Network Security – Issues and New Challenges

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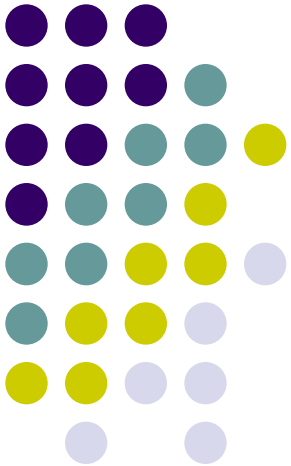
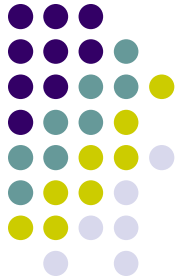


RAPIDSOFT SYSTEMS

Rapidsoft Systems
redefining business relationships

Contents Overview

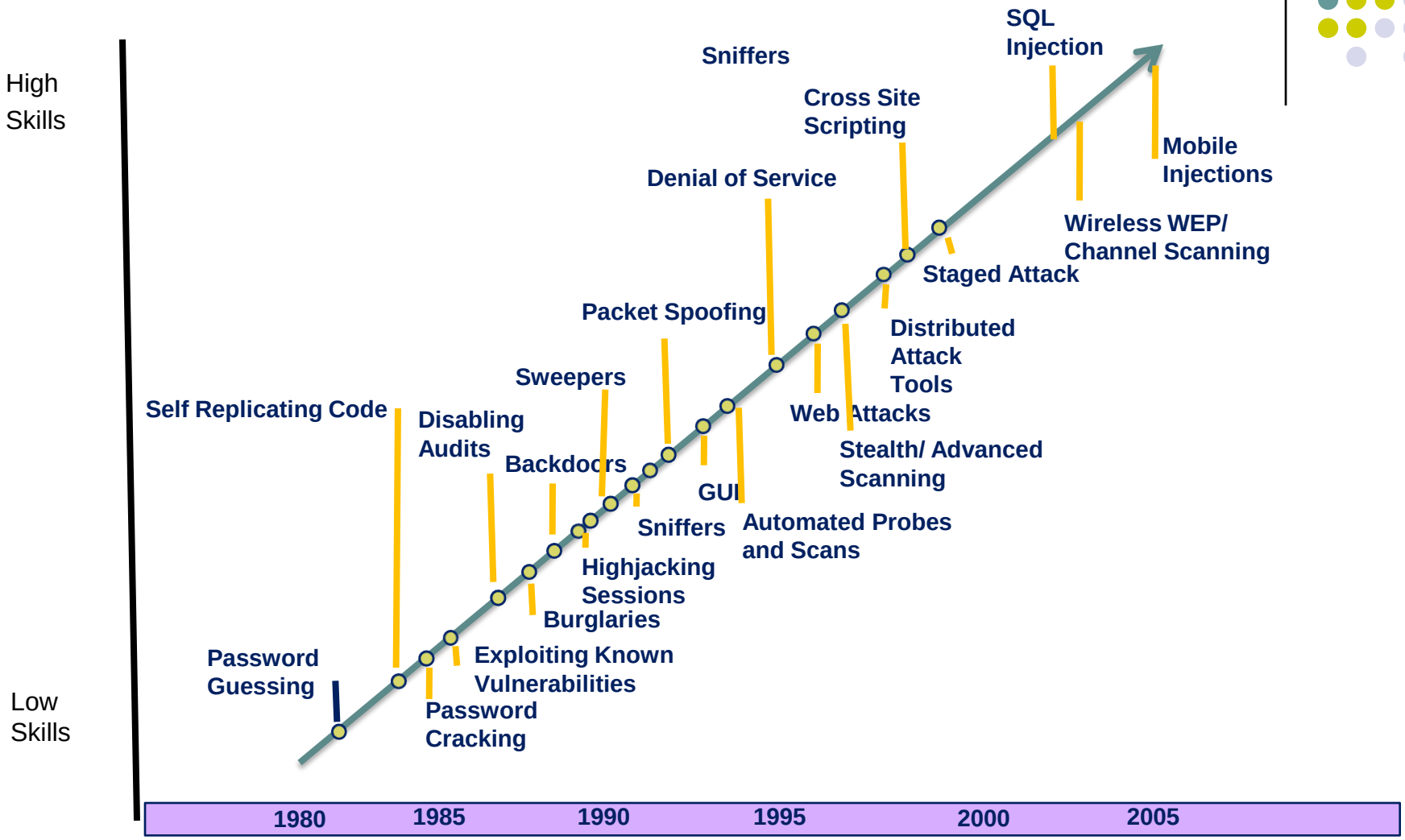


- The problem
- Historical Perspective
- Software - Vulnerability
- Networks – IP protocols, Routing, DNS and SMTP, VoIP
- Web - IIS, Apache
- Wireless - Cellular, Wi-Fi Security

Why aren't Computer or Network Secure?

