Mobile Devices Vulnerabilities and Attacks (1)

Lecture 7

Security of Mobile Devices

2022

General concepts

Application security

Remote attack surfaces

Local attack surfaces

Physical attack surfaces

Bibliography

Outline

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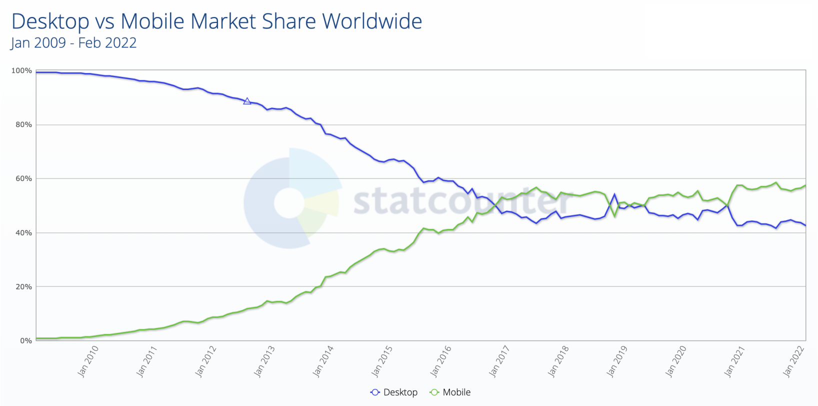
Bibliography

- Vulnerabilities
- What can you gain?
- Causes



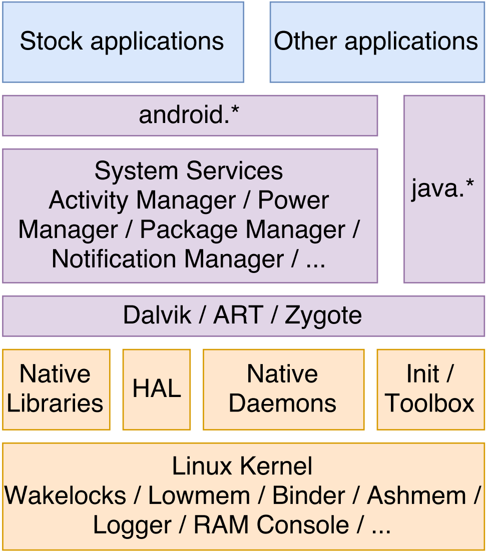
Source: statcounter.com

Attack surface

- Attack vector
- Attack surface
- Castle analogy

Attack surface

Android system attack surface



Stock applications

Other applications

android.*

java.*

System Services
Activity Manager / Power Manager / Package Manager / Notification Manager / ...

Dalvik / ART / Zygote

Native Libraries

HAL

Native Daemons

Init / Toolbox

Linux Kernel
Wakelocks / Lowmem / Binder / Ashmem / Logger / RAM Console / ...

Attack surface classification

- Remote
- Local
- Physical

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Android application attack surface

- Activities
- Services (exposed and bound services)
- Broadcast receivers
- Content providers

Application security

- application permission issues
  - Android documentation related to permissions does not correspond with what the Android middleware actually requires
  - undergranting or overgranting permissions
- insecure transmission of sensitive data
- insecure data storage
  - plaintext storage
  - no encryption
  - Skype - world-readable, world-writable permissions, no encryption

Application security

- information leakage through logs
  - excessive, very verbose logging
  - Firefox - browsing activity, session identifiers
- insecure transmission of sensitive data
- Unsecured IPC endpoints
  - who can access whom?
  - activities - UI redressing attacks (clickjacking) - Cloak and Dagger
  - bounded services - expose functionality
  - content providers - expose data, susceptible to SQLite injection
  - broadcast receivers - implicit intents

