Carnegie Mellon
Software Engineering Institute

CERT
Coordination
Center

CERT/CC Overview

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CERT® Coordination Center
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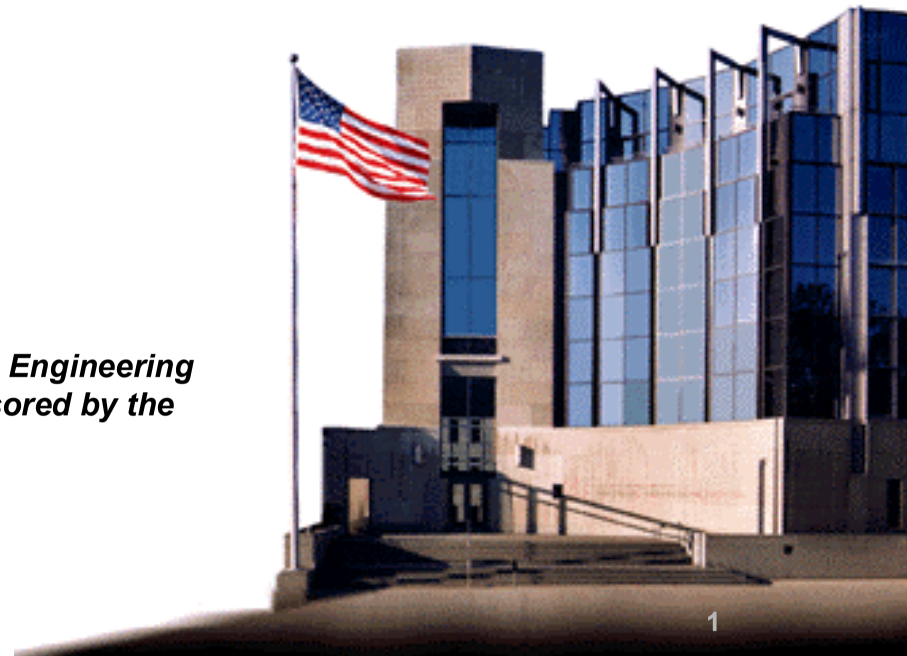


Today's agenda

- The CERT/CC
  - Incident Handling
  - Vulnerability Handling
  - Artifact Analysis
- Principles / Constituency
- Experiences / Observations
- Questions?

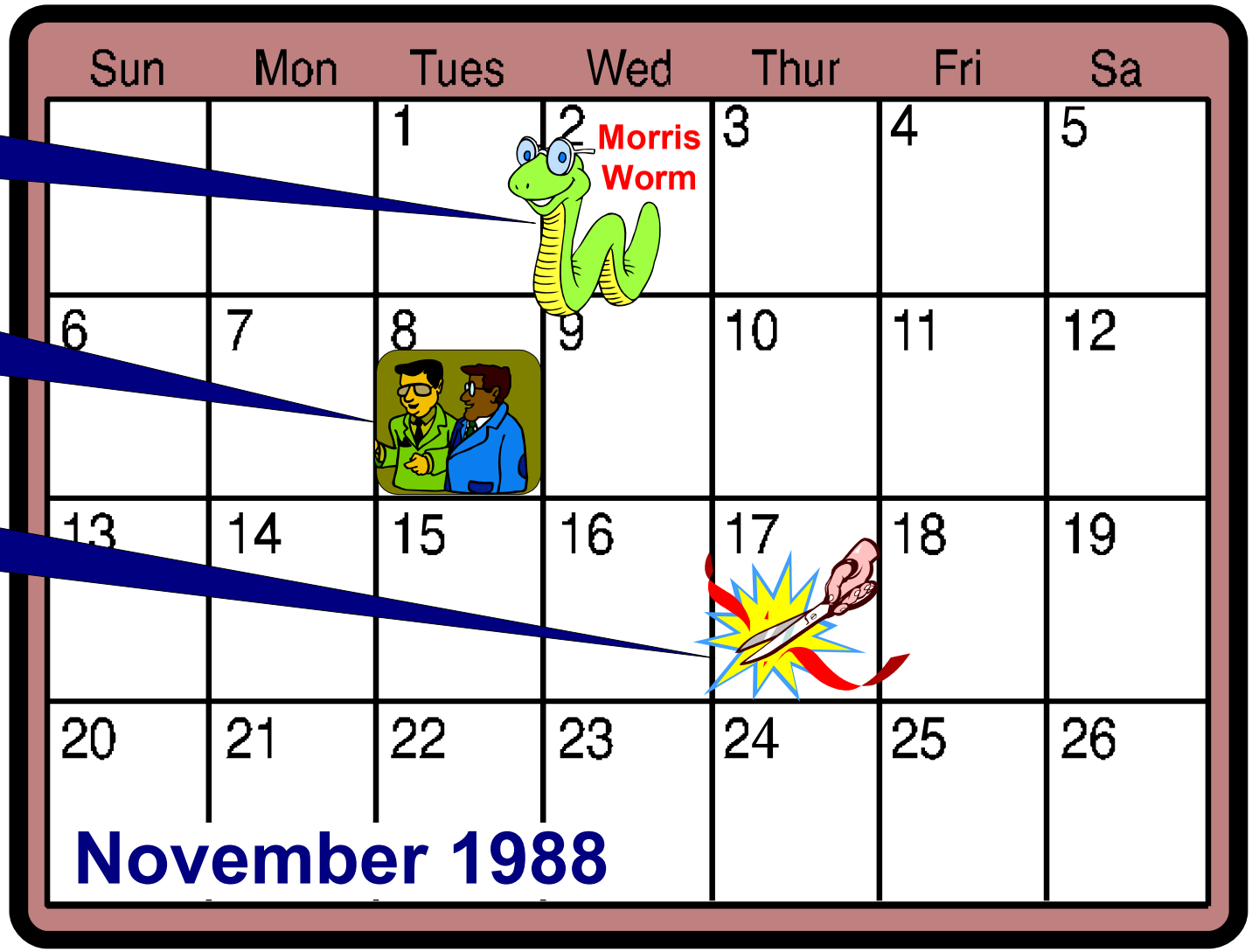
  Either raise your hand or wait until the end – I'm flexible.