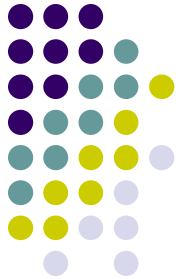
- Both Computer and Networking Originated In the University Labs.
- University environments are collaborative places with focus on solving problems in efficient and unique ways
- Adversarial model analysis is not what researchers really did on old days
- Applies to Software to Nuclear Technologies!
- Result – quite open issues in just about every thing – Software, Protocols -- IP, TCP, SMTP, DNS
- Patchwork solutions – Discover a problem – Patch it.

Always Something New Invented



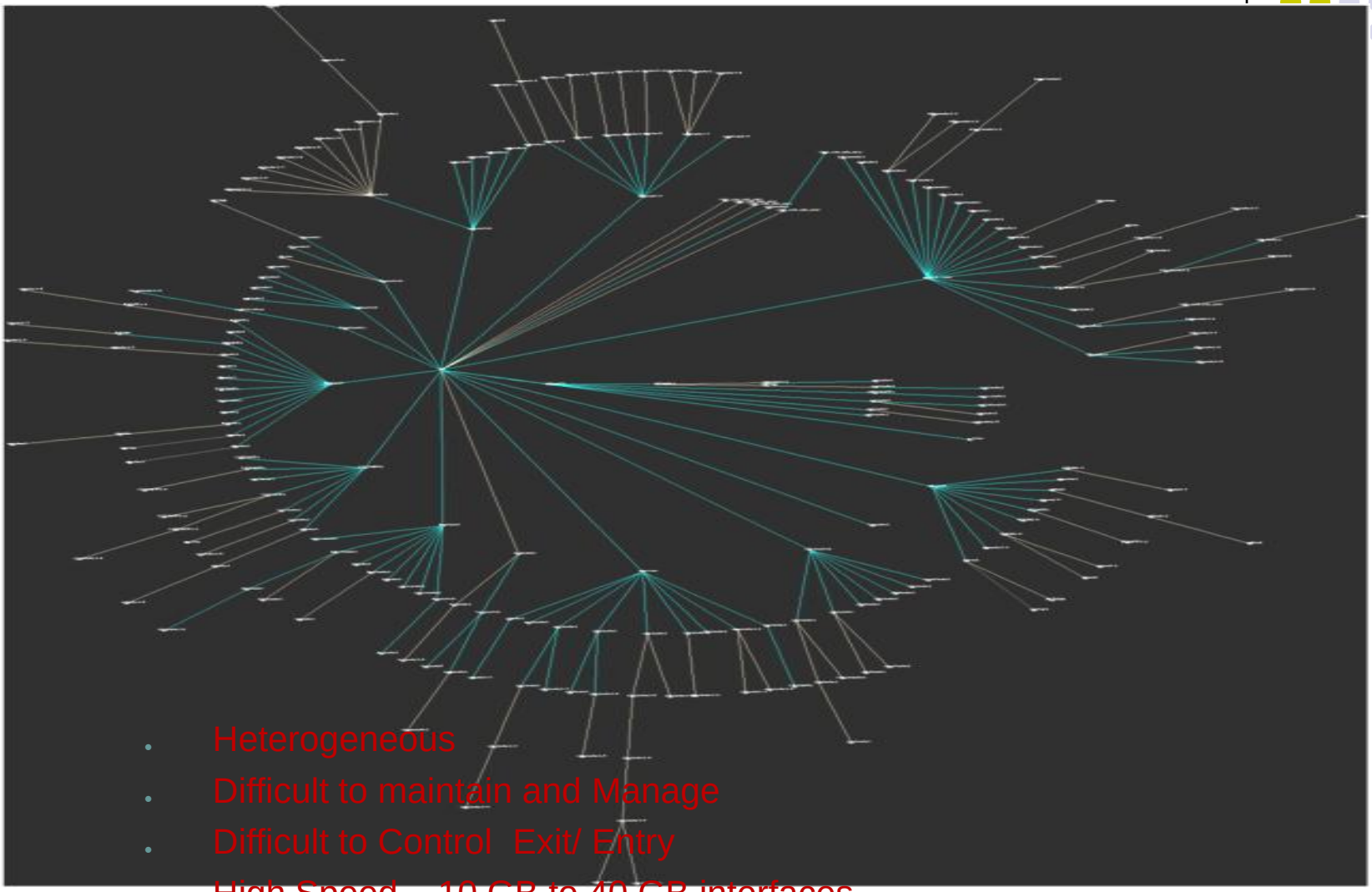
Source: Extended from Julia H. Allen, CERT Guide to System and Network Security, Addison Wesley, 2001

Internet is Getting Less Secure



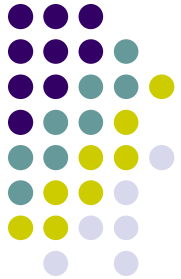
- By every measure, Internet is becoming less secure every day:
  - More attacks, More damages and more losses
  - Severity of damages is increasing – stolen users data, credit card, Id-theft, System high-jacking
- Security is in architecture, and not in patch solutions
  - If Firewalls were so good – we would have solved all the security problems ? Is Industry fooling you?
  - If virus checker are great then why they haven't solved the security problems? Give me money every year Trap?

