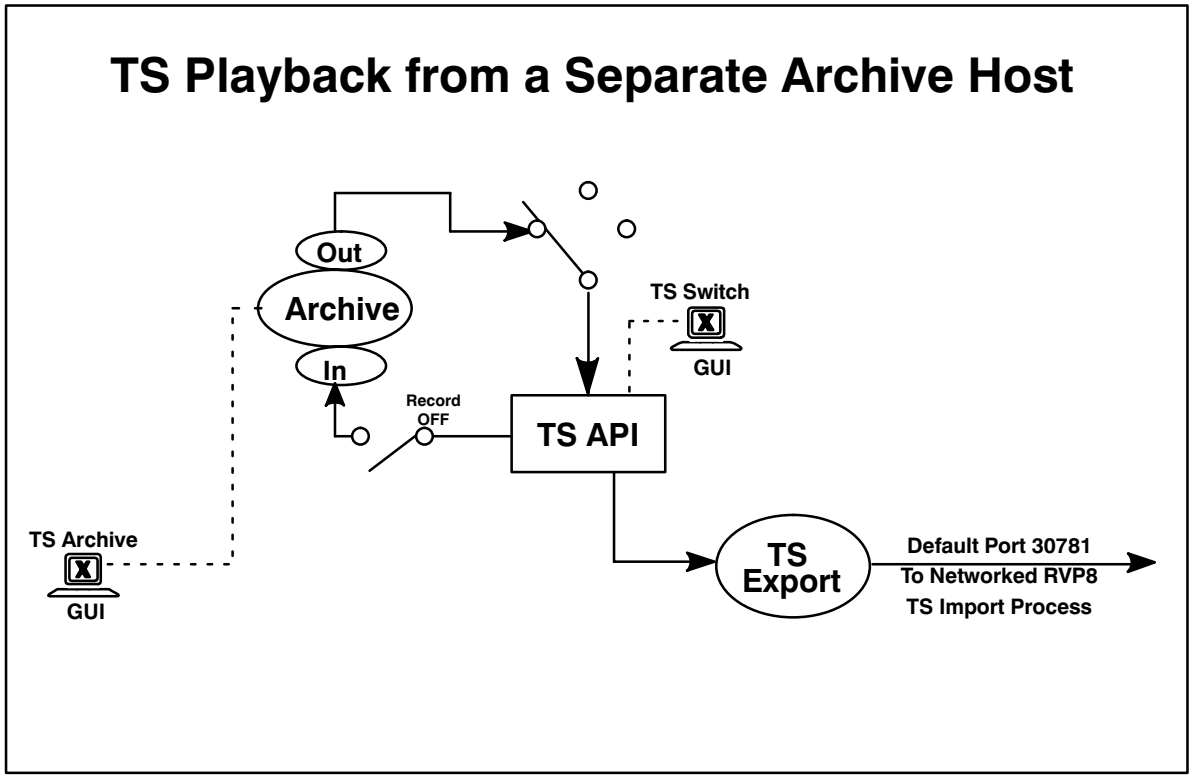
Utility Settings:

RVP8
TS Switch: Local Archive
TS Archive: Play

The difference is that applications that use the time series must know that the data are playback rather than real time data. This information as well as all of the required housekeeping data are actually part of the time series data format.

F.6.4 Case 4: TS playback from a separate archive host to an RVP8

This is the recommended mode of operation



Here the TS Switch is set to write data from the TS Archive to the TS API. TS Export then sends these via a UDP broadcast over the network to an RVP8 for processing.

Utility Settings:

RVP8
TS Switch: Network
TS Archive: N/A

Archive Host
TS Switch: Local Archive
TS Archive: Play

The diagram for the corresponding RVP8 would be identical to the previous page (Case 3: Playback from Local RVP8), except that the TS Switch would be set to write data from the TS Import process.

F.6.5 Quick Guides

The following steps should be used in conjunction with the software specific application examples described in the previous sections.