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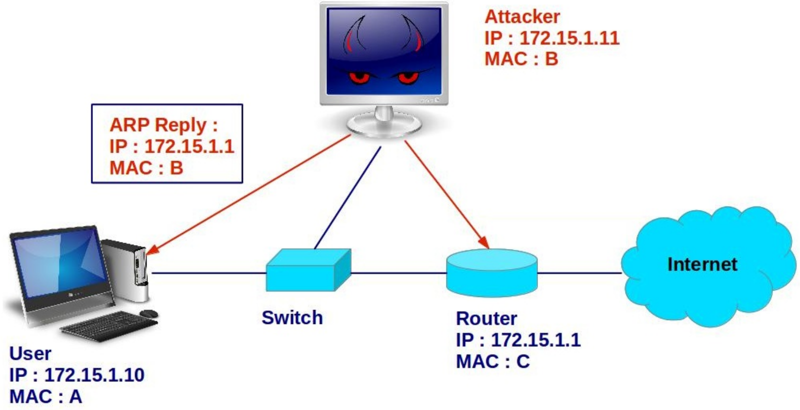
Network attacks

- No network services available
- Susceptible to common network attacks
  - Spoofing attacks (ARP, DNS, DHCP)
  - Man in the middle attacks
  - TCP attacks (SYN flooding, RST attack, sequence prediction attack)
  - DoS attacks

ARP Spoofing



- Cellular communications - an additional remote surface attack
- SMS, MMS
- WAP push (Wireless Application Protocol)

- Dialer attack
  - tel://URI received through SMS, Twitter post
  - USSD code for factory reset
  - USSD code for reseting PUK - after 10 times, SIM card is destroyed

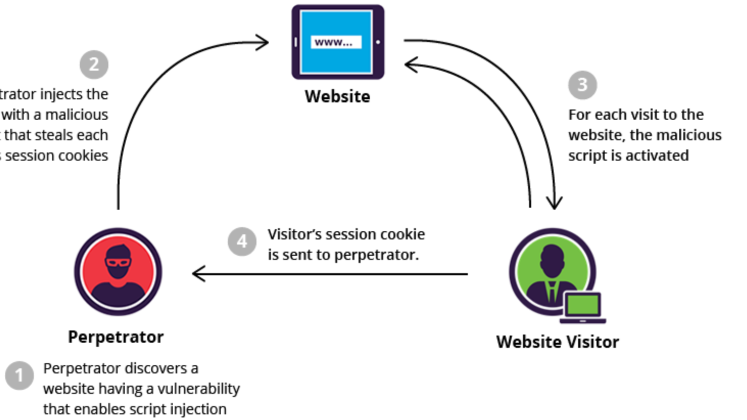
Mobile network attacks

- Stagefright attack
  - Android native multimedia library
  - exploited through MMS, Hangouts, web browsers
  - integer overflow leads to heap overflow
  - shellcode with a reverse TCP connection callback

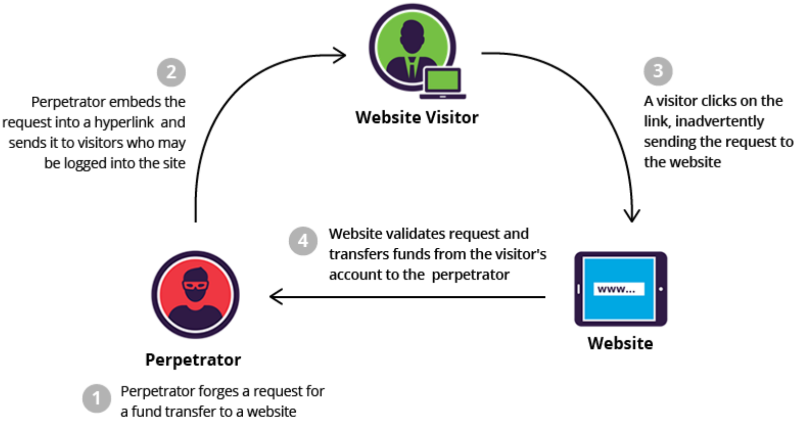
Client-side attack surface

- Client applications
- Browser attacks
  - Plethora of technologies: HTTP(S)/FTP, HTML, JavaScript
  - rogue URL
  - cross-site scripting (XSS)
  - cross-site request forgery (CSRF)

Cross-site scripting


www...
Website
2
Perpetrator injects the website with a malicious script that steals each visitor's session cookies
3
For each visit to the website, the malicious script is activated
4
Visitor's session cookie is sent to perpetrator.
Perpetrator
Website Visitor
1
Perpetrator discovers a website having a vulnerability that enables script injection

