HelloDevice Super Series

User Customization Guide

Version 1.2.1

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Trademark Information

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Revision history

Revision	Date	Name	Description
V0.0.1	**2003-09-09**	**H. Yeom**	Initial Draft
V1.0.0	**2003-09-22**	**H. Yeom**	Initial Release
V1.1.0	**2004-01-12**	**H. Yeom**	GDB support and sample filter programs are added
V1.2.0	**2011-03-08**	**JOJ**	Added descriptions for NFS support to Section 3.1
V1.2.1	**2015-09-09**	**W.K. Kim**	Updates the contact information of technical support and links

Content

1. Overview

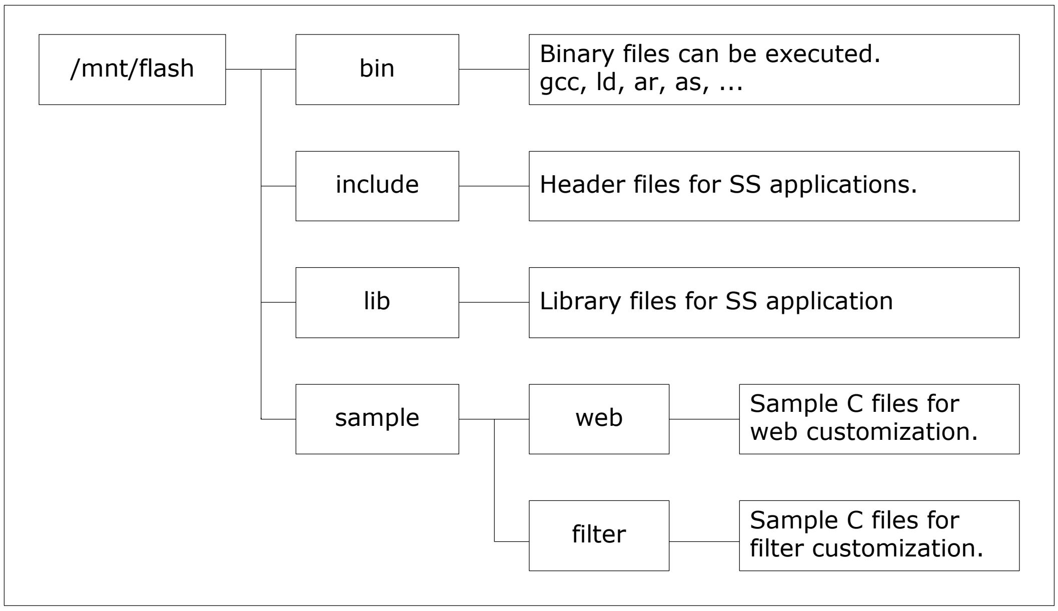
The HelloDevice Super Series is a serial to Ethernet programmable communication gateway for RS-232/422/485 based serial devices with various customization options.

Sena provides easy to use Software Development Kit (SDK) environment to quickly develop custom applications that run on the HelloDevice Super Series. Users can customize the web management interface, and integrate the programmed dynamic web pages to web menu.

In addition, user can manipulate the data stream which routes from serial device to socket and socket to serial device. The user-defined filter program communicates with other programs that are reading/writing serial port and socket by using FIFOs, and so user can easily manipulate the serial data without programming related to serial port and socket. The unit runs the embedded Linux Operating system and facilitates programming using command-line interface or one of several prepared scripts, using UNIX / Linux commands.

2. SDK (Software Development Kit)

To make user’s own application code, SDK for SS110/400/800 is needed. SS110/400/800 SDK is provided in the form of PC CF card (Please contact Sena Technical Support to get SDK for SS110/400/800.). The SDK contains compiler, linker, library files, header files and some sample C files. The directory structure of the SDK is as follows.


/mnt/flash
bin
Binary files can be executed.
gcc, ld, ar, as, ...
include
Header files for SS applications.
lib
Library files for SS application
sample
web
Sample C files for web customization.
filter
Sample C files for filter customization.

