Lab Wall Update Adventure Summer 2014

Beginning

The original wall in the lab was driven by an older machine which is now experiencing memory issues which seem to be unrelated to the actual DIMM used. This indicates an issue with the motherboard and thus requires either that the motherboard be replaced or a different computer be found. Given the age of the current computer and the financial constraints of the setup, a different computer was required.

New Computer

The first step was to find a computer that would work. The old machine had an AMD processor and it was determined that another computer with an AMD processor would be the easiest replacement. A suitable replacement was located, the hard drive migrated, and the xorg.conf was reconfigured to adjust for the change in graphics card PCI bus changes. The same three NVIDIA Quadro NVS 420's (Q420) were used and no updates were made to the OS, a version of Arch Linux running a 3.x kernel with unknown custom configurations. The cards were connected such that the a card was located at PCI address 03:0.0, one at address 07:0.0, and one at address 0c:0.0. The top and bottom cards had four monitors connected to each with the middle card having a single monitor connected.

Xorg.conf

The previous version of the xorg.conf file (config file) was modified to work with the new configuration. It wasn't a one to one modification and the original configuration was not saved during this stage, which prevents any in depth analysis of the changes. Changes were made to the ServerLayout, Device, and Screen sections. It was determined through trial and error that five Screens were needed.

PCI Address

It appears that the way that the Q420 handles the four connected monitors is such that ports 1 and 2 can be connected as TwinViews and ports 3 and 4 can be connected as TwinViews. As there are nine monitors and three Q420's, two cards were completely filled and the third had only a single monitor connected as described above. Each card was defined in a Device section with the BusID specifying the PCI address with the periods replaced by colons such that 03:0.0 becomes 3:0:0. Each card appears to be addressable at two specific addresses, the one at which it is specifically defined, and the next sequential address. In the case of the card located at 03:0.0, the card, and two of the monitors attached to it, are addressable at

04:0.0. For addresses above 09:0.0, such as 0c:0.0, the numerical value is used in the config file. In the example, 0c:0.0, PCI:12:0:0 is used.

Device Section

Five devices were defined the xorg.conf file. Each device has a specific BusID. The BusID's used were PCI:3:0:0, PCI:4:0:0, PCI:7:0:0, PCI:8:0:0, and PCI:12:0:0. The definition of the Device section looks like the following

```
Section "Device"
       Identifier           "DeviceX"
       Driver               "nvidia"
       VendorName           "NVIDIA Corporation"
       BoardName            "Quadro NVS 420"
       BusID                "PCI:X:0:0"
EndSection
```

where PCI:X:0:0 is replaced by the correct address and DeviceX is replaced by sequentially increasing values starting at Device0.

Screen Section

For each device, a screen was defined, resulting in five screens starting from Screen0 and ending at Screen4. Many of the options are left over from the original config file and their meanings are not explored nor explained here. The only pieces modified were the Identifier and the Device. An example Screen section looks like the following

```
Section "Screen"
       Identifier    "ScreenX"
       Device        "DeviceX"
       Monitor       "Monitor0"
       DefaultDepth  24
       Option        "ConnectedMonitor" "DFP,DFP"
       Option        "UseDisplayDevice" "DFP-0,DFP-1"
       Option        "CustomEDID"
       "DFP-0:/etc/X11/edid.bin;DFP-1:/etc/X11/edid.bin"
       Option        "TwinView" "1"
       Option        "TwinViewXineramaInfoOrder" "DFP-0"
       Option        "metamodes" "DFP-0: nvidia-auto-select +0+0, DFP-1:
       nvidia-auto-select +0+1024"
       SubSection    "Display"
                     Depth  24
       EndSubSection
EndSection
```

with ScreenX and DeviceX changed to the corresponding screen and device. The options for TwinView and TwinViewXineramaInfoOrder are what is believed to allow the screen to encompass two monitors. In Screen4, several options are slightly different. These differences are shown below.

```
Option         "TwinView" "0"
Option         "TwinViewXineramaInfoOrder" "DFP-0"
Option         "metamodes" "DFP-0: nvidia-auto-select +0+0"
```

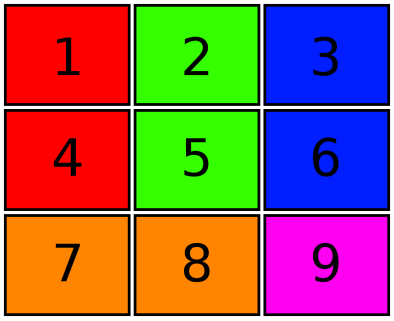
These options remove the use of TwinView and specify only a single monitor as this is screen which only a single monitor attached.

