ECE532S Digital Systems Design

DESL Network Connectivity for Remote Access

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Given the remote nature of the course this year, we can only access the FPGA boards using the remotely accessible DESL machines. The Nexys DDR boards can be accessed using the DESL-A pool, and the Nexys Video boards can be accessed using the DESL-B pool. In order to use the network interfaces of the boards, we have connected all of the FPGA boards to a 1Gbps switch. The DESL Desktops that these boards are connected to are also connected to this 1Gbps switch. Note, this network is separate from the main network the DESL machine use to access the Internet; it is a completely private network with no connectivity to the outside world. All of the FPGA boards and all of the Desktops should be able to communicate to all other FPGA boards and all other Desktops on this network. See Figure 1 for a depiction of the setup.
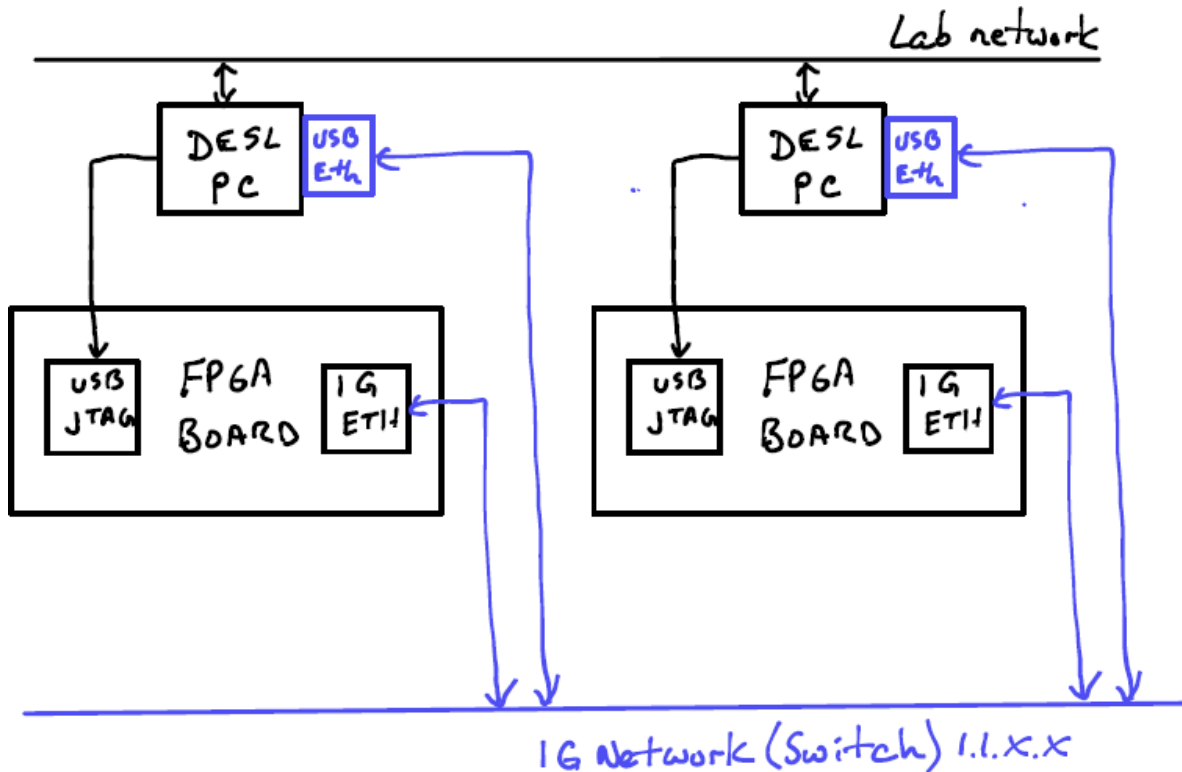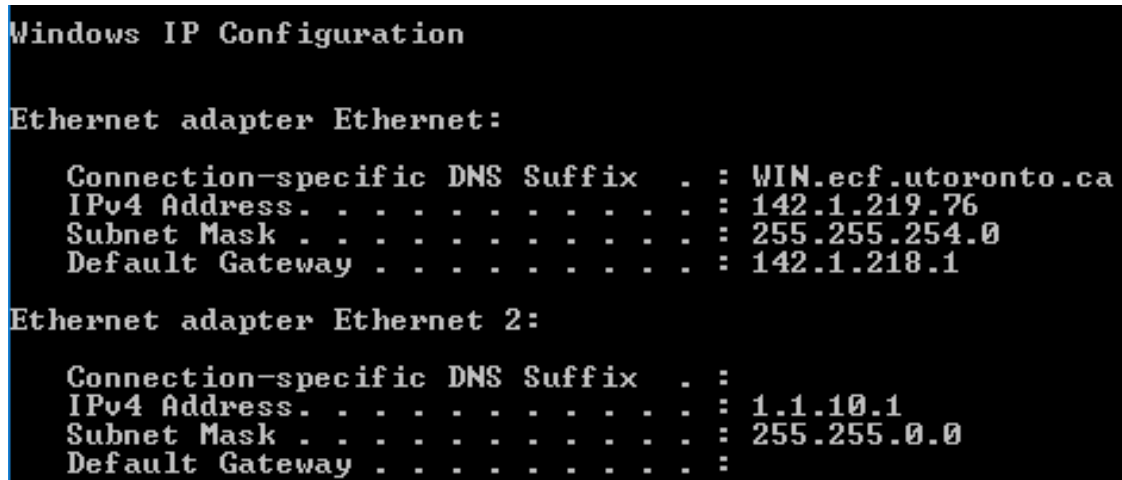