3. How to build user programs?

3.1. Preparing

The development environment for customization of Super Series can be made by using CF card or by using NFS.

3.1.1 Using CF card

Follow the below steps to prepare the development environment for customization.

1) Get a SDK for SS110/400/800 in the form of CF card.
2) Insert the SDK into the PCMCIA (PC card) slot of the SS device.
3) On the configuration menu, probe the PC card and then save and apply it.

3.1.2 Using NFS

If a CF card is not available, NFS(Network File System) can be used to make the development environment for customization.

1) Install (Decompress) SDK on NFS server under the NFS exported directory of it.
2) Mount the exported directory on /mnt/flash directory of Super series from the CLI of Super series.
3) Check the /mnt/flash directory if SDK files and directories can be accessed from it.

Example)

-Install SDK on NFS server

```
[root@localhost /]# cd /SS100SDK_NFS
[root@localhost SS100SDK_NFS]# ls
ss_sdk-v1.1.1.tar.gz
[root@localhost SS100SDK_NFS]# tar xzf ss_sdk-v1.1.1.tar.gz
[root@localhost SS100SDK_NFS]# ls
bin  include  lib  sample  ss_sdk-v1.1.1.tar.gz  version
```

where ss_sdk-v1.1.1.tar.gz = SDK of Super Series

/SS100SDK_NFS = the exported directory of NFS server

-Mount the exported directory from the CLI of Super Series

```
root@SS100_Device:/mnt# mount -t nfs 192.168.17.12:/SS100SDK_NFS /mnt/flash/
root@SS100_Device:/mnt# ls /mnt/flash/
bin                lib                ss_sdk-v1.1.1.tar.gz
include            sample             version
```

The syntax for mount command on the CLI of Super Series is

mount –t nfs <NFS server IP address>:<NFS directory path> /mnt/flash

If CF card service is running on Super Series, it should be stopped first before running mount command

3.2. Coding

Write source files in the C language and Makefiles. You can edit the source files on the Super Series CLI but if it is uncomfortable, you can do it on PC or Linux box. Almost all the Linux libraries are located at /mnt/flash/lib directory.

3.3. Uploading Files

If you edit the files on the Super Series CLI, skip over this section. To compile the source files, you must have uploaded the files to the SS device. You can upload the files in three ways as follows.

A. SCP

B. FTP

C. Configuration menu

For more detail information, refer to the User Guide.

3.4. Building and Executing

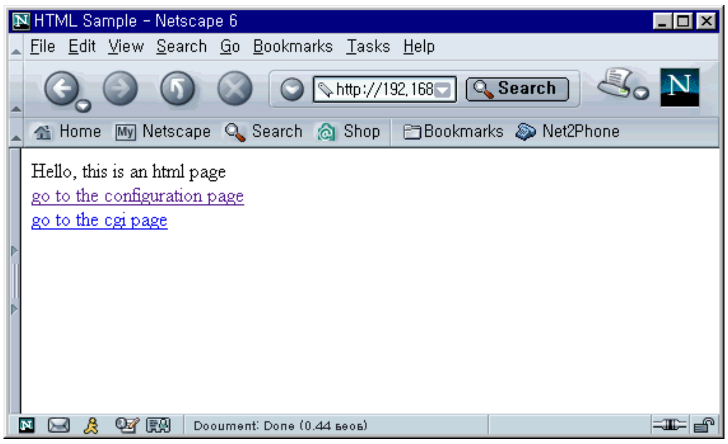
Compile, link and execute the programs as follows. (Imagine, a program named `prog` consists of two C source files `proga.c` and `progb.c`).

```
 # gcc -o  prog proga.c progb.c
 # ./prog
```

4. User Web Customization

4.1. HTML Files

You may customize the web management interface by adding your own HTML files in Super Series. All the HTML files must be in the /usr2/usrweb directory. There is a sample HTML file that is named index.html. Copy the file to /usr2/usrweb, and then you can see the HTML page like below.


