Denying DDoS Attacks

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Agenda

- The Anatomy of a Denial-of-Service attack
- Distributed Denial-of-Service
- Trends and Factors
- A history in the making
- Distributed Denial-of-Service tools
- Is there an solutions?
- Where can I find more information
- Conclusion
- Questions?

I: The Anatomy of a Denial-of-service Attack

What Is a Denial-of-Service

A Denial-of-Services is when someone or something is prevented from performing a desired task or operation.

Types of Denial-of-Service Attacks

- **Bandwidth Consumption**
  - Flooding a smaller network with data
    - **flooding a 56-kbps network connection from a T1 connection.**
    - **This may actually be legitimate network usage**
  - Using multiple sources to flood a network
- **Resource Starvation (Consuming system resources)**
  - filling Disk/File system
  - memory fully allocated
  - CPU at maximum usage
  - Filling process table

Definitions from “Hacking Exposed”

Types of Denial-of-Service Attacks

- **Programming Flaws**
  - Buffer overflows that cause services to terminate prematurely
  - Memory leaks that can be used to consume system resources
  - Malformed or illegal network packets that cause kernel crashes
- **Routing and DNS Attacks**
  - Manipulation of routing tables to prevent legitimate access (breaking into routers)
  - Manipulation of DNS tables to point to alternate IP addresses

Definitions from "Hacking Exposed"

DoS Attacks Can Strike Anywhere

- **Web browsers**
  - The browser becomes unresponsive
  - Continues to open windows (until system resources are exhausted)
- **Individual Services**
  - Disable or crash network services (a buffer overflow can cause a service to crash)
- **The whole system**
  - Resource attacks (file system, process table, memory, …)
- **The whole network**
  - NIS, DNS, …

Common Denial-of-Service attacks

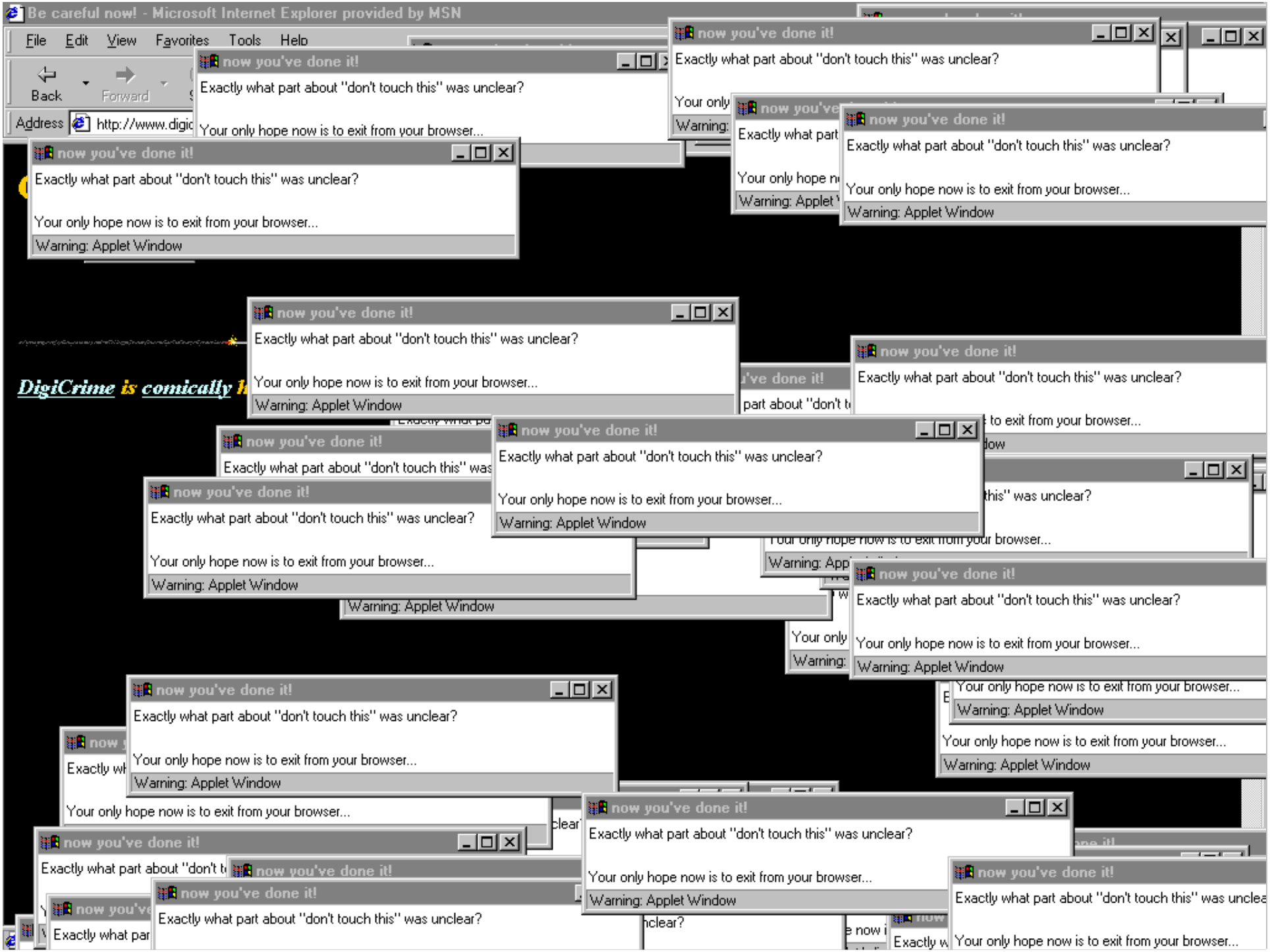
- **Hostile Java Applets**
- **Ping of death**
  - Sending oversized (>64k) ICMP echo packets to a vulnerable system
- **“Drop” attacks (Teardrop, syndrop, boink)**
- **SYN flood**
- **Smurf**
- **Land**
- **WinNuke**
- **Process table flooding through network services**

Networks

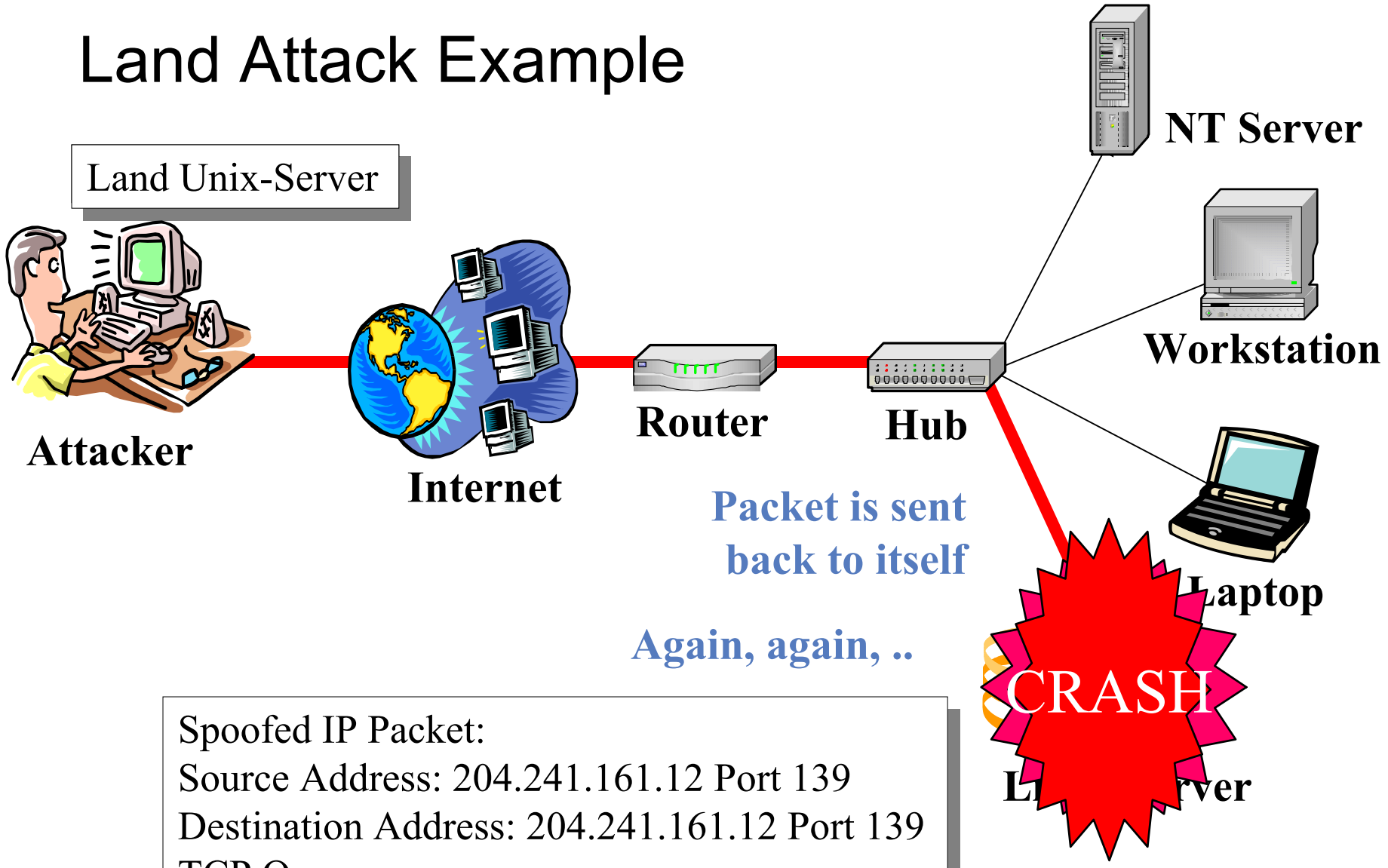
- **Cause a large amount of network traffic**
- **Connectivity slows to a standstill**
- **Starts dropping packets**
- **Network Information Service (NIS) attack:**
  - Systems using NIS must request user information from the NIS server, one user at a time.
  - This creates a spike in network traffic (not to heavy under normal use).
  - The follow could be used to perform a network DoS:

```
while :
do
        finger bogus-name@system &
done
```

The system power turns off!

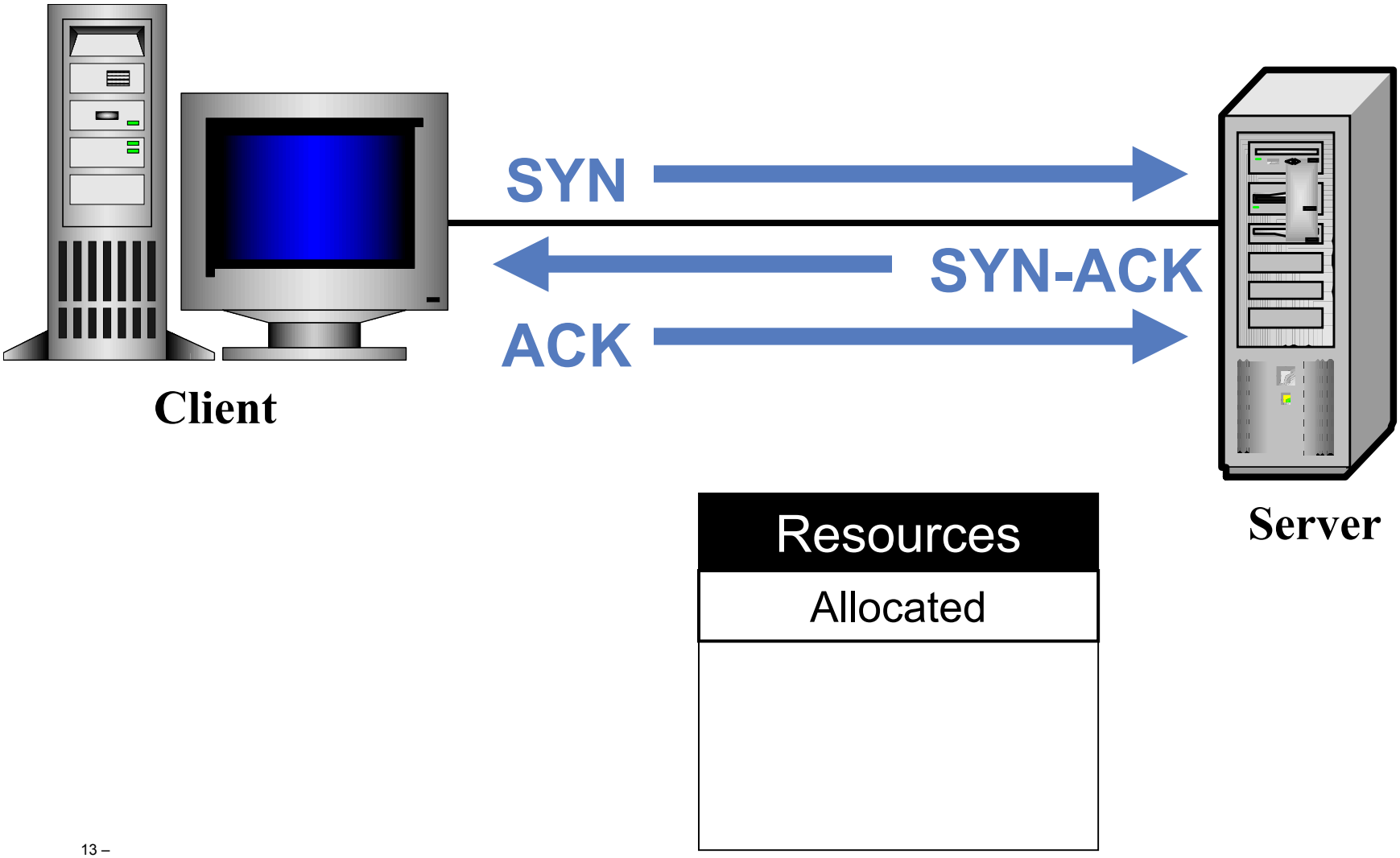

Be careful now! - Microsoft Internet Explorer provided by MSN
File Edit View Favorites Tools Help
Back Forward
Address http://www.digic
now you've done it!
Exactly what part about "don't touch this" was unclear?
Your only hope now is to exit from your browser...
Warning: Applet Window
DigiCrime is comically