Figure 1: The Network Connectivity of DESL Machines and the Connected FPGA Boards

This is a shared network, and as such we must ensure that we set our MAC addresses and IP addresses correctly or we may interfere with the network communications of others. The MAC and IP addresses of the DESL Desktops are already set, but the MAC and IP addresses of the FPGAs

must be set on our FPGA projects. The IP addresses of the DESL Desktops are set to 1.1.X.1, where X is replaced by the station number. The source IP addresses of the FPGA boards should be set to 1.1.X.2, where X should be the station number of the DESL Desktop that FPGA board is attached to. The Subnet Mask of all systems should be set to 255.255.0.0. Finally, the source MAC addresses of the FPGA boards should be set to 00:0a:35:00:00:XX, where XX should be that same station number (without translation into hex, e.g. for station 12, the MAC address should be set to 00:0a:35:00:00:12).

To determine the station number of the DESL machine you are connected to, run the **Command Prompt** and enter the command `ipconfig`. This command should print the IP details of the Desktop's Network Interface Devices (NICs). Find the IP address of the form 1.1.X.1 to determine what value X should take. See Figure 2 for an example (station 10 in this case).


```
Windows IP Configuration

Ethernet adapter Ethernet:

   Connection-specific DNS Suffix  . : WIN.ecf.utoronto.ca
   IPv4 Address. . . . . . . . . . . : 142.1.219.76
   Subnet Mask . . . . . . . . . . . : 255.255.254.0
   Default Gateway . . . . . . . . . : 142.1.218.1

Ethernet adapter Ethernet 2:

   Connection-specific DNS Suffix  . :
   IPv4 Address. . . . . . . . . . . : 1.1.10.1
   Subnet Mask . . . . . . . . . . . : 255.255.0.0
   Default Gateway . . . . . . . . . :
```