ServerLayout Section

The ServerLayout section defines the positions of the screens as well as the input devices and the Xinerama option. The screen positions are absolute, but relative positions could theoretically also have been used. The actual SeverLayout section is shown below.

```
Section "ServerLayout"
       Identifier     "Layout0"
       Screen         0  "Screen0" 0 0
       Screen         1  "Screen1" 1280 0
       Screen         2  "Screen2" 0 2048
       Screen         3  "Screen3" 2560 0
       Screen         4  "Screen4" 2560 2048
       InputDevice    "Keyboard0" "CoreKeyboard"
       InputDevice    "Mouse0" "CorePointer"
       Option         "Xinerama" "1"
EndSection
```

Each monitor has a maximum resolution of 1280x1024 which is used. The figure below shows the layout. Each monitor is labeled and each screen is color coded. Screen0 is in red, Screen1 is in green, Screen2 is in blue, Screen3 is in orange, and Screen4 is in purple. The working config file can be found in Appendix A.



Wall Monitor and Screen Layout

Issues

This setup worked, but it was impossible to update the system for several reasons. The system had not been updated for quite some time and several changes have been made to the file system used by Arch Linux in the interval. There were also the unknown custom configuration which might be overwritten by an update. The file system changes made to Arch Linux are difficult to apply all at once but an attempt was made to update the system. The process broke basically everything and it became necessary to reinstall the operating system.

New Computer First Try

The lab has several computers not currently in use and several were tested. The intent was to simply use the old NVIDIA Quadro NVS 420's that powered the previous version of the wall along with a new install of Arch Linux. It is difficult to install an operating system on the wall when all the monitors are connected due to ergonomics, the size of the screen, and the limited range a wired keyboard and mouse have. As such, an old video card was placed in the computer in place of the Q420's for installation purposes.

OS Installation

The installation followed the Arch Linux Beginner's Guide and was fairly straight forward. The hard drive for the computer is 320GB. The partitioning scheme chosen was 50GB for the root file system partition, 16GB for the swap partition, and the remaining portion for the home partition. Once the OS had been installed, including a graphical environment, in this case KDE, the Q420's were installed and the computer was moved to the wall.

Issues

After some research, it turns out that the NVIDIA drivers no longer support the Q420 and the legacy drivers are not only difficult to come by, but not fully supported by newer versions of Xorg. Since the purpose of this whole operation was to get the wall back up and running in such as state that updating the OS was possible, it was decided that the Q420's were not the best choice of video cards for the job.

New Computer Second Try

The wall that had been up at the Innovation Center was removed during the 2013-2014 school year and the computer had been sitting in the lab since it's removal. That wall was a 16 monitor setup using three ATI Radeon HD 5870's (R5870). The R5870 used is a hex head graphics card with six mini-displayports. It was thought that there was no real issue with this computer and so the hard drive from the wall in the lab was reconfigured yet again for this

computer. As it turns out, this computer has an issue with its RAM. Unfortunately, the CPU heatsink obstructs at least one of the RAM DIMMs and would have to be removed in order to test the RAM. As this could be a long process, it was decided that this computer was also undesirable for the wall.

New Computer Third Try

At this point, the original replacement computer was configured to use two of the R5870's and to drive the wall. This finally ended up working and the following section uses this computer. This is an older computer with an AMD PHenom 8650 Triple-Core Processor at 1.15GHz with 4GB DDR2. The same procedure for installing the OS was followed as above except that the installation was done with a single R5870 already installed. Once that worked, the second R5870 was installed and the computer was moved to the wall for installation.