Land Attack Example

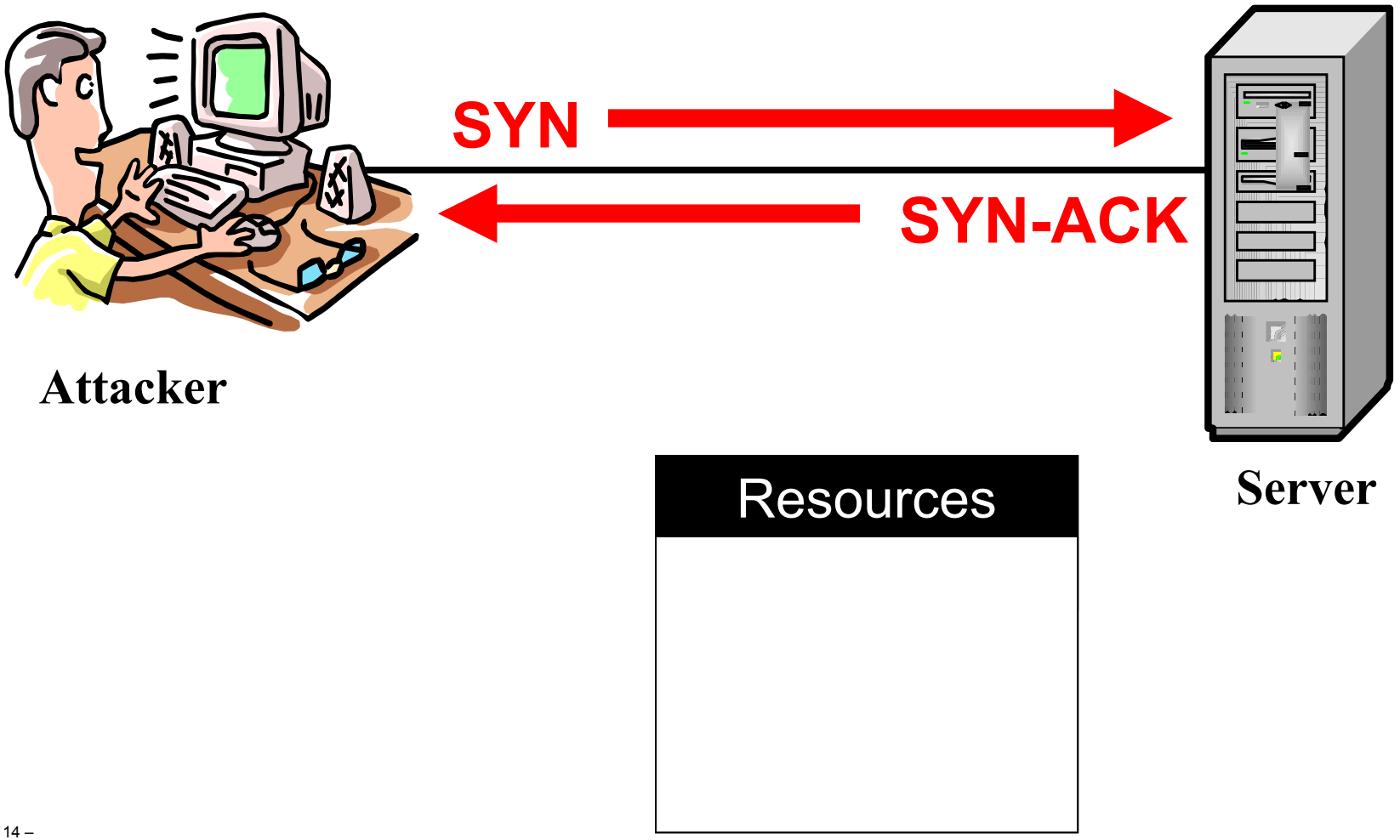


Spoofed IP Packet:
Source Address: 204.241.161.12 Port 139
Destination Address: 204.241.161.12 Port 139
TCP Open

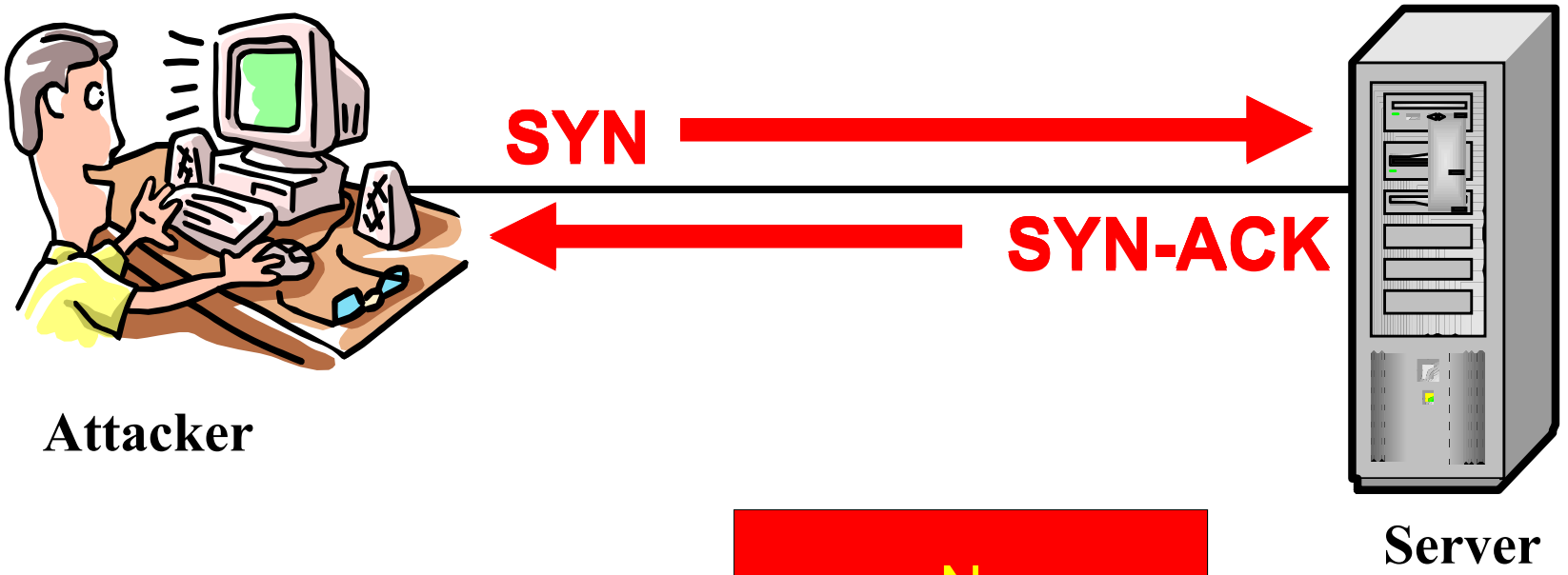
Connection Oriented 3-Way Handshake



Beginning of a Syn-flood Attack



The Complete Syn-flood



No

More

Resources

Evidence of SYN Flood

- **Look for too many connections in the state "SYN_RECEIVED" may indicate an attack**
  - SunOS
    - **netstat -a –f inet**
  - FreeBSD
    - **netstat -s |grep "listenqueue overflows"**
  - Windows
    - **netstat –a**
  - Linux
    - **netstat –a**

Smurf Attack

Attacker sends a ICMP ping to the broadcast address of a router.

Attacker

Router

Server A

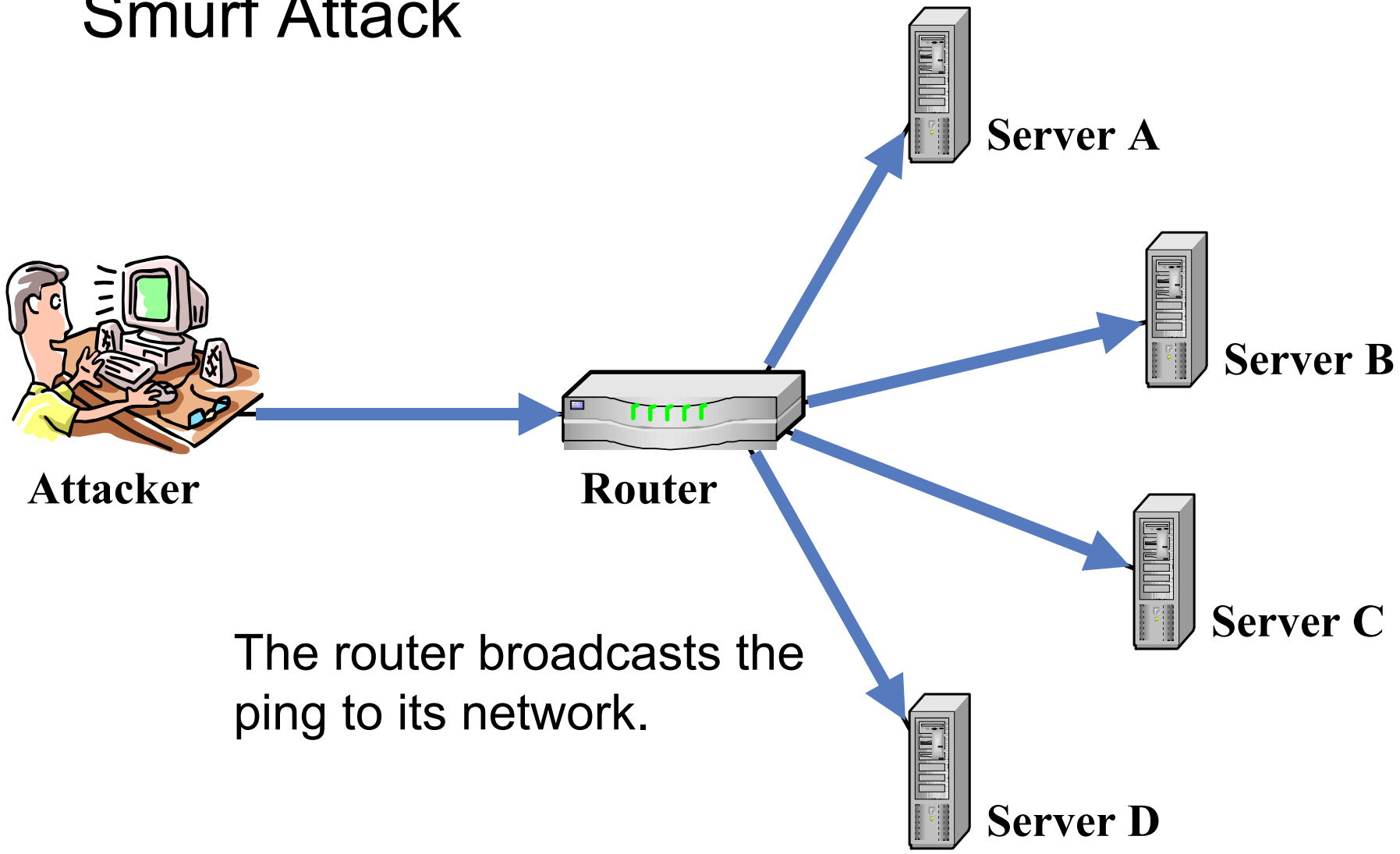
Server B

Server C

Server D

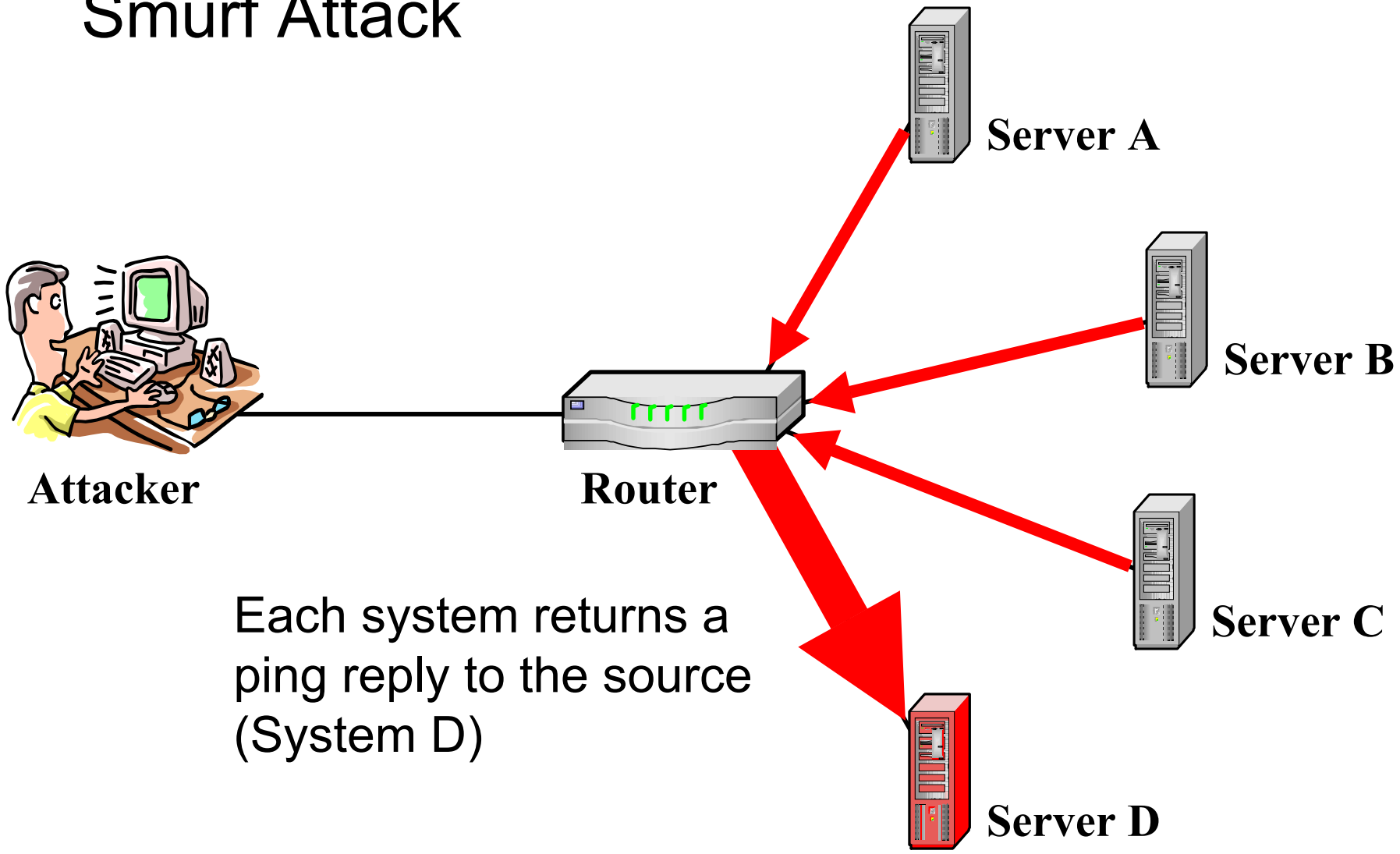
The source IP address is set (spoofed) to that of Server D.