The Beginning of the CERT/CC

worm attack

post mortem

CERT/CC created



What is the CERT/CC? (1)

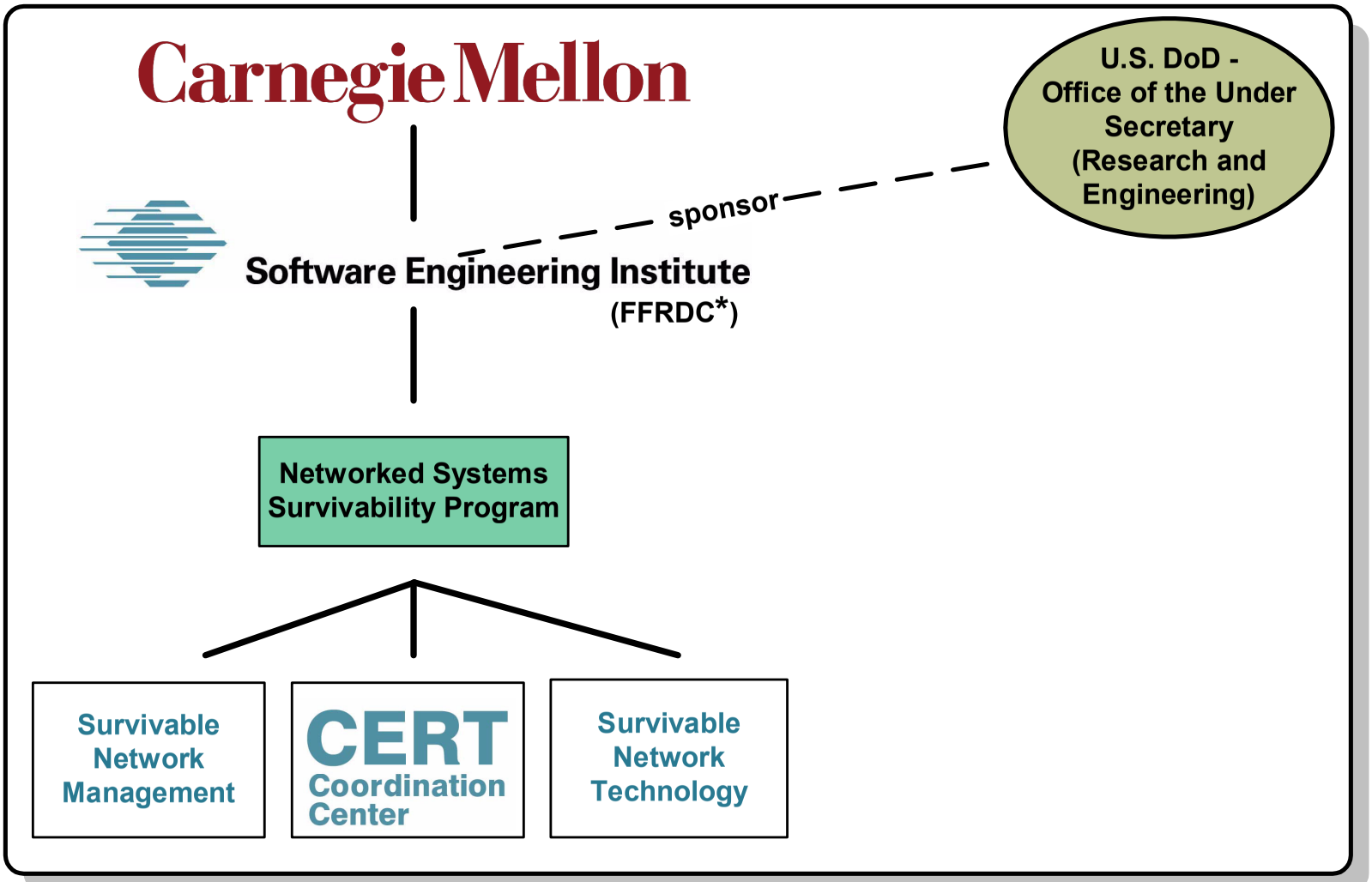
- responsibilities include providing
  - Internet security information for
    - system and network administrators
    - technology managers
    - policy makers
  - guidance and coordination for major Internet security events
    - Melissa virus
    - Y2K
  - leadership in the response team community
    - CSIRT formation and development assistance

What is the CERT/CC? (2)

- the CERT/CC focuses specifically on technical issues related to Internet security