R5870 Port Numbering

The R5870 has six mini-displayport heads which are enumerated starting at DisplayPort-0. Below is a picture showing the first port as seen from the rear of the card when installed..

Xrandr

With the installation of an up-to-date OS and kernel, xrandr was an available option for configuration. When only a single graphics card was installed, xrandr worked very well at setting up screens. However, when a second card was added, xrandr did not recognize it automatically. When the command to link the second card to the screens was initialized, some of the screens would become available, but not all of them and other commands to position them did not work or were ignored. It would seem then, that even in the August of 2014, xrandr is not suitable for multiple video cards and multiple monitors.

Xorg

At this point, xorg seemed to be the only option left. The majority of posted information regarding multihead config files focuses on NVIDIA graphics cards and uses TwinView as is outlined in the original config file. TwinView is an NVIDIA only option and cannot be used by AMD/ATI cards. The first step to success was generating a default config file by running

```
Xorg -configure
```

which can only be run as root. It is possible that this could be run using sudo, The documentation suggests that using `sudo` may not work as it states

> This option is only available when the server is run as root (i.e. with real-uid 0).

However, using sudo worked when attempted as shown below.

```
sudo Xorg -configure
```

This creates a default file at `/root/xorg.conf.new` which can been seen in Appendix B. This file didn't do everything desired, but it did correctly find two graphics cards and create Device sections for them with all options listed and commented out.

Device Section

From the newly created file and many Google searches, it was determined that the Device section has a Screen option that can be specified. According to the xorg man page,

> Screen number
> This option is mandatory for cards where a single PCI entity can drive more than one display (i.e., multiple CRTCs sharing a single graphics accelerator and video memory). One Device section is required for each head, and this parameter determines which head each of the Device sections applies to. The legal values of number range from 0 to one less than the total number of heads per entity. Most drivers require that the primary screen (0) be present.

This was a revelation which lead to creating separate Device sections for each port used on each card. An example Device section is shown below.

```
Section "Device"
       Identifier          "CardX"
       Driver              "radeon"
       BusID               "PCI:X:0:0"
       Screen              Y
EndSection
```

The Identifier CardX replaced by a sequentially increasing number starting at Card0. Screen Y is replaced with a number between zero and one less than the number of heads on the card. Screen X references which head is being referenced and the values start at zero and go up to one minus the number of heads on the card. For the R5870's, that would be five. For a single card, the numerical values for CardX and Screen Y are the same. When a second card is introduced, the first card will still have the same values, but while the CardX values will continue to increase, the Screen Y values will start over at zero.

ZaphodHeads Option

The example section above is still missing one option, ZaphodHeads, which is only available for ATI cards. This option allows a specific device to be bound to a specific output. Unfortunately, the man page for xorg.conf doesn't contain any information regarding this option. The explanation for how it works came from the ArchWiki ATI page. The output value used can be referenced in two ways. If xrandr is enabled, the name to use can be found using

```
xrandr -q
```

and for each head, there is a name. Most current systems have `xrandr` enabled, but if it isn't, the xorg log file found at /var/log/Xorg.0.log can be used and should give the correct name for the output. In the case of the R5870, each port's name is of the form DisplayPort-X, where X is replaced by a numerically increasing value starting at 0 on the first card. A complete Device section including the ZaphodHeads option is shown below.

```
Section "Device"
       Identifier          "CardX"
       Driver              "radeon"
       BusID               "PCI:1:0:0"
       Screen              X
       Option              "ZaphodHeads" "DisplayPort-X"
EndSection
```

Screen Section

Each individual monitor will have a Screen section which binds a device to a screen. There should be one screen per device and so for this setup, there are nine devices and nine screens. A sample Screen section is shown below.

```
Section "Screen"
       Identifier           "ScreenX"
       Device               "CardX"
       Monitor              "Default-Monitor"
EndSection
```

ScreenX and CardX are replaced by previously defined values as described above. The full config file can be found in Appendix C.