Smurf Attack



The router broadcasts the ping to its network.

Smurf Attack

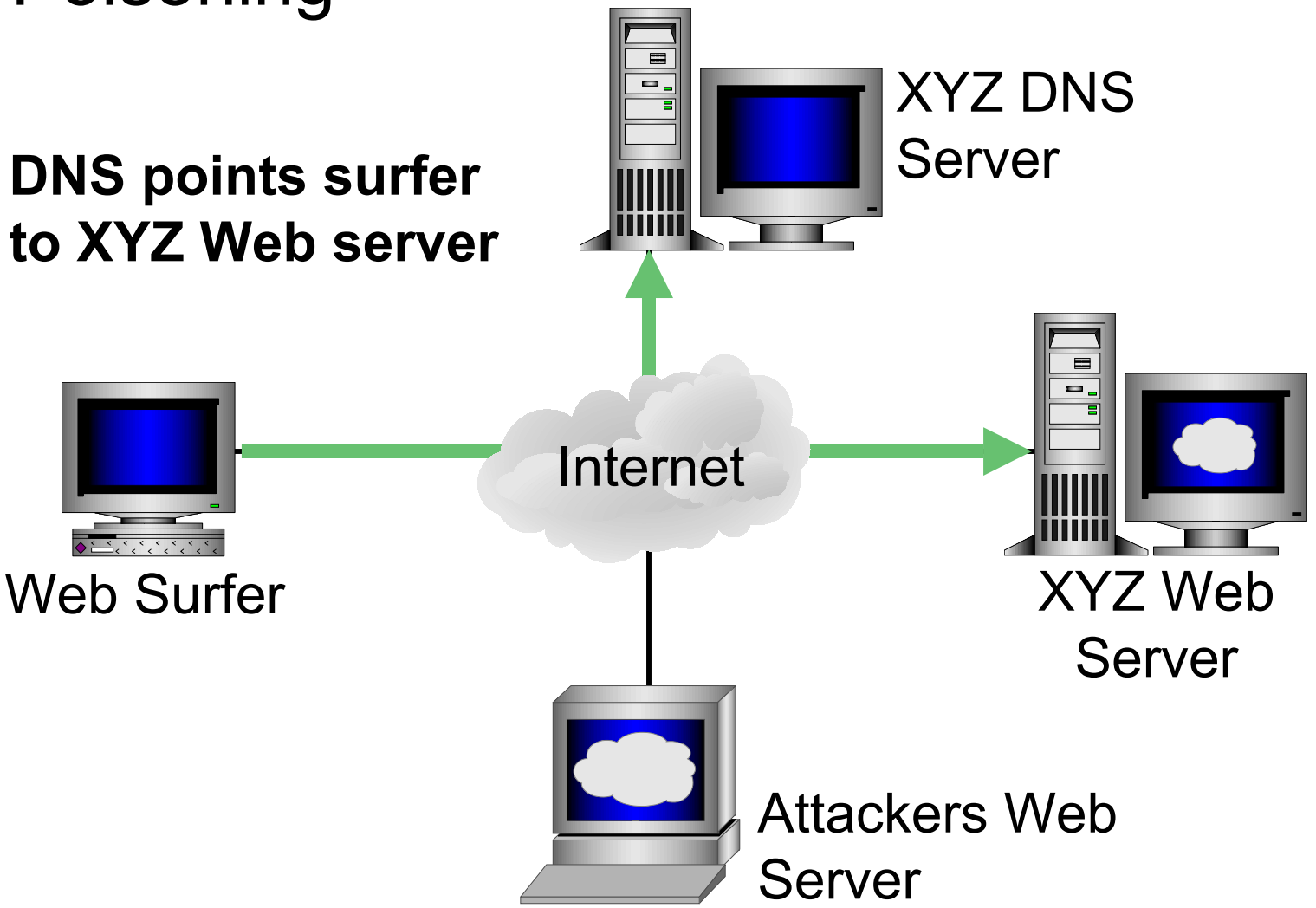


Each system returns a ping reply to the source (System D)

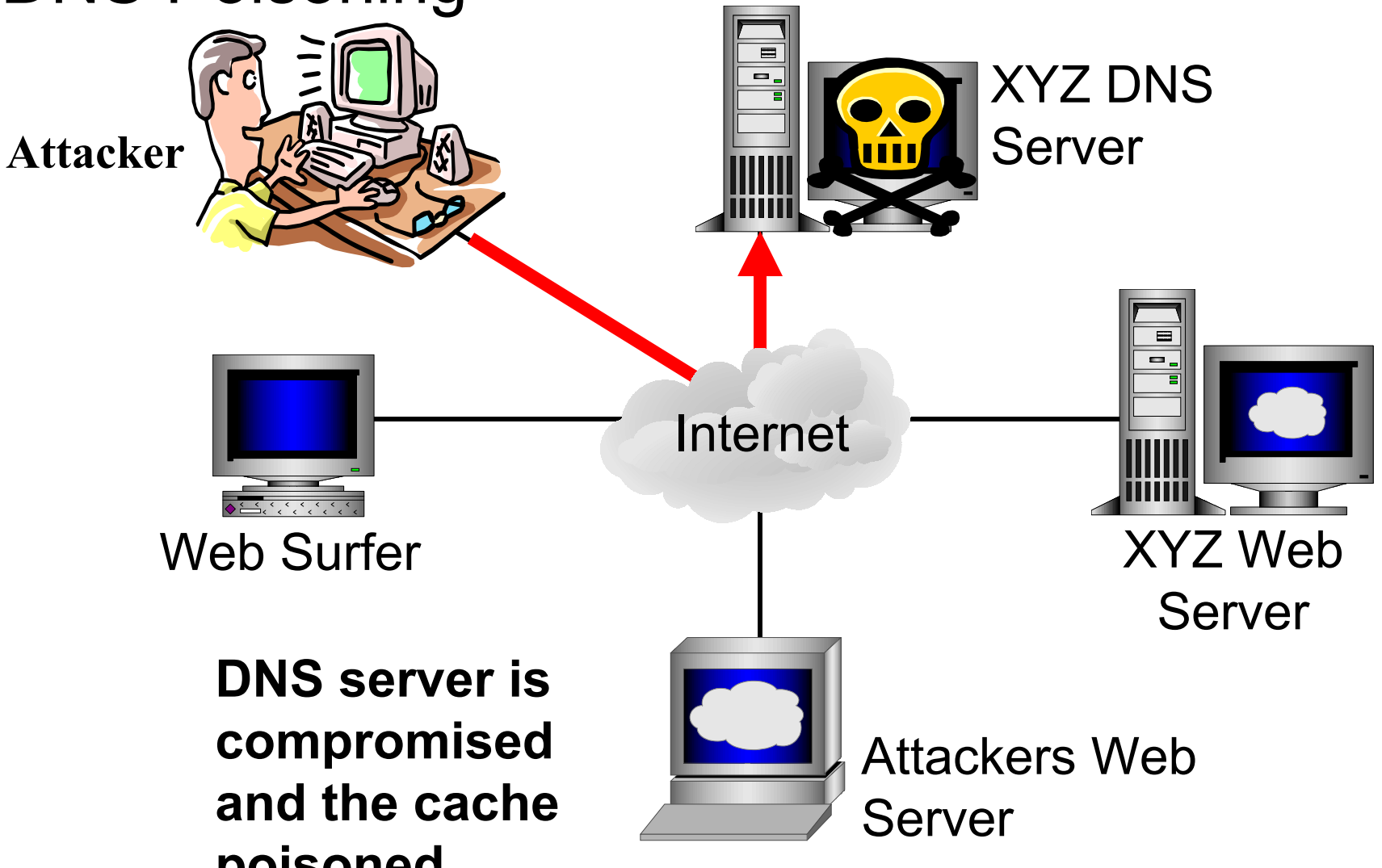
DNS Attacks (Domain Name Service)

- **DNS is used to equate a human readable system name to a numeric IP address**
  - My.Domain.Com = 12.208.5.23
  - Your.Domain.Com = 12.208.6.87
- **Program and design flaws have allowed the DNS server information to be poisoned with incorrect data**

DNS Poisoning

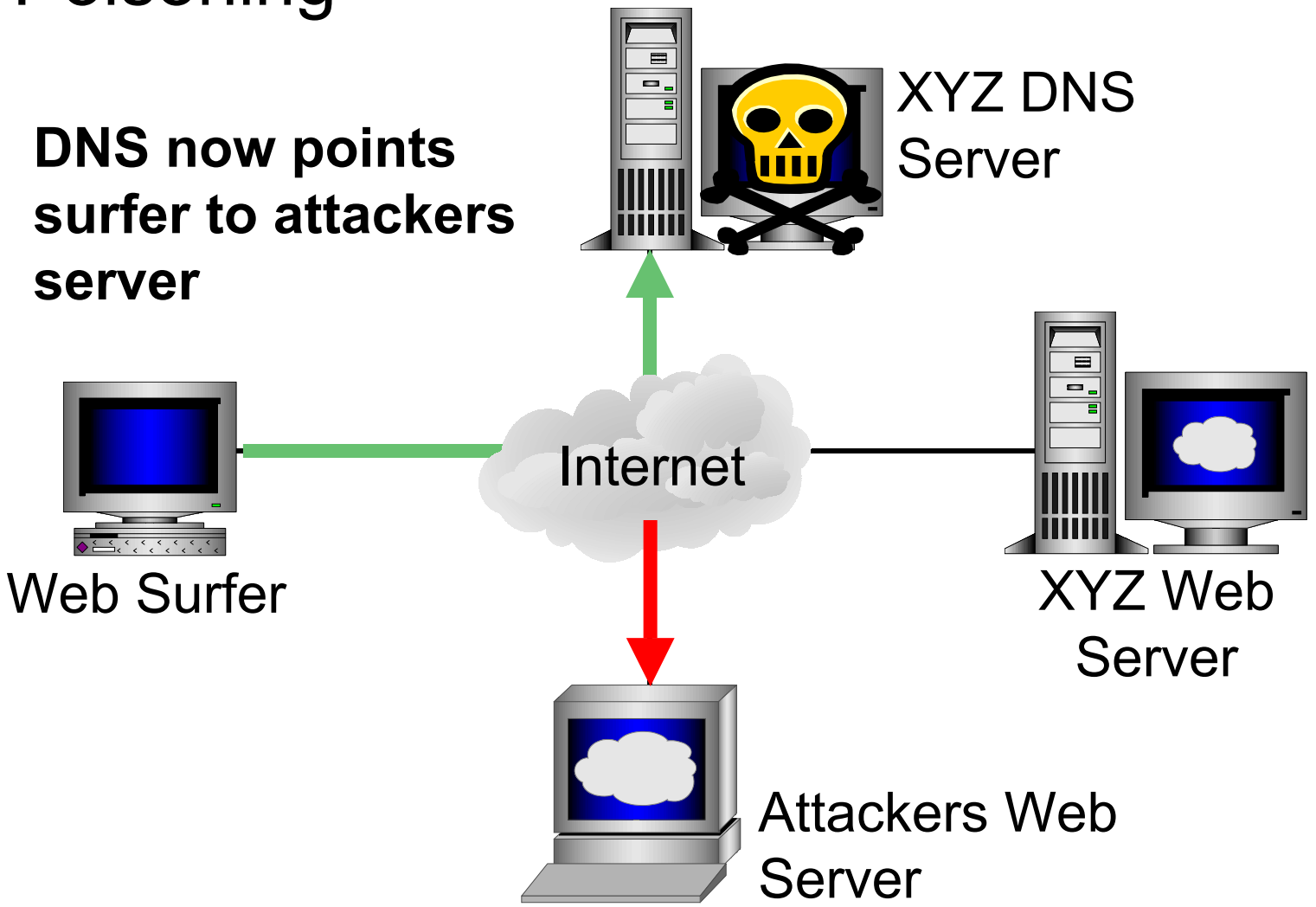


DNS Poisoning



DNS server is compromised and the cache poisoned

DNS Poisoning



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- more nike sites
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- membership
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CHARLES BARKLEY NETWORK