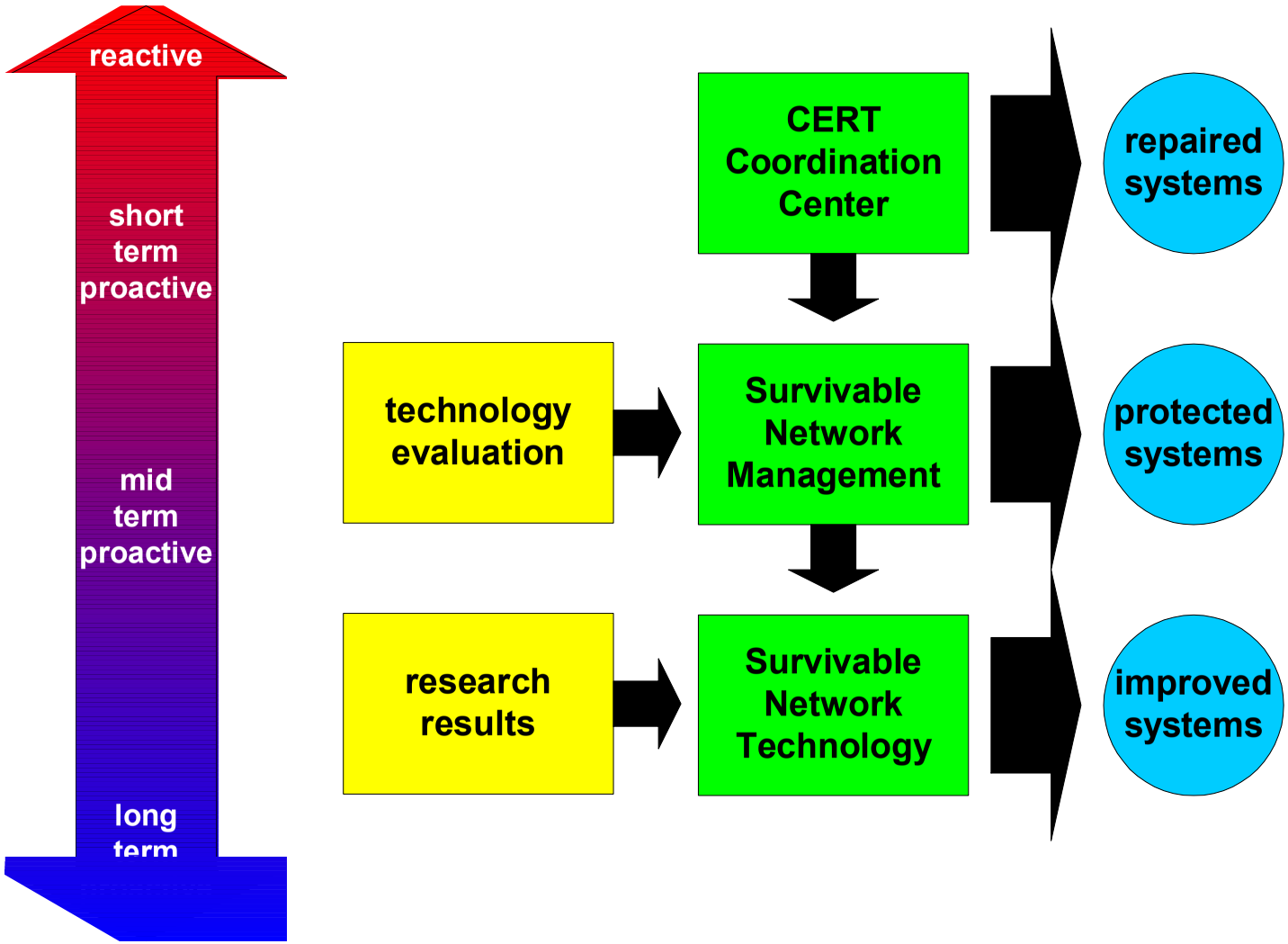
- the CERT/CC does not focus on
  - who the intruders are
  - where intruders are located (physically)
  - motivations of intruders
  - monitoring/surveillance of intruders
    - other than understanding the technical implications of what the intruder community is doing

CERT/CC Located at Carnegie Mellon

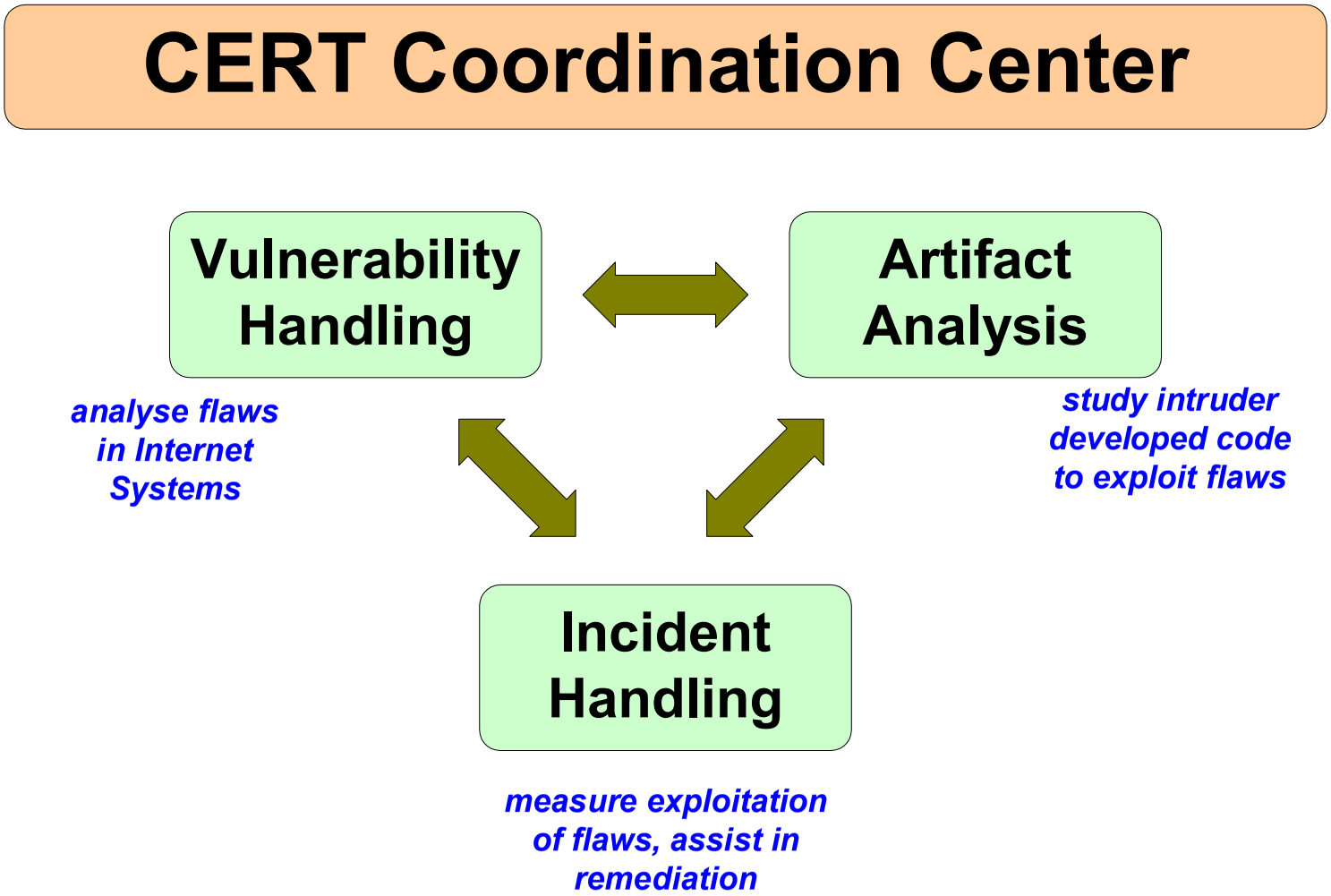


*FFRDC - Federally Funded Research and Development Center

NSS Program Strategies



CERT/CC Teams



CERT Incident Handling Team (1)

