

Dummysnet on the GENIUS Bridge Machine

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Abstract- In this technical report we document how the GENIUS Bridge Machine (GBM) was configured to run dummysnet. The GBM is used at CAIA in order to induce packet delay and packet loss during human game trials. We also discuss how the GBM may be physically connected to two Xboxes and the commands required in order to introduce packet delay and loss.

Keywords- delay, game, loss, packet, Xbox

I. INTRODUCTION

This technical report begins with documentation on how the GBM is configured to run dummysnet. Dummysnet allows the introduction of controlled levels of packet delay and packet loss for the purpose of simulating Internet conditions. Next, we discuss how the GBM is connected to two Xboxes so as to introduce packet delay and packet loss into a game of Halo between the two Xboxes. We also look at how this could be achieved with four Xboxes.

II. BRIDGE MACHINE CONFIGURATION

Once installing FreeBSD 4.10-RELEASE on the GBM the following steps are required to install bridging and dummysnet. Note that since the GBM is only acting as a bridge, no network configuration has been entered for its fxp0 and fxp1 interfaces during installation of FreeBSD 4.10. The GBM has been given the hostname `genius-bridge.caia.swin.edu.au`.

1. In the directory `/boot/loader.conf` the following lines are added to automatically load the bridge kernel and dummysnet at boot-up [1]:

```
bridge_load="YES"
ipfw_load="YES"
```

2. The `/usr/local/etc/` and `/usr/local/etc/rc.d` directories are added as follows:

```
genius-bridge# cd /usr/local
genius-bridge# mkdir etc
genius-bridge# cd etc
genius-bridge# mkdir rc.d
genius-bridge# cd rc.d
```

3. To load the dummysnet kernel and add pipe 1, we create the file `dummysnet.sh` in the `/usr/local/etc/rc.d/` directory and enter into this file the following lines:

```
kldload dummysnet
ipfw add 1 pipe 1 ip from any to any bridged
ipfw add 2 allow ip from any to any
```

4. We then make `dummysnet.sh` executable upon boot-up:

```
genius-bridge# chmod +x dummysnet.sh
```

5. We edit the kernel and rebuilt it in order to set the timer granularity to 1000Hz. In the directory `/usr/src/sys/i386/conf/` we copy the GENERIC file:

```
genius-bridge# cp GENERIC GENERIC_1000Hz
```

and add to the bottom of this file the following line:

```
options          HZ=1000
```

Next we proceed to recompile the kernel:

```
genius-bridge# config GENERIC_1000Hz
genius-bridge# cd
../../compile/GENERIC_1000Hz/
genius-bridge# make depend && make && make
install
```

Once this process is finished, we reboot the GBM.

6. The next step is to add the following lines into `/etc/sysctl.conf`:

```
net.link.ether.bridge=1
net.link.ether.bridge_cfg=fxp0:1,fxp1:1
net.link.ether.bridge_ipfw=1
net.inet.ip.fw.enable=1
net.inet.ip.fw.one_pass=1
```

For more details on these commands see the ipfw manual page

<http://www.freebsd.org/cgi/man.cgi?query=ipfw&apropos=0&sektion=0&manpath=FreeBSD+4.10-RELEASE&format=html>.

7. Finally the following line is added to /etc/rc.conf:

```
gateway_enable="YES"
```

III. DUMMYPNET COMMANDS

In order to begin bridging and introduce packet delay or loss, the following commands need to be entered at the prompt:

```
genius-bridge# ipfw pipe 1 config delay Xms
genius-bridge# ipfw pipe 1 config plr Y
```

where X is any number from 0ms onwards and Y is any floating point number from 0.00 (0% packet loss) to 1.00 (100% packet loss). When these commands are entered, any previous commands are deleted, that is, dumynet will introduce conditions as specified in the last valid command. In order to enable both delay and packet loss, enter the following command:

```
genius-bridge# ipfw pipe 1 config delay Xms
plr Y
```

IV. XBOX SET UP

Table 1 lists the equipment required for setting up the human game trials featuring two Xboxes. Figure 1 shows the physical diagram of this set up. In this report we assume the game Halo will be played.