Future Work

While the current setup for the wall works and can be updated, we have several computer in the lab which are newer, have more powerful processors, and would generally be better suited to run the wall. Unfortunately, they all seem to have memory issues at the moment. Once these have been addressed, one of them should be configured to use run the wall as it should improve the performance significantly. Currently, when a program such as Google-Earth is running, the CPU can be maxed out. A newer, faster processor should handle this much better.

Appendix A NVIDIA Quadro NVS 420 xorg.conf

```
Section "ServerLayout"
       Identifier          "Layout0"
       Screen              0  "Screen0" 0 0
       Screen              1  "Screen1" 1280 0
       Screen              2  "Screen2" 0 2048
       Screen              3  "Screen3" 2560 0
       Screen              4  "Screen4" 2560 2048
       InputDevice         "Keyboard0" "CoreKeyboard"
       InputDevice         "Mouse0" "CorePointer"
       Option              "Xinerama" "1"
EndSection

Section "Files"
EndSection

Section "InputDevice"
       # generated from default
       Identifier    "Mouse0"
       Driver        "mouse"
       Option        "Protocol" "auto"
       Option        "Device" "/dev/psaux"
       Option        "Emulate3Buttons" "no"
       Option        "ZAxisMapping" "4 5"
EndSection

Section "InputDevice"
       # generated from default
       Identifier          "Keyboard0"
       Driver              "kbd"
EndSection

Section "Monitor"
       Identifier          "Monitor0"
       VendorName          "Unknown"
       ModelName           "DELL 1907FP"
       HorizSync           30.0 - 81.0
       VertRefresh         56.0 - 76.0
       Option              "DPMS"
EndSection

Section "Device"
       Identifier          "Device0"
       Driver              "nvidia"
       VendorName          "NVIDIA Corporation"
       BoardName           "Quadro NVS 420"
       BusID               "PCI:3:0:0"
EndSection
```

```
Section "Device"
       Identifier          "Device1"
       Driver              "nvidia"
       VendorName          "NVIDIA Corporation"
       BoardName           "Quadro NVS 420"
       BusID               "PCI:4:0:0"
EndSection

Section "Device"
       Identifier          "Device2"
       Driver              "nvidia"
       VendorName          "NVIDIA Corporation"
       BoardName           "Quadro NVS 420"
       BusID               "PCI:7:0:0"
EndSection

Section "Device"
       Identifier          "Device3"
       Driver              "nvidia"
       VendorName          "NVIDIA Corporation"
       BoardName           "Quadro NVS 420"
       BusID               "PCI:8:0:0"
EndSection

Section "Device"
       Identifier          "Device4"
       Driver              "nvidia"
       VendorName          "NVIDIA Corporation"
       BoardName           "Quadro NVS 420"
       BusID               "PCI:12:0:0"
EndSection

Section "Screen"
       Identifier          "Screen0"
       Device              "Device0"
       Monitor                    "Monitor0"
       DefaultDepth  24
       Option              "ConnectedMonitor" "DFP,DFP"