- receives reports related to computer security from sites connected to the Internet
  - attack attempts, probes, scans
  - successful attacks
    - compromises
    - denial-of-service
    - other
  - new types of attacks/intruder tools
  - proactively looks at Internet information sources for incident-related issues
    - mailing lists
    - web sites

CERT Incident Handling Team (2)

- provides 24-hr. emergency incident response for
  - possible life-threatening activity
  - threats or attacks on the Internet infrastructure, such as:
    - root and other DNS servers
    - routing infrastructure
    - major archive sites
    - network access points (NAPs)
  - widespread automated attacks against Internet sites
  - new types of attacks or new vulnerabilities
  - threat or attacks involving U.S. government machines

CERT Incident Handling Team (3)

- analyzes reports
  - determine attack method
  - correlate with other reports
    - › determine scope and magnitude
  - what can be learned from this attack
    - › determine if new type of attack
    - › identify a change in frequency of attack method
    - › identify need for new defences or countermeasures
- provides feedback to reporting sites involved

CERT Incident Handling Team (4)

- informs the Internet community about
  - current activity
  - new types of attacks
  - detection and recovery from attacks
  - defence against attacks
- Internet community informed through
  - CERT advisories, incident notes and summaries
  - current activity page on www.cert.org
  - tech tips and other documents on CERT/CC web site

CERT Vulnerability Handling Team (1)

- receives vulnerability reports
  - direct reports
  - proactively looks at Internet information sources for incident-related issues
    - mailing lists
    - web sites

CERT Vulnerability Handling Team (2)

- verifies and analyzes reports
  - is this really a vulnerability?
  - what is effect of vulnerability?
  - how many systems or types of systems are affected?
  - are exploits available or in circulation?
  - is the vulnerability actively being exploited?

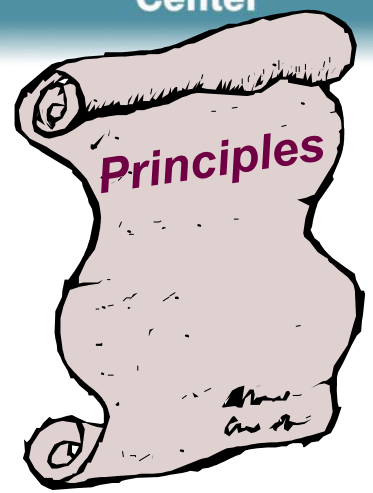
CERT Vulnerability Handling Team (3)

- works with vulnerability reporters, vendors, Internet experts to
  - better understand vulnerability
  - develop countermeasures and fixes
- publicizes information about vulnerabilities and countermeasures
  - CERT advisories and vulnerability notes
  - tech tips and other documents on www.cert.org
  - CERT/CC Knowledgebase Vulnerability Reports Catalog

CERT Artifact Analysis Team (1)

- focused on code written by intruders
  - viruses
  - Trojan horses
  - exploit scripts
- analyze code
  - what does it do?
  - what vulnerabilities are exploited?
  - how do you defend against it?
  - who might be victims or targets?
- develop capability to predict trends in malicious code development and functionality

CERT/CC Principles



- provide valued services
  - proactive as well as reactive
- ensure confidentiality and impartiality
  - we do not identify victims but can pass information anonymously and describe activity without attribution
  - unbiased source of trusted information
- coordinate with other organizations and experts
  - academic, government, corporate
  - distributed model for incident response teams (coordination and cooperation, not control)

