Network Security Workshop

Threat Pragmatics

bdNOG 1
Bangladesh Network Operators Group

CONFERENCE
& APNIC REGIONAL MEETING

Track 2: Network Security

Workshop Venue
United International University

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Targets

- Many sorts of targets:
    - Network infrastructure
    - Network services
    - Application services
    - User machines

Network Infrastructure

- Links
- Routers (and routing protocols)
- Switches and other network elements
- Critical Services (DNS, Email, HTTP)

Links

- Primary risk is wiretapping
- Easily defeated by encryption—but are people using it?
- Most encryption doesn’t protect against traffic analysis—but that isn’t in everyone’s threat model
- Link-layer encryption protects against most traffic analysis, but it has to be done on every vulnerable link

Traffic Analysis

- Looks at external characteristics of traffic: who talks to whom, size of messages, etc.
- Very valuable to intelligence agencies, police, etc.
  - Who works with whom? Who gives orders to whom?
- Not generally useful for ordinary thieves, though a few sophisticated attackers could use it to find targets

Solutions

- Use VPNs or application-level encryption
- Use link encryption for high-risk links (e.g., WiFi)
- Also use link encryption for access control (especially WiFi)

Switches and the Like

- Compromised switches can be used for eavesdropping
- Special risk in some situations: reconfigured VLANs
- VLANs provide good traffic separation between user groups
- Especially useful against ARP- and MAC-spoofing attackers
- Other danger point: the monitoring port

ARP and MAC Spoofing

- ARP maps the IP address desired to a MAC address
- Switches learn what MAC addresses are on what ports, and route traffic accordingly
- If a malicious host sends out traffic with the wrong MAC address, the switch will send traffic to it
- If a malicious host replies to an ARP query for some other machine, the malicious host will receive the traffic, but this might be noticed

Defenses

- Harden switch access
  - ACLs
  - ssh-only access; no passwords
- Hosts should use crypto and cryptographic authentication

Routers

- Routers can be used for the same sorts of attacks as switches
- Because routers inherently separate different networks, they always defend against certain kinds of address spoofing
- This makes them targets
- Worse yet, routers can launch routing protocol attacks

Routing Protocol Attacks: Effects

- Traffic is diverted
  - Attacker can see the traffic and do traffic analysis
  - Attacker can modify packets
  - Attacker can drop packets
  - Attacker can hijack prefixes
- End-to-end crypto can protect the packets' contents, but can't stop traffic analysis or denial of service

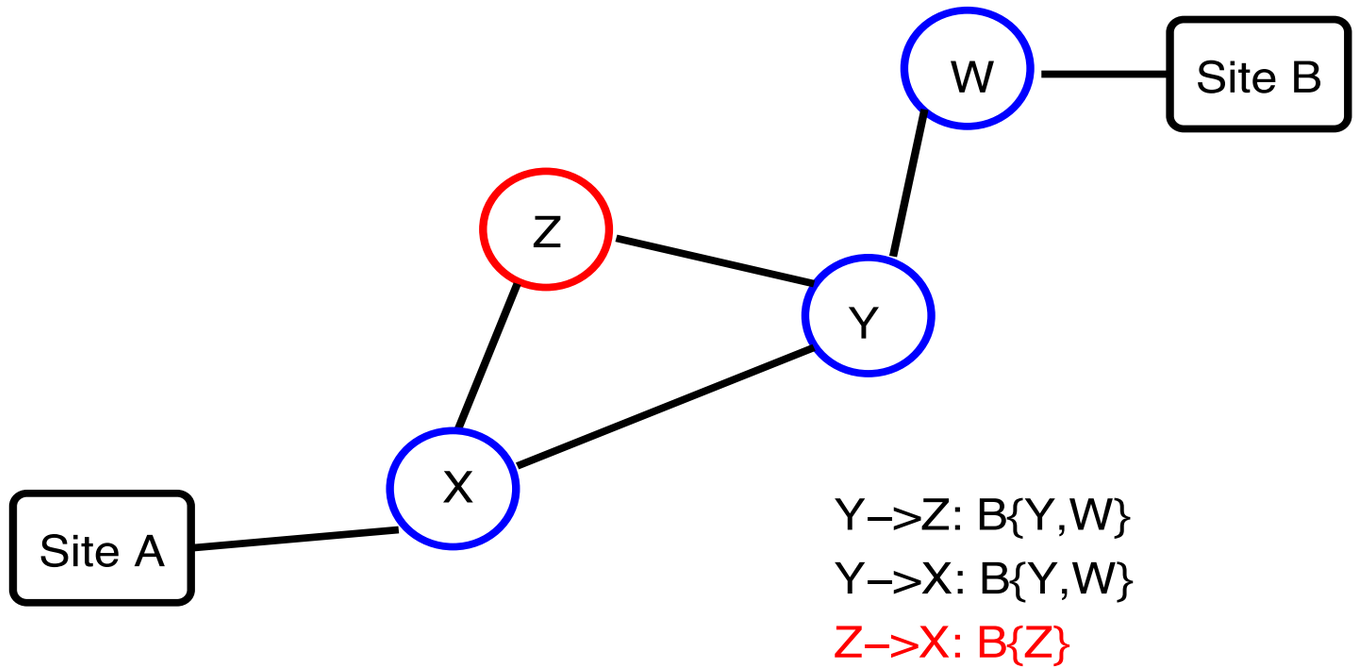
Why is Routing Security Different?

