DEBUGGING

EPICS APPLICATIONS

FOR BEGINNERS

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DEBUGGING REFERENCES

- EPICS Documentation on WWW at APS
  http://epics.aps.anl.gov/asd/controls
  - Applications Developer's Guide
    - Particularly -- Chapter 2. -- IOC Test Facilities
  - Record Reference Manual

- VxWorks Programmer's Manual
  Particularly
  - Chapter 2 -- Getting Started
  - Chapter 12 -- Debugging
  - Chapter 11 -- The Shell

PHASES OF DEBUGGING

- **Your new application:**

  "It's never worked and it's never going to work!"

- **Your existing application:**

  "It worked yesterday and I didn't change a thing!"

- **Someone else's application:**

  "It's not my application!
  How should I know why it doesn't work?"

New Application

- Use working applications as templates.

- Make small changes and try them out.

- Try out subroutines from the vxWorks shell.
  Subroutine Records and sequences should call subroutines that can be called easily from the vxWorks shell.

- If it works save it!
  SCCS
  CVS
  tar

If It Works Save It -- tar

- Save whole application directories with tar.
  cd <application directory>
  tar -cvf <filename> .

(. means you will also include invisible files from your current directory)

- Example:
  cd ~training/et1
  tar -cvf /local_temp/et1.tar .

- tar saves symbolic links unless special flags are used.

- Don’t use cp to copy application directories
  or you will copy most of epics.

If it Works Save It -- Boot Parameters

- **Log onto the IOC or tip hardwire to it.**
- **Type:**

  bootChange

  and enough carriage returns to get all the boot parameters on the screen

Copy the text to a file on the sun.

You can do this from a cmdtool on the sun by

clicking with the left mouse button on the first letter of the text.

clicking with the middle button on the last.

Hit the copy key (3rd from bottom on left key pad)

Open a text file and hit the paste key.

Results of Saving a Boot File

```
'.mv167> bootChange

'.' = clear field;  '-' = go to previous field;  ^D = quit

boot device          : ei
processor number     : 0
host name            : leia
file name            : ~wright/vx/v51.epics/config/mv167/vxWorks
inet on ethernet (e) : 189.165.32.83:ffffff00
inet on backplane (b):
host inet (h)        : 189.165.32.26
gateway inet (g)     :
user (u)             : vx
ftp password (pw) (blank = use rsh): xxxxxxx
flags (f)            : 0x29
target name (tn)     : vxmv156733a
startup script (s)   : ~wright/camac_demo/camac/startup.mv167
other (o)            :
```

Why Save the Boot Parameters?

- The injector arcs
  and the boot parameters disappear.
- Someone else is sharing your IOC
  and the parameters get changed.
- You change the parameters yourself
  and put in some strange characters.
- You can cut and paste from a saved file into
  the boot parameters.
- You don’t have a serial connection
  and you’ve forgotten the network address.

If It Doesn’t Work, Start At the Beginning

- **Watch the ioc boot.**
- **Use a serial link (tip hardwire).**
  (You may not be able to log in remotely.)
- **Does vxWorks load? Or do you get this message:**

  Attaching network interface ei0... done.
  Attaching network interface lo0... done.
  Loading...
  Error loading file: errno = 0xd.
  Can’t load boot file!!
- **Possible Reasons: Network down, address bad,**
  vx user doesn’t have permission to ftp to sun.

Useful IOC tools

- i -- lists processes running
- spy -- statistics about task execution (spyStop - to stop)
- checkStack -- statistics on stack usage for every task
- memShow -- memory usage on the system
- tt <task name or id> -- task trace -- works with suspended tasks
- td <task name or id> -- task delete
- lkup "<string>" -- prints all symbol table elements containing <string>
- help -- lists useful commands with examples
  dbgHelp -- help with debugging. break points etc.
  lkup "Help" -- will list all help routines.

- **sp <routine name>, <parameter>,...,<parameter>-- spawns a task with default stack and priority. You must use this if your routine calls channel access or you want to use the break point facilities.**

- **< <script name>**
  -- runs the vxWorks script (located in the UNIX working directory) on the IOC.