The CERT/CC Constituency - Internet

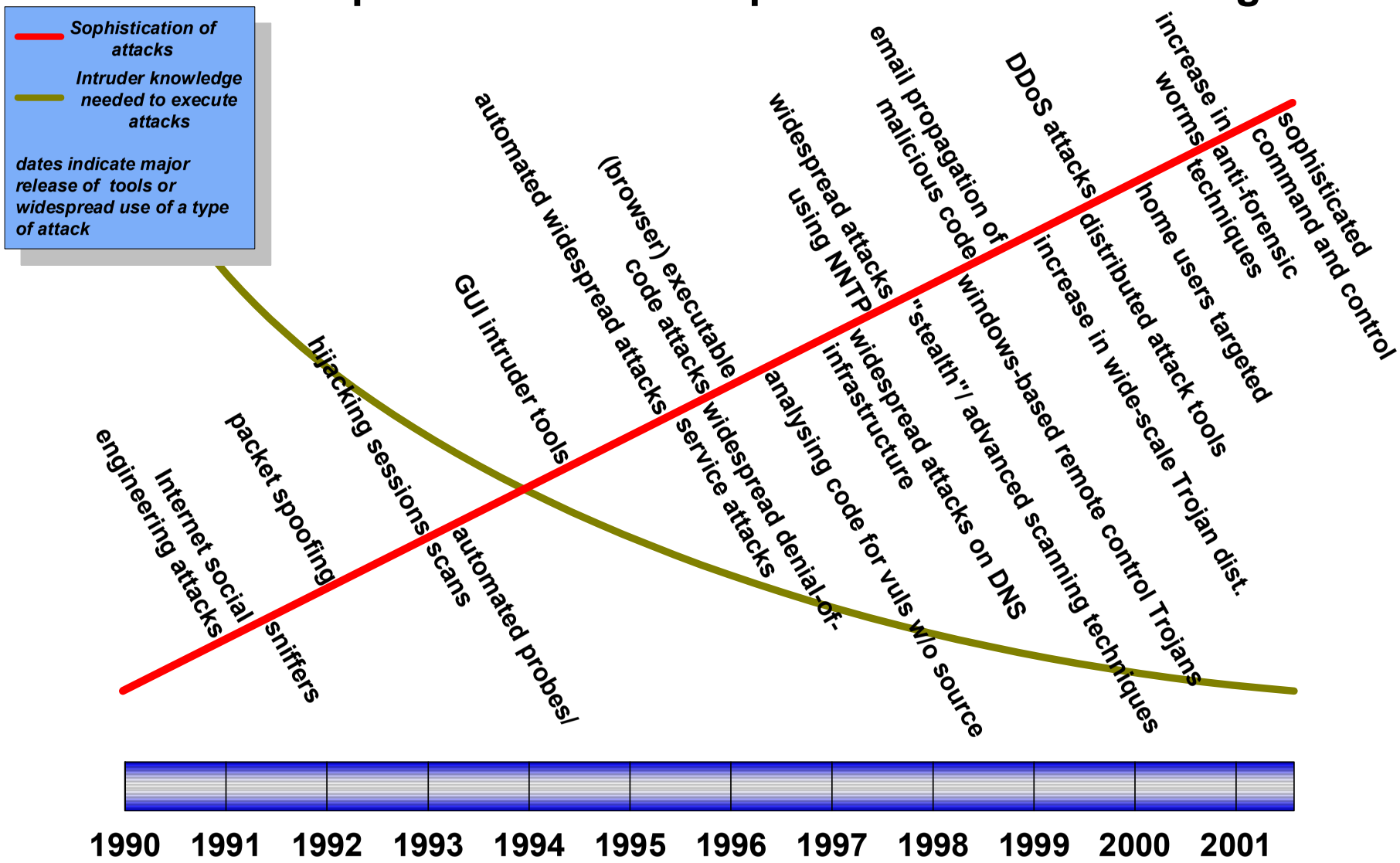
- global distribution
  - more than 109 million host computers (as of January 2001*)
- diverse user demographics
  - government agencies
  - academic and research institutions
  - corporate users
  - home users

*Source: Internet Software Consortium (http://www.isc.org/)

Recent CERT/CC Experiences

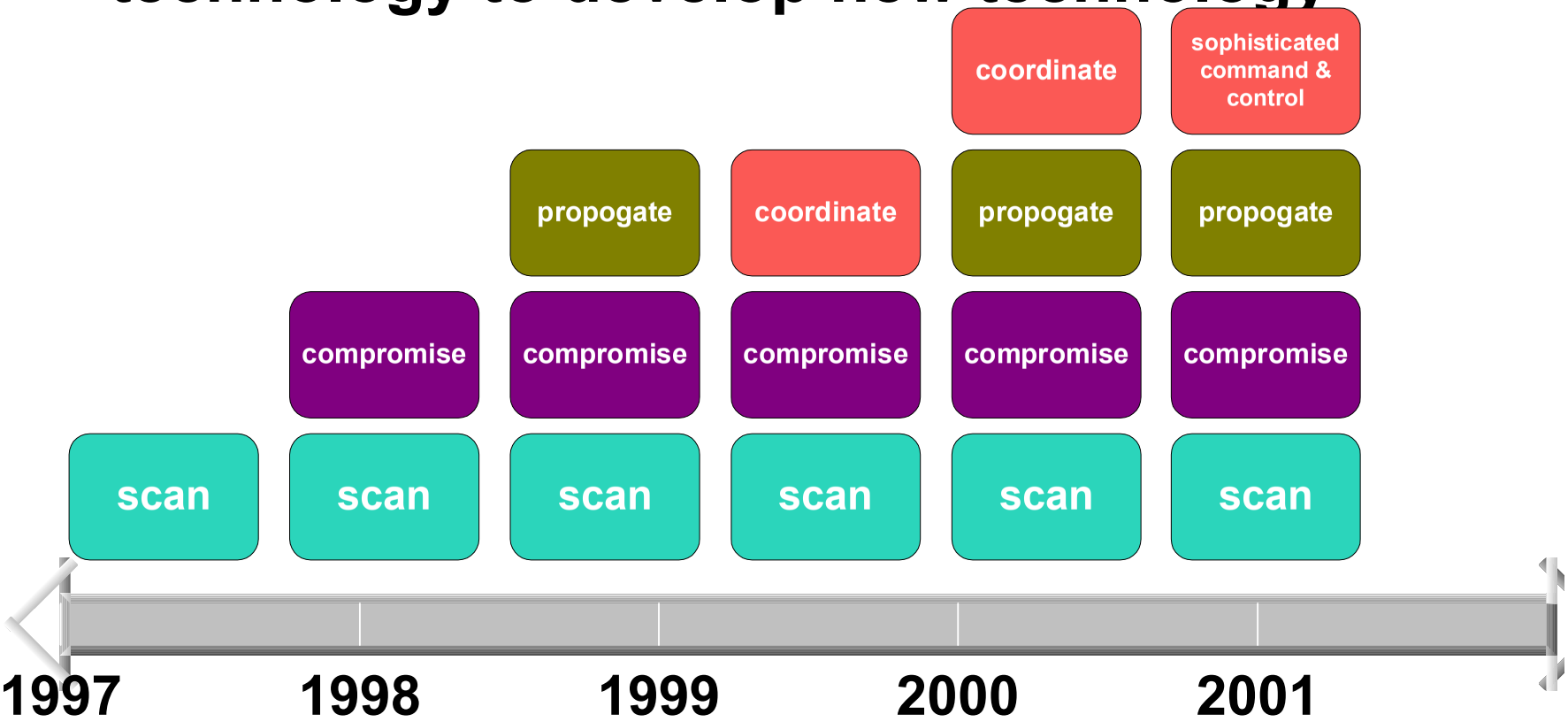
	1997	1998	1999	2000	2001
Incidents Handled	3,285	4,942	9,859	21,756	52,658
Vulnerabilities reported	196	262	417	1090	2437
Email msgs processed	38,406	31,933	34,612	56,365	118,907
CERT Advisories	28	13	17	22	37
Vulnerability Notes	44	34	20	38	300
Incident Notes	6	15	13	14	15