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LANCE ARMSTRONG

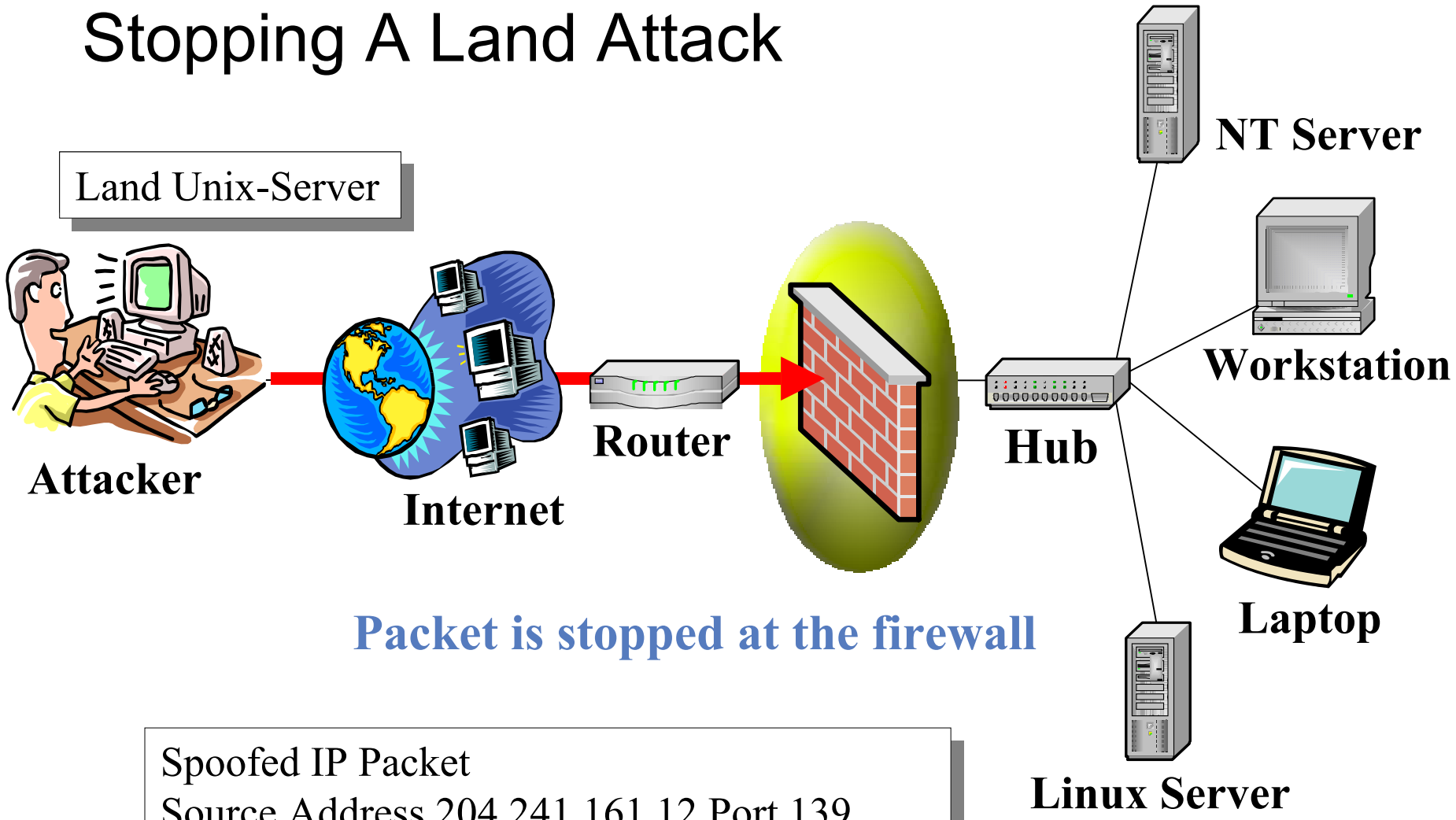
NIKE DIGITAL VIDEO

80days 22hours 41mins 51secs

quick re-entry

Stopping A Land Attack

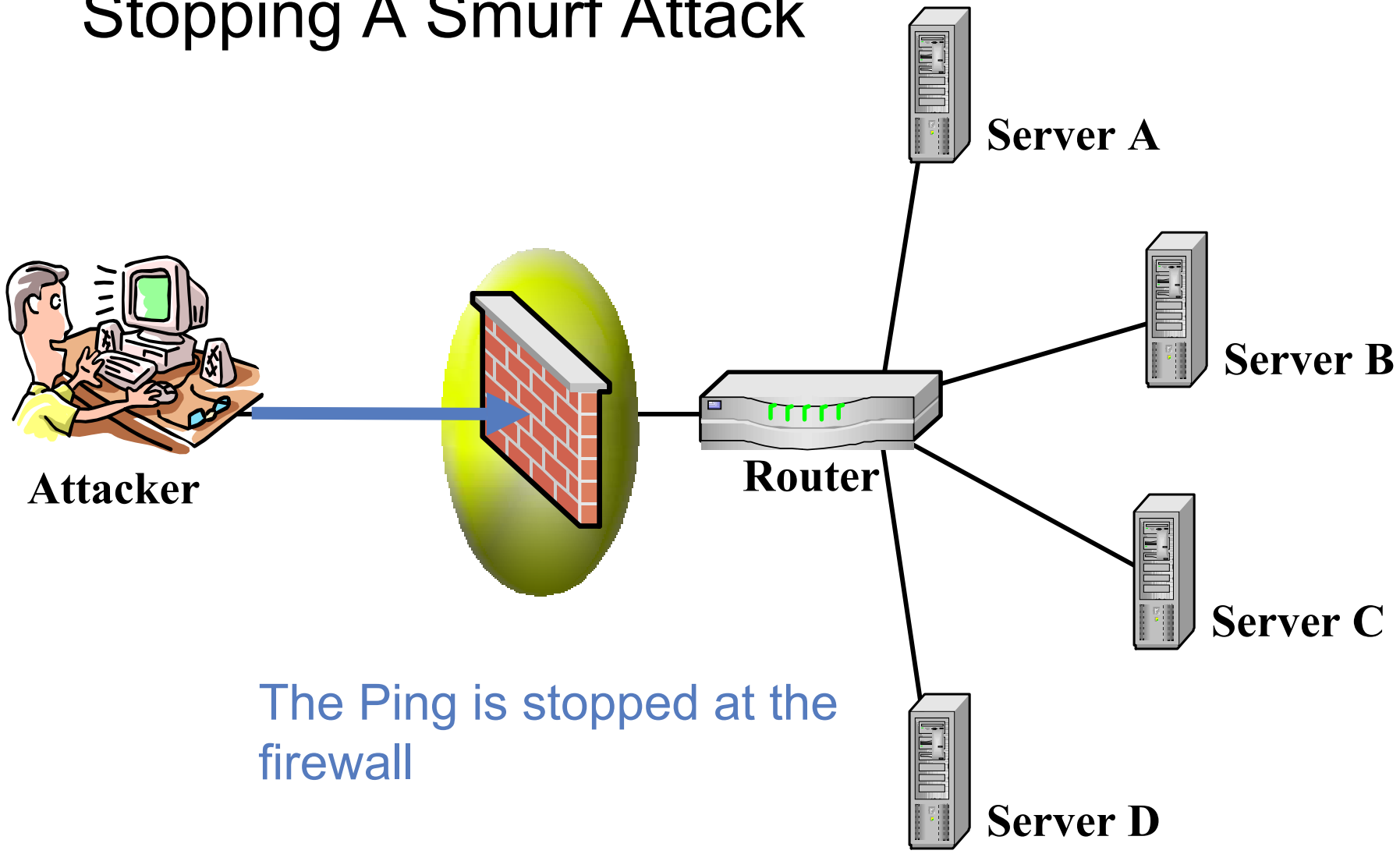
Land Unix-Server



Packet is stopped at the firewall

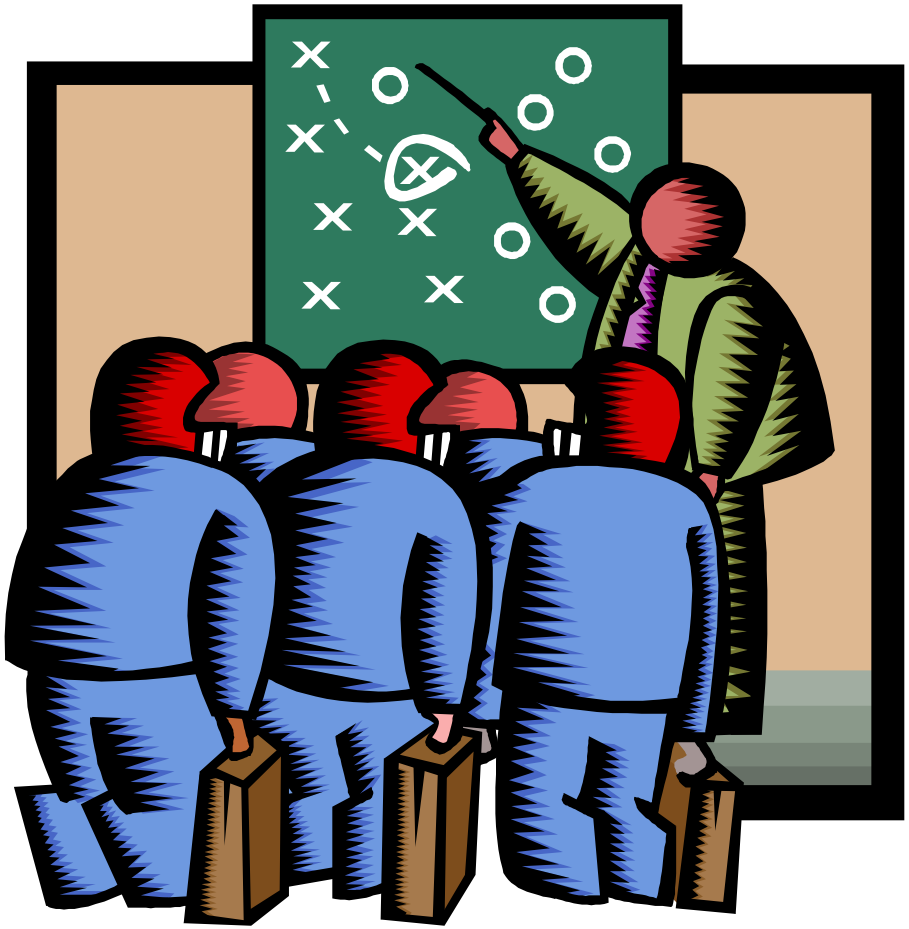
Spoofed IP Packet
Source Address 204.241.161.12 Port 139
Destination Address 204.241.161.12 Port 139
TCP Open

Stopping A Smurf Attack



The Ping is stopped at the firewall

II: Distributed Denial-of-Service



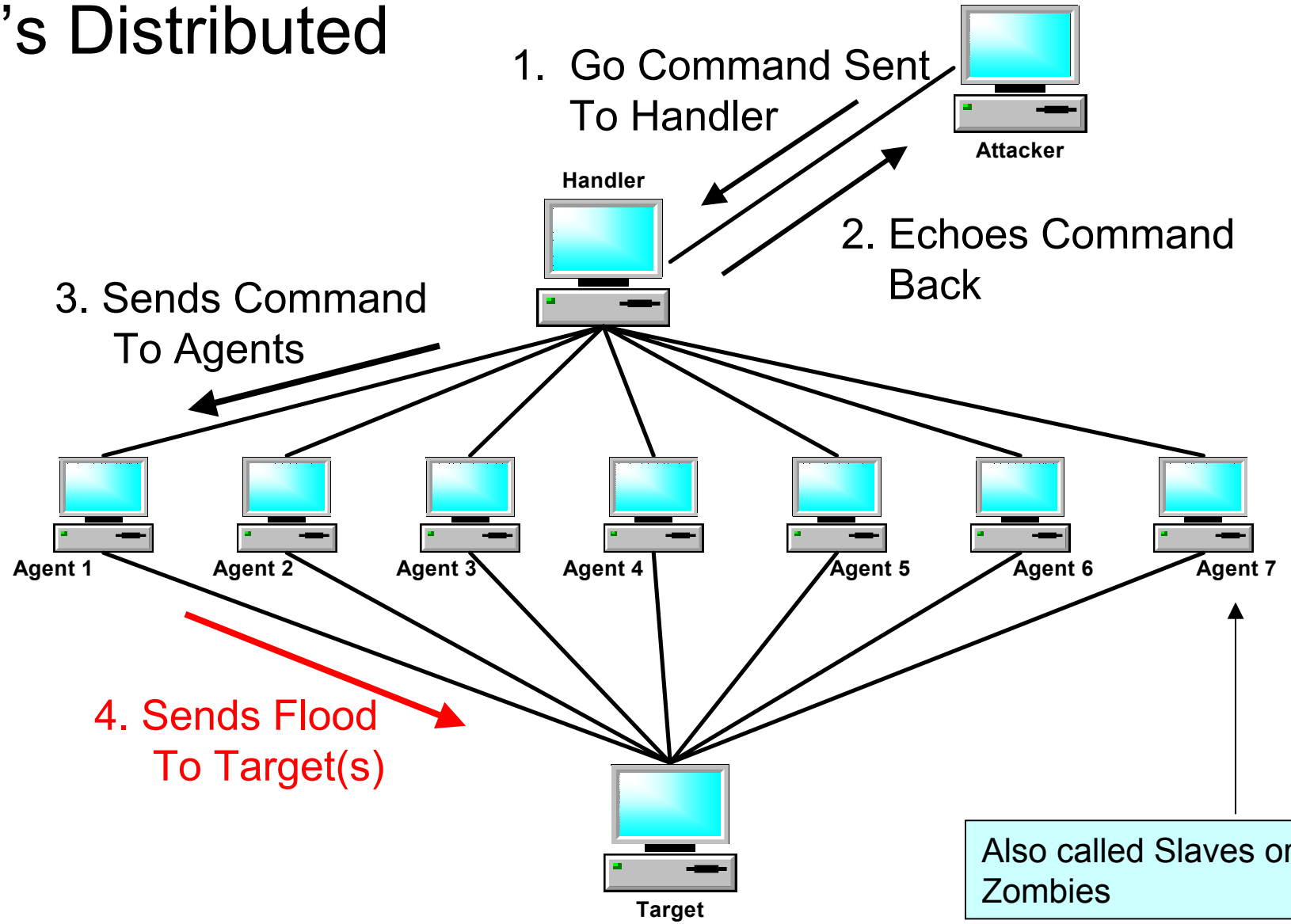
A Definition Found on the Internet

"A computer attack that hijacks dozens or sometimes hundreds of computers around the Internet and instructs each of them to inundate a target site with meaningless requests for data."

