Xserver Provider for DTrace

Alan Coopersmith, Oracle Corporation

X Server Version 1.12.2

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Introduction

This page provides details on a statically defined user application tracing provider [http://wikis.sun.com/display/DTrace/Statically+Defined+Tracing+for/User+Applications] for the DTrace [http://hub.opensolaris.org/bin/view/Community+Group+dtrace/] facility in Solaris™ 10, MacOS X™ 10.5, and later releases. This provider instruments various points in the X server, to allow tracing what client applications are up to.

The provider was integrated into the X.Org git master repository with Solaris 10 & OpenSolaris support for the Xserver 1.4 release, released in 2007 with X11R7.3. Support for DTrace on MacOS X was added in Xserver 1.7.

These probes expose the request and reply structure of the X protocol between clients and the X server, so an understanding of that basic nature will aid in learning how to use these probes.

Available probes

Due to the way User-Defined DTrace probes work, arguments to these probes all bear undistinguished names of <code>arg0</code>, <code>arg1</code>, <code>arg2</code>, etc. These tables should help you determine what the real data is for each of the probe arguments.

Table 1. Probes and their arguments

<table>
<thead>
<tr>
<th>Probe name</th>
<th>Description</th>
<th>arg0</th>
<th>arg1</th>
<th>arg2</th>
<th>arg3</th>
<th>arg4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Request Probes</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
| request-start            | Called just before processing each client request.                         | request-Name | request-Code | requestLength | client- | request-Buff
|                          |                                                                            |       |       |       |       |       |
| request-done             | Called just after processing each client request.                          | request-Name | request-Code | sequenceNumber | client- | result-
|                          |                                                                            |       |       |       |       | Code  |
| Event Probes             |                                                                            |       |       |       |       |       |
| send-event               | Called just before send each event to a client.                            | client-Tid | event-Code | event-Buffer |
| Client Connection Probes |                                                                            |       |       |       |       |       |
| client-connect           | Called when a new connection is opened from a client                       | client-Tid |              | client-Pid |
| client-auth              | Called when client authenticates (normally just after connection opened)    | client-Tid | client-Addr | client-Pid | client-
| client-disconnect        | Called when a client connection is closed                                   | client-Tid |              |             |       |
| Resource Allocation Probes |                                                                            |       |       |       |       |       |
### Data Available in Probe Arguments

To access data in arguments of type string, you will need to use `copyinstr()` [http://wikis.sun.com/display/DTrace/Actions+and+Subroutines#ActionsandSubroutines-{{copyinstr}}]. To access data buffers referenced via `uintptr_t`'s, you will need to use `copyin()` [http://wikis.sun.com/display/DTrace/Actions+and+Subroutines#ActionsandSubroutines-{{copyin}}].

**Table 2. Probe Arguments**

<table>
<thead>
<tr>
<th>Argument name</th>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>clientAddr</td>
<td>string</td>
<td>String representing address client connected from</td>
</tr>
<tr>
<td>clientFD</td>
<td>int</td>
<td>X server's file descriptor for server side of each connection</td>
</tr>
<tr>
<td>clientId</td>
<td>int</td>
<td>Unique integer identifier for each connection to the X server</td>
</tr>
<tr>
<td>clientPid</td>
<td>pid_t</td>
<td>Process id of client, if connection is local (from <code>getpeerucred()</code>)</td>
</tr>
<tr>
<td>clientZoneId</td>
<td>zoneid_t</td>
<td>Solaris: Zone id of client, if connection is local (from <code>getpeerucred()</code>)</td>
</tr>
<tr>
<td>eventBuffer</td>
<td><code>uintptr_t</code></td>
<td>Pointer to buffer containing X event - decode using structures in <code>&lt;X11/Xproto.h&gt;</code> [<a href="http://cgit.freedesktop.org/xorg/proto/xproto/tree/Xproto.h">http://cgit.freedesktop.org/xorg/proto/xproto/tree/Xproto.h</a>] and similar headers for each extension</td>
</tr>
<tr>
<td>eventCode</td>
<td><code>uint8_t</code></td>
<td>Event number of X event</td>
</tr>
<tr>
<td>resourceId</td>
<td><code>uint32_t</code></td>
<td>X resource id (XID)</td>
</tr>
<tr>
<td>resourceType-Id</td>
<td><code>uint32_t</code></td>
<td>Resource type id</td>
</tr>
<tr>
<td>resourceType-Name</td>
<td>string</td>
<td>String representing X resource type (&quot;PIXMAP&quot;, etc.)</td>
</tr>
<tr>
<td>resourceValue</td>
<td><code>uintptr_t</code></td>
<td>Pointer to data for X resource</td>
</tr>
<tr>
<td>resultCode</td>
<td>int</td>
<td>Integer code representing result status of request</td>
</tr>
<tr>
<td>requestBuffer</td>
<td><code>uintptr_t</code></td>
<td>Pointer to buffer containing X request - decode using structures in <code>&lt;X11/Xproto.h&gt;</code> [<a href="http://cgit.freedesktop.org/xorg/proto/xproto/tree/Xproto.h">http://cgit.freedesktop.org/xorg/proto/xproto/tree/Xproto.h</a>] and similar headers for each extension</td>
</tr>
</tbody>
</table>
### Examples

