Internet Primer
Internet Primer

• We’ve reached the point in the course where we begin the transition away from the command-line oriented world of C and start considering the web-based world of PHP and the like.

• Before we dive headlong into that world, it’s a good idea to have a basic understanding of how humans and computers interact over the internet.
Internet Primer

You

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Internet Primer

• IP Address

• In order for your machine to uniquely identify itself on the Internet, it needs an address.
  • This way, it can send information out and also receive information back to the correct location.

• The addressing scheme used by computers is known as IP addressing.
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• IP Address

• As originally developed, the IP addressing scheme would effectively allocate a unique 32-bit address to each device hoping to connect to the internet.

• Instead of representing these 32-bit addresses as hexadecimal, we represent them as four clusters of 8-bits using decimal notation.
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• IP Address

\[ w.x.y.z \]

• Each of \( w, x, y, \) and \( z \) can be a nonnegative value in the range \([0, 255]\).
Internet Primer

• IP Address

123.45.67.89

• Each of w, x, y, and z can be a nonnegative value in the range [0, 255].
Internet Primer

• IP Address

140.247.223.81

• Each of w, x, y, and z can be a nonnegative value in the range [0, 255].
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• IP Address

• If each IP address is 32 bits, that means there are roughly 4 billion addresses to give out.

• The population of the world is somewhere in excess of 7 billion, and most folks in the western world have more than 1 device capable of Internet connectivity.
  • Some workarounds have allowed us to deal with this problem (for now).
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• IP Address

• In recent years, we’ve been slowly phasing out this old scheme (IPv4) and replacing it with a newer scheme (IPv6) that assigns computers 128-bit addresses, instead of 32-bit addresses.

4,294,967,296
Internet Primer

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• IP Address

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340, 282, 366, 920, 938, 463, 463, 374, 607, 431, 768, 211, 456
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• IPv6 Address

s:t:u:v:w:x:y:z

• Each of s, t, u, v, w, x, y, and z is represented by 1 to 4 hexadecimal digits in the range [0, ffff].
Internet Primer

• IPv6 Address

1234:5678:90ab:cdef:fedc:ba09:8765:4321

• Each of s, t, u, v, w, x, y, and z is represented by 1 to 4 hexadecimal digits in the range [0, ffff].
Internet Primer

• IPv6 Address

2001:4860:4860:0:0:0:0:8844

• Each of s, t, u, v, w, x, y, and z is represented by 1 to 4 hexadecimal digits in the range [0, ffff].
• IPv6 Address

2001:4860:4860::8844

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• DHCP

• How do we get an IP address in the first place though? Surely we can’t just choose any one we want. What if the want we want is already taken?

• Somewhere between your computer and the Internet at large exists a Dynamic Host Configuration Protocol (DHCP) server, whose role is to assign IP addresses to devices.
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• DHCP

• Prior to the widespread promulgation of DHCP, the task of assigning IP addresses fell to a system administrator, who would need to manually assign such addresses.
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You -> Internet
Internet Primer

You

DHCP Server

Internet
Internet Primer

• DNS

• Odds are, you’ve never actually tried to visit a website by typing its IP address into your browser.

• The Domain Name System (DNS) exists to help us translate IP addresses to more memorable names that are more human-comprehensible.

• In this way, DNS is somewhat like the yellow pages of the web.
## Internet Primer

- **DNS**

<table>
<thead>
<tr>
<th>Host</th>
<th>IPv4 Address</th>
</tr>
</thead>
<tbody>
<tr>
<td>info.host1.net</td>
<td>0.0.0.0</td>
</tr>
<tr>
<td>info.host2.net</td>
<td>0.0.0.1</td>
</tr>
<tr>
<td>io-in-f138.1e100.net</td>
<td>74.125.202.138</td>
</tr>
<tr>
<td>info.hostn-1.net</td>
<td>255.255.255.254</td>
</tr>
<tr>
<td>info.hostn.net</td>
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## Internet Primer

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<td>google.com</td>
<td>74.125.202.138</td>
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**Internet Primer**

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<td>0:0:0:0:0:0:0:1</td>
</tr>
<tr>
<td></td>
<td>...</td>
</tr>
<tr>
<td>lk-in-x93.1e100.net</td>
<td>2a00:1450:4010:c09:0:0:0:93</td>
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• DNS

• Much like there is no yellow pages of the world, there is really no DNS record of the entire internet.

• Rather, large DNS server systems (like Google’s own) are more like aggregators, collecting smaller sets of DNS information and pooling them together, updating frequently.
Internet Primer

• DNS

• In that way, large DNS servers are like libraries that stock many different sets of local yellow page books. In order to have the most up-to-date phone numbers for businesses, libraries must update the books they have on hand.

• DNS record sets are thus fairly decentralized.
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You → DHCP Server → Internet
Internet Primer

You

DHCP Server

DNS Server

Internet
Internet Primer

- **Access Points**

- One of the ways we’ve dealt with the IPv4 addressing problem is to start assigning multiple people to the same IP address.

- The IP address is assigned to a *router*, whose job it is to act as a traffic cop that allows data requests from all of the devices on your local network (your home or business, e.g.) to be processed through a single IP address.
• **Access Points**

• Modern home networks consist of access points that combine a router, a modem, a switch, and other technologies together into a single device.

• Modern business networks or large-scale wide-area networks (WANs) still frequently have these as separate devices to allow the size of their network to scale more easily.
Internet Primer

You → DHCP Server → DNS Server → Internet
Internet Primer

You -> DHCP Server -> DNS Server -> Access Point -> Internet
Internet Primer

• This isn’t a course on networking, so this is far from the whole story, but it’s enough to get us started.

• At home or at work we have local, small networks, and these networks are woven together to create a large, interconnected network—an Internet.
  • If you think about each of these small networks being isolated communities with only a single road in or out, the picture becomes a bit clearer.
Internet Primer

You → DHCP Server → DNS Server → Access Point → Internet
Internet Primer

Network

DHCP Server
DNS Server
Access Point

Internet
Internet Primer
Internet Primer

protocols