TS Archive Recording Quick Guide

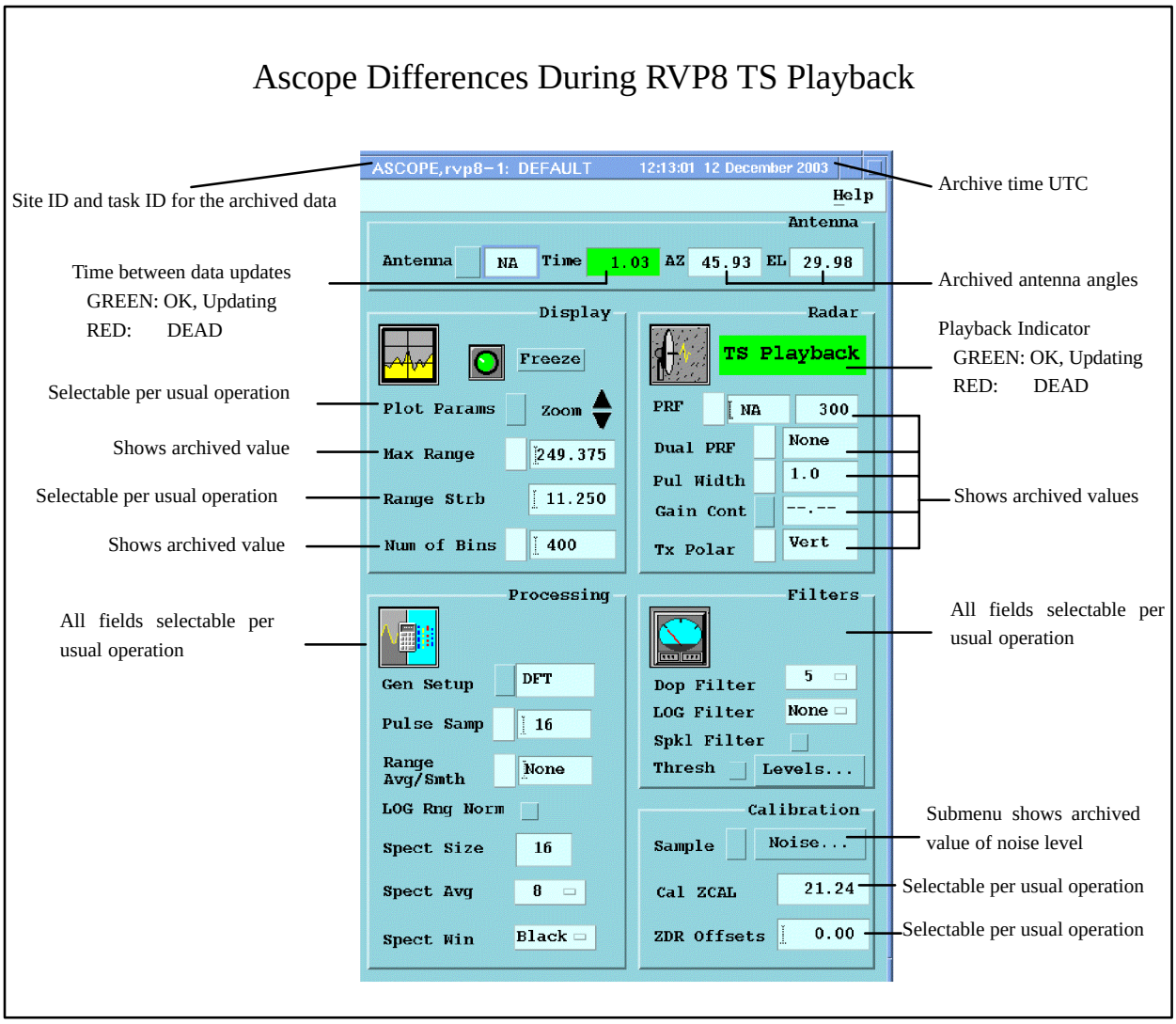
- Select a directory for the TS data to be written to. Make sure the desired directory already exists in the file system.
- Initialize the directory and give it a title. If the directory has already been used for archiving, then there is no reason to re–initialize it unless you want the data to be erased.
- Select the data source and make sure the light is green.
- Press record and watch for data to arrive in the log section.