2 x Xbox
2 x Halo CD (or other system-link game)
2 x Televisions (or projectors)
2 – 8 x Xbox controllers
2 x Xbox video/audio output cables
2 x Xbox power cables
2 x CAT5 UTP crossover cables
1 x Bridge running dumynet
1 x Computer screen
1 x keyboard
PC power cables

Table 1: Xbox Set up equipment for two consoles

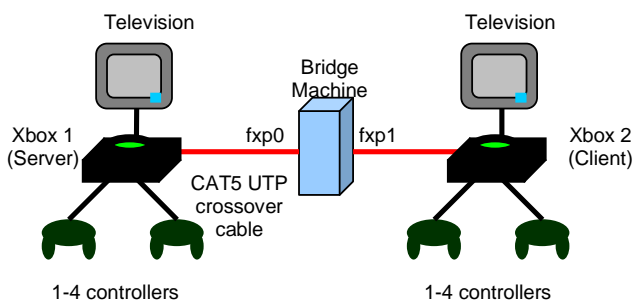


Figure 1: Set up with two Xboxes

V. ENABLING SYSTEM-LINK IN HALO

After placing a Halo CD into each Xbox, the Time Setting menu will appear. Press the Red 'B' button to exit and enter the main menu. Scroll down to 'Multiplayer' then select 'System-Link Game' from the menu. Players may then choose their character and change controller settings. Once the team intending to be the Server Xbox has selected their characters, they must choose a map and the type of game that is to be played, for example, Capture The Flag (CTF).

The team on the Client Xbox will see the game being offered by the Server when they finish choosing their characters. Upon accepting the game being offered by the Server Xbox, each team should see the names of all Xboxes participating in the game and the names of the characters. Each player may choose which colour team they will be on during the 30-second game countdown if applicable to the type of game being played.

VI. INTRODUCING PACKET DELAY AND LOSS IN HALO

Once game play has begun, packet delay and loss may be introduced. The levels of packet delay and loss entered into the game will depend upon what is being tested. The original Xbox trials [2] focused on satisfaction levels and playing ability as delay and loss were increased.

When packet loss or delay are introduced into the game, players on the Server Xbox should not experience a (significant) change in game quality while those on the Client Xbox will be visibly impacted. Packet delay generally causes players to experience a lag between the time they give a command, for example, shoot, and the time at which this command is executed. With packet loss, even a small percentage is noticeable, causing the game to momentarily freeze and lock the players out.

VII. INTRODUCING MORE XBOXES INTO THE SYSTEM

When more than two Xboxes participate in the game, a switch is required. Table 2 lists the equipment required and Figure 2 shows a physical diagram with four Xboxes in the system.

4 x Xbox
4 x Halo CD (or other system-link game)
4 x Televisions (or projectors)
4 – 16 x Xbox controllers
4 x Xbox video/audio output cables
4 x Xbox power cables
1 x CAT5 UTP crossover cable
4 x CAT5 UTP straight through cable
1 x switch
1 x Bridge running dumynet
1 x Computer screen
1 x keyboard
PC power cables

Table 2: Xbox Set up equipment for four consoles

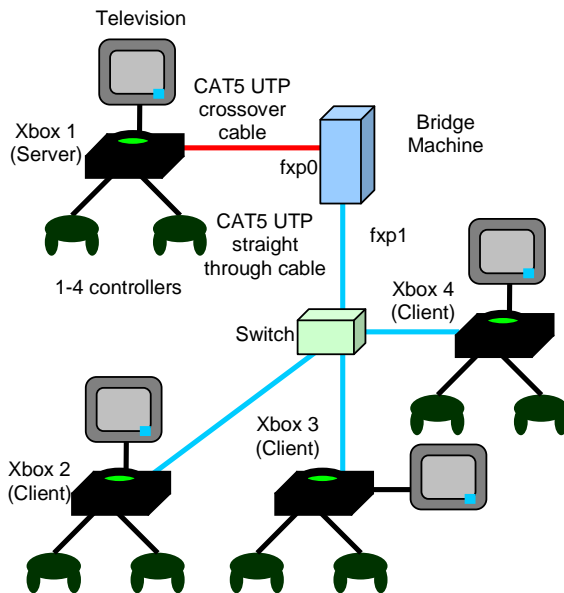


Figure 2: Set up with four Xboxes

VIII. CONCLUSION

This technical report documented the configuration of dummynet on the GBM for the purpose of introducing packet delay and loss into multiplayer games. We then looked at how the GBM may be set up with two Xboxes and how system-link can be initiated in a game of Halo. Lastly we discussed the impact of packet loss and delay in a game of Halo and showed the physical layout if more than two Xboxes were to be added into this system.

IX. REFERENCES

- [1] W.A. Vanhonacker, "Evaluation of the FreeBSD Dummynet Network Performance Simulation Tool on a Pentium 4-based Ethernet Bridge", CAIA Technical Report 031202A, <http://caia.swin.edu.au/reports/031202A/CAIA-TR-031202A.pdf>, December 2, 2003.
- [2] Tanja Lang, "User Experience While Playing Halo with Network Delay or Loss", CAIA Technical Report 031205A, <http://caia.swin.edu.au/reports/031205A/CAIA-TR-031205A.pdf>, December 5, 2003.

X. ACKNOWLEDGEMENTS

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