- **<vxWorks command> > <UNIX file name>**
  -- Puts output from vxWorks Command into the UNIX file.

- **copy "<UNIX file name>"**
  -- prints UNIX file contents to standard output on the IOC.

- **i (with EPICS running).**

```
 NAME        ENTRY       TID    PRI   STATUS      PC       SP     ERRNO  DELAY
---------- ------------ -------- --- ---------- -------- -------- ------- -----
tExcTask   _excTask      3dc2f4   0 PEND         5a83c   3dc25c   3006b     0
tLogTask   _logTask      3d99f4   0 PEND         5a83c   3d9958       0     0
tShell     _shell        3a85f4   1 READY        46f08   3a82d0  3d0001     0
tRlogind   _rlogind      3b72dc   2 PEND          a2a0   3b70e0       0     0
tTelnetd   _telnetd      3b5438   2 PEND          a2a0   3b5368       0     0
tRdbTask   _rdbTask      3b2a08  20 PEND          a2a0   3b28e8   d0003     0
timeStamp  _gts_select   2b9570  32 PEND          a2a0   2b9414       0     0
callback   _callbackTas  2bd2cc  40 PEND          a2a0   2bd284       0     0
scanEvent  30da20        299184  41 PEND          a2a0   29913c       0     0
gpibLink   2c99b2        2bb5e4  47 PEND          a2a0   2bb590       0     0
tNetTask   _netTask      3d5668  50 PEND          a2a0   3d5610       0     0
scanPeriod 30d676        29ba44  53 DELAY        46772   29b9f8       0     4
CA client  _camsgtask    2ad814 180 PEND          a2a0   2ad71c       0     0
CA repeater_ca_repeater  38439c 181 PEND          a2a0   384250       0     0
CA TCP     _req_server   2b5a28 181 PEND          a2a0   2b598c       0     0
CA event   _event_task   27f7c0 181 PEND          a2a0   27f778       0     0
CA event   _event_task   33ce64 181 PEND          a2a0   33ce1c       0     0
CA UDP     _cast_server  2b44b0 182 PEND          a2a0   2b4384       0     0
CA online  _rsrv_online  2b2f24 183 DELAY        46772   2b2e88       0   283
taskwd     31a368        2c4500 200 DELAY        46772   2c444c       0   241
value = 0 = 0x0
```

- **i -Without Epics running**

```
 NAME       ENTRY      TID    PRI   STATUS      PC       SP     ERRNO  DELAY
---------- ------------ -------- --- ---------- -------- -------- ------- -----
tExcTask   _excTask      3dc2f4   0 PEND         5a83c   3dc25c      0     0
tLogTask   _logTask      3d99f4   0 PEND         5a83c   3d9958      0     0
tShell     _shell        3a8834   1 READY        46f08   3a8510      0     0
tRlogind   _rlogind      3b72dc   2 PEND          a2a0   3b70e0      0     0
tTelnetd   _telnetd      3b5438   2 PEND          a2a0   3b5368      0     0
tRdbTask   _rdbTask      3b2a08  20 PEND          a2a0   3b28e8   d0003    0
tNetTask   _netTask      3d5668  50 PEND          a2a0   3d5610      0     0
tFtpdTask  _ftpdTask     3b0550  55 PEND          a2a0   3b0494      0     0
tPortmapd  _portmapd     3b3f20 100 PEND          a2a0   3b3dec     16     0
value = 0 = 0x0
```

What Happend to EPICS?

- The startup file doesn't exist.
- The startup file has an error in it.
- You need to watch the ioc boot!

Booting Problems
"When I telnet on to the IOC, EPICS is not running?"

- telnet onto a sun that has a serial link to the IOC
- tip hardwire
- reboot

- OR: if you don't have a serial link to the IOC
- Create an empty startup file

Creating and Using an Empty Boot File
To Watch an IOC Boot from telnet

- **On the SUN**
  cd <your application directory>
  cp startup.mv167 startup.full
  edit startup.mv167 and delete all lines
  after pwd.

