The Internet Shouldn't Work: Networking 101

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Roadmap

- History
- Governance and protocols
- Putting it all together: what happens when you browse the web
- Current events: networking in the news
- Demos, interspersed
- Q & A
History

Announcing a new era of integrated electronics

Computer Network Protocols
• UCLA
• Stanford Research Institute’s Augmentation Research Center
• UC Santa Barbara
• University of Utah’s Computer Science Department

THE ARPA NETWORK
DEC 1969
Y NODES
The Design Philosophy of the DARPA Internet Protocols, David C. Clark

- "Develop an effective technique for multiplexed utilization of existing interconnected networks"
- Robust
- Support for many communication services
- Support for heterogeneous networks
- Distributed management of resources
- Cost effective
- Low effort for host connection
- Accountability of resources
The World Wide Web
1945, Vannevar Bush's Memex
Early 90s, Tim Berners-Lee, WWW, HTML, web browsers
The Internet today
Top 10 sites according to Alexa

1. Google
2. Facebook
3. YouTube
4. Yahoo!
5. Baidu
7. Windows Live
8. Blogspot
9. Twitter
10. Amazon
You type google.com into your browser bar and hit enter.

What happens?
Names and Hierarchies

- IP addresses
  - IPv4, 32-bit addresses => $2^{32}$
    (4,294,967,296) addresses
- Hostnames
- Domain Name Service (DNS)

DNS translates IP addresses to hostnames
### The TCP/IP model (RFC 1122)

#### Application Layer
- BGP
- DHCP
- DNS
- FTP
- Gopher
- GTP
- HTTP
- IMAP
- IRC
- NNTP
- NTP
- POP
- RIP
- RPC
- RTCP
- RTP
- RTSP
- SDP
- SIP
- SMTP
- SNMP
- SOAP
- SSH
- STUN
- Telnet
- TIME
- TLS/SSL

#### Transport Layer
- TCP
- UDP
- DCCP
- SCTP
- RSVP

#### Internet Layer
- IP (IPv4, IPv6)
- ICMP
- ICMPv6
- IGMP

#### Link Layer
- ARP
- RARP
- NDP
- OSPF
- Tunnels (L2TP)
- Media Access Control (Ethernet, DSL, ISDN, FDDI)
- Device Drivers

### Protocols
- HTTP
- TCP
- IP
- Ethernet
Application Layer:
HTTP

Hypertext Transfer Protocol

Clients use HTTP to request resources from servers

telnet demo!
Transport Layer:

TCP

Transmission Control Protocol

TCP reliably delivers data across the internet
Internet Layer:

IP

Internet Protocol

IP handles addressing and routing

traceroute demo!
You type google.com into your browser bar and hit enter.

What happens?
wireshark Demo
Governance
Internet Service Providers (ISPs)

Autonomous System (AS), BGP
“Never underestimate a Southern gentleman with a backhoe and a shotgun.”
Current events
IPv4 address exhaustion

IANA released its remaining blocks on 2/3/2011
IPv4:
\[2^{32} = 4.3 \text{ billion addresses}\]

IPv6:
\[2^{128} = 340282366920938463463374607431768211456 \text{ addresses}\]

“4.8×10^{28} \text{ addresses for each of the seven billion people alive in 2011}”
Privacy

- Coffee shop wireless
- HTTPS
Twitter, Inc. (twitter.com)
The identity of Twitter, Inc. at San Francisco, California US has been verified by VeriSign Class 3 Extended Validation SSL CA.

Certificate Information

Your connection to twitter.com is encrypted with 128-bit encryption.

The connection uses TLS 1.0.

The connection is encrypted using RC4_128, with SHA1 for message authentication and RSA as the key exchange mechanism.

The connection is not compressed.

Site information
You first visited this site on Dec 31, 2011.

What do these mean?
Net neutrality, Internet Censorship

- Oppressive regimes
- Great Firewall of China
- Tor
- Stop Online Piracy Act (SOPA) and Protect IP Act (PIPA)