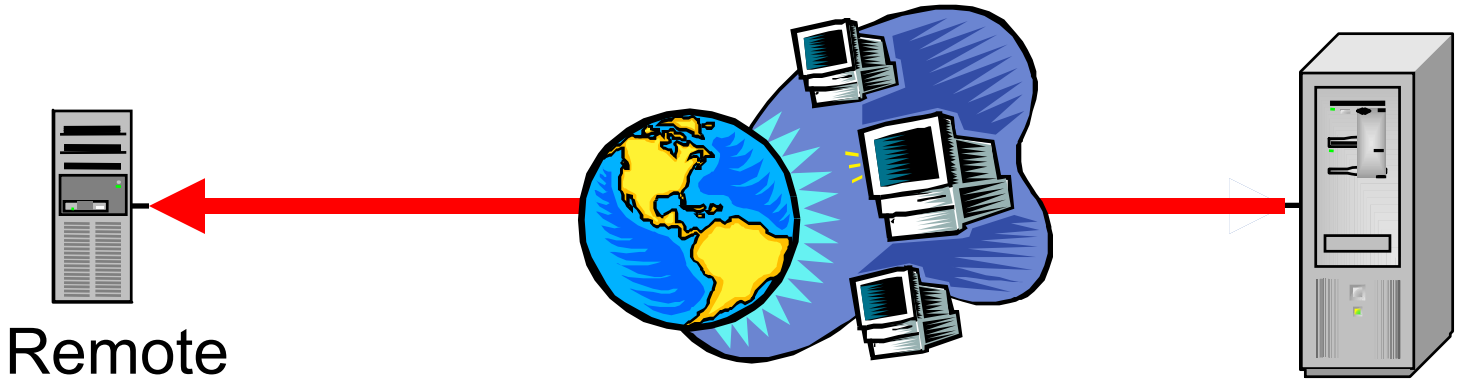
What Is It?

- **Represents a new level of attack**
- **Use of multiple, sometimes compromised systems, to launch attacks**
- **Type of attacks include:**
  - Denial-of-service (Trinoo, tribal flood network, …)
  - Password cracking (saltine cracker, Slurpie)
  - Information gathering (none available yet)

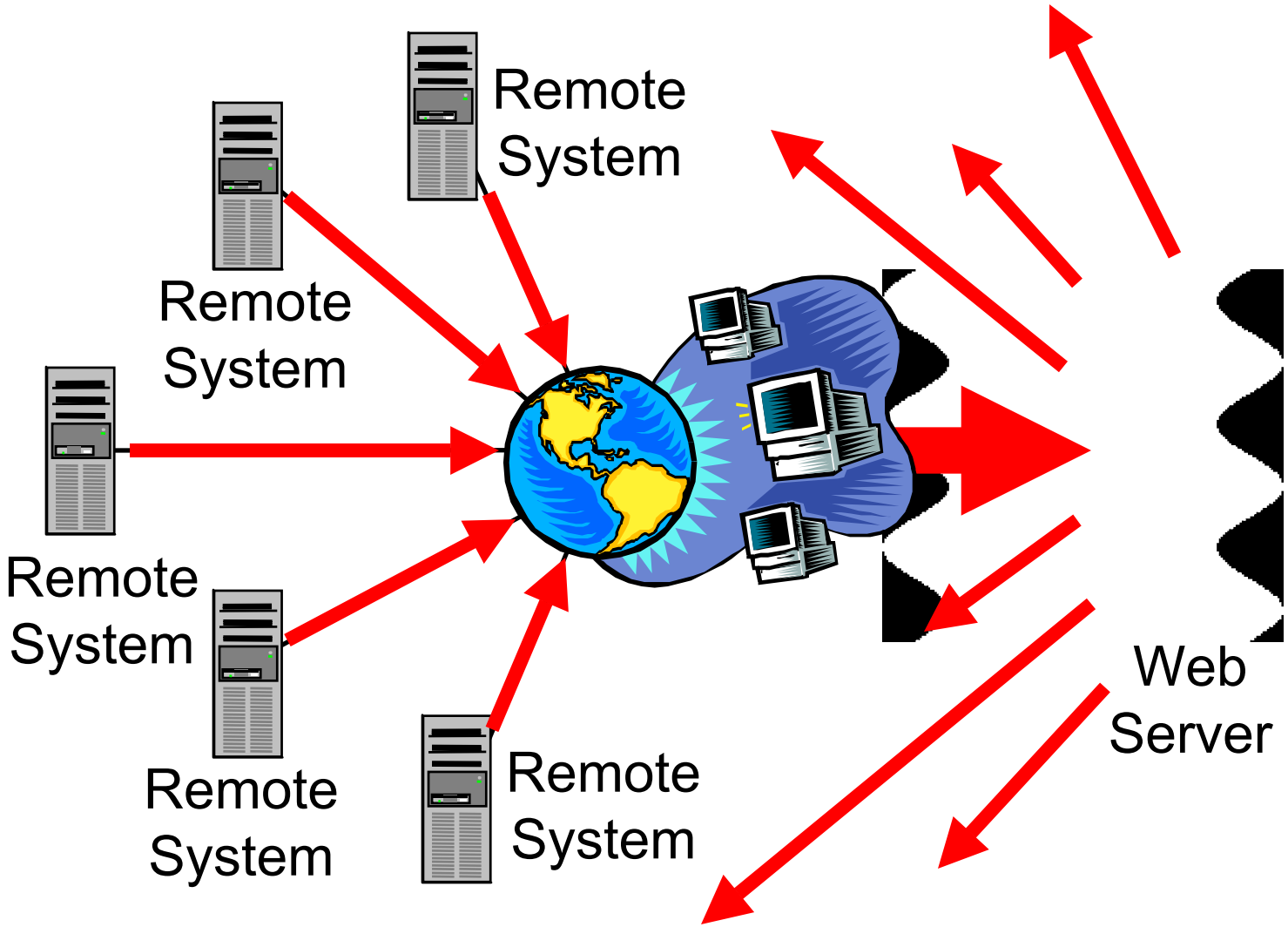
It's Distributed



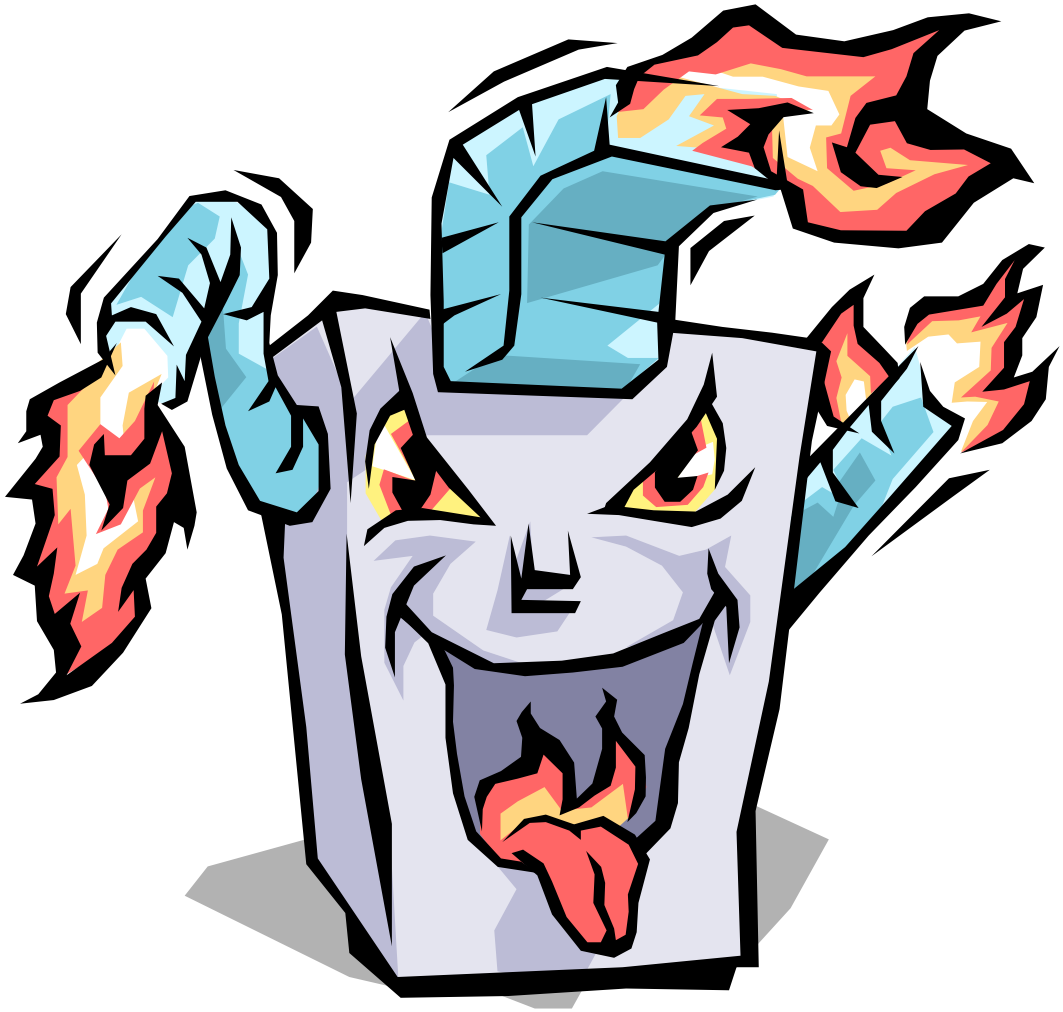
Simple ICMP (Ping)



ICMP (Ping) Flood



III: Trends and Factors



Development

- **Attack technologies are being developed in a open source environment and are evolving quickly**
  - Underground community providing quick feed back
  - New ideas and features discussed in group forums
  - Global development teams via the internet
  - The time between idea and deployment can outpace the system and security administrators (opening a window of opportunity for abuse)
  - As long as defensive strategies are defensive, this situation will continue
  - Solutions must be international in scope

Easy Deployment

- **There are tens of thousands (perhaps even millions) of computers with week security connected to the internet**
  - They make easy targets for attack
  - Attackers will compromise many of these systems
  - Backdoors, Trojan horses and/or Distributed Denial-of-Service clients (zombies) will be installed
  - These systems systems can then be combined to form attack networks
  - Availability of broadband internet connections in the home, schools, libraries, and other locations (likely without any implemented security measures) increases the problem

Vulnerabilities

- **Increasing complex software is being written**
  - New developers with little or no training in writing secure code
  - Many working in environments where time-to-market is more important that security
  - Testing time and QA has not always increased to match the code complexity
  - Complex software is being deployed in security-critical environments
  - The end user is at risk

Demand for Features

- **User demand for new features**
  - Industry response is often to put security last or even as an afterthought
  - Results in software that is increasingly subject to:
    - **Subversion**
    - **Computer viruses**
    - **Data theft**
    - **Other forms of abuse**

Internet Complexity

- **It is unlikely that changes to specific technologies will eliminate newly emerging problems due to the scope and variety of the internet**
  - Broad community action required
  - Point solutions only help dampen effects of attacks
  - Need robust solutions that may require concentrated effort and several years
  - Many issues are due to inadequacies and shortcomings in a design that is over 30 years old

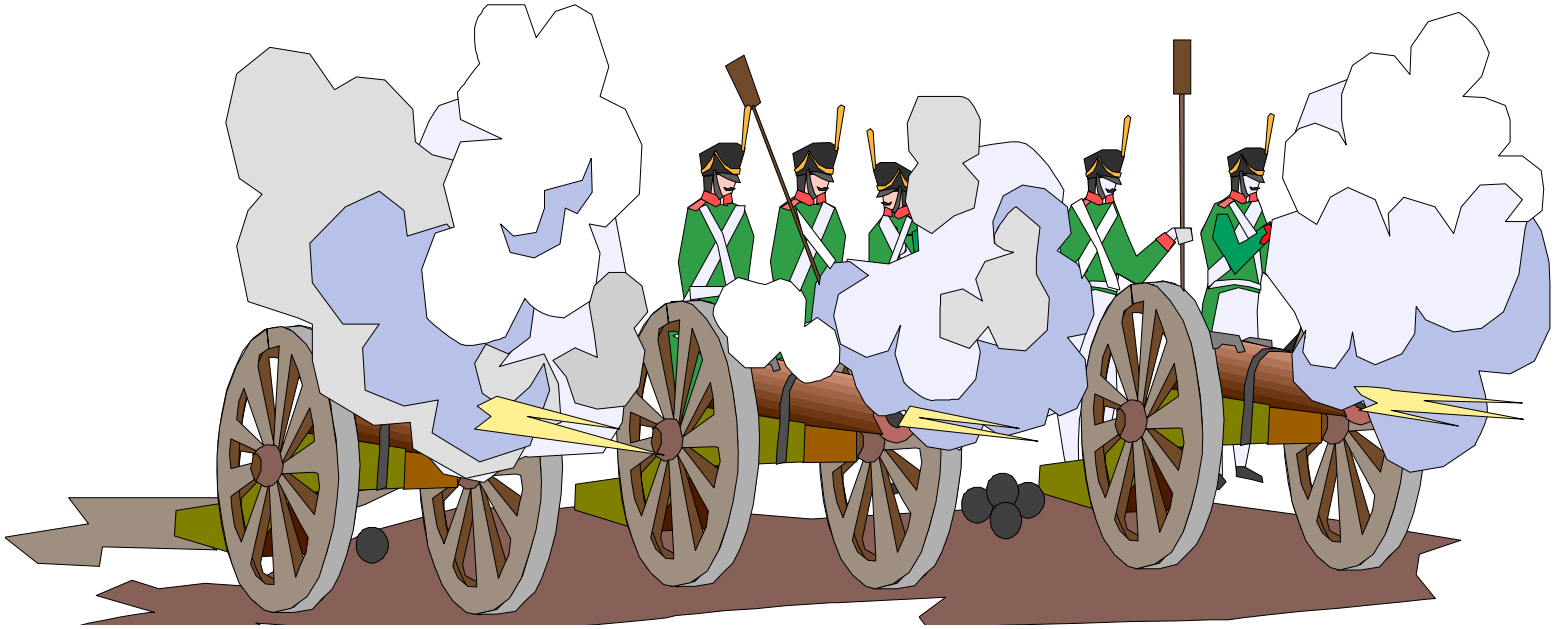
Technical Talent

- **Technical talent is growing scarce**
  - The growth of the internet has out paced availability
  - The average level technical ability and knowledge has decreased of the past few years
  - People with little or no technical experience are being placed in system and network administrative positions (often right out of school)
  - Graduates have little real experience and there is little effort to improve this in the educational system

Finding the Attacker

- **International law and the complexity of attacks makes apprehension and prosecution of computer crime difficult or unlikely**
  - Attack systems me be located across the globe
  - Incriminating evidence may be unattainable
  - True identify of perpetrator may never be determined
  - The attack may not even be illegal in the country where the attacker lives
  - Some governments unwilling to aid other (enemy) in an investigation