TS Archive Playback Quick Guide

- Select the directory that contains the TS data to be played.
- Select Local Archive in the TS Source section.
- Make sure that the light is green.
- Select the files that you wish to playback and (right–click and select Playback) mark them for playback.
- Select any playback options.
- Press the Playback button.

F.7 Ascope Playback Features

The **ascope** utility is a full-featured, stand-alone signal processor configuration and plotting utility. When an RVP8 is in playback mode, **ascope** can be used to configure the processing of the playback data and display the results. For more information on the **ascope** utility please refer to **Chapter 3** of the ***IRIS Utilities Manual.*** The figure below illustrates the differences in the meanings of various menu fields when the RVP8 is in playback mode.



When the RVP8 is in playback mode, vs processing real time data, the major difference is that, some parameters were fixed at the time when the data were recorded. Examples of fixed parameters are:

- Maximum range
- PRF
- Transmit polarization

- Number of range bins
- Phase coding
- Value of noise level

All of these relate to the transmit characteristics of the radar and for these, **the archived value is displayed- users may not alter the field**s. There are other parameter fields that can be changed, identical to using ascope for real time data, such as the parameters to configure processing and plotting, e.g., the processing major mode and clutter filtering. The user may freely select these while the RVP8 is in playback mode.

There are several ways to use ascope during RVP8 playback.

- The archive can be on the local RVP8.
- The archive can be on a separate archive host.

Note that it does not matter where ascope is run, i.e., either on the local RVP8 or on a networked host computer via **DspExport**.

Archive on Local RVP8

Utility Settings:

RVP8
TS Switch: Local Archive
TS Archive: Play

Network Note: In most cases you will not be sitting up at the radar so you will need to export the displays for these utilities over the network. There are two ways to do this:

- Easy way: Use sigterm <hostname> to open a terminal window, or manually
- rlogin and export the display with DISPLAY=<hostname>:0.0 (you may also need to type xhost + on your local workstation).

It is often convenient to get the playback going in TS Archive with "Repeat" set, and then start ascope. The ascope utility will start-up in the playback mode and be updating the display appropriately. You are free to select the data processing and display parameters "on-the-fly" as playback is continuing and repeating.

When **ascope** is set the way that you want it, you can use the TS Archive menu to select different files and/or restart the playback.

Archive on Separate Archive Host

In this case the various support menus would be set as follows:

Utility Settings:

RVP8
TS Switch: Network
TS Archive: N/A

Archive Host
TS Switch: Local Archive
TS Archive: Play

Again, use "sigterm" or rlogin to export these menus to the workstation where you are sitting and viewing **ascope**.

F.8 TS Viewing Utility (tsview)

F.8.1 Overview

The **tsview** utility allows users to specify a TS file and obtain print-out of header information and time series data on a terminal screen. This capability is usually used to view header information to see how the data were collected, or to verify that IQ data were indeed recorded. Since the **tsview** source code is provided, perhaps the most important use of the **tsview** software is to serve as a model for developers building their own off-line applications for reading and processing time series data.

Important: If the TS archive utility has been licensed, the tsview utility can be accessed by right–clicking on the desired file in the TS inventory area. See section F.5.4.