- **Telnet onto the IOC and type**
  reboot

- **Telnet on again and type**
  < startup.full

Now that EPICS is there the Database Doesn't Work

- **Watch for errors in dbLoad**

  dbLoad "~wright/appl/camac/db/camac.database"
  0xfa9f10 (tShell): dbLoad: check sdrSum Error: Database out of date
  value = -1 = 0xffffffff = _asLock + 0xff055b1b

- **Or iocInit**

  0xfa9f10 (tShell): Missing record support entry table record support entry table not found for _gsubRSET
  0xfa9f10 (tShell): iocInit: Record Support Failed during Initialization

EPICS DIAGNOSTIC TOOLS

- CAU
  Used on both the Sun and the IOC.
  (cau must be loaded separately on the ioc
  and is in the extensions for UNIX tools in 3.12.)

- dbl, dbpr, dbpf, dbtr -- see Chapter 2
  of the IOC Application Developer's Guide

- Tracing by setting the TPRO field -- see Chapter 2
  of the IOC Record Reference Manual

I Can See the Database On the IOC But the Display Doesn't Connect

- **Make sure the names are really the same:**

- **dbl lists names on the ioc**

  mv167> dbl "ai"
  camac_ai_3
  value = 0 = 0x0

- **If the display has camac_al_3, it will not connect**

- **The net mask on the ioc must agree with the net mask on the sun**

  inet on ethernet (e) : 128.165.32.83:ffffff00

My XY plots of Waveforms Don't Update

- **Time stamps must be working -- this is what you might see on the ioc**

  Could not contact a master timing IOC
  0xfa9f10 (tShell): iocInit: All initialization complete

- **You need an environmental resource file to tell the ioc what the Network address of the time server is. Example:**

  (This is what you need for EPICS 3.11.
  3.12 shouldn't need EPICS_IOCMCLK_INET)

  houston% cat ~wright/appl/camac/resource.def
  EPICS_SYSCLK_INET DBF_STRING 128.165.32.95
  EPICS_IOCMCLK_INET DBF_STRING 128.165.32.214

Useful Unix Tools for Debugging EPICS

- grep -- searches files for strings or regular expressions
  Use it to:
  - find the definition of an EPICS define used in a program, for example:
    - grep ERROR /home/epics/r3.11/share/epicsH/*.h
  - get a list of all the channels in a short report,

- which -- tells you which version of a program you are using.
  for example:
  which dct
  .epicsUnix/sun4/bin/dct

- **ls -l -- tells you where links point and what permissions are.**

  for example:

  ls -l .epicsUnix

lrwxrwxrwx 1 wright 32 Jan 13 12:17 .epicsUnix -> /home/epics/release/R3.11.4/Unix/

- **printenv -- prints your UNIX environmental variables**

  for example:

  printenv| grep EPICS

EPICS_DISPLAY_PATH=.:./dl

Debugging the Application
That Worked Yesterday and You Made No Changes

- **Prove that you made no changes:**

You kept a tar file because it worked, so:

mkdir <new directory>

cd <new directory>

tar -xvf <your tar file>

diff -r . < your "unchanged" application directory>

- **If there really were no changes.**

It's the hardware!

It's a memory problem!

It's a network problem!

It's a subtle problem!

Debugging Someone Else's Application

- **Sign onto the IOC and look at the boot parameters**

- **The startup file will tell you what directory the application is in.**

- **Go into their directory and look at the startup file.**
  This should tell you
  exactly what was loaded and executed on the IOC.

- **Look at the Makefile in their src directory.**
  Hopefully
  they used the standard directory structure.
  This should tell what files were made and
  what compilers were used.

- **If there are Capfast or Gdct files you have a good chance**
  of understanding the database.

- **To get a list of all the channels used in the displays.**
  (Assuming they are using edd and dm)
  First report the display to a .adl file.
  If you are lucky, they have some names in common
  from the standard naming convention,

as for example

```
grep R03 mydisplay.adl > display.list
```

- **To get a list of all database channels used in sequences.**

```
grep assign *.st > st.dblist
```

- **To get a list of channels used in the database**
  from a short report.

```
grep PV myreport.short > PV.list
```

or

go into dct and ask it to Print One-Line Summaries.