       Option              "UseDisplayDevice" "DFP-0,DFP-1"
       Option              "CustomEDID"
"DFP-0:/etc/X11/edid.bin;DFP-1:/etc/X11/edid.bin"
       Option              "TwinView" "1"
       Option              "TwinViewXineramaInfoOrder" "DFP-0"
       Option              "metamodes" "DFP-0: nvidia-auto-select +0+0, DFP-1:
nvidia-auto-select +0+1024"
       SubSection          "Display"
              Depth        24
       EndSubSection
EndSection
```

```
Section "Screen"
       Identifier          "Screen1"
       Device              "Device1"
       Monitor                   "Monitor0"
       DefaultDepth  24
       Option              "ConnectedMonitor" "DFP,DFP"
       Option              "UseDisplayDevice" "DFP-0,DFP-1"
       Option              "CustomEDID"
"DFP-0:/etc/X11/edid.bin;DFP-1:/etc/X11/edid.bin"
       Option              "TwinView" "1"
       Option              "TwinViewXineramaInfoOrder" "DFP-0"
       Option              "metamodes" "DFP-0: nvidia-auto-select +0+0, DFP-1:
nvidia-auto-select +0+1024"
       SubSection          "Display"
              Depth        24
       EndSubSection
EndSection

Section "Screen"
       Identifier          "Screen2"
       Device              "Device2"
       Monitor                   "Monitor0"
       DefaultDepth  24
       Option              "ConnectedMonitor" "DFP,DFP"
       Option              "UseDisplayDevice" "DFP-0,DFP-1"
       Option              "CustomEDID"
"DFP-0:/etc/X11/edid.bin;DFP-1:/etc/X11/edid.bin"
       Option              "TwinView" "1"
       Option              "TwinViewXineramaInfoOrder" "DFP-0"
       Option              "metamodes" "DFP-0: nvidia-auto-select +0+0, DFP-1:
nvidia-auto-select +1280+0"
       SubSection          "Display"
              Depth        24
       EndSubSection
EndSection

Section "Screen"
       Identifier          "Screen3"
       Device              "Device3"
       Monitor                   "Monitor0"
       DefaultDepth  24
       Option              "ConnectedMonitor" "DFP,DFP"
       Option              "UseDisplayDevice" "DFP-0,DFP-1"
       Option              "CustomEDID"
"DFP-0:/etc/X11/edid.bin;DFP-1:/etc/X11/edid.bin"
       Option              "TwinView" "1"
       Option              "TwinViewXineramaInfoOrder" "DFP-0"
       Option              "metamodes" "DFP-0: nvidia-auto-select +0+0, DFP-1:
nvidia-auto-select +0+1024"
       SubSection          "Display"
```

```
            Depth        24
      EndSubSection
EndSection

Section "Screen"
      Identifier          "Screen4"
      Device              "Device4"
      Monitor                   "Monitor0"
      DefaultDepth  24
      Option              "ConnectedMonitor" "DFP,DFP"
      Option              "UseDisplayDevice" "DFP-0,DFP-1"
      Option              "CustomEDID"
"DFP-0:/etc/X11/edid.bin;DFP-1:/etc/X11/edid.bin"
      Option              "TwinView" "0"
      Option              "TwinViewXineramaInfoOrder" "DFP-0"
      Option              "metamodes" "DFP-0: nvidia-auto-select +0+0"
      SubSection          "Display"
            Depth        24
      EndSubSection
EndSection

Section "Extensions"
      Option       "Composite" "Disable"
EndSection
```