Attack Sophistication vs. Required Intruder Knowledge

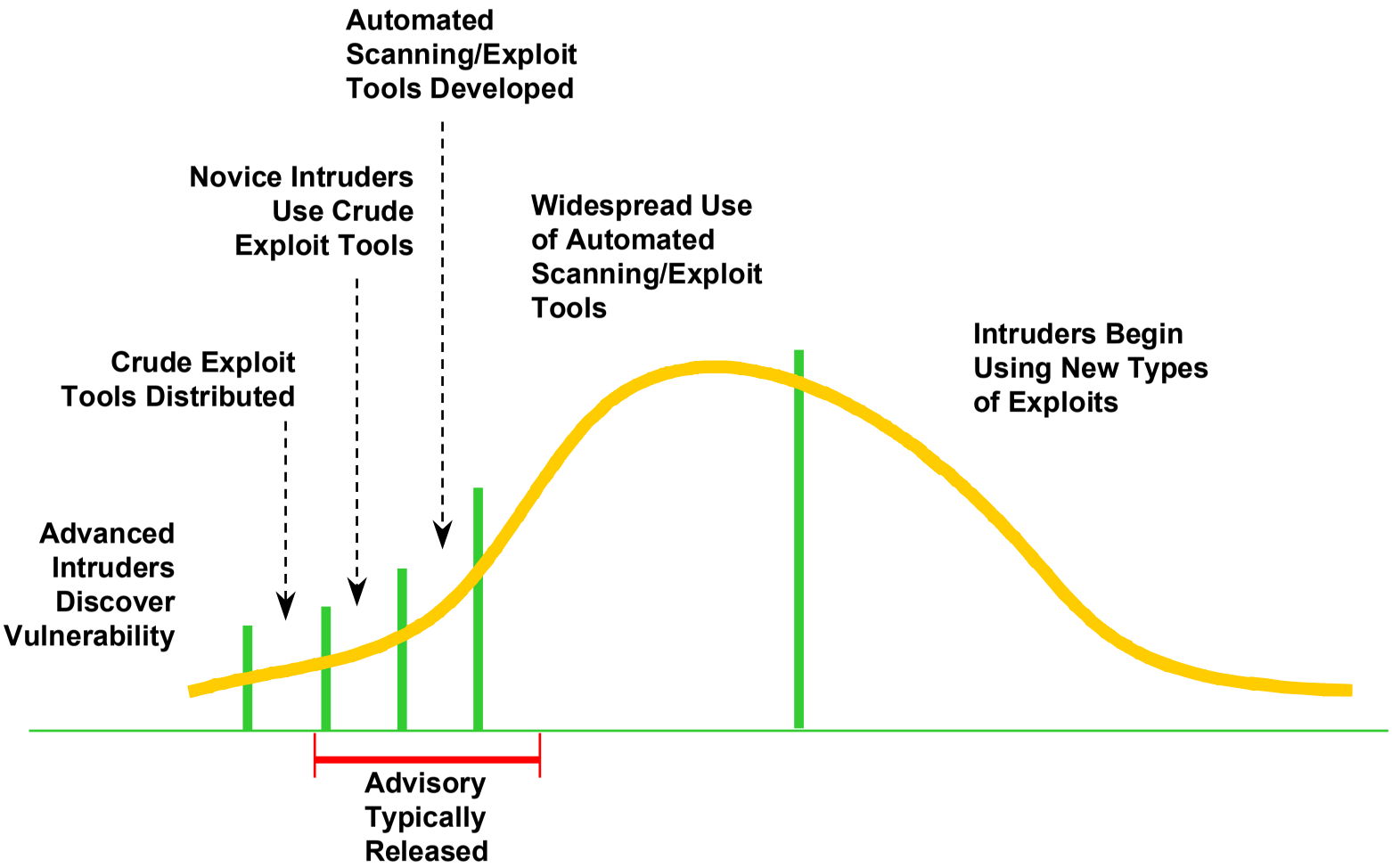


Intruder Technology

- Intruders use currently available technology to develop new technology

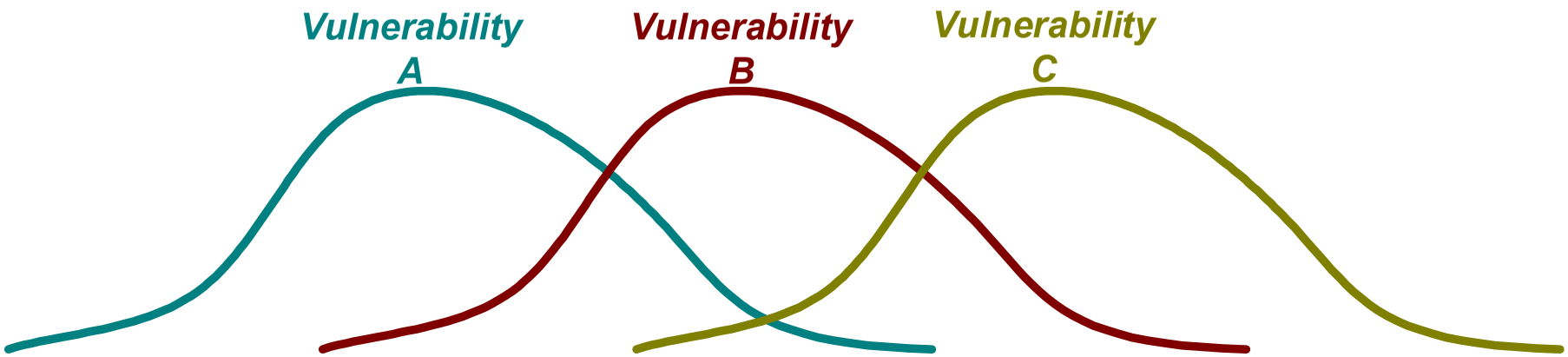


Vulnerability Exploit Cycle (1)