#### Example 1. Counting requests by request name

This script simply increments a counter for each different request made, and when you exit the script (such as by hitting Control+C) prints the counts.

```bash
#!/usr/sbin/dtrace -s
Xserver*:::request-start
{
    @counts[copyinstr(arg0)] = count();
}
```

The output from a short run may appear as:

<table>
<thead>
<tr>
<th>Request Name</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>QueryPointer</td>
<td>1</td>
</tr>
<tr>
<td>CreatePixmap</td>
<td>2</td>
</tr>
<tr>
<td>FreePixmap</td>
<td>2</td>
</tr>
<tr>
<td>PutImage</td>
<td>2</td>
</tr>
<tr>
<td>ChangeGC</td>
<td>10</td>
</tr>
<tr>
<td>CopyArea</td>
<td>10</td>
</tr>
<tr>
<td>CreateGC</td>
<td>14</td>
</tr>
<tr>
<td>FreeGC</td>
<td>14</td>
</tr>
<tr>
<td>RENDER</td>
<td>28</td>
</tr>
<tr>
<td>SetClipRectangles</td>
<td>40</td>
</tr>
</tbody>
</table>

This can be rewritten slightly to cache the string containing the name of the request since it will be reused many times, instead of copying it over and over from the kernel:

```bash
#!/usr/sbin/dtrace -s

string Xrequest[uintptr_t];

Xserver*:::request-start
/Xrequest[arg0] == "/"
{
```

```bash
```

```bash
```
Xrequest[ arg0 ] = copyinstr( arg0 );
}

Xserver*:::request-start
{
    @counts[ Xrequest[ arg0 ] ] = count();
}

Example 2. Get average CPU time per request

This script records the CPU time used between the probes at the start and end of
each request and aggregates it per request type.

#!/usr/sbin/dtrace -s

Xserver*:::request-start
{
    reqstart = vtimestamp;
}

Xserver*:::request-done
{
    @times[ copyinstr( arg0 ) ] = avg( vtimestamp - reqstart );
}

The output from a sample run might look like:

<table>
<thead>
<tr>
<th>Function</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>ChangeGC</td>
<td>889</td>
</tr>
<tr>
<td>MapWindow</td>
<td>907</td>
</tr>
<tr>
<td>SetClipRectangles</td>
<td>1319</td>
</tr>
<tr>
<td>PolyPoint</td>
<td>1413</td>
</tr>
<tr>
<td>PolySegment</td>
<td>1434</td>
</tr>
<tr>
<td>PolyRectangle</td>
<td>1828</td>
</tr>
<tr>
<td>FreeCursor</td>
<td>1895</td>
</tr>
<tr>
<td>FreeGC</td>
<td>1950</td>
</tr>
<tr>
<td>CreateGC</td>
<td>2244</td>
</tr>
<tr>
<td>FreePixmap</td>
<td>2246</td>
</tr>
<tr>
<td>GetInputFocus</td>
<td>2249</td>
</tr>
<tr>
<td>TranslateCoords</td>
<td>8508</td>
</tr>
<tr>
<td>QueryTree</td>
<td>8846</td>
</tr>
<tr>
<td>GetGeometry</td>
<td>9948</td>
</tr>
<tr>
<td>CreatePixmap</td>
<td>12111</td>
</tr>
<tr>
<td>AllowEvents</td>
<td>14090</td>
</tr>
<tr>
<td>GrabServer</td>
<td>14791</td>
</tr>
<tr>
<td>MIT-SCREEN-SAVER</td>
<td>16747</td>
</tr>
<tr>
<td>ConfigureWindow</td>
<td>22917</td>
</tr>
<tr>
<td>SetInputFocus</td>
<td>28521</td>
</tr>
<tr>
<td>PutImage</td>
<td>240841</td>
</tr>
</tbody>
</table>
Example 3. Monitoring clients that connect and disconnect

