Internet Security: Then and Now

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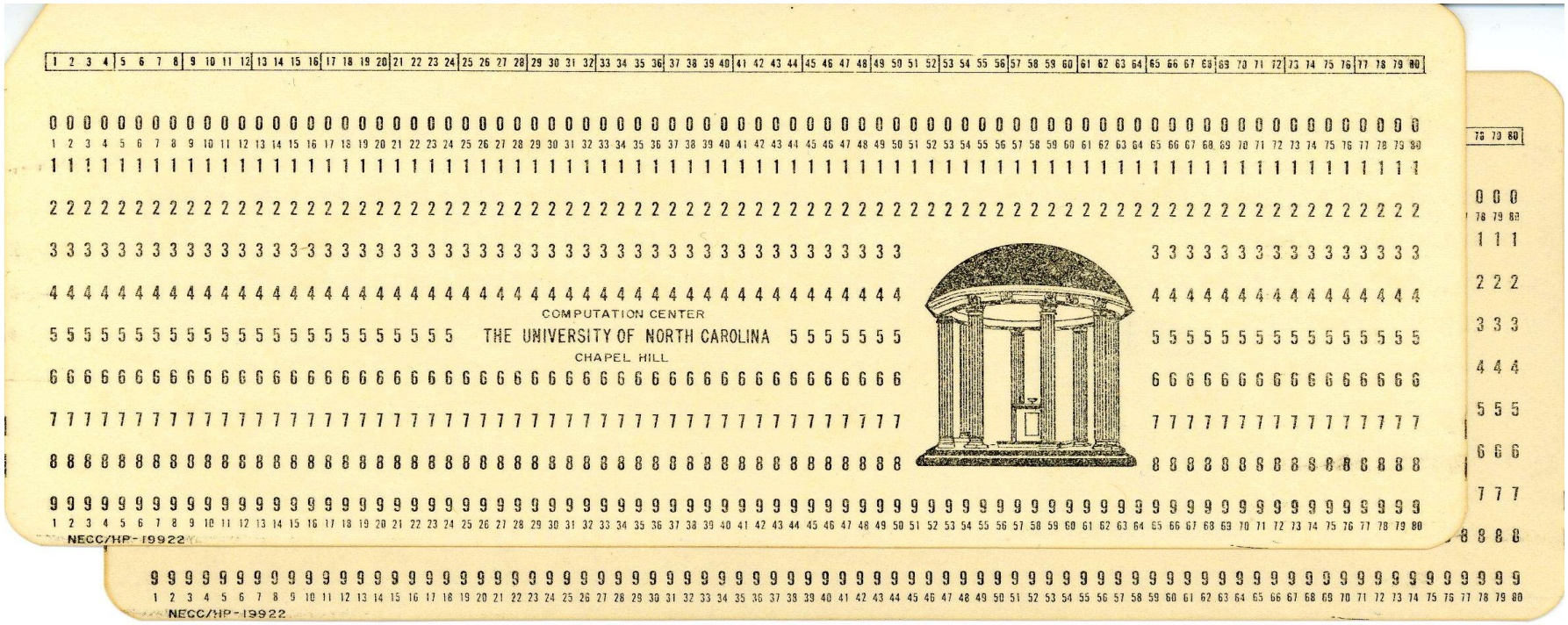
Early Communications Technology



Network Connectivity

- With no networks, security was simpler:
  - Corrupt insiders
  - Physical attack
  - Some connectivity goes way back, but there was too little to present an attractive target
- Networks carry good things and bad: hosts are exposed
- Must protect the network, too
  - Do highway robbers steal the asphalt?

What is Security?

- The classics: confidentiality, integrity, availability
- Today
  - Control *any* access to hosts
    - Hosts themselves inadequately secured
  - Privacy
  - Web servers
  - Prevent abuse of network bandwidth
  - Out-of-band attacks

Threats

- Password sniffing
  - Started in 1993, on major backbones
  - Wireless makes it worse – but ARP-spoofing is bad, too
- Protocol weaknesses
  - Example: TCP sequence number guessing
  - More complex protocols today (NetBIOS, SIP, H.323)
- DDoS
- Worms and viruses
- ***Buggy code***

Privacy

- Sites know a *lot* about people
- How do they protect this information?
- Or don't they?
- Note: correlations yield a *lot* of information
- Example: orkut.com's privacy policy explicitly gives them the right to share personally identifying data with Google.

Web Servers

- Very hard to protect
- The most dangerous service – port 80 – can't be blocked off
- The hardest problem is buggy code – and web servers have lots of it

Buggy Code

- Oldest unsolved problem in computer science
- Will probably remain unsolved
- National Research Council study: 85% of CERT advisories through 1998 described problems not fixable by crypto
- Most were due to buggy code or configuration errors

Defenses

Defenses

- Protocol analysis
- Crypto
  - Point-to-point and VPNs
- Black holes
- Firewalls

Protocol Analysis

- Hard to do
- Point-to-point is easier – bolt-on crypto
- Multiparty is hard
  - BGP – must trust remote data
  - Think VoIP and SIP – must trust many parties
- *Authorization* is the hardest part
  - Again, much harder for multiparty

Crypto

- Naivete 10 years ago – some people thought crypto was the solution
  - Crypto is *a* solution to *some* problems
- Crypto is hard – not the protocols (though those are hard enough), but managing them
  - Who is *authorized* to talk to you
- Three successful uses: SSL, IPsec VPNs, ssh
- A failure: secure email

SSL

- To some extent, a fig leaf: "it's safe to shop here, because your traffic is encrypted"
- 99.999% of consumers don't check certificates
  - 99.999% don't know what a certificate is
  - 99.999% don't know their root CAs, or why they're trustable
- Vulnerable to active attack by sophisticated adversary
- But – it does stop credit card sniffing. (Bad guys hack servers instead.)