IV: A History in the Making



The Internet Meltdown – February 7, 2000

- **Yahoo hit by first recorded denial-of-service attack.**
- **Many other high profile commercial sites where hit next over a three day period of time.**
- **During proceeding months many sites with high speed connections were broken into and infested with “zombies”.**
- **Zombie systems waited until they received attack command.**
- **System owners were unaware of their participation.**
- **Broadcast amplification using “ICMP echo reply” intensified attack.**
- **Flood estimated at over 1 gigabit per second.**

The Internet Meltdown – February 7, 2000

- **The following Sites where attacked:**

• Yahoo	10:20 a.m.	2/7/00 PST	3 hours
• Buy.com	10:50 a.m.	2/8/00 PST	3 hours
• eBay	3:20 p.m.	2/8/00 PST	90 minutes
• CNN.com	4:00 p.m.	2/8/00 PST	110 minutes
• Amazon.com	5:00 p.m.	2/8/00 PST	1 hour
• ZDNet	6:45 a.m.	2/9/00 PST	3 hours
• E*Trade	5:00 a.m.	2/9/00 PST	90 minutes

- **Many others sites rumored to have been attacked**

Why Should I Be Worried

- **As late as February 2001**
  - Microsoft (router glitch)
  - IRC servers
- **It has been estimated by at least one internet service provider that up to 10 percent of internet traffic on it's networks are from attackers attempting a denial of service attack (source ZDNet)**
- **New attacks and methods are being created even as we speak**

V: Distributed Denial-of-Service Tools

Distributed Denial-of-Service Tools

- **These are some of the automated tools that attackers might use to simplify the task**
  - Mstream
  - Trin00
  - TFN/TFN2K– Tribe Flood Network
  - Trinity
  - Stacheldraht
  - Shaft
  - omegav3
- **Primary purpose is to inundate a web site or server with data, stopping the servers ability to respond to other request**

Distributed Denial-of-Service Tools

- **mstream**
  - TCP ACK Flood
- **Trin00**
  - No source IP spoofing
  - UDP Flood Attack
- **TFN/TFN2K– Tribe Flood Network**
  - Source IP randomization
  - UDP Flood Attack
  - TCP SYN Flood
  - ICMP Echo Request Flood
  - ICMP Directed Broadcast (smurf)

Distributed Denial-of-Service Tools

- **Stacheldraht**
  - Encrypted communications
  - Source IP randomization
  - UDP Flood Attack
  - TCP SYN Flood
  - ICMP Echo Request Flood
  - ICMP Directed Broadcast (smurf)
  - TCP ACK flood
  - TCP NULL (no flag) flood

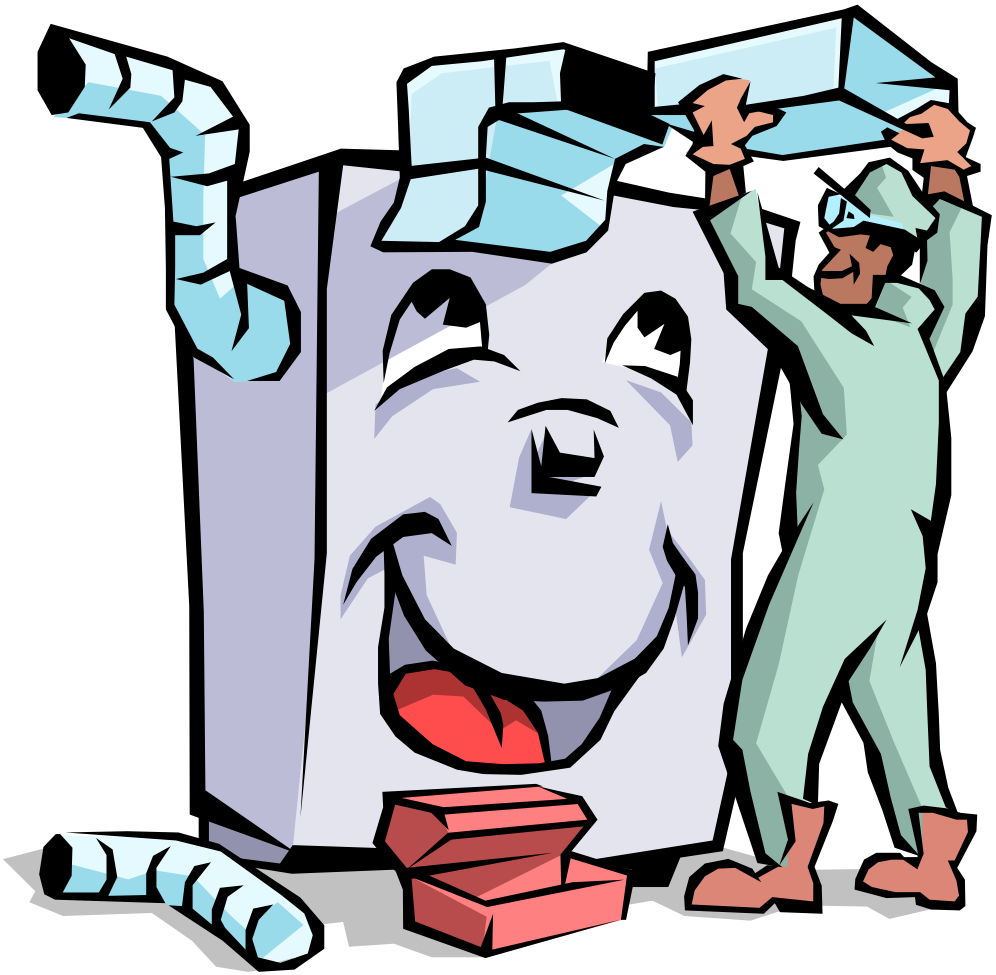
Distributed Denial-of-Service Tools

- **Shaft**
  - UDP flood
  - TCP SYN flood
  - ICMP Echo Flood
  - Can randomize all Three floods
- **Omegtav3**
  - TCP ACK flood
  - ICMP flood
  - IGMP flood
  - UDP flood

Distributed Denial-of-Service Tools

- **Trinity**
  - Can be controlled through IRC (Trinity connects to IRC and chooses a nickname)
  - UDP flood
  - Fragmented flood
  - TCP SYN flood
  - TCP RST flood
  - TCP Random Flag flood
  - TCP ACK flood
  - Establish flood

VI: Is There a Solution?



Indicators And Safeguards

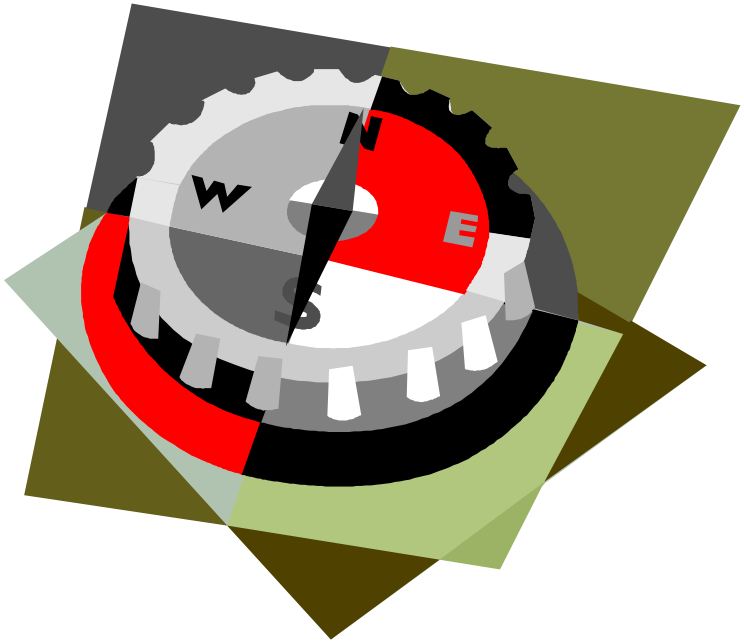
- **Indications your system may have been compromised for the purpose of being used as a Distributed Denial-of-Service agent or handler**
  - Unknown open ports (the tools can change port numbers at compile time)
  - Startup scripts may have changed
  - Run “strings” on unknown binaries (see CERT advisories)
  - May have rootkit or back orifice install

Offensive Problems

- **Source IP spoofing makes it very difficult to identify the attack system**
- **Broadcast amplification can increase attack intensity by magnitude greater**
- **Lack of appropriate response to attacks – many organizations will not respond to complaints of misuse**
- **Hundreds (possibly thousands) of attack systems intensify the issue – many with little or no security that where enlisted as zombies by the attacker**
- **Distributed Denial-of-Service attacks appear as normal network connection/control traffic – no way to identify it as an attack until its to late)**

IP Spoofing

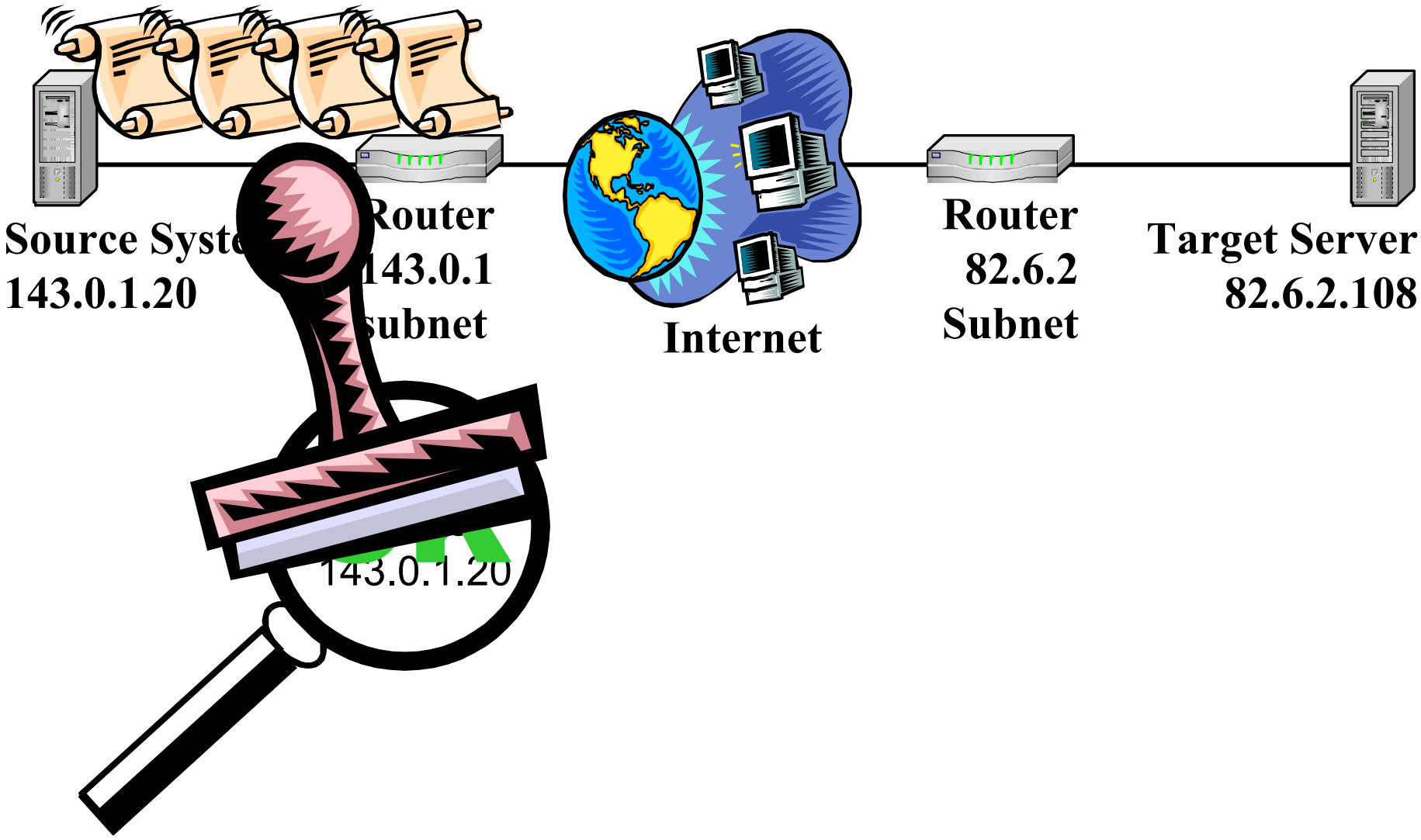
- **Egress filtering**
  - Insure that packets leaving a site contain a source IP address consistent with that site
  - Insure that no packets with unroutable packets are sent from the site
  - Limits IP spoofing to addresses within the site
  - Attack could be traced back to site (helps identify attack traffic source)
- **Ingress filtering**
  - ISPs only accept traffic from authorized sources



IP Spoofing

- **Dialup users**
  - Ensure that proper filters are in place to prevent dial-up connections from using spoofed addresses
  - Network equipment vendors should ensure that no-IP-spoofing is a user setting, and the default setting, on their dial-up equipment
- **itrace (an ICMP Traceback message) has bee proposed by the engineering task force to help solve problem of spoofed IP addresses**
  - Routers would generate a Traceback message that is sent along to the destination
  - With enough Traceback messages from enough routers along the path, the traffic source and path can be determined

