OS Fingerprinting

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We pledge our honor that we have abided by the Stevens Honor System.

What is it?

- The process of learning what operating system is running on a particular device
  - Analyze certain protocol flags, options, and data in the packets a device sends onto the network
- OS has a fingerprint
  - Unique characteristics in its communication implementation that can identify it on a network
  - Signatures:
    - Time to Live (TTL)
    - Window Size
    - Don’t Fragment bit (DF)
    - Type of Service (TOS)

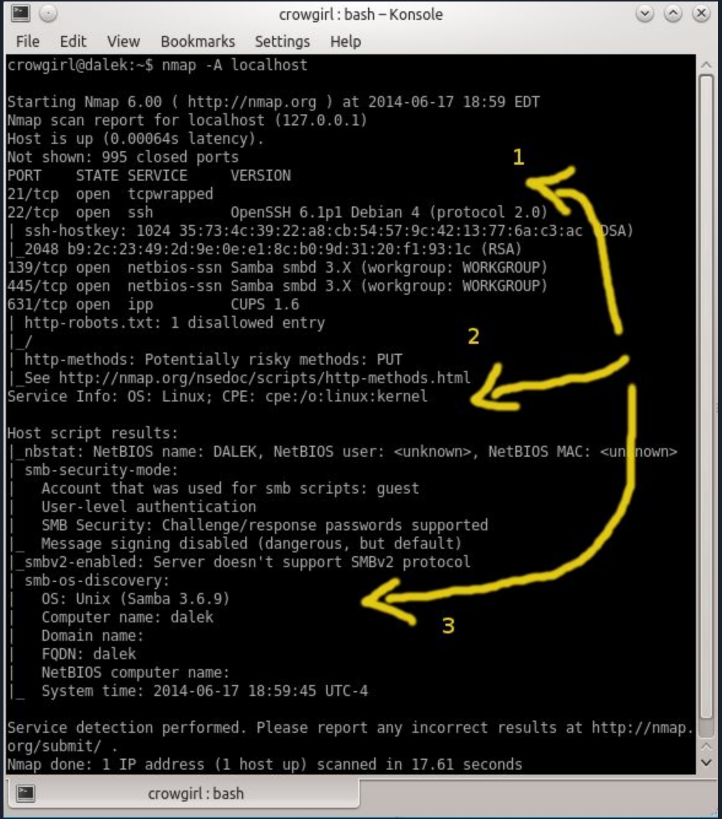
What is it used for?

- Hacking
  - Good reconnaissance
  - Importance of a device
- Network Maintenance
  - Notification of new device
  - Keep network inventory clean and up to date

Active Fingerprinting

- More likely to return information that will benefit an attacker
  - More accurate results a shorter amount of time
- Risk of being caught by an IDS, IPS, or a firewall
- Sending packets to target host
  - Analyzing the packets that are sent back
- Nmap
  - Monitor the security of networks
  - Firewalls are properly configured