IPsec VPNs

- Moderate-scale deployment
- Multi-vendor harder than it should be – *much* harder
- Simple authorization model: central site hands out credentials
- Mixed bag – not nearly as common or as effective as we'd hoped 10 years ago

Secure Email?

- By most standards, secure email is a failure
- Virtually unused, except by ubergeeks
- Why:
  - Hard to use – needlessly hard?
  - Where do keys come from?
  - Many models require central deployment – the Internet is bad at centralization
  - People don't perceive a threat

ssh

- Decentralized deployment
- No authority needed
  - No key server needed
- Tunnels other protocols
  - Easier to deploy than IPsec; no kernel mods needed
- Deals with a perceived threat model

Black Holes and DDoS

- Few good defenses out there
- Most common “defense”: null-route the victim, to avoid collateral damage
- Most attacks have been self-limiting – this far
- We don't have good defenses in the network
  - This is the attack where the network itself is at risk

Firewalls

- Our best defense against buggy code
- Not a network security device
  - Firewalls are the network response to the host security problem
  - Damning indictment of the state of the art of software engineering
- But firewalls are failing

Big Firewalls are Obsolescent

- Too much connectivity, around and through the firewall
  - We run too useful a network...
- Mobile hosts
  - Remember the worm problem at the last NANOG?
- Split-use hosts
  - Home machines used for telecommuting
- How did Code Red and Slammer, get inside corporate nets?

Now What?

- The threat isn't going away
- We don't have major new defenses on the horizon
- We have to leverage the Internet's strengths

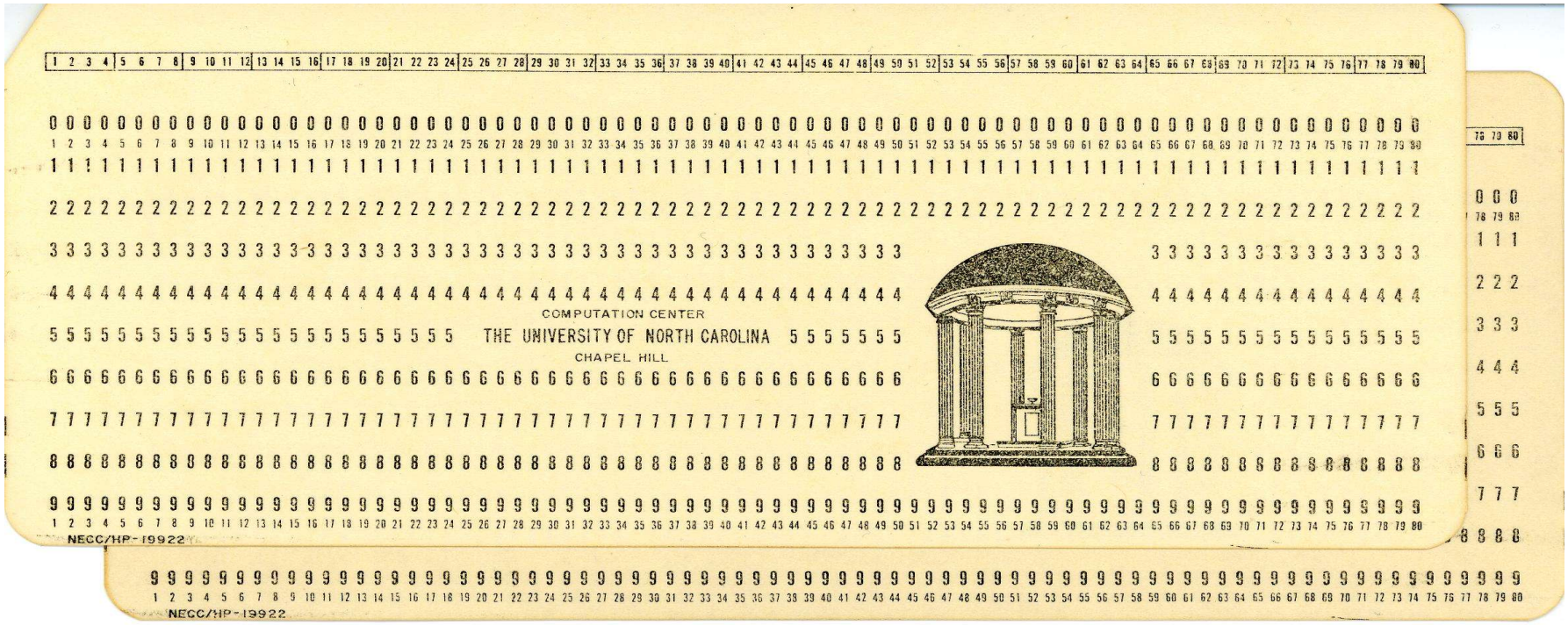
Future Directions

- We can usually secure special-purpose hosts, in ones and twos
- Manageability is the key: must find a way to *scale* good system management
- Saying "no" is easy – how do we say "yes"?
  - Crypto where it helps – preferably, decentralized crypto
  - Limit range of peers, enforced by crypto
  - Sandboxes on hosts
  - Special-purpose appliances – use an Internet Phone, rather than a PC

Things that Won't Work

- ISP-enforced security
  - Hurts innovation
  - Doesn't scale well – large ACLs; customer complaints
- Mandatory, automatic patches
  - Breaks too much software
- Central management of decentralized concepts
  - But central management is needed to solve centralized authorization issues
- Wishing the problem will go away

If We Fail...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