Figure 2: ipconfig Run on Command Prompt for the DESL Machine Station Number 10

When you run a python script on the DESL Desktop machines, make sure to specify the IP address of the form 1.1.X.1 in the python script so that Windows knows to use that NIC for the communication. If you look at the the source files included with Tutorial 5, specifically the versions modified for use on the DESL, you should notice the variable named `HOST`, which is set to the placeholder value 1.1.X.1. Here is where you should replace the X with the proper station number. If you are trying to access the network interface from the Microblaze, make sure to specify the IP Address, the MAC Address, and Subnet Mask to the correct values. In the source file intended for the MicroBlaze from Tutorial 5, the macros `SRC_MAC_ADDR`, `SRC_IP4_ADDR`, and `IP4_NETMASK` should be set correctly. They have been initialized with default values including an X that should be replaced with the proper station number. **Note, make sure to update these values every time you connect to a different DESL machine, otherwise you may use the wrong values and disrupt the network for others.** See Table 1 for the proper IP addresses and MAC addresses to use for all of the different stations.

Finally, it is often useful for a network connected device to announce its MAC address and the IP address that corresponds to that MAC address; this is done by sending a packet known as a Gratuitous ARP. The Gratuitous ARP is broadcast to all devices on the same network, which should allow all other devices to learn the sending device's address details. In LWIP, the function to send a Gratuitous ARP is `etharp_gratuitous`, and if you look at the MicroBlaze code from Tutorial 5, you can see we've added this on line 210. Tutorial 5 implements a TCP client, but if you are trying to implement a TCP echo server based on the example project provided by Xilinx,

note that no Gratuitous ARP is sent. To add the Gratuitous ARP to that code, add the line `etharp_gratuitous(echo_netif);` right before the function call `start_application()` on line 229 of main.c and add the include line `#include "lwip/etharp.h"` at the beginning of main.c.

DESL Desktop	Desktop IP Address	FPGA IP Address	FPGA MAC Address
DESL-A-01	1.1.1.1	1.1.1.2	00:0a:35:00:00:01
DESL-A-02	1.1.2.1	1.1.2.2	00:0a:35:00:00:02
DESL-A-03	1.1.3.1	1.1.3.2	00:0a:35:00:00:03
DESL-A-04	1.1.4.1	1.1.4.2	00:0a:35:00:00:04
DESL-A-05	1.1.5.1	1.1.5.2	00:0a:35:00:00:05
DESL-A-06	1.1.6.1	1.1.6.2	00:0a:35:00:00:06
DESL-A-07	1.1.7.1	1.1.7.2	00:0a:35:00:00:07
DESL-A-08	1.1.8.1	1.1.8.2	00:0a:35:00:00:08
DESL-A-09	1.1.9.1	1.1.9.2	00:0a:35:00:00:09
DESL-A-10	1.1.10.1	1.1.10.2	00:0a:35:00:00:10
DESL-A-11	1.1.11.1	1.1.11.2	00:0a:35:00:00:11
DESL-A-12	1.1.12.1	1.1.12.2	00:0a:35:00:00:12
DESL-B-19	1.1.19.1	1.1.19.2	00:0a:35:00:00:19
DESL-B-20	1.1.20.1	1.1.20.2	00:0a:35:00:00:20
DESL-B-21	1.1.21.1	1.1.21.2	00:0a:35:00:00:21
DESL-B-22	1.1.22.1	1.1.22.2	00:0a:35:00:00:22
DESL-B-23	1.1.23.1	1.1.23.2	00:0a:35:00:00:23
DESL-B-24	1.1.24.1	1.1.24.2	00:0a:35:00:00:24
DESL-B-25	1.1.25.1	1.1.25.2	00:0a:35:00:00:25
DESL-B-26	1.1.26.1	1.1.26.2	00:0a:35:00:00:26
DESL-B-27	1.1.27.1	1.1.27.2	00:0a:35:00:00:27
DESL-B-28	1.1.28.1	1.1.28.2	00:0a:35:00:00:28
DESL-B-29	1.1.29.1	1.1.29.2	00:0a:35:00:00:29
DESL-B-30	1.1.30.1	1.1.30.2	00:0a:35:00:00:30

Table 1: Summary of IP Addresses and MAC Addresses to Use for the DESL Desktops and Their Connected FPGAs