Appendix B Auto Configured xorg.conf

```
Section "ServerLayout"
       Identifier          "X.org Configured"
       Screen              0  "Screen0" 0 0
       Screen              1  "Screen1" RightOf "Screen0"
       InputDevice         "Mouse0" "CorePointer"
       InputDevice         "Keyboard0" "CoreKeyboard"
EndSection

Section "Files"
       ModulePath          "/usr/lib/xorg/modules"
       FontPath            "/usr/share/fonts/misc/"
       FontPath            "/usr/share/fonts/TTF/"
       FontPath            "/usr/share/fonts/OTF/"
       FontPath            "/usr/share/fonts/Type1/"
       FontPath            "/usr/share/fonts/100dpi/"
       FontPath            "/usr/share/fonts/75dpi/"
EndSection

Section "Module"
       Load         "glx"
EndSection

Section "InputDevice"
       Identifier          "Keyboard0"
       Driver              "kbd"
EndSection

Section "InputDevice"
       Identifier          "Mouse0"
       Driver              "mouse"
       Option              "Protocol" "auto"
       Option              "Device" "/dev/input/mice"
       Option              "ZAxisMapping" "4 5 6 7"
EndSection

Section "Monitor"
       Identifier          "Monitor0"
       VendorName          "Monitor Vendor"
       ModelName           "Monitor Model"
EndSection

Section "Monitor"
       Identifier          "Monitor1"
       VendorName          "Monitor Vendor"
```

```
        ModelName           "Monitor Model"
EndSection

Section "Device"
            ### Available Driver options are:-
            ### Values: <i>: integer, <f>: float, <bool>: "True"/"False",
            ### <string>: "String", <freq>: "<f> Hz/kHz/MHz",
            ### <percent>: "<f>%"
            ### [arg]: arg optional
            #Option       "Accel"                        # [<bool>]
            #Option       "SWcursor"                     # [<bool>]
            #Option       "EnablePageFlip"          # [<bool>]
            #Option       "ColorTiling"                  # [<bool>]
            #Option       "ColorTiling2D"           # [<bool>]
            #Option       "RenderAccel"                  # [<bool>]
            #Option       "SubPixelOrder"           # [<str>]
            #Option       "AccelMethod"                  # <str>
            #Option       "EXAVSync"                     # [<bool>]
            #Option       "EXAPixmaps"              # [<bool>]
            #Option       "ZaphodHeads"                  # <str>
            #Option       "EnablePageFlip"          # [<bool>]
            #Option       "SwapbuffersWait"         # [<bool>]
        Identifier              "Card0"
        Driver                  "radeon"
        BusID                   "PCI:1:0:0"
EndSection

Section "Device"
            ### Available Driver options are:-
            ### Values: <i>: integer, <f>: float, <bool>: "True"/"False",
            ### <string>: "String", <freq>: "<f> Hz/kHz/MHz",
            ### <percent>: "<f>%"
            ### [arg]: arg optional
            #Option       "Accel"                        # [<bool>]
            #Option       "SWcursor"                     # [<bool>]
            #Option       "EnablePageFlip"          # [<bool>]
            #Option       "ColorTiling"                  # [<bool>]
            #Option       "ColorTiling2D"           # [<bool>]
            #Option       "RenderAccel"                  # [<bool>]
            #Option       "SubPixelOrder"           # [<str>]
            #Option       "AccelMethod"                  # <str>
            #Option       "EXAVSync"                     # [<bool>]
            #Option       "EXAPixmaps"              # [<bool>]
            #Option       "ZaphodHeads"                  # <str>
            #Option       "EnablePageFlip"          # [<bool>]
            #Option       "SwapbuffersWait"         # [<bool>]
        Identifier              "Card1"
        Driver                  "radeon"
        BusID                   "PCI:2:0:0"
EndSection
```

```
Section "Screen"
       Identifier          "Screen0"
       Device              "Card0"
       Monitor                    "Monitor0"
       SubSection          "Display"
              Viewport     0 0
              Depth        1
       EndSubSection
       SubSection "Display"
              Viewport     0 0
              Depth        4
       EndSubSection
       SubSection "Display"
              Viewport     0 0
              Depth        8
       EndSubSection
       SubSection "Display"
              Viewport     0 0
              Depth        15
       EndSubSection
       SubSection "Display"
              Viewport     0 0
              Depth        16
       EndSubSection
       SubSection "Display"
              Viewport     0 0
              Depth        24
       EndSubSection
EndSection

Section "Screen"
       Identifier          "Screen1"
       Device              "Card1"
       Monitor                    "Monitor1"
       SubSection          "Display"
              Viewport     0 0
              Depth        1
       EndSubSection
       SubSection "Display"
              Viewport     0 0
              Depth        4
       EndSubSection
       SubSection "Display"
              Viewport     0 0
              Depth        8
       EndSubSection
       SubSection "Display"
              Viewport     0 0
              Depth        15
```

```
        EndSubSection
        SubSection "Display"
                Viewport     0 0
                Depth        16
        EndSubSection
        SubSection "Display"
                Viewport     0 0
                Depth        24
        EndSubSection
EndSection
```