HTML Sample - Netscape 6
File Edit View Search Go Bookmarks Tasks Help
http://192.168
Search
Home My Netscape Search Shop Bookmarks Net2Phone
Document: Done (0.44 secs)

Hello, this is an html page
go to the configuration page
go to the cgi page

4.2. CGI files

4.2.1 Building CGI files

Below is the procedure to build CGI files. Sample CGI source file is located at

/mnt/flash/sample/web/cgi/shell.c,

Step 1. Build the CGI file.

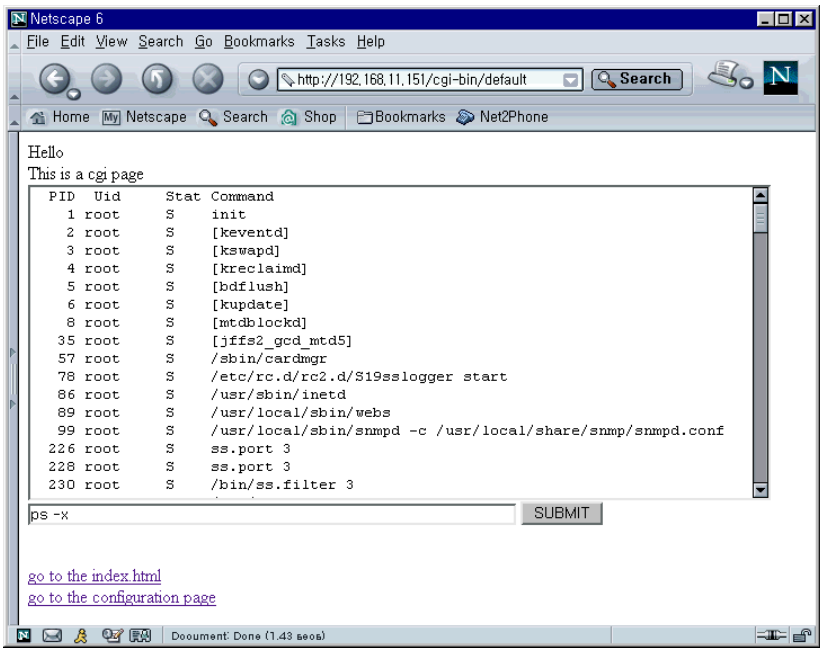
```
# cd /mnt/flash/sample/web/cgi
# make
```

Step 2. Copy the CGI file.

```
# cp shell.cgi /usr2/cgi-bin/
```

Step 3. Execute a Web browser, connect to the SS110/400/800, and log in.

Step 4. At the Web browser, go to `http://192.168.1.2/cgi-bin/shell.cgi`. (Suppose that the IP address of the SS110/400/800 is `192.168.1.2`)


Netscape 6
File Edit View Search Go Bookmarks Tasks Help
http://192.168.11.151/cgi-bin/default
Search
Home Netscape Search Shop Bookmarks Net2Phone
SUBMIT
Document: Done (1.43 secs)

Hello
This is a cgi page

```
  PID  Uid      Stat Command
    1 root      S     init
    2 root      S     [keventd]
    3 root      S     [kswapd]
    4 root      S     [kreclaimd]
    5 root      S     [bdflush]
    6 root      S     [kupdate]
    8 root      S     [mtdblockd]
   35 root      S     [jffs2_gcd_mtd5]
   57 root      S     /sbin/cardmgr
   78 root      S     /etc/rc.d/rc2.d/S19sslogger start
   86 root      S     /usr/sbin/inetd
   89 root      S     /usr/local/sbin/webs
   99 root      S     /usr/local/sbin/snmpd -c /usr/local/share/snmp/snmpd.conf
  226 root      S     ss.port 3
  228 root      S     ss.port 3
  230 root      S     /bin/ss.filter 3
```

ps -x

go to the index.html
go to the configuration page

4.2.2 Using CGI files

The CGI files must be in the /usr2/cgi-bin directory. If there is a CGI file named default, the file can be an entry page of the custom pages.