F.8.2 Starting tsview and Sample Session

You must have operator privilege to run tsview. The TS View utility must be installed on the same node where the IQ data are archived. Before starting **tsview** it is usually most convenient to **"cd"** to the directory where the archive files are located. This will save you from having to specify the full path and allow the X-window center button copy/paste technique to be used to avoid typing file names. Once you are in the archive directory you can issue an **"ls"** command to view the files, and then run **"tsview <pathname> <–options>**." To see the various options simply use the **–help** option, i.e.,

```
$ tsview –help
Options: –count:N  (only print N pulses)
         –data     (print data values)
         –help     (print this list and exit)
         –length:N (max line length to use)
         –skip:N   (skip the first N pulses)
         –verbose  (print full header info)
         –noExit   (do not exit when done)
         pathname
         (all other arguments ignored)
```

A sample session is provided below. In this session you will view the pulse header information for the 101'st pulse in a TS file. The archive directory is called **"/bigdisk/tsarchive":**

```
$ cd /bigdisk/tsarchive     Change directory to location of TS files

$ ls *20031208.192519*      List all files from  8 Dec 03 19:25:19
RVP8.20031208.192519.074.Ascope_DEFAULT.0.H.249        One file found
```

```
$ tsview RVP8.20031208.192519.074* –count:1 –skip:100 –v       run tsview
Pulse Info size:1148                                           tsview output
==============TS Pulse Info==============
                Site:'RVP8'
              Version:0
            Major Mode:1 (FFT)
          Polarization:1 (Vertical)
   Phase mod sequence:0 (Fixed)
             Task Name:'Ascope_DEFAULT'
          Sweep Number:0
                   . . .
```

Details of the header format and information content are provided in **Section F.9**. The file naming convention is discussed in the next section under the heading "pathname".

F.8.3 Tsview Command Line Options

`–help`

Gives a list of available options as shown on the previous page.

`pathname` *(and file naming convention)*

This is the directory and name of the TS file. As shown above in the sample session, it is easiest to **`"cd"`** to the directory where the archive files are stored, then you only need to provide the file name. Once there you can do an **`"ls"`** command searching for the files that you want by date and time using standard UNIX options for **`"ls"`**. Note that "*" is a wild card. The file names are very long so you don't want to type them. Instead, use the X–window trick of highlighting the file name and then clicking the middle button to copy the text to the terminal cursor location.

The reason why the file names are so long is that the file name format is designed to make it easy to identify TS files. In the example we used a file with the name:

`RVP8.20031208.192519.074.Ascope_DEFAULT.0.H.249`

The file name format is:

`site.YYMMDD.HHMMSS.SSS.taskname.sweep.polarization.maxrangekm`

Most of the fields are self-explanatory. Details for the less obvious fields are given below:

- **site**- This is the site name typed into the setup program on the RVP8 which generated the data. Both site and taskname fields are preprocessed to remove characters which would mess up the filename, such as unprintable characters, space and "/".
- **taskname**- This is the identification of the configuration of the application that was operating when the TS data were collected. In the case of IRIS, it is the IRIS TASK name. In the case of the **ascope** utility, it is set to "ascope_<filename>" where filename is the name of the saved ascope configuration that was used to collect the data (see example above). In the case of a custom user application, the

user could specify an appropriate ID for the configuration so that it is archived appropriately.

- **sweep**- A sweep is a full 360 degree (or partial sector in sector mode) of data, typically collected at a fixed elevation angle. Most data acquisition software packages such as IRIS, collect volume scan data this way. The sweeps are indexed 1, 2, 3, ... In the case where **ascope** is used for RVP8 operation, there is no concept of a "sweep" and the sweep number is set to "0". Note that for RHI scanning, the concept of a sweep is the same, except that it is elevation sweep rather than azimuth sweeps.
- **polarization**- This refers to the transmit polarization. There are three choices: H, V, H+V (simultaneous H and V transmit) and ALT (alternating H and V transmit).

–count:N

Each file consists of the IQ data for all range bins for each pulse in the sweep. "Count" is how many pulses we want to display. In the example below in the **–data** section, the count is set to 1, i.e., only the information for one pulse is displayed.