Egress / Ingress Filtering



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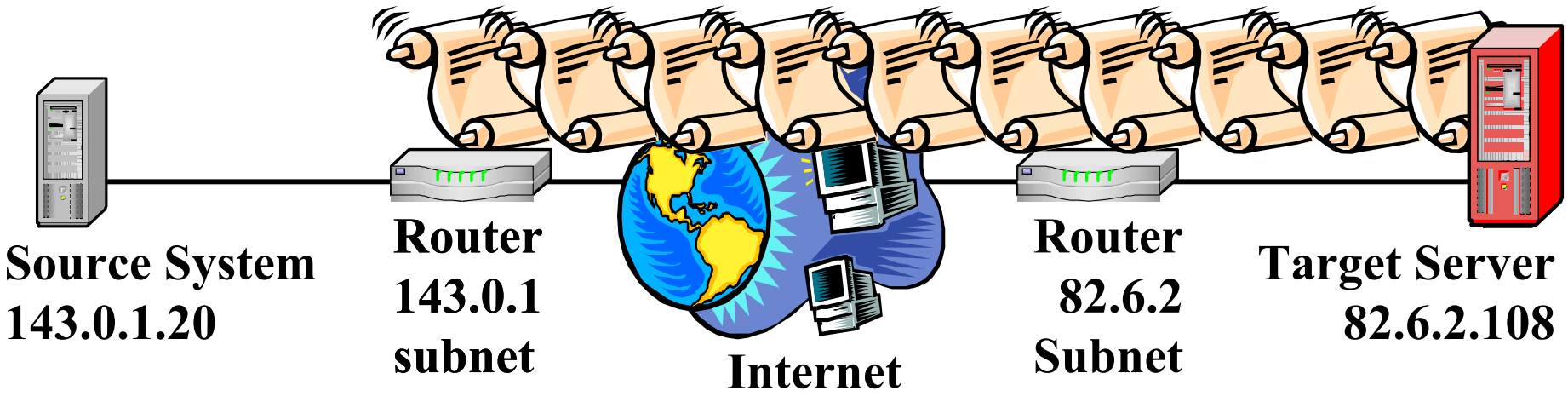

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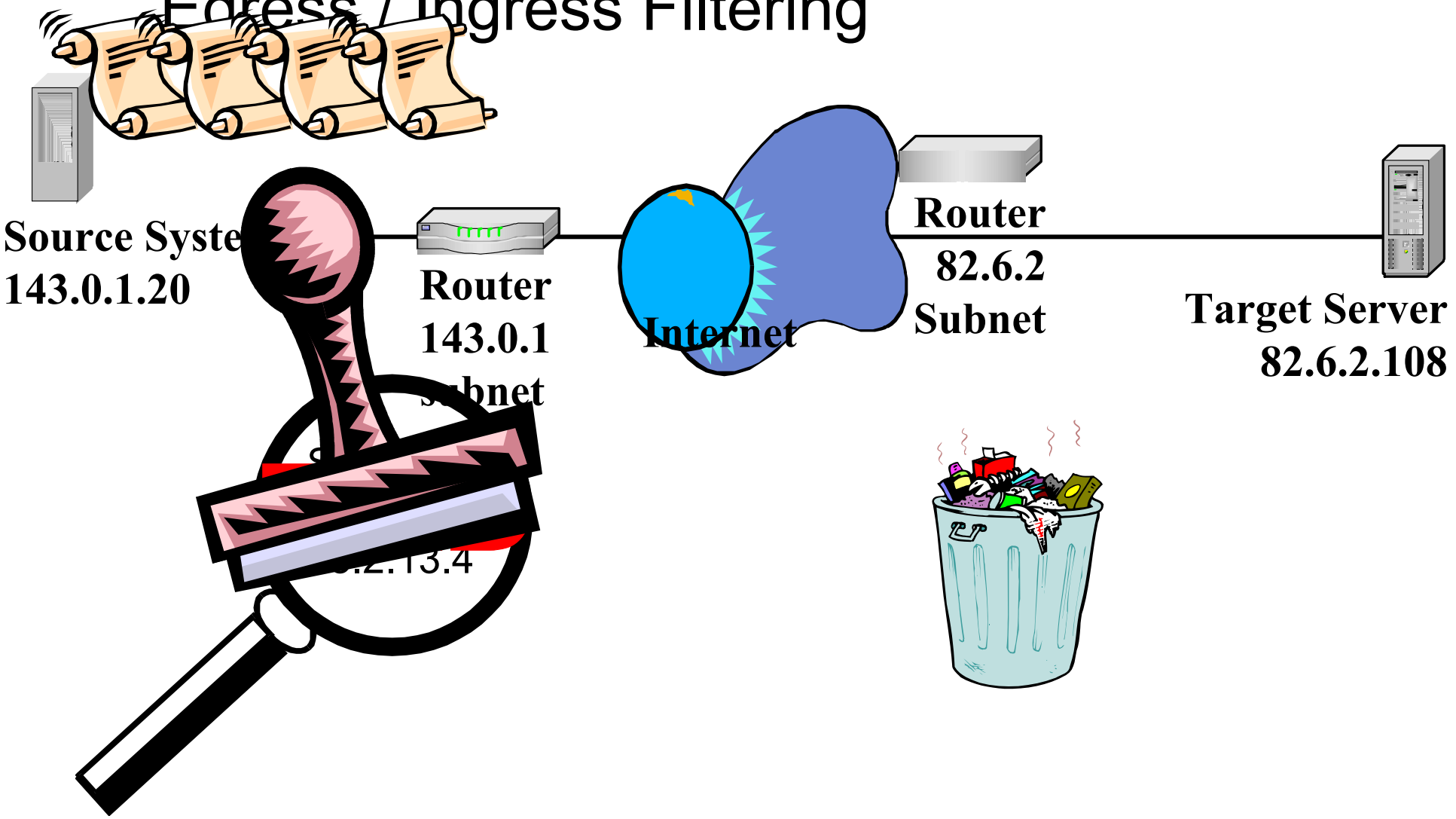

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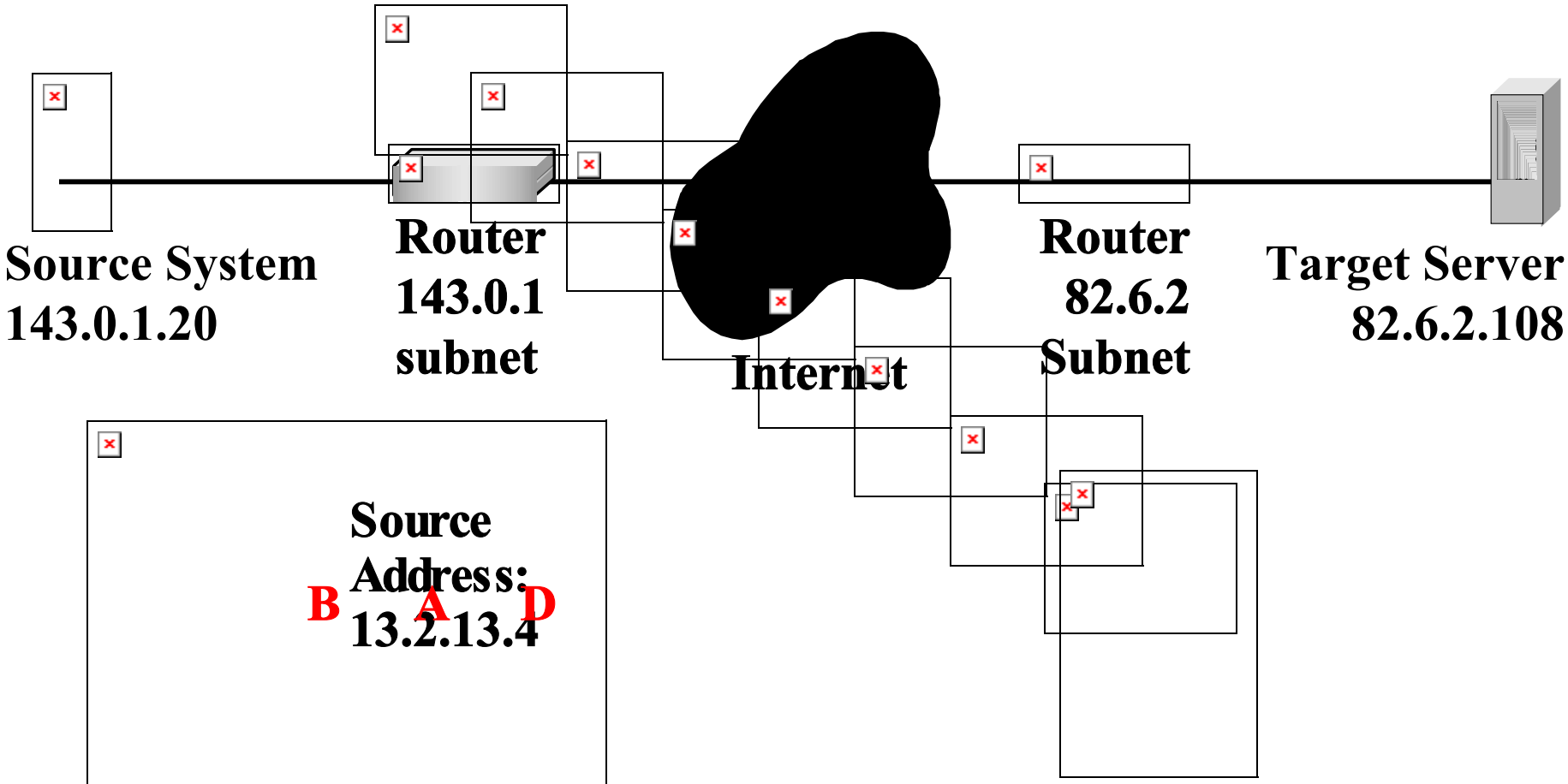