Here is a Makefile to make the shell.c.

```
CC = gcc
BIN = shell.cgi
OBJS = shell.o util_cgi.o
LDFLAG = -L/mnt/flash/lib

BIN : $(OBJS)
       $(CC) -o $(BIN) $(OBJS) $(LDFLAG)
c.o :
       $(CC) -c $<
all : $(BIN)
clean :
       rm -f $(BIN) $(OBJS)
```

The `util_cgi.h` and `util_cgi.c` are attached at the Appendix A. These CGI programs must be in the `/usr2/cgi-bin` directory.

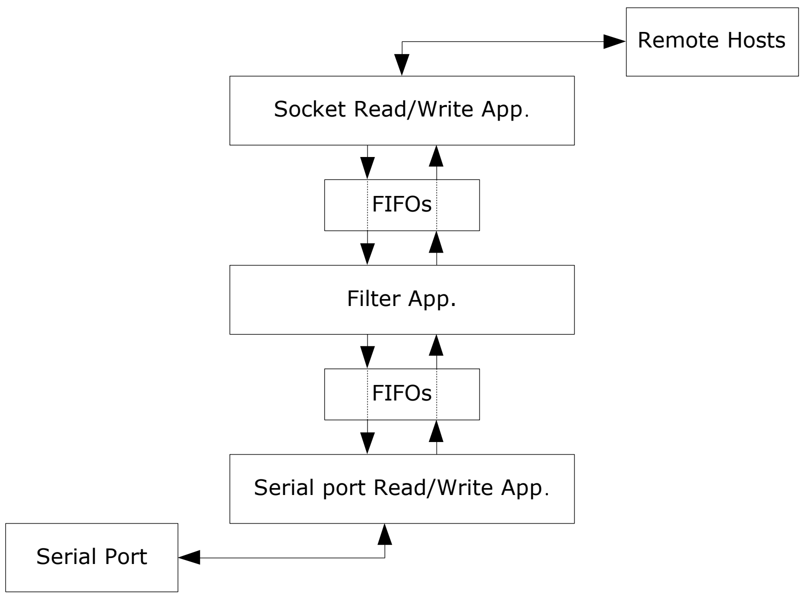
4.3. Java applets and so on

JAVA applets are also available. The applet files and all web files except CGI program must be in the `/usr2/usrweb` directory.

5. User Filter Customization

5.1. Understanding Filter Programs

SS110/400/800 uses FIFO method for inter-process communication. User can insert a program to manipulate the data stream which routes from serial device to socket and socket to serial device. The user-defined filter program communicates with other programs that are reading/writing serial port and socket by using FIFOs.



The user-defined filter reads a FIFO that is streaming the serial port data, manipulate the data and write the manipulated data to a FIFO that is sent to socket. The data stream that goes from socket to serial port can be manipulated in the same way. It must be satisfactory for following qualifications.

1) Write the data stream going to serial port to FIFO that is named `/tmp/port_fifos/port`*`X`*`_f2s` (*X* is the port index based on 1).
2) Write the data stream going to serial port to FIFO that is named `/tmp/port_fifos/port`*`X`*`_f2e`.
3) Read the data stream coming from serial port to FIFO that is named `/tmp/port_fifos/port`*`X`*`_s2f`.

4) Read the data stream coming from socket to FIFO that is named `/tmp/port_fifos/portX_e2f`.
5) Open four FIFOs on being executing and do not close the FIFOs except to be terminated.
6) Have more than one arguments and the first argument must indicate the port number.
7) Record the PID (Process ID) to the file that is named `/var/run/portX_filter.pid`. (This PID file is used to terminate the filter application, but it is terminated only in case the port is disabled.)
8) Be terminated when it receives the SIGTERM signal.