–data

Use the **–data** option to see the actual IQ values for each range bin. Here are the time series values for 400 bins for the 101'st pulse. The label on the left is the index number of the first range bin on the line.

```
$ tsview RVP8.20031208.192519.074* –count:1 –skip:100 –data
Site:RVP8
 Pulse #101 at:19:25:19.406  8 DEC 2003 UTC, Az: 9.99, El:29.98
   0: (–91.2,244) (–91.2,  0) (–80.4,209) (–87.4,149) (–82.2,150) (–79.9, 95)
   6: (–84.2,157) (–81.4,182) (–81.6,100) (–83.8,276) (–79.2,331) (–83.9,220)
  12: (–83.2,202) (–84.9, 53) (–78.7, 52) (–82.3,184) (–82.7,121) (–78.7,286)
. . .
 390: (–90.2,244) (–83.5,228) (–83.7,264) (–86.4,181) (–85.4,182) (–84.8,206)
 396: (–84.5, 19) ( –118,233) (–81.0,149) (–96.5,256) (–90.9,249)
        Bin 396     Bin 397     Bin 398     Bin 399     Bin 400
```

–length:N

Since there are a lot of bins, and you may be using a terminal window with either a large or small font, the **"–length"** option allows you to specify the maximum number of characters to display under the **"–data"** option. In the example below, the length is set to 43 characters.

```
$ tsview RVP8.20031208.192519.074* –count:1 –skip:100 –data –length:43
Site:RVP8
 Pulse #101 at:19:25:19.406  8 DEC 2003 UTC, Az: 9.99, El:29.98
   0: (–91.2,244) (–91.2,  0) (–80.4,209)
   3: (–87.4,149) (–82.2,150) (–79.9, 95)
```

–skip:N

Used to specify how many pulses to skip before starting the terminal listing. In the example, we wanted the 101'st pulse, so we specified **"skip:100"**.

–verbose

To see the detailed information contained in the headers. This was enabled in the example session.

F.9 TS Record Data Format

Each TS file recorded to disk contains a run of 1 or more pulses which are from the same basic configuration of the RVP8. In RVP8 nomenclature, this is called the "Acquisition Mode". The definition of an acquisition mode is stored in a structure called the "rvp8PulseInfo". Each time something is changed, such as the PRF, the acquisition mode will change, and a new file is created. If there are no changes, then files will be arbitrarily written every 200000 pulses.

TS files consist of an interesting mixture of ASCII headers and binary data as shown in Table F–1 . They start with the rvp8PulseInfo structure. This is followed by possibly a great many pulses. Each pulse has a rvp8PulseHdr structure followed by an array of 16-bit binary data.

Table F–1: TS File Format

<rvp8PulseInfo> Variable size, even
<rvp8PulseHdr #1> Variable size, even
Pulse Data #1 16-bit words, count from header
<rvp8PulseHdr #2> Variable size, even
Pulse Data #2 16-bit words, count from header
...

Each individual time series sample consists of 2 floating point numbers representing the I followed by the Q voltage. The values are scaled such that the full magnitude is a value of 1. This represents +6dBm on the IFD rev D, but may change in future revisions. Floating point numbers are packed into 16-bit words using "High SNR" packed floating format described in section 6.7. These 16-bit words are always stored in the little-endian byte order which is native to the Intel processor chips common on PCs, which is the reverse of "Network order" used on sockets. Note that tsview displays the (I, Q) samples in power and angle format, as follows:

$$Power = 6dBm + 10 \times \log_{10}[I^2 + Q^2]$$

$$Angle = atan2(Q, I)$$

The first time series sample number is from the burst pulse. This is followed by a sample from each range bin with data. The iNumVecs field in the pulse hdr indicates the total number of samples. If is is a dual polarization receiver system, then this is duplicated for the second receiver (the iVIQPerBin field in the pulse hdr). Thus the total number of bytes of data is:

$$Bytes = 2 \times 2 \times iNumVecs \times iVIQPerBin$$

Note that the number of sample can be different in each pulse within the same file. This is because the sampling stops when the next trigger arrives. If triggers are from an external source, the PRT may fluctuate.

