Course wrap-up
Ben's wrap-up

CSCI E 45a: The Cyber World – part A

1

It's all bits, and inter-connected boxes

- Bits = data = code
  - Code is data, and data is code
  - The same bits can be used/read differently depending on your goal/intent

- Small pieces, loosely joined
  - A critical design principle at every level

2

Moore's law is pretty powerful

- Physical devices
  - Smaller
  - More powerful
  - Inter-connected
  - Increasing in number at a faster pace

- Or devices being virtualized
  - It's all bits!

3

The world is programmable

- All the inter-connected devices are programmable
  - Your clothes and your toasters are next
- The network is indeed the computer
- Virtualized infrastructure is programmable
  - "Infrastructure as code"
- You too shall program

4

Trust

- How do you know?
- The more complex the system the more opportunities to subvert
- Exploring and researching vulnerabilities is an important aspect of making technology safer, more secure, more trustworthy?
  - The color of your hat matters

5

The cyber infrastructure

- Locally structured but globally messy and redundant
  - "Two is one, and one is none"
  - Topology as well as management
- Layered topology
  - Core, Distribution, Access
- Management tools and frameworks
  - Necessary but not sufficient
  - Not a replacement for thinking

6

Grounded in the cloud

- Change from purchasing hardware to purchasing cycles
  - Right sizing resources
- A brave new world full of unknowns
- Cycles
  - Outsourcing, versus insourcing
  - Centralized to distributed

7

Where we are, where we are going

The "blessing and the curse" of a technology augmented life

8

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Course wrap-up
Scott's wrap-up

CSCI E 45a: The Cyber World – part A

History 1 – packets & ARPANET

- Deep in the "cold war"
  - Sputnik caused ARPA
  - Paul Baran developed datagram networks to survive a first strike
    - Named "packet" by Donald Davies
  - Mesh network with cheap forwarders
  - Reliability from redundant paths
- Larry Roberts built the ARPANET to share computers using the datagram (packet) concept
  - ARPANET was an inter-site network

History 2 - Internet

- Cerf & Kahn built on Baran's & Pouzin's work to define IPTCP
  - Split into TCP/IP to support Cohen's voice transport
- IP is an end-to-end bearer service
  - Using inter-network addresses
- ARPANET converted to TCP/IP January 1, 1983
  - Became an inter-network network
  - 1 M hosts by January 1993
  - 171 M hosts by January 2003
  - 963 M hosts by January 2013

Internet services

- Services ride on the Internet
  - Not provided by the net
    - Reliability, flow control, congestion control, security are end-system-based functions
- Network just forwards packets to a destination as best it can - using routers
- Routers use routing protocols to know where to forward packets
  - Routing protocols run over the Internet
  - Routers use destination inter-network addresses to forward packets

4

Internet plumbing

- Lots of other boxes in the net – mostly invisible to end hosts
  - NATs, firewalls, proxies, caches, load balancers, etc.
  - May maintain state, but state not required by end hosts
- Domain name system (DNS) used to translate user-friendly host names into inter-network addresses
  - DNS uses the Internet, DNS is not provided by the Internet

5

Security

- IT security is not easy
  - Determining the actual risk is often the hard part
    - People are not good at understanding risk
- Good design and operations can reduce risk
  - Good (exterior) walls not enough
- Enterprise security policies do as well
  - Assuming they are clear and actionable

6

Encryption

- Encryption makes the Internet safer and more secure
  - Public key encryption is the foundation for Internet commerce and secure communication
    - Not currently breakable
  - Standard symmetric encryption is top-secret strong
- But encryption runs counter to governments desire to know what is going on

7

Regulation

- The Internet flourished in an era of little regulation
  - At least in US & Europe
- Unlike the telephone world
  - Services & tariffs are controlled
- Internet regulations becoming more common
  - But still nowhere near what the telephone world has

8

Standards

- All important Internet standards developed or maintained by multistakeholder SDOs
  - E.g., IETF, W3C
- Old telephone standards developed or maintained by SDOs where governments have the final say
  - E.g., ITU-T, ISO, ETSI
- Some people would like the first to change

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