Appendix C Radeon HD 5870 xorg.conf

```
Section "ServerLayout"
       Identifier          "X.org Configured"
       Screen              0  "Screen0" 0 0
       Screen              1  "Screen1" 1280 0
       Screen              2  "Screen2" 2560 0
       Screen              3  "Screen3" 0 1024
       Screen              4  "Screen4" 1280 1024
       Screen              5  "Screen5" 2560 1024
       Screen              6  "Screen6" 0 2048
       Screen              7  "Screen7" 1280 2048
       Screen              8  "Screen8" 2560 2048
       InputDevice         "Mouse0" "CorePointer"
       InputDevice         "Keyboard0" "CoreKeyboard"
       Option              "Xinerama"
EndSection

Section "Files"
       ModulePath          "/usr/lib/xorg/modules"
       FontPath            "/usr/share/fonts/misc/"
       FontPath            "/usr/share/fonts/TTF/"
       FontPath            "/usr/share/fonts/OTF/"
       FontPath            "/usr/share/fonts/Type1/"
       FontPath            "/usr/share/fonts/100dpi/"
       FontPath            "/usr/share/fonts/75dpi/"
EndSection

Section "Module"
       Load         "glx"
EndSection

Section "InputDevice"
       Identifier          "Keyboard0"
       Driver              "kbd"
EndSection

Section "InputDevice"
       Identifier          "Mouse0"
       Driver              "mouse"
       Option              "Protocol" "auto"
       Option              "Device" "/dev/input/mice"
       Option              "ZAxisMapping" "4 5 6 7"
EndSection

Section "Monitor"
       Identifier          "Default-Monitor"
EndSection

Section "Device"
```

```
        Identifier          "Card0"
        Driver              "radeon"
        BusID               "PCI:1:0:0"
        Screen              0
        Option              "ZaphodHeads" "DisplayPort-0"
EndSection

Section "Device"
        Identifier          "Card1"
        Driver              "radeon"
        BusID               "PCI:1:0:0"
        Screen              1
        Option              "ZaphodHeads" "DisplayPort-1"
EndSection

Section "Device"
        Identifier          "Card2"
        Driver              "radeon"
        BusID               "PCI:1:0:0"
        Screen              2
        Option              "ZaphodHeads" "DisplayPort-2"
EndSection

Section "Device"
        Identifier          "Card3"
        Driver              "radeon"
        BusID               "PCI:1:0:0"
        Screen              3
        Option              "ZaphodHeads" "DisplayPort-3"
EndSection

Section "Device"
        Identifier          "Card4"
        Driver              "radeon"
        BusID               "PCI:1:0:0"
        Screen              4
        Option              "ZaphodHeads" "DisplayPort-4"
EndSection

Section "Device"
        Identifier          "Card5"
        Driver              "radeon"
        BusID               "PCI:1:0:0"
        Screen              5
        Option              "ZaphodHeads" "DisplayPort-5"
EndSection

Section "Device"
        Identifier          "Card6"
        Driver              "radeon"
```

```
        BusID               "PCI:2:0:0"
        Screen              0
        Option              "ZaphodHeads" "DisplayPort-6"
EndSection

Section "Device"
        Identifier          "Card7"
        Driver              "radeon"
        BusID               "PCI:2:0:0"
        Screen              1
        Option              "ZaphodHeads" "DisplayPort-7"
EndSection

Section "Device"
        Identifier          "Card8"
        Driver              "radeon"
        BusID               "PCI:2:0:0"
        Screen              2
        Option              "ZaphodHeads" "DisplayPort-8"
EndSection

Section "Screen"
        Identifier          "Screen0"
        Device              "Card0"
        Monitor             "Default-Monitor"
EndSection

Section "Screen"
        Identifier          "Screen1"
        Device              "Card1"
        Monitor             "Default-Monitor"
EndSection

Section "Screen"
        Identifier          "Screen2"
        Device              "Card2"
        Monitor             "Default-Monitor"
EndSection

Section "Screen"
        Identifier          "Screen3"
        Device              "Card3"
        Monitor             "Default-Monitor"
EndSection

Section "Screen"
        Identifier          "Screen4"
        Device              "Card4"
        Monitor             "Default-Monitor"
EndSection
```

```
Section "Screen"
       Identifier          "Screen5"
       Device              "Card5"
       Monitor             "Default-Monitor"
EndSection

Section "Screen"
       Identifier          "Screen6"
       Device              "Card6"
       Monitor             "Default-Monitor"
EndSection

Section "Screen"
       Identifier          "Screen7"
       Device              "Card7"
       Monitor             "Default-Monitor"
EndSection

Section "Screen"
       Identifier          "Screen8"
       Device              "Card8"
       Monitor             "Default-Monitor"
EndSection
```