Security Part One: Attacks and Countermeasures

15-441

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Flashback .. Internet design goals

1. Interconnection
2. Failure resilience
3. Multiple types of service
4. Variety of networks
5. Management of resources
6. Cost-effective
7. Low entry-cost
8. Accountability for resources

Where is security?

Why did they leave it out?

- Designed for connectivity
- Network designed with implicit trust
  - No "bad" guys
- Can't security be provided at the edge?
  - Encryption, Authentication etc
  - End-to-end arguments in system design

Security Vulnerabilities

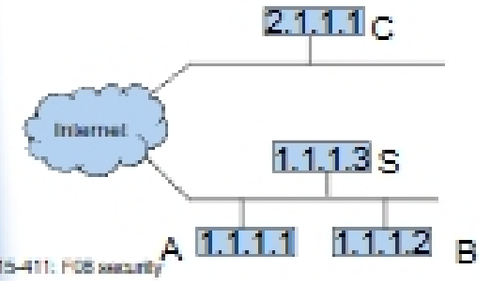
- At every layer in the protocol stack!
- Network-layer attacks
  - IP-level vulnerabilities
  - Routing attacks
- Transport-layer attacks
  - TCP vulnerabilities
- Application-layer attacks

IP-level vulnerabilities

- IP addresses are provided by the source
  - Spoofing attacks
- Using IP address for authentication
  - e.g., login with .rhosts
- Some "features" that have been exploited
  - Fragmentation
  - Broadcast for traffic amplification

Security Flaws in IP

- The IP addresses are filled in by the originating host
  - Address spoofing
- Using source address for authentication
  - r-utilities (rlogin, rsh, rhosts etc..)



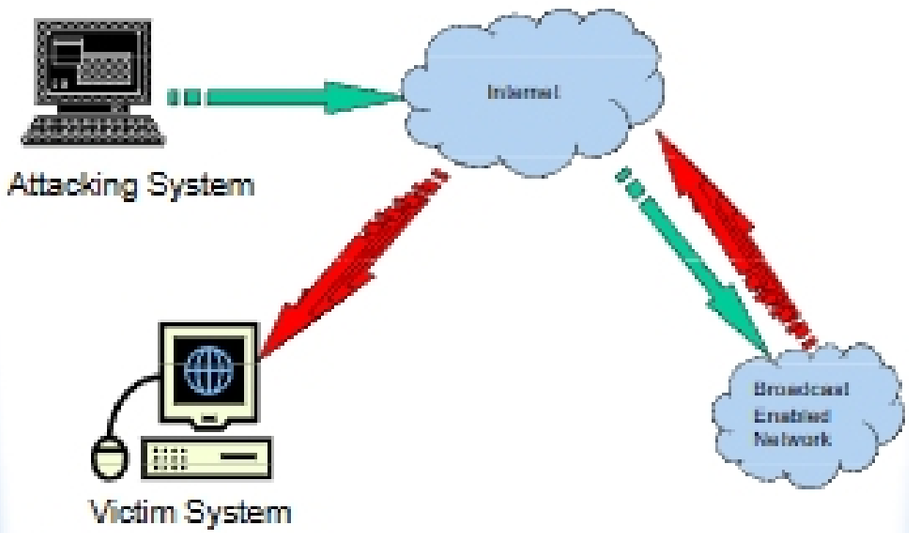
•Can A claim it is B to the server S?

•ARP Spoofing

•Can C claim it is B to the server S?

•Source Routing

Smurf Attack



ICMP Attacks

- No authentication
- ICMP redirect message
  - Can cause the host to switch gateways
  - Benefit of doing this?
    - Man in the middle attack, sniffing
- ICMP destination unreachable
  - Can cause the host to drop connection
- ICMP echo request/reply
- Many more…
  - http://www.sans.org/rr/whitepapers/threats/477.php

Routing attacks

- Divert traffic to malicious nodes
  - Black-hole
  - Eavesdropping
- How to implement routing attacks?
  - Distance-Vector:
  - Link-state:
- BGP vulnerabilities

Routing attacks

- Divert traffic to malicious nodes
  - Black-hole
  - Eavesdropping
- How to implement routing attacks?
  - Distance-Vector: Announce low-cost routes
  - Link-state: Dropping links from topology
- BGP vulnerabilities
  - Prefix-hijacking
  - Path alteration

TCP-level attacks

- SYN-Floods
  - Implementations create state at servers before connection is fully established
- Session hijack
  - Pretend to be a trusted host
  - Sequence number guessing
- Session resets
  - Close a legitimate connection

Session Hijack