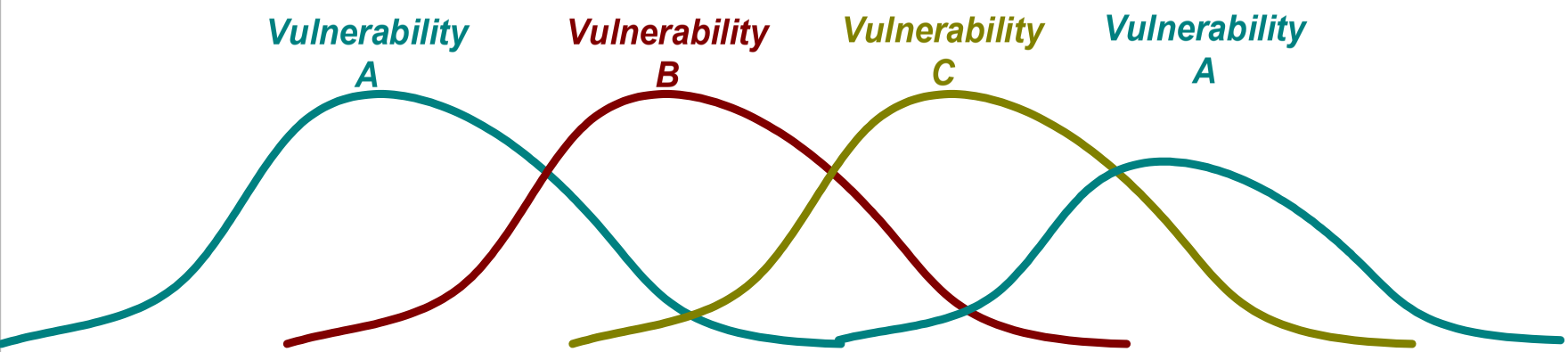
Vulnerability Exploit Cycle (2)

- The exploitation cycles of various vulnerabilities will overlap.



Vulnerability Exploit Cycle (3)

- For some vulnerabilities, there may be a resurgence in its exploitation.



Direction of Internet Security (1)

- **What the Internet community is facing in terms of Internet security in the next few years can be summed up in the following statements:**
  - **the expertise of intruders is increasing**
  - **the sophistication of attacks and intruder tools/toolkits is increasing**
  - **the effectiveness of intruders is increasing (*knowledge is being passed to less knowledgeable intruders thus making them effective*)**

Direction of Internet Security (2)

- the number of intrusions is increasing
- the number of companies and users of the Internet is increasing
- the complexity of protocols and applications run on clients and servers attached to the Internet is increasing
- the complexity of the Internet as a network is increasing

Direction of Internet Security (3)

- the information infrastructure has many fundamental security design problems that cannot be quickly addressed
- the number of people with security knowledge and expertise is increasing, but at a significantly smaller rate than the increase in the number of Internet users
- the number of security tools available is increasing, but not necessarily as fast as the complexity of software, systems and networks

Direction of Internet Security (4)

- the number of incident response teams is increasing, but the ratio of incident response personnel to Internet users is decreasing
- the vendor product development and testing cycle is decreasing
- vendors continue to produce software with vulnerabilities, including types of vulnerabilities where prevention is well-understood *(such as buffer overflows)*

CERT Hotline calls at 11:52 on Friday night...

"I can't take the machine off-line to recover it."

- to fully recover a compromised machine, it must be taken offline
- many sites do not have sufficient backup resources for mission critical systems to take them offline
- system administrators making this comment are frequent repeat customers

"I have no way to verify the integrity of my machine."

- once a machine is compromised, the integrity of the entire machine must be verified
- most sites do not have an infrastructure that facilitates verifying the integrity
  - software
  - configuration files
  - logs
- only recourse for many sites is
  - reinstall operating system and applications
  - apply all security patches and workarounds

"How do I monitor my network?"

- many sites do not have sufficient host or network logging/monitoring
- insufficient logging makes it very difficult to determine how a compromise occurred
- without sufficient logging, intensive monitoring usually needed to determine what is going on
- many sites are not prepared to do this kind of monitoring

"What is a patch?"

- yes, system administrators have asked this question
- many system administrators who do know what a patch is, do not install all the security patches because they
  - do not know how
  - do not have the resources
  - do not maintain all of the machines
  - have users who will not let them

"How can I figure out what patches are available for my operating system?"

- most vendors distribute patches via the Internet
  - even if you do not have a support contract
- many system administrators do not know how to get patches from their vendors

"I am going to leave my systems open and try to catch the intruder."

- have you consulted with your
  - management
  - legal counsel
- if you are not planning to involve law enforcement, to what end is effort being spent "catching the intruder?"

"When the intruder broke into my system, I exploited a vulnerability on his system and logged in to see who it was."

- we do not recommend that sites attack back
- no matter what the intent is, it can be viewed as hostile activity by the remote site
  - the remote site might be a victim as well
- it might expose the system administrator's organisation to legal liability

"The system administrator quit and now I have to do it, in addition to my real job which is _____."

- fill in the blank with:
  - intern or graduate student
  - graphic artist
  - secretary
  - manager trainee
  - etc.

- many employees performing system administration functions are not adequately prepared or trained

"I don't have backups for this machine."

- when intruders compromise machines, the integrity of the software and data is in question
- many sites do not have sufficient backups to restore data that has integrity
- even with backups, integrity can still question because intruders might have been operating long before they were discovered

"But, I am not running an IMAP server on this machine…"

- Surprise! Yes, you are!
  - many services are installed by default when installing the operating system on a machine
  - system administrators might not realise that they are being installed
  - having unneeded services unknowingly installed
    - increases the likelihood of compromise
    - makes it more difficult for the system administrator to track down problems

"I don't know where that machine is."

- many sites do not have adequate tracking of machines attached to the network
- machines might suddenly appear (or disappear and reappear, or reappear somewhere else)

"Employees are not permitted to use modems."