5.2. Building Filter Program

Below is the procedure to build Filter program. The sample programs are located at `/mnt/flash/sample/filter/` directory.

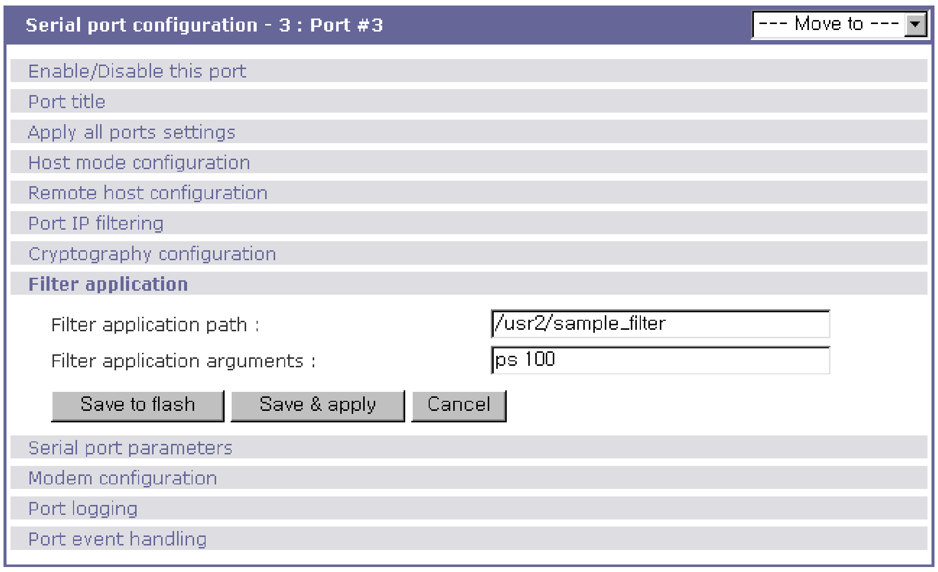
Step 1. Build a filter program.

```
# cd /mnt/flash/sample/filter
# make
```

Step 2. Copy one of sample filter programs to user space.

```
# cp data_conversion /usr2/sample_filter
```

Step 3. Configure the filter application settings as follows:



Filter application path : /usr2/sample_filter

Filter application arguments : ps 100

5.3. Filter Samples

All sample programs are composed of three threads, one main thread, one reading on serial port thread and one reading on socket thread. The main thread creates the other threads, and then waits until SIGTERM signal is received. If main thread receives SIGTERM signal, it cancels the other threads. The readings on serial port/socket threads are modified to its purpose.

- **`empty.c`**

  This sample filter connects the serial port read/write application and socket read/write application with FIFOs. It does not manipulate the data.

- **`periodic_command.c`**
  This sample filter connects the serial port read/write application and socket read/write application with FIFOs and writes a command to serial port periodically.
- **`data_conversion.c`**
  This sample filter is an example for protocol conversion.
- **`data_calibration.c`**
  This sample filter is an example that calculates the average of periodically incoming serial port data (e.g. thermometer data, hygrometer data) and sends it.
- **`data_storing.c`**
  This sample filter is an example that watches serial port data (e.g. thermometer data, hygrometer data) and saves it to RAM disk.(under /tmp directory)
- **`data_event_handling.c`**
  This sample filter is an example that watches serial port data (e.g. thermometer data, hygrometer data) and sends SNMP traps.
- **`cq.c`**
  Utility routines for circular queue.

6. Debugging with GDB

The SDK for HelloDevice Super Series supports GNU GDB debugger so that user can see what is going on inside user program while it executes.

(Please note that GDB support is added from the SDK v1.1.0 or later)

GDB can do four main kinds of things to help user catch bugs in the act:

- Start your program, specifying anything that might affect its behavior
- Make user's program stop on specified conditions
- Examine what has happened, when user's program has stopped
- Change things in user's program so user can experiment with correcting the effects of one bug and go on to learn about another.