Modern Networks are Really Large ..



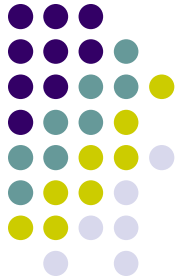
- Heterogeneous
- Difficult to maintain and Manage
- Difficult to Control Exit/ Entry
- High Speed – 10 GB to 40 GB interfaces

Network Growth



- Tremendous Network growth from 1994-2008
- Many millions of new nodes
- No national boundaries
- Makes Attacks relatively safe since there are no way to monitor or catch the culprits
- Software is still the mystery
- Not every user is a computer science graduate
- Firewalls and Virus checking don’t really work.

Network Telescope at caida.org (ucsd)



Interesting stuff to study network (attack) traffic

Continuous Monitoring of Chunk of (globally) routed IP address space

- 16 million IP addresses

Little or no legitimate traffic (or easily filtered)

Unexpected traffic arriving at the network telescope can imply remote network/security events

Setup - Generally good for seeing explosions, not small events

Reaction - Depends on random component in spread

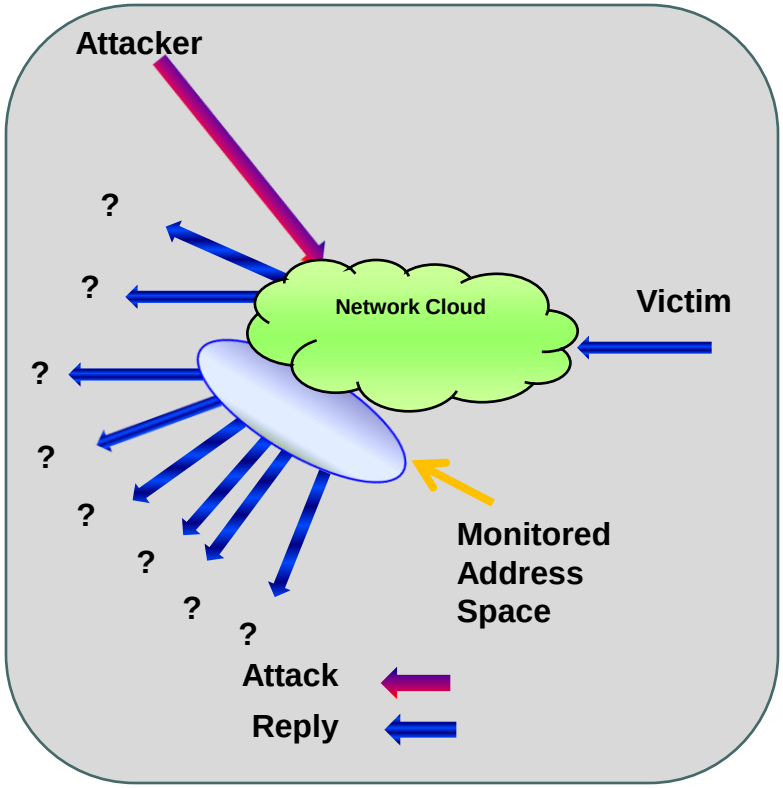
I like the data they generate – great source!

Denial-of-Service Attacks : Network Telescope Experiment

Attacker floods the victim with requests using random spoofed source IP addresses