- modems provide convenient backdoors for intruders
- modems are used by employees, even against policy, because it is convenient

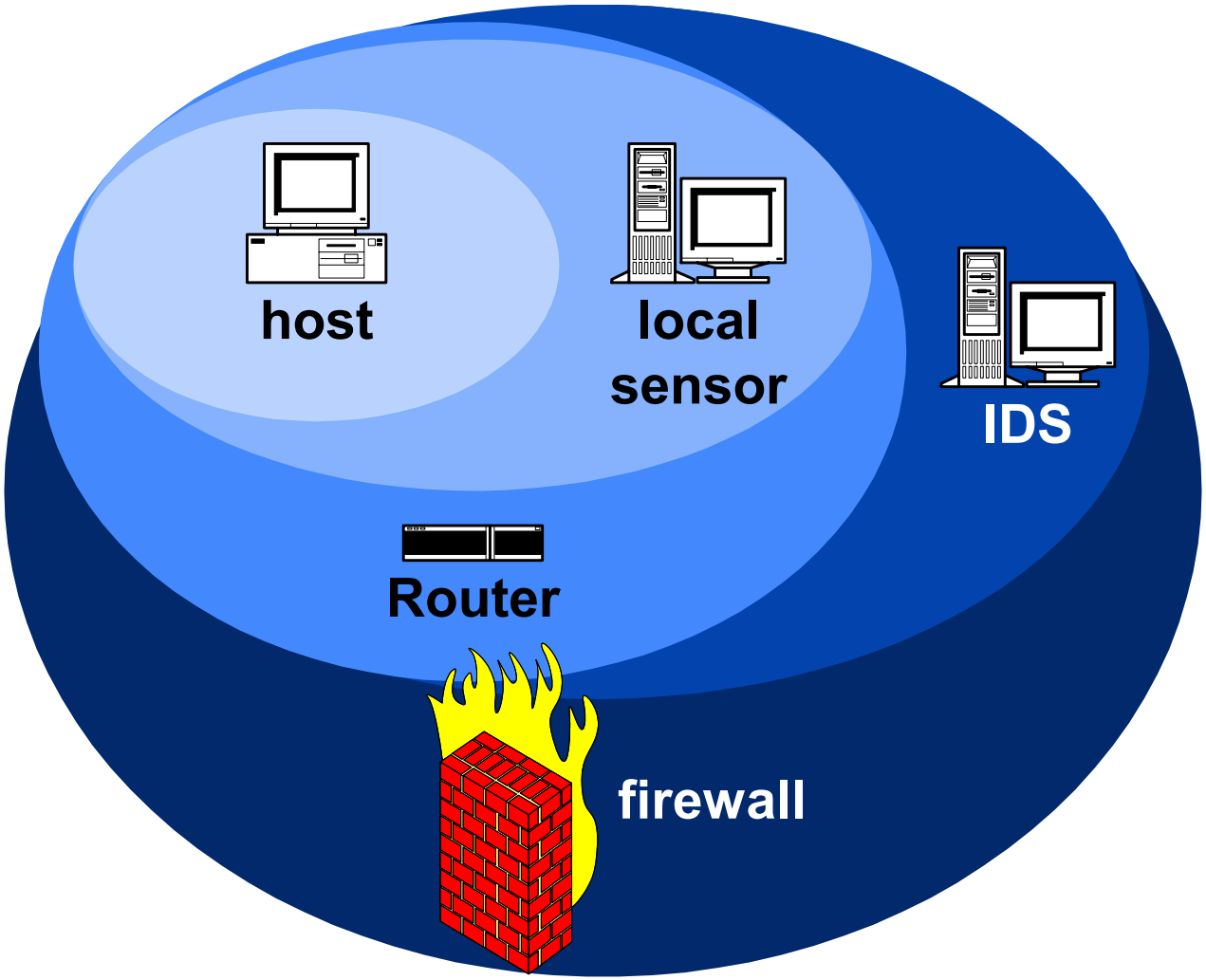
"No one knows our dialup number."

- many sites are under the false impression that their unauthenticated modem connections will not be discovered
- intruders will discover them through "war dialling"

"But, I have a firewall…"

- firewalls do not alleviate the need for host security
- intruders might compromise some other machine, and use it as a launching point to attack other internal machines
- firewalls generally do not protect against insider attacks

Layered Approach to Security



"This machine cannot talk to the Internet -- it is blocked at the router."

- another compromised machine on the internal network might be the one attacking the machine
- an insider might be launching the attack
- a user might have cause the compromise by unknowingly running malicious code

"All of our email is filtered, so no viruses can enter."

- how often are the filters/anti-virus software updated?
- can users read email from web-based email services, like Hotmail? can they download attachments from those services?

"No, I did not know that machine was compromised…"

- we have discovered many sites with compromised machines, based on reports from other sites
- when we contact many of these sites, they had no idea they were compromised

"Physical access is tightly controlled here."

- many attacks are initiated by insiders who have authorised access
- some employees, such as janitors, have vast access
  - what background checks are performed on your janitors?
- who verifies the background of contractors
  - might contractors be formerly terminated employees?

"The hacker is coming from Korea!"

- the source address might be "a.example.kr", but that does not mean the intruder is in Korea

- the intruder might have
  - altered DNS records
  - compromised a machine in Korea from another location
  - spoofed the source address

2001-2002 CERT/CC PGP Key

- **Key ID:** `0xD02361C9`
- **Key Type:** `RSA`
- **Expires:** `10/01/2002`
- **Key Size:** `1024`
- **Fingerprint:** `8F E3 1F 95 94 BE FD E7 9B EE 92 06 D7 35 AC F5`
- **UserID:** `CERT Coordination Center <cert@cert.org>`

- The CERT/CC PGP key is an RSA key, and is constructed to provide maximum interoperability with as many versions of PGP as possible as well as with GPG.

CERT® Contact Information

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CERT personnel answer 8:00AM-5:00PM EST(UTC-5)/EDT(UTC-4), and are on call for emergencies.

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