Cross-site request forgery



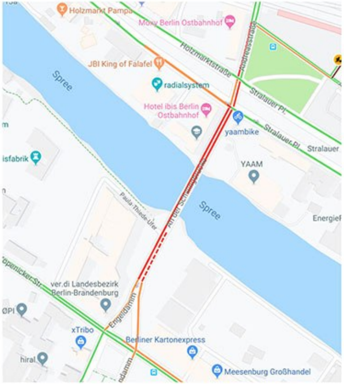
Website Visitor
2
Perpetrator embeds the request into a hyperlink and sends it to visitors who may be logged into the site
3
A visitor clicks on the link, inadvertently sending the request to the website
4
Website validates request and transfers funds from the visitor's account to the perpetrator
www...
Website
Perpetrator
1
Perpetrator forges a request for a fund transfer to a website

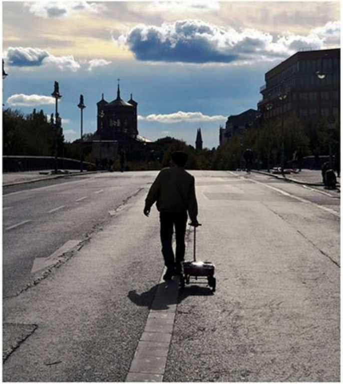
Client-side attack surface

- Web-Powered mobile applications - Twitter, Dropbox
- Authentication - SSL/TLS certificates
- Apps do not adequately validate the certificates
- 8% of the apps on Google Play Store exposed to MitM attacks

Wireless communication attacks

- GPS
  - no known attacks to compromise a device
  - GPS spoofing





Wireless communication attacks

- Baseband (GSM, HSPA, LTE)
  - emulate a base station (cell tower) - specialized equipment
  - RIL (Radio Interface Layer) - AT commands through USB or Bluetooth (attention commands that can read/write messages, downgrade OS, charge the user)

Wireless communication attacks

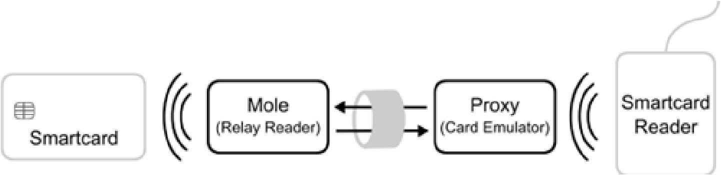
- Bluetooth
  - weaknesses related to pairing and encryption in the Android Bluetooth stack (BlueDroid)
  - Bluejacking - send unsolicited messages to the target
  - Bluesnarfing - access unrestricted data from the target
  - BlueBorne - unrestricted access to a remote device. Heap overflow generated by sending multiple Bluetooth discovery packets.
  - BlueFrag - allows remote code execution through a specially crafted Bluetooth packet. Bluetooth address can be deduced from MAC address.

- WiFi
  - WEP, WPA, WPA2, WPA3
  - rogue AP (access point)
  - Krack - Key Reinstallation Attack

Wireless communication attacks

- NFC
    - lack of encryption and authentication
    - browser attack
    - NFC relay attack

Wireless communication attacks



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Local attack surfaces

- file system - files, pipes, character and block devices
  - F2FS (Flash Friendly File System) vulnerabilities
  - memory corruption → boundary checks → integer overflows
- TCP/IP stack
  - CVE-2014-0100
  - IPv4 fragmentation
  - race condition - fragment deleted before being added to a LRU list
  - use-after-free issue
  - internal denial of service

Local attack surfaces

- binder
  - use-after-free issue caused by race conditions between binder ioctl calls
- shared memory
  - KillingInTheNameOf jailbreak
  - remaps the system properties address space to be writable
  - ro.secure = 0
  - root access through ADB

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Physical attack surfaces

- dismantling the device
- USB
  - send AT commands to the RIL - issue calls, alter the pin
  - vold vulnerability - allows to overwrite filesystems through USB

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- Android Hacker's Handbook, Joshua J. Drake, 2014
- A Survery on Smartphones Security: Software Vulnerabilities, Malware and Attacks

Keywords

- Attack vector
- Attack surface
- Application security
- Cellular communications
- WiFi
- Bluetooth
- NFC