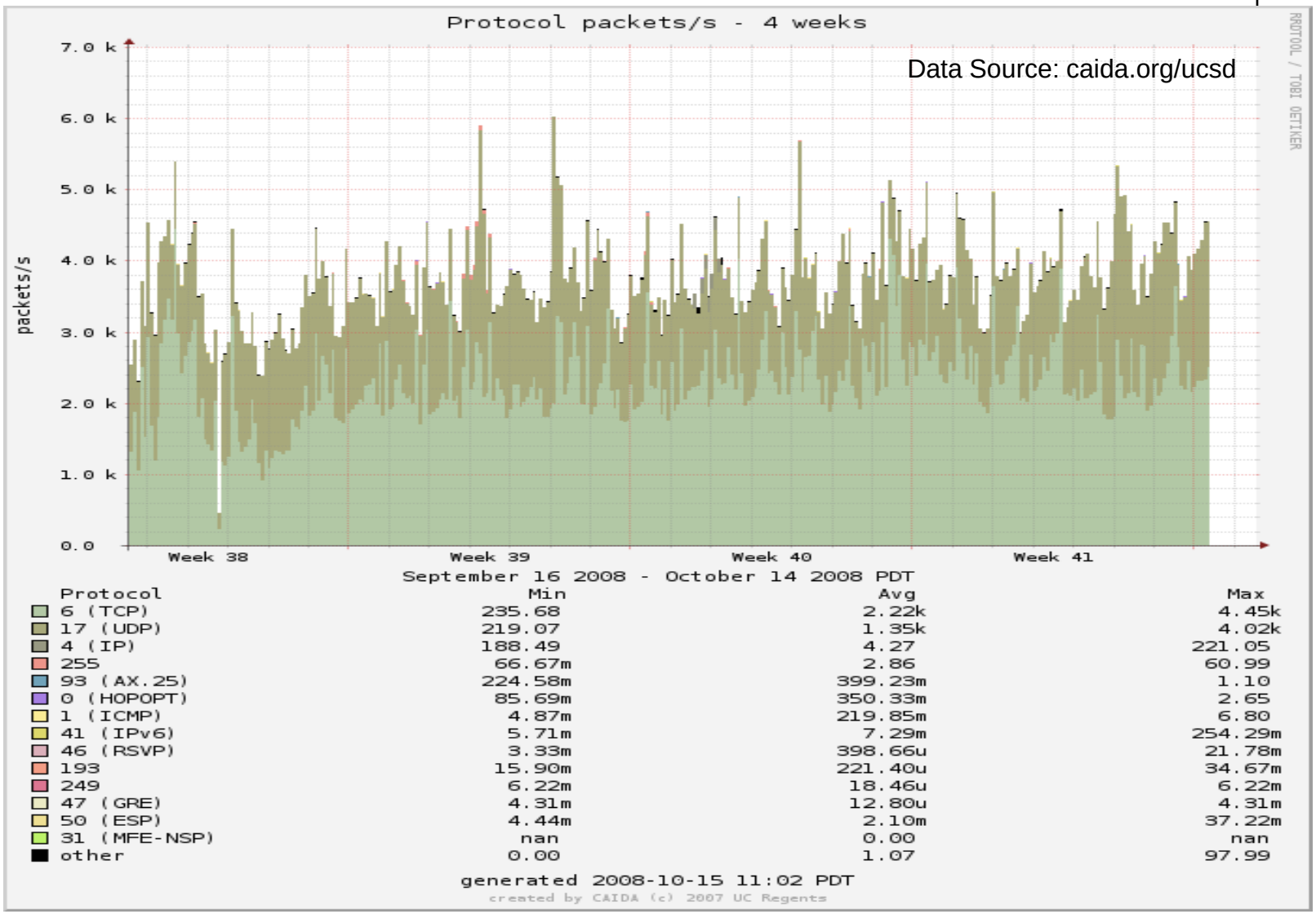
Victim believes requests are legitimate and responds to each spoofed address