This script simply prints information about each client that connects or disconnects from the server while it is running. Since the provider is specified as `Xserver$1` instead of `Xserver*` like previous examples, it won't monitor all Xserver processes running on the machine, but instead expects the process id of the X server to monitor to be specified as the argument to the script.

```
#!/usr/sbin/dtrace -s

Xserver$1:::client-connect
{
  printf("** Client Connect: id %d\n", arg0);
}

Xserver$1:::client-auth
{
  printf("** Client auth'ed: id %d => %s pid %d\n", arg0, copyinstr(arg1), arg2);
}

Xserver$1:::client-disconnect
{
  printf("** Client Disconnect: id %d\n", arg0);
}
```

A sample run:
```
# ./foo.d 5790
```
```
dtrace: script './foo.d' matched 4 probes
CPU     ID                    FUNCTION:NAME
0  15774 CloseDownClient:client-disconnect ** Client Disconnect: id 65
2  15774 CloseDownClient:client-disconnect ** Client Disconnect: id 64
0  15773 EstablishNewConnections:client-connect ** Client Connect: id 64
0  15772            AuthAudit:client-auth ** Client auth'ed: id 64 => local host pid 2034
0  15773 EstablishNewConnections:client-connect ** Client Connect: id 65
0  15772            AuthAudit:client-auth ** Client auth'ed: id 65 => local host pid 2034
0  15774 CloseDownClient:client-disconnect ** Client Disconnect: id 64
```

Example 4. Monitoring clients creating Pixmaps

This script can be used to determine which clients are creating pixmaps in the X server, printing information about each client as it connects to help trace it back to the program on the other end of the X connection.
#!/usr/sbin/dtrace -qs

string Xrequest[uintptr_t];
string Xrestype[uintptr_t];

Xserver$1:::request-start
/Xrequest[arg0] == ""/
{
    Xrequest[arg0] = copyinstr(arg0);
}

Xserver$1:::resource-alloc
/arg3 != 0 && Xrestype[arg3] == ""/
{
    Xrestype[arg3] = copyinstr(arg3);
}

Xserver$1:::request-start
/Xrequest[arg0] == "X_CreatePixmap"/
{
    printf("-> %s: client %d\n", Xrequest[arg0], arg3);
}

Xserver$1:::request-done
/Xrequest[arg0] == "X_CreatePixmap"/
{
    printf("<- %s: client %d\n", Xrequest[arg0], arg3);
}

Xserver$1:::resource-alloc
/Xrestype[arg3] == "PIXMAP"/
{
    printf("** Pixmap alloc: %08x\n", arg0);
}

Xserver$1:::resource-free
/Xrestype[arg3] == "PIXMAP"/
{
    printf("** Pixmap free:  %08x\n", arg0);
}

Xserver$1:::client-connect
{
    printf("** Client Connect: id %d\n", arg0);
}

Xserver$1:::client-auth
{
    printf("** Client auth'ed: id %d => %s pid %d\n", arg0, copyinstr(arg1), arg2);
}
Xserver Provider for DTrace

Xserver$1:::client-disconnect
{
    printf("** Client Disconnect: id %d\n", arg0);
}

Sample output from a run of this script:

** Client Connect: id 17
** Client auth'ed: id 17 => local host pid 20273
-> X_CreatePixmap: client 17
** Pixmap alloc: 02200009
<- X_CreatePixmap: client 17
-> X_CreatePixmap: client 15
** Pixmap alloc: 01e00180
<- X_CreatePixmap: client 15
-> X_CreatePixmap: client 15
** Pixmap alloc: 01e00181
<- X_CreatePixmap: client 15
-> X_CreatePixmap: client 14
** Pixmap alloc: 01c004c8
<- X_CreatePixmap: client 14
** Pixmap free: 02200009
** Client Disconnect: id 17
** Pixmap free: 01e00180
** Pixmap free: 01e00181