- Most security failures are due to buggy code, buggy protocols, or buggy sysadmins

- Routing security problems happen when everything is working right, but some party decides to lie. The problem is a dishonest participant

- Most routers can lie to any routing protocols they speak

A Routing Attack



Defending Against Routing Attacks

- Must know authoritative owner of prefixes
    - Generally done with a certificate signed by the address space owner
    - Being rolled out today as RPKI
- All routing announcements must be digitally signed
    - Each router needs a route-signing certificate
    - All signatures must be over the full path; signatures are thus nested
    - In the IETF process as BGPSEC

Network Services

- Certain core services are ubiquitous—and frequently attacked
    - DNS
    - SMTP
    - Assorted local services: file servers, printers, LDAP, and more
- These are the means, not the goals of the attackers

DNS

- DNS responses are easily spoofed by attackers
    - Cache contamination
    - Query ID guessing
    - Deliberate tinkering by ISPs, nation-states, hotels, etc.
- Because responses are cached, client/server authentication can’t solve it.
- Must have digitally signed responses

SMTP

- Historically, a major attack target; principle implementations were very buggy
- Today, the big problem is spam; must keep attackers from spamming your users, and from using you to spread spam
- Secondary issue: separate inside and outside email systems—inside email often has sensitive information

Encrypted Mail

- Email messages themselves can be encrypted: useful for end-to-end security

- SMTP can be encrypted, too
  - Not that crucial for site-to-site relaying (but eavesdroppers do exist); very important for authenticated email submission

  - Your users must authenticate somehow—via IP address if inside; via credentials if roaming—before sending mail through your outbound SMTP server

User Machines

- Ordinary desktops are targets, too
    - Plant keystroke loggers to steal passwords, especially for financial sites
    - Turn into bots—bandwidth is what matters
    - Turn into spam engines; use machine's privileges (generally based on network location) to send out spam through the authorized SMTP server

Users

- Users make mistakes
    - They click on things they shouldn’t
    - They visit dangerous sites
    - They mistake phishing emails for the real thing
    - They don’t keep their systems up to date
    - “PEBCAK”: Problem Exists Between Chair and Keyboard
- (It’s not even their fault; our systems are horribly designed)

Social Engineering

- Try to trick people into doing things they shouldn't
- People want to help
  - Walk in the door dressed as a delivery or repair person
  - Call and sound like an insider: "Chris, could you reset my password on server #3 in rack 7? Its connection to the RADIUS server is hung."
- A very different skill than purely technical stuff—but very useful