Reported Observations 1/256th of all *victim responses* to spoofed addresses

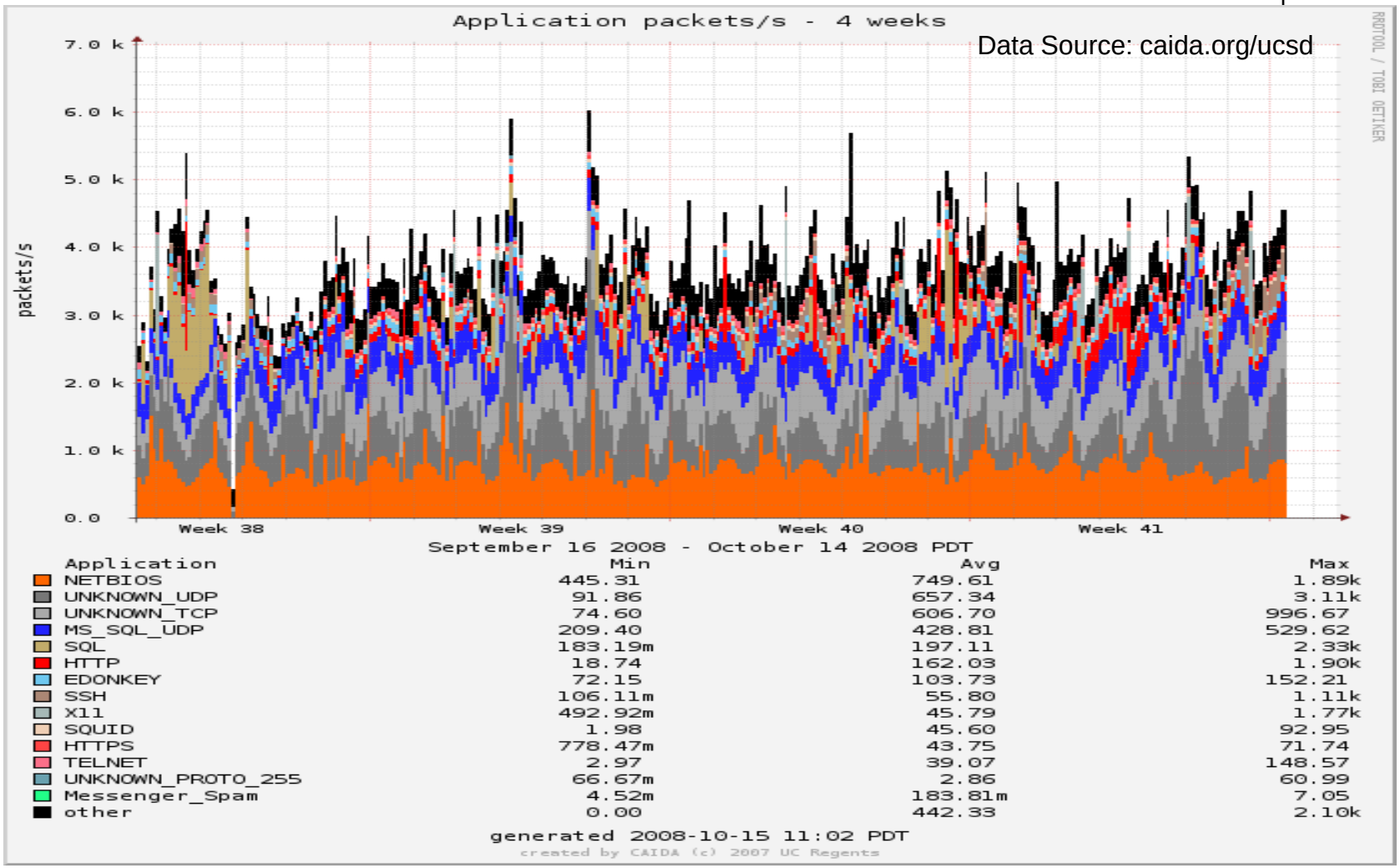


Source: caida.org/ucsd

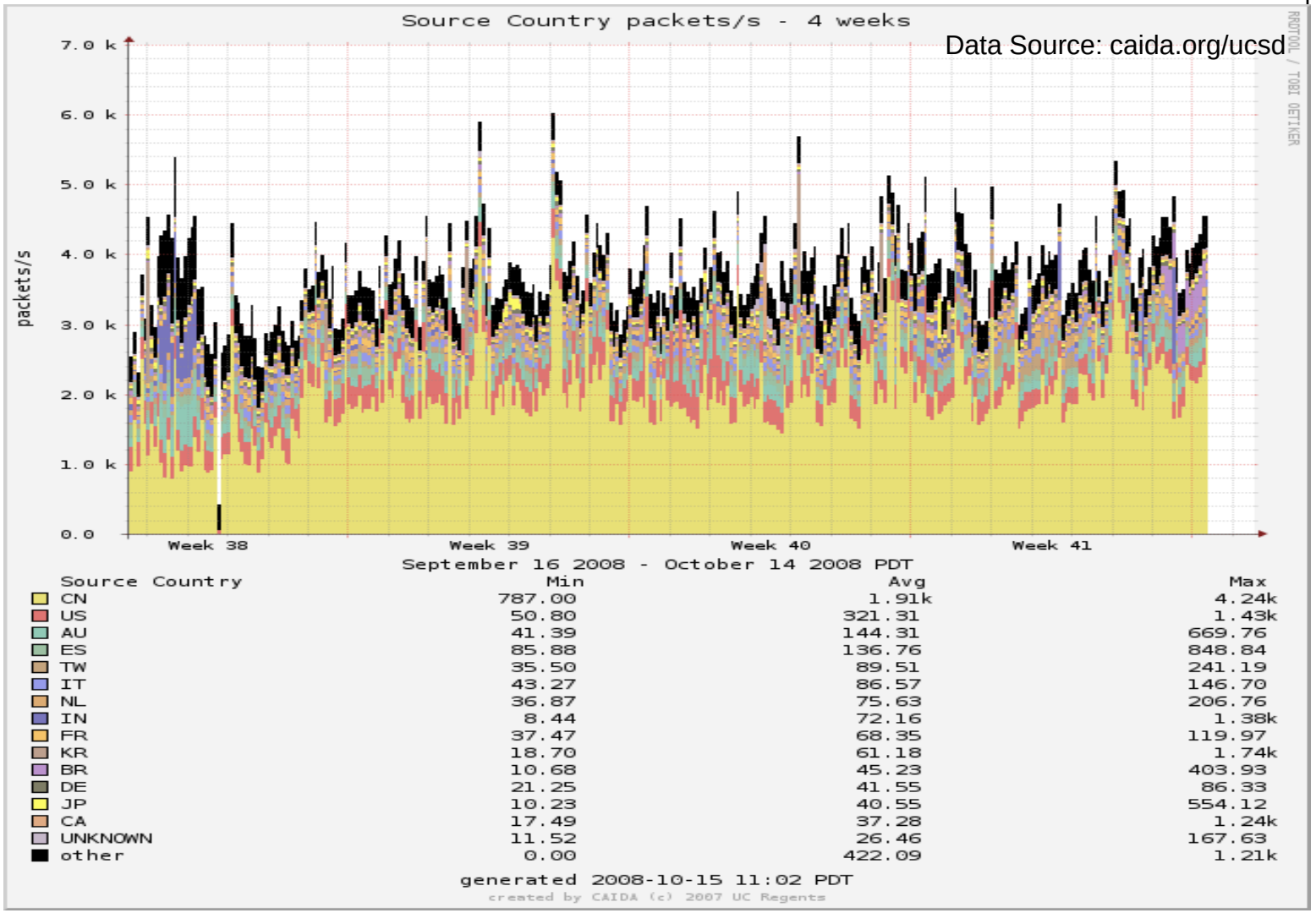
Attack packets By Protocol



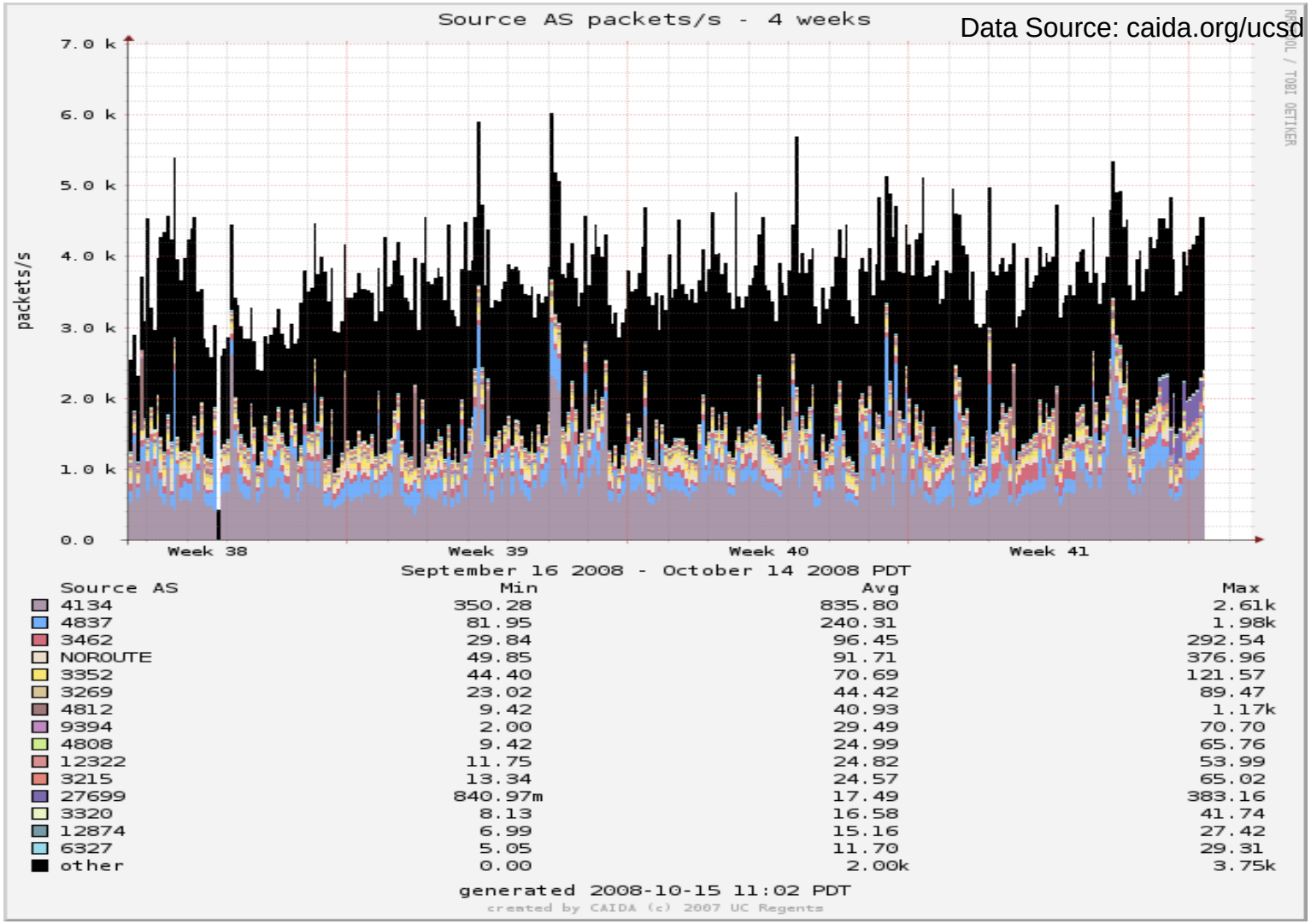
Attack packets by Application



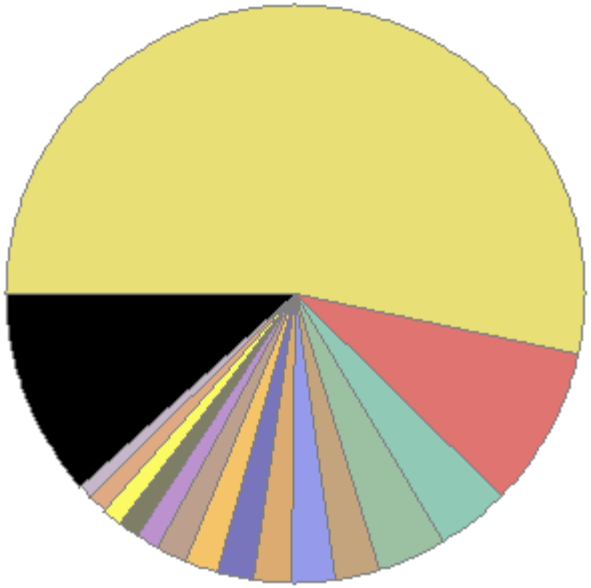
Attack Packets by Originating Country



Attack Packets By AS Number