To explain the rvp8PulseInfo structure, we give an example from the file. You can find more details in our header file rvp8.h

rvp8PulseInfo start	The structure is bracketed by start and end
iVersion=0	Structure version number
iMajorMode=1	1:FFT, 2:Random Phase (see dsp.h)
iPolarization=1	Transmit polarization: 0:H, 1:V, 2:Alt, 3:H+V
iPhaseModSeq=0	See dsp.h
taskID.iSweep=0	Application Sweep number
taskID.iAuxNum=0	Application auxiliary number
taskID.sTaskName=Ascope_DEFAULT	Application task name
sSiteName=RVP8	Site name of RVP8
iAqMode=161	Increments each time there is a change
iUnfoldMode=0	Dual-PRF flag, see PRF_* in dsp_lib.h
iPWidthCode=0	Pulse width index (0–3)
fPWidthUSec=1	Actual pulsewidth in microseconds
fAqClkMHz=35.9751	Acquisition clock rate
fWavelengthCM=10.7	Radar wavelength in cm
fSaturationDBM=6	Saturation power of the I & Q samples
fRangeMaskRes=125	Range mask resolution in meters
iRangeMask=33825 ...	Full range mask, up to 512 16-bit numbers
fNoiseDBm=–81.6584 –81.6584	Noise samples for the 2 channels
fNoiseStdvDB=–0.00540576 –0.00540576	Standard deviation of the noise samples
fNoiseRangeKM=525	Range at which the last noise was taken
fNoisePRFHz=250	PRF at which the last noise was taken
iGparmLatchSts=0 0	Latched status from GPARM command
iGparmImmedSts=21124 8963 771 19 0 0	Immediate status from GPARM command
iGparmDiagBits=0 0 0 0	Diagnostic results from GPARM command
sVersionString=8.04.4	Version of RVP8
rvp8PulseInfo end	

The rvp8PulseHdr structure is also defined in the rvp8.h file. Here is an example:

rvp8PulseHdr start	
iVersion=0	
iFlags=3	Bit 0: N/A Bit 1: Gap before this pulse Bit 2: First pulse in trigger bank Bit 3: Last pulse in trigger bank Bit 4: Trig bank (possibly unchanged) is just beginning Bit 5: Triggers were blanked on this pulse
iMSecUTC=179	The data acquisition time milliseconds
iTimeUTC=1071875957	The data acq. time in seconds since 1970, UTC
iBtime=2429100475	Ms time pulse inserted in API

iSysTime=45973182	Acq clock count of pulse acquisition
iPrevPRT=119917	Acq clock period from previous trigger
iNextPRT=119917	Acq clock period to next trigger
iSeqNum=287828	Sequence number of pulse in API
iAqMode=161	Acq Mode sequence number (8-bits)
iPolarBits=0	Polarization control bits
iTxPhase=182	Transmit phase 1 deg (16-bit binary angle)
iAz=16381	Azimuth=89.98 deg (16-bit binary angle)
iEl=179	Elevation=0.98 deg. (16-bit binary angle)
iNumVecs=401	The number of TS samples in this pulse
iMaxVecs=401	The max possible number (1+#bins requested)
iVIQPerBin=1	1 for single polarization, 2 for dual
iTgBank=0	Trigger bank number
iTgWave=0	Trigger waveform sequence number
uiqPerm.iLong=0 0	User tag bits, permanent
uiqOnce.iLong=0 0	User tag bits, one time
RX[0].fBurstMag=3.58298e–05	Burst pulse amplitude, 1=full scale 0.446Volts
RX[0].iBurstArg=45561	Burst pulse phase difference (previous–this)
RX[1].fBurstMag=0	Second receiver burst info
RX[1].iBurstArg=0	
rvp8PulseHdr end	