EE458 - Embedded Systems
Netburner Networking

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Netburner Networking

Introduction

• You can program the Netburner using the Ethernet connection. This is much faster than programming over the serial link, but setting the connection up is slightly more complex and applications must be specially written to support transfer over Ethernet.

• If your application crashes then you will not be able to transfer over Ethernet and you must fall back to transfer over the serial link.
Netburner Networking

Introduction

- `printf/scanf` I/O defaults to the serial link.
- Debugging with the `gdb` debugger requires two connections to the board. We will use the Ethernet and serial connections.
- During project development I recommend using both the network and serial connections. For a fully networked application you can disconnect the serial link during deployment.
Netburner Networking
The Ethernet Connection

● Every Ethernet device must have a 48-bit Ethernet (or MAC or physical or hardware) address. This is usually hardwired into the device by the manufacturer.

● Ethernet devices are typically connected to a *hub* using a standard cable. Directly connecting two Ethernet cards requires a crossover cable (the red one). Note: Due to auto configuration capability either cable can be used with modern equipment.
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TCP/IP Basics

- We will communicate over Ethernet using the higher level TCP/IP (Internet) protocol. Each device must have an IP address.
- The IP address is a 32-bit address that is usually given in *dotted-quad* notation, e.g. 100.10.0.224. (Each byte is converted to a decimal number between 0 and 255.)
- This notation is easier for humans to remember than a 32-bit number. The computer uses only the 32-bit number.
The 32-bit IP address is separate from the 48-bit MAC address. Communication over the local LAN is done using Ethernet (MAC) addressing. The Address Resolution Protocol (ARP) is used to convert IP addresses to Ethernet addresses.

By programming at the IP level we do not have to worry about (or even understand) ARP. This is handled automatically and transparently for us.
Netburner Networking
TCP/IP Setup

- TCP/IP comm. is done using IP addresses
- Most TCP/IP applications can convert a name (google.com, csserver.evansville.edu) to an IP address using Dynamic Name Services (DNS). This is usually done via a call to `gethostbyname()`. However, it is the IP address (and not the name) that is embedded in the network data packet.
- We will not (initially) be using DNS.
Netburner Networking
TCP/IP Setup

• A netmask is used to split an IP address into network and host number components. For an IP address of 100.10.0.224 a netmask of 255.255.0.0 would imply a network address of 100.10.0.0 and a host address of 0.224.

• Another device with IP address 100.10.50.4 would be on the same network while a device with address 100.12.50.4 would be on a different network and could be reached only via a network router.
Netburner Networking
TCP/IP Setup

• An IP address (and netmask) can either be assigned to the device by the network administrator (static assignment) or the device can be configured to request an IP address from a DHCP (Dynamic Host Configuration Protocol) server.

• Most networks use DHCP to assign IP addresses to all devices except for servers and routers (gateways).
Netburner Networking
TCP/IP Setup

• We will be using static IP assignment.

• The original program on the Netburner requested an IP address via DHCP, so the board could be immediately connected to a network with a DHCP server.

• We have overwritten the original program though, so we will need to manually assign an IP address by booting into the monitor program over the serial link.
Netburner Networking
TCP/IP Setup

- We will use a **private** network between the PC and the Netburner. The Netburner IP address has been set to 191.168.17.2 with a netmask of 255.255.255.0.

- I suggest an IP address of 192.168.17.1 with a netmask of 255.255.255.0 for the USB/Ethernet adapter or wired Ethernet on your computer.
Netburner Networking
TCP/IP Setup

- Connect both the serial and red network cables now. Boot into the monitor program over the serial link and type “setup” to verify the IP address and netmask.

- If necessary, set the IP address to 192.168.17.2 and the netmask to 255.255.255.0. You may leave the other network settings (IP Gateway, TFTP Server, DNS Server) alone.
Netburner Networking
TCP/IP Setup

• To communicate with the Netburner from your own computer, you will need to assign your USB or wired network card an IP address on the same network as the Netburner. I suggest using 192.168.17.1. Use a netmask of 255.255.255.0.

• After using the Netburner, you will need to reset your Ethernet card back to DHCP before reconnecting it to your regular network. (If you use wired Ethernet.)
Netburner Networking
TCP/IP Setup

![USB Ether Properties](image)
Netburner Networking
TCP/IP Setup

192.168.17.1
Netburner Networking Application Configuration

- To configure the network interface on the Netburner, you must include the `ip.h` header file and you must call the `InitializeStack()` function at the beginning of `UserMain()`. (The Stack in the function name refers to the TCP/IP protocol stack, not the CPU stack)

- To transfer new programs over Ethernet, include the `autoupdate.h` header and call the `EnableAutoUpdate()` function at the beginning of `UserMain()`.
Netburner Networking
Application Configuration

// OTHER STANDARD HEADERS HERE
#include <ip.h>
#include <autoupdate.h>

void UserMain (void *pd) {
    InitializeStack ();
    EnableAutoUpdate ();
    OSChangePrio(MAIN_PRIO);

    // REST OF USERMAIN HERE

}
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TCP/IP Network Model