GDB is invoked with the shell command gdb. Once started, it reads commands from the terminal until user tells it to exit with GDB command ***quit***. User can get online help from gdb itself by using the command ***help***.

User can run gdb with no arguments or options; but the most usual way to start GDB is with one argument or two, specifying an executable program as the argument.

Before run user program with GDB, user should compile his program with –g option.

6.1. Debugging sample filter program with GDB

This section describes how to debug sample filter program(data_conversion.c) with GDB debugger step by step. To debug sample filter program properly, it is recommended that user should set each parameters for serial ports previously using configuration tools such as Web UI or editconf. And also disable all serial ports using configuration tools so that user can run each port functions manually at the appropriate time.

Step 1. Copy sample program to user space

```
# cp /mnt/flash/sample/filter/Makefile /usr2/
# cp /mnt/flash/sample/filter/data_conversion.c /usr2/
# cp /mnt/flash/sample/filter/cq.c /usr2/
# cp /mnt/flash/sample/filter/cq.h /usr2/
```

Step 2. Modify Makefile to compile program with –g option.

Add –g option to CFLAGS variable.

```
# cd /usr2/
# vi Makefile
...
//CFLAGS = -pipe
CFLAGS = -pipe -g
...
```

Step 3. Modify source program to fit it to run with GDB debugger.

Remove `do_daemon() and save_pid(portnum) functions calls.`

Please note that user should run his program on the foreground to debug it with GDB.

```
# vi data_conversion.c
...
int main(int argc, char **argv)
{
      if (argc < 2)  {
              fprintf(stderr,  "\nUsage:  %s  [portnumber]  [echo|no_echo]\n\n",
get_program_name(argv[0]));
              return -1;
      }

      portnum = atoi(argv[1]);
      if (argc>2 && !strcmp(argv[2], "no_echo")) echo_flag = 0;

      (void) signal(SIGTERM, handle_sigterm);
      (void) signal(SIGPIPE, handle_sigterm);

// Remark following two lines to run this program on the foreground
//    do_daemon();
//    save_pid(portnum);

      do_filter();
      close_fifos();

      return 0;
}
...
```

Step 4. Compile sample filter program.

```
# make data_conversion
```

Step 5. Start serial port daemon(ss.port) and tcp socket daemon(ss.tcp) programs manually.

The ss.port is a daemon program for serial port and ss.tcp is a daemon program for tcp port.

These two programs are located under /bin directory of SS device.

Argument '1' means that it is run for port #1.

```
# ss.port 1
# ss.tcp 1
# ps -ef
   PID  Uid     Stat Command
    1 root     S    init
    2 root     S    [keventd]
    3 root     S    [kswapd]
    4 root     S    [kreclaimd]
    5 root     S    [bdflush]
    6 root     S    [kupdate]
    8 root     S    [mtdblockd]
   35 root     S    [jffs2_gcd_mtd5]
   57 root     S    /sbin/cardmgr
   80 root     S    dhcpcd eth0
   87 root     S    /etc/rc.d/rc2.d/S19sslogger start
   97 root     S    /usr/sbin/inetd
  100 root     S    /usr/local/sbin/webs
  110 root     S    /usr/local/sbin/snmpd -c /usr/local/share/snmp/snmpd.conf
  113 root     S    /bin/linkupchecker -c 1
  118 root     R    /etc/rc.d/rc2.d/S53ss800mand start
  126 root     S    /etc/rc.d/rc2.d/S53ss800mand start
  128 root     S    /usr/sbin/cron
  129 root     S    -bash
  523 root     S    ss.port 1
  524 root     S    ss.port 1
  525 root     S    ss.port 1
  526 root     S    ss.port 1
  527 root     S    ss.port 1
  529 root     S    ss.tcp 1
  530 root     S    ss.tcp 1
  532 root     S    ss.tcp 1
  533 root     S    ss.tcp 1
  534 root     S    ss.tcp 1
  535 root     R    ps -ef
```

Step 6. Run sample filter program using GDB.

```
# /mnt/flash/bin/gdb data_conversion
```

Step 7. After running GDB, user can use GDB commands to control it.

