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.
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.
Netburner Networking
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.
Netburner Networking
TCP/IP Setup

• 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.
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. A second card on the computers in the lab has been assigned the address 192.168.100.1 with a netmask of 255.255.255.0.

- We will need to assign the Netburner an IP address on the same network. I suggest using 192.168.100.2. You should use a netmask of 255.255.255.0.
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 set the IP address and netmask.

- Set the IP address to 192.168.100.2 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 wired network card an IP address on the same network as the Netburner. I suggest using 192.168.100.1. 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)

- Connect using:
  - Realtek RTL8150 USB 10/100 Fast Ethernet Adapter

- This connection uses the following items:
  - Client for Microsoft Networks
  - VirtualBox Host Interface Networking Driver
  - QoS Packet Scheduler
  - File and Printer Sharing for Microsoft Networks
  - Internet Protocol Version 6 (TCP/IPv6)
  - Internet Protocol Version 4 (TCP/IPv4)
  - Link-Layer Topology Discovery Mapper I/O Driver
  - Link-Layer Topology Discovery Responder

- Description:
Netburner Networking
TCP/IP Setup

Internet Protocol Version 4 (TCP/IPv4) Properties

General
You can get IP settings assigned automatically if your network supports this capability. Otherwise, you need to ask your network administrator for the appropriate IP settings.

- Obtain an IP address automatically
- Use the following IP address:
  - IP address: 192.168.100.1
  - Subnet mask: 255.255.255.0
  - Default gateway:

- Obtain DNS server address automatically
- Use the following DNS server addresses:
  - Preferred DNS server:
  - Alternate DNS server:

Advanced...
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()`.
// OTHER STANDARD HEADERS HERE
#include <ip.h>
#include <autoupdate.h>

void UserMain (void *pd) {
    InitializeStack ();
    EnableAutoUpdate ();
    OSChangePrio(MAIN_P prio);

    // REST OF USERMAIN HERE
}

Netburner Networking
TCP/IP Network Model
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TCP/IP Network Model