Example



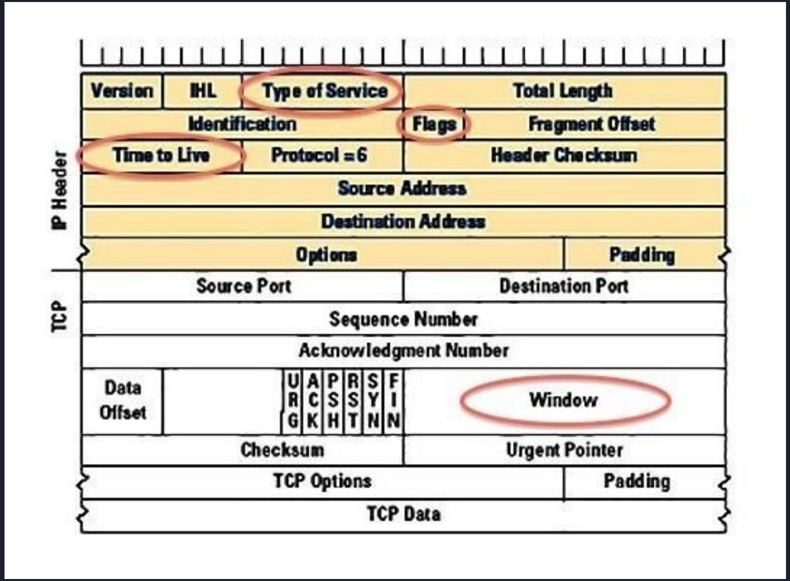
```
crowgirl@dalek:~$ nmap -A localhost

Starting Nmap 6.00 ( http://nmap.org ) at 2014-06-17 18:59 EDT
Nmap scan report for localhost (127.0.0.1)
Host is up (0.00064s latency).
Not shown: 995 closed ports
PORT    STATE SERVICE     VERSION
21/tcp  open  tcpwrapped
22/tcp  open  ssh         OpenSSH 6.1p1 Debian 4 (protocol 2.0)
| ssh-hostkey: 1024 35:73:4c:39:22:a8:cb:54:57:9c:42:13:77:6a:c3:ac (DSA)
|_2048 b9:2c:23:49:2d:9e:0e:e1:8c:b0:9d:31:20:f1:93:1c (RSA)
139/tcp open  netbios-ssn Samba smbd 3.X (workgroup: WORKGROUP)
445/tcp open  netbios-ssn Samba smbd 3.X (workgroup: WORKGROUP)
631/tcp open  ipp         CUPS 1.6
| http-robots.txt: 1 disallowed entry
|_/
| http-methods: Potentially risky methods: PUT
|_See http://nmap.org/nsedoc/scripts/http-methods.html
Service Info: OS: Linux; CPE: cpe:/o:linux:kernel

Host script results:
|_nbstat: NetBIOS name: DALEK, NetBIOS user: <unknown>, NetBIOS MAC: <unknown>
| smb-security-mode:
|   Account that was used for smb scripts: guest
|   User-level authentication
|   SMB Security: Challenge/response passwords supported
|_  Message signing disabled (dangerous, but default)
|_smbv2-enabled: Server doesn't support SMBv2 protocol
| smb-os-discovery:
|   OS: Unix (Samba 3.6.9)
|   Computer name: dalek
|   Domain name:
|   FQDN: dalek
|   NetBIOS computer name:
|_  System time: 2014-06-17 18:59:45 UTC-4

Service detection performed. Please report any incorrect results at http://nmap.
org/submit/ .
Nmap done: 1 IP address (1 host up) scanned in 17.61 seconds
```

- Debian version of OpenSSH is running from port 22
  - Ubuntu, Xubuntu, original Debian
- OS kernel - Linux
- Samba server 3.6.9 - Unix version
- Overall: Debian-based Linux distro
  - May not know specific Linux kernel version
  - Vulnerabilities that apply to all current Debian-based OSes

Passive Fingerprinting

- Less likely to return information that will benefit an attacker
  - Less accurate and less control over the data analyzed
- Almost undetectable
- Sniffs for TCP/IP ports
  - Analyzing the network traffic
- Packet capture API
  - Time to Live
  - TCP window size
- NetworkMiner and Satori
- No question to legality nature

Example



- Type of Service
  - Minimize Delay, Maximize Throughput, Maximize Reliability, Minimize Monetary Cost
- Flags
  - SYN, RST, ACK, etc
  - Whether the packet has been fragmented
- Time to Live (TTL)
  - Maximum number of hops that packet can traverse before it times out
    - Windows - 32
    - Linux - 64
- Windows Field
  - Size of the buffer of sending system
    - 70-80% chance of determining OS

Scanners

- Nmap - Active scanner, most popular network scanner in use today
  - Rapidly scans large segments of a network for active devices
  - OS detection can only be performed after a port scan has been completed
- Xprobe2 - ICMP scanner, one of the quietest active scanners
  - Matrix based fingerprint matching
  - Fast results, little packet traffic
  - Very difficult to detect
- P0f - Passive OS detection, useful when stealth needed
  - Reads and analyzes packets without generating its own traffic
  - Four modes: SYN, SYN-ACK, RST, and stray ACK

How to prevent successful fingerprinting?

- This is only necessary when malicious reconnaissance is a concern
- Need to protect the edge of the network, or detect if someone is already on your network
- Preventing OS fingerprinting may not be 100% possible
- Make sure external hosts cannot scan internal hosts
- Change TCP/IP settings
  - This changes how network traffic appears and has an impact on networks performance
- Best advice: Perform scans against your own network, and document your findings
  - This will allow you to see what changes need to be made to your system.

Works Cited

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