Attack packets by Source Country



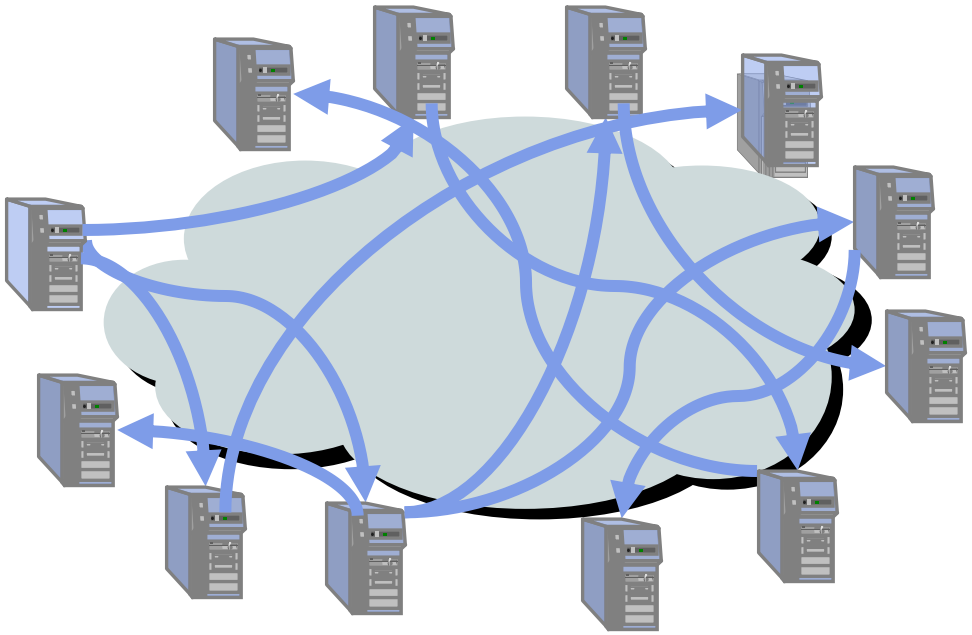
CN
US
AU
ES
TW
IT
NL
IN
FR
KR
BR
DE
JP
CA
UNKNOWN
other

Data Source: caida.org/ucsd

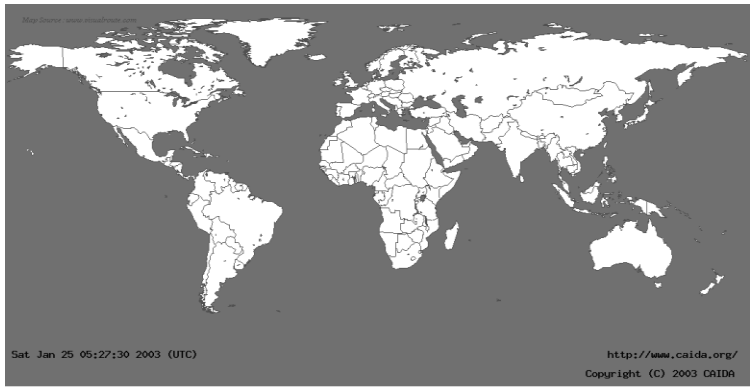
Network Worm Spread

Self-propagating self-replicating network program

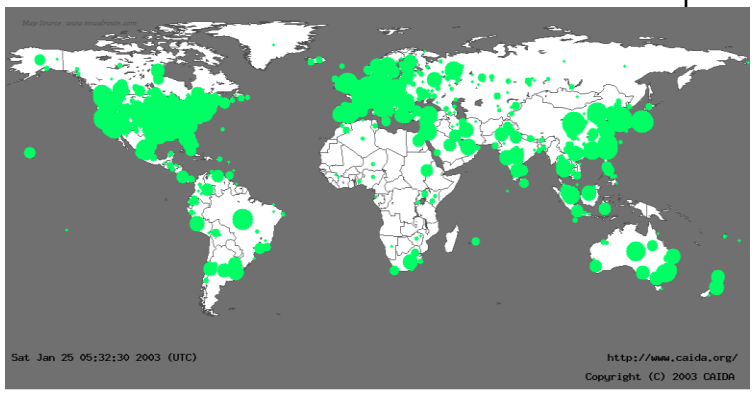
- Exploits some vulnerability to infect remote machines
  - No human intervention necessary
- Viral Nature - Infected machines continue propagating infection



Witty March 16 – 2004



- Before 9:30PM (PST)



- After 9:45PM (PST)

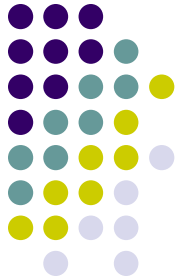
- ~12,000 hosts infected in **30 minutes**
- Averaged more than 11 million probes per second world-wide
- Unstoppable (UDP Scan of Hosts at Line rates)
- Irreparably destroyed a significant number of infected computers