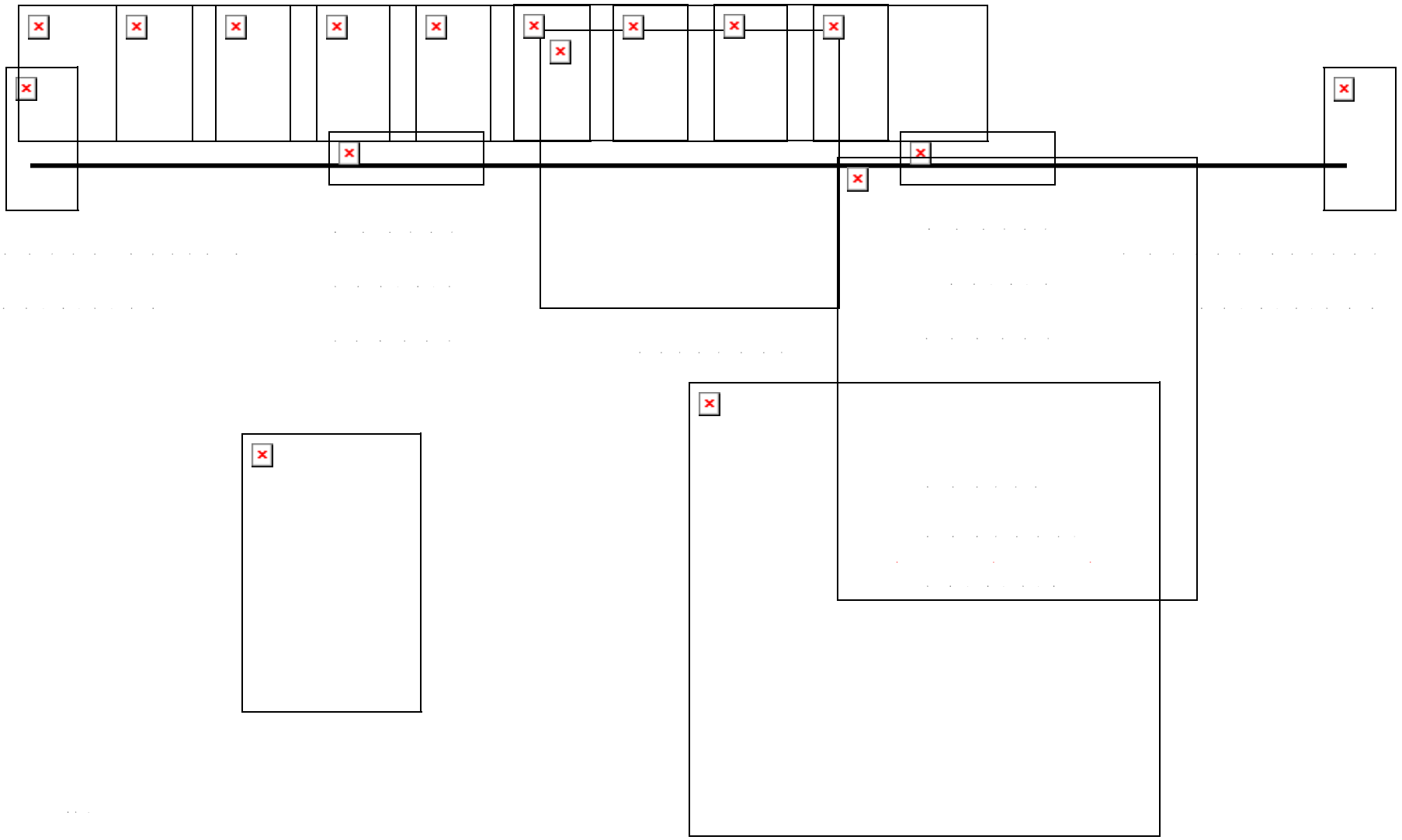

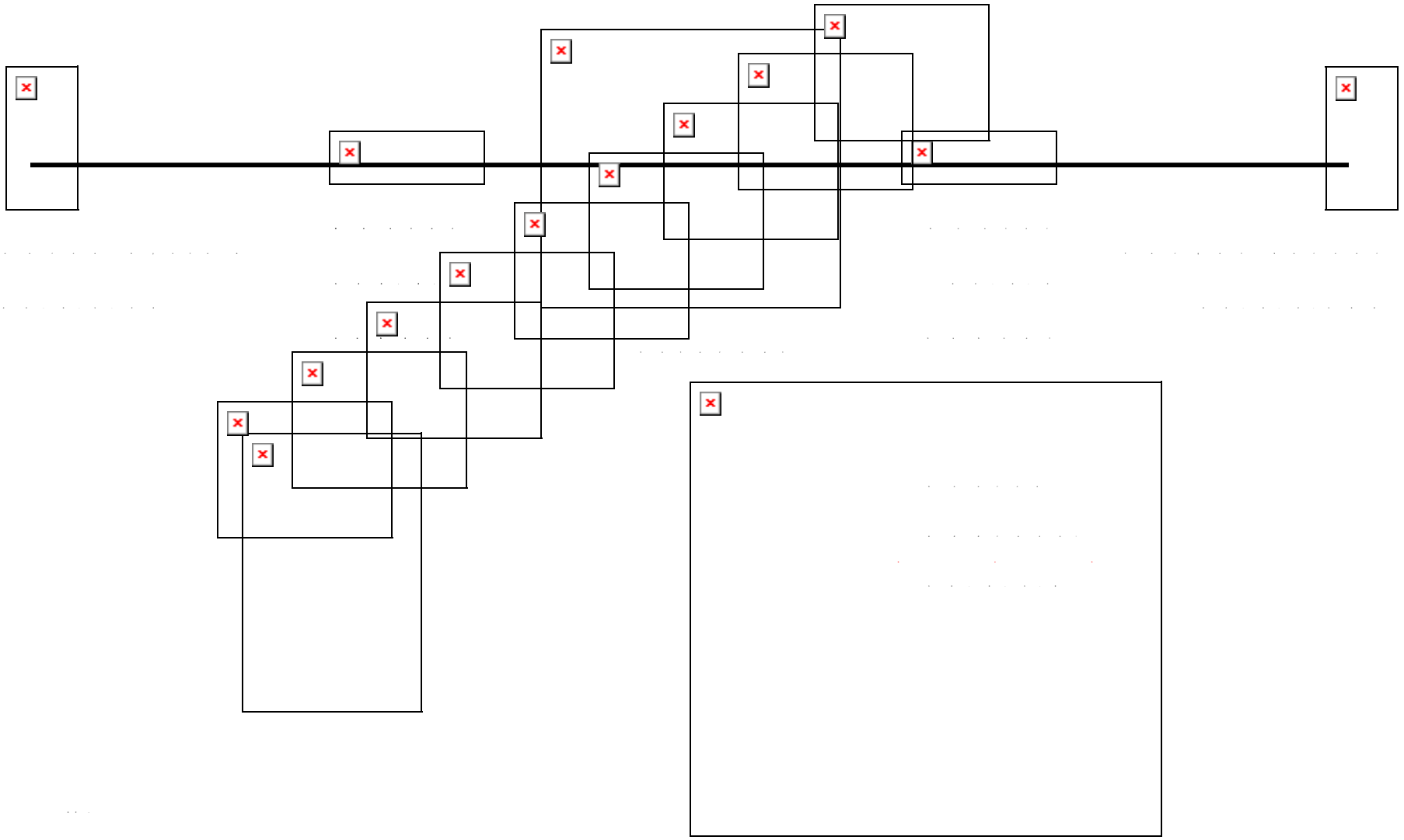

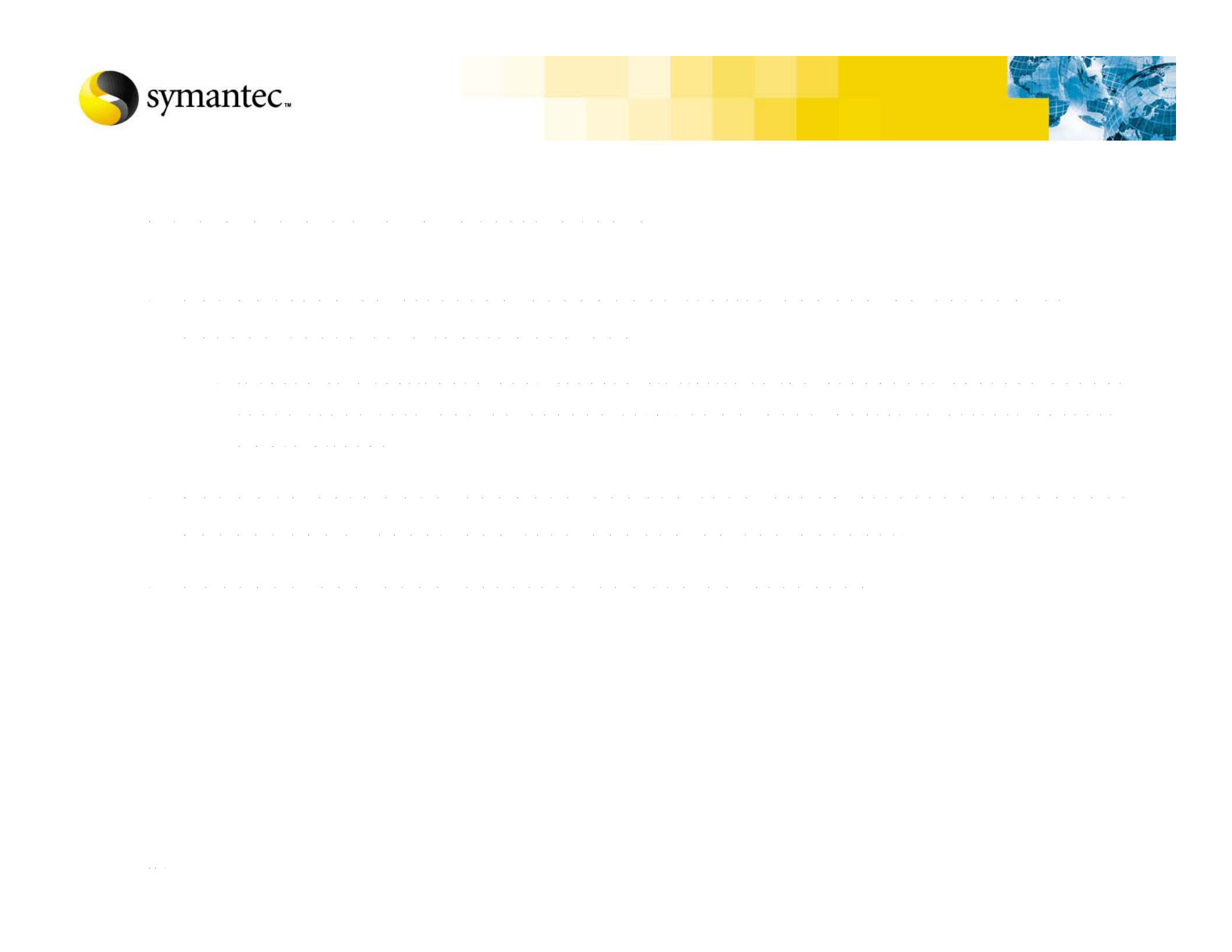

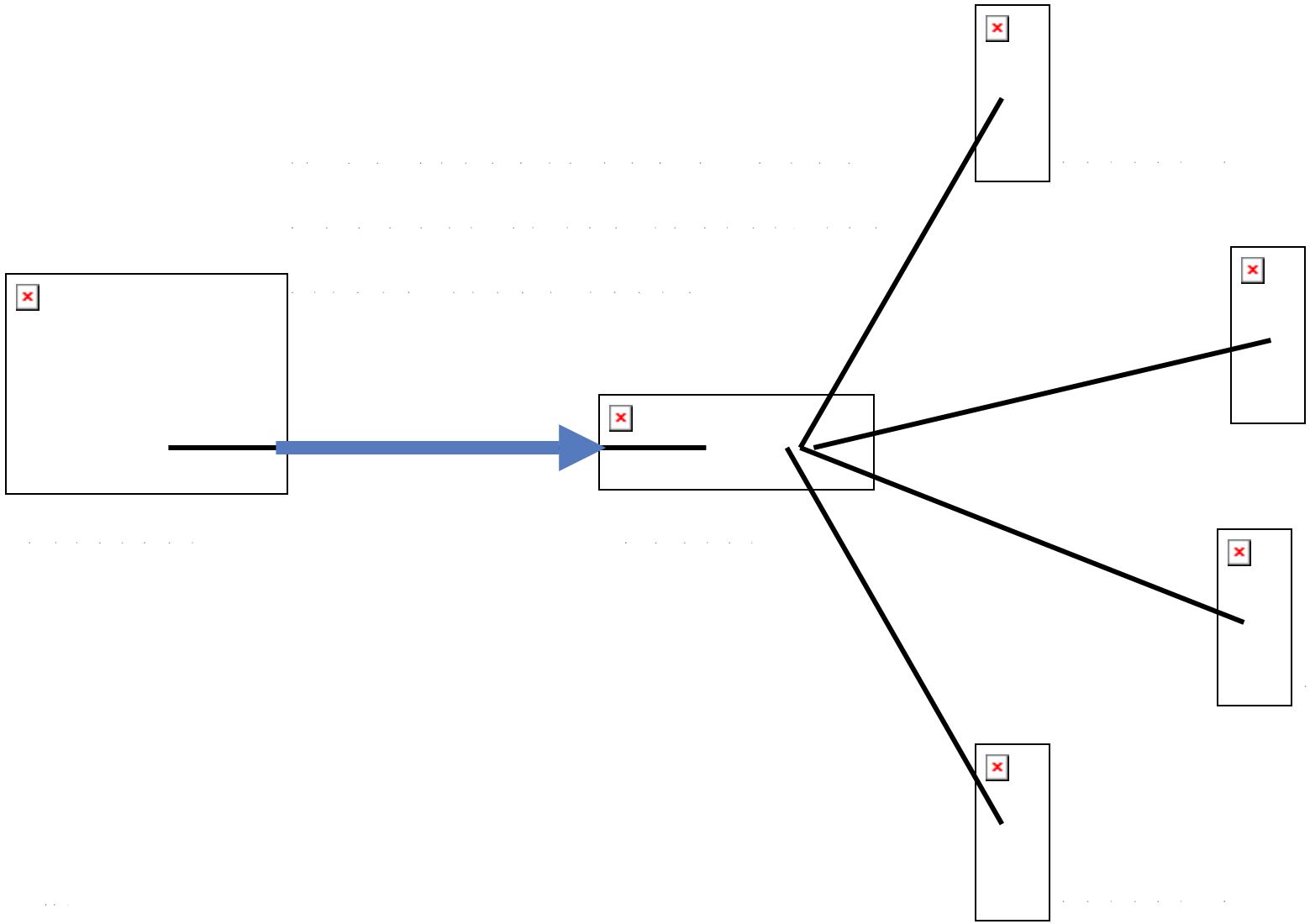

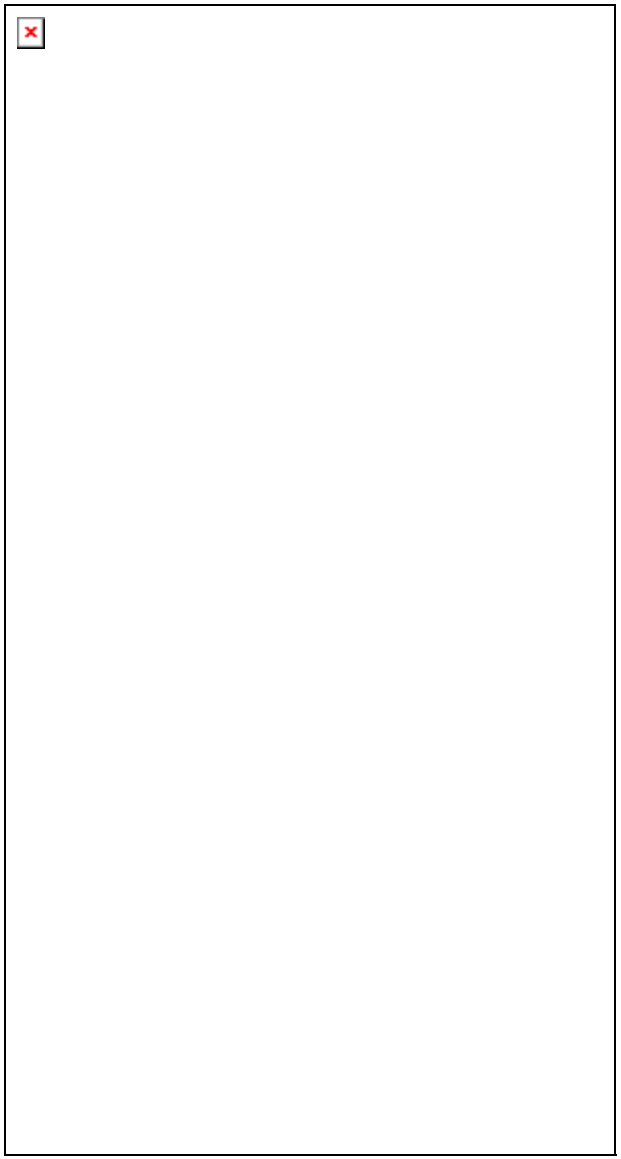

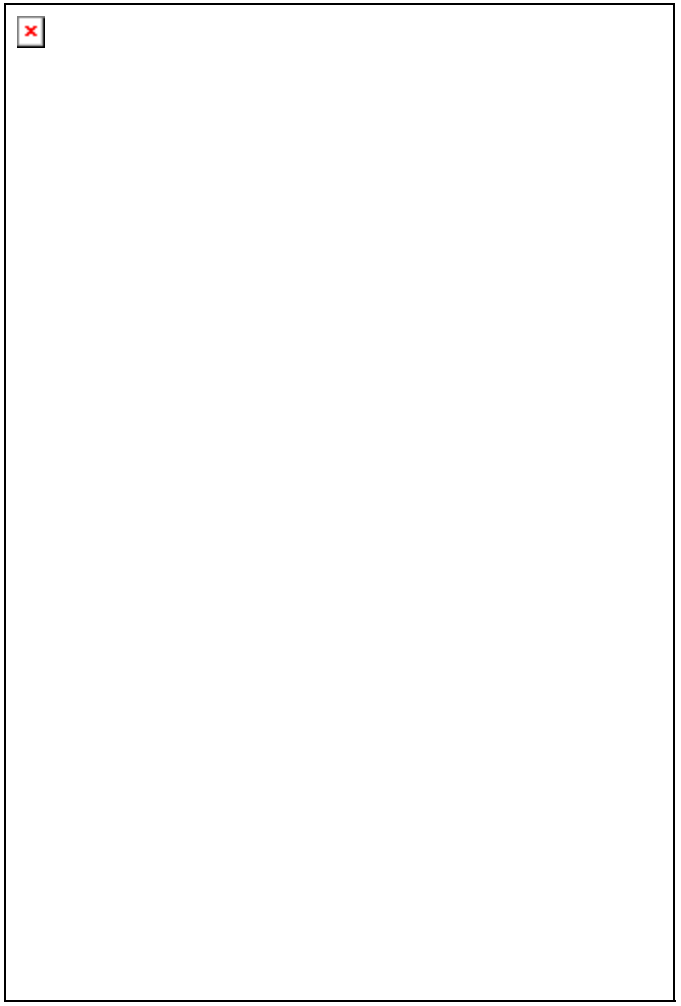


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