In this example, first user should set argument for sample filter program as follows,

```
GNU gdb 5.0
Copyright 2000 Free Software Foundation, Inc.
GDB is free software, covered by the GNU General Public License, and you are
welcome to change it and/or distribute copies of it under certain conditions.
Type "show copying" to see the conditions.
There is absolutely no warranty for GDB.  Type "show warranty" for details.
This GDB was configured as "powerpc-hardhat-linux"...
(gdb) set args 1
```

Argument '1' means that this sample filter program is run for port #1.

Step 8. And then set breakpoint at the proper positions to stop program run.

For example, user can set break point on *e2s_thread function to check what is entering from tcp port.

```
  (gdb) break *e2s_thread
   Breakpoint 1 at 0x10003054: file data_conversion.c, line 255.
```

And then run program with 'r' command

```
  (gdb) r
 Starting program: /usr2/data_conversion 1
 [New Thread 539 (manager thread)]
 [New Thread 538 (initial thread)]
 [New Thread 540]
 [New Thread 541]
 [Switching to Thread 541]

 Breakpoint 1, e2s_thread (arg=0x0) at data_conversion.c:255
 255    {
 (gdb)
```

Step 9. After for a while, program will be stopped at the entry point of *e2s_thread function. User can run next step by entering 'n' (next) command.

```
 (gdb) n
 e2s_thread (arg=0x0) at data_conversion.c:257
 257            int nread=0;
 (gdb) n
 261            pthread_setcancelstate(PTHREAD_CANCEL_ENABLE, NULL);
 (gdb) n
 262            pthread_setcanceltype(PTHREAD_CANCEL_ASYNCHRONOUS, NULL);
 (gdb) n
 ...
```

Step 10. When program run is reached at the line #274, user should make a tcp connection to a serial port #1 of SS device and send any data to serial port #1 using any terminal emulation program such as TeraTerm Pro or Hyper Terminal so that sample filter program reads data from tcp buffer and keeps going to run next step.

```
 ...
 (gdb) n
 270            if (f2s_fd < 0) pthread_exit(NULL);
 (gdb) n
 272            while(!exit_flag) {
 (gdb) n
 274                    nread = read(e2f_fd, buf, sizeof(buf));
 (gdb) n
 275                    if (nread<=0) continue;
 (gdb)
```

Step 11. By setting break point at line #275 and display variable buf[0], user can monitor data coming from tcp port whenever there is a data from it.

```
  (gdb) display buf[0]
 1: buf[0] = 97 'a'
 (gdb) break 275
 Breakpoint 2 at 0x10003160: file data_conversion.c, line 275.
 (gdb) n
```

```
277                     if (echo_flag) {
1: buf[0] = 97 'a'
(gdb) c
Continuing.

Breakpoint 2, e2s_thread (arg=0x0) at data_conversion.c:275
275                     if (nread<=0) continue;
1: buf[0] = 50 '2'
(gdb) c
Continuing.

Breakpoint 2, e2s_thread (arg=0x0) at data_conversion.c:275
275                     if (nread<=0) continue;
1: buf[0] = 51 '3'
(gdb)
```

Step 12. User can stop the GDB debugger using 'quit' command.

```
(gdb) quit
The program is running.  Exit anyway? (y or n) y
```

To run sample filter program again, repeat from Step 5. after killing existing ss.port and ss.tcp daemon.

```
# killall ss.port
# killall ss.tcp
```

Fro more detail information about GDB debugger, please refer to GNU documentation page. (http://www.gnu.org/software/gdb/documentation/)