Source: caida.org/ucsd

What we learnt from this

- Patch model of networked device security doesn’t work
- End-user behavior alone cannot solve current software security problems
- End-user behavior cannot effectively mitigate current software security problems
- Study Concluded:
  - Actively address prevention of software vulnerabilities
  - Turn our attention to developing large-scale, robust, reliable infrastructure that can mitigate current security problems without end-user intervention

Emergence of Botnets



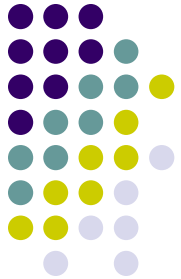
Significant transition in motivation for widespread, non-specific malicious activity

- From notoriety -> want to be noticed
- To money -> want stealth to protect revenue stream
- No one does it just for fun – (Too risky)

So how do you make money?

- Sending spam – 90% mails are spam
- DoS extortion – Blackmail, Threats
- Active (phishing) and passive identity theft

New Challenges

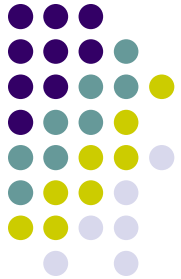


- Malicious software development is Group activity with a purpose.
- Need expertise to build scalable, manageable distributed (negatively) purposeful software systems. Time and resource needed.
- Coordinated activity makes current antivirus activities increasingly irrelevant
- Signature-based security don’t work in this environment
- Increasing system complexity + naïve / untrained IT/ Software Developers = Security Disaster

Malicious Code

- Tracking Software – Evil Biz
- Advertising Display Software - Internet is built on adverts.
- Remote Control Software – Session Highjacking, Data Transporting
- Redirection Software - Absolute Evil
- System Modifying Software – Rootkits, Spyware of All kinds, Very Nasty, Hard to Remove.
- Security Analysis Software
- Automatic Download Software –Click yes or no – it will still download.
- Passive Tracking Technologies
  - Spyware / Snoopware
  - Keylogger (Unauthorized)
  - Screen Scraper (Unauthorized)

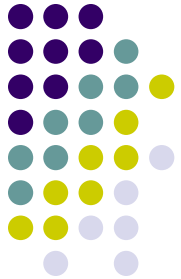
Typical intrusion scenario



All intrusion attempts go through a simple three steps:

- **Footprinting:** To identify and find out more information about the target
- **Scanning:** To look for open back doors
- **Exploiting:** To attempt to gain access through the back doors
- **Conquered**: Establishing the compromised system for the next intrusion.

Security Measures



Security measures Can be defined as Three

- Prevention
  - – UAC, Cryptography, Firewalls
- Detection
  - - IDS – Audit Trail, Logs and Forensic (e.g., Snort)
- Response.
  - Depends On the Nature of Compromise (Technical/ Legal, Combined)

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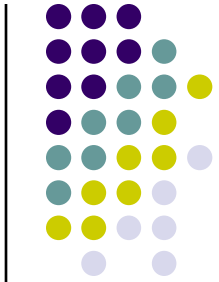
Software Security

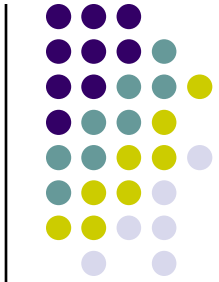


- Secure Operating Systems -
  - Example - Secure Linux Project
  - Access Control and Privileges controlled
  - Inter-process barriers
  - Access control barriers for inter task communications
  - Sandboxed Tasks
- Defensive programming

Majority of software subversion vulnerabilities result from a few known kinds of coding defects. Common software defects include:

- buffer overflows,
- format string vulnerabilities,
- integer overflow, and
- code/command injection.

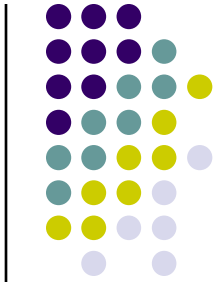
Network Security



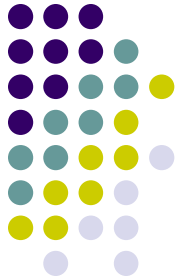
- Security Domain plans
- Traffic flow separation
- Perimeter protection
- Defense in depth
- Secure protocols (IPSEC, SSH)
- Security systems (Firewalls, VPNs etc.)

- **Wireless:**
- Wireless Wi-Fi Security – So much has already been written and said.
- Cellular Wireless – So far Isolated from these threats. But Emerging.

Some new research Areas in Security



- NSF's Next gen Network – Redesign protocols with clean slate.
- Security and Privacy in Low power Sensor Networks
- Security and Privacy in Ad-hoc Wireless Networks
- Secure Operating Systems
- Proactive Web Security
- Multi-point Distributed Intrusion Detection Systems
- Systems Approaches for Constructing Distributed Trust
- Reputation systems for improved collaborative anomaly and intrusion detection for internetworking protocols
- Cellular Systems Vulnerabilities and protections
- Proactive Spam control
- Botnet detection and counter/ reverse attacks



Thank You –