Final Security Requirements Report

Architeture	IoT System
Application domain type	Smart Home
Authentication	Username and Password
Has DB	Yes
Type of data storage	SQL
Which DB	MySQL
Type of data stored	Personal Information ; Critical Data
User Registration	Yes
Type of Registration	Will be a administrator that will register the users
Programming Languages	C/C++
Input Forms	Yes
Upload Files	No
The system has logs	Yes
The system has regular updates	No
The system has third-party	No
System Cloud Environments	Public Cloud
Hardware Specification	Yes
HW Authentication	TPM (Trusted Platform Module)
HW Wireless Tech	Wi-Fi ; Bluetooth
Data Center Phisical Access	Yes

Confidentiality

The property that ensures that information is not disclosed or made available to any unauthorized entity. In other words, information cannot be accessed by an unauthorized third party.

Note: *This requirement is applied were the information is stored.*

Failure to guarantee this security requirement can lead to the leakage or loss of confidential data shared among authorized users of the application.

Integrity

Is the property of safeguarding the correctness and completeness of assets in a Cloud & Mobile system. In other words it involves maintaining the data consistent, trustworthy and accurate during it life-cycle.

Note: *This requirements is applied in the Cloud and Mobile Ecosystem.*

Not addressing this requirement may lead to vulnerabilities explored by attacks such as:

1. SQL Injection Attacks:

In this type of attack, the attacker inserts malicious code with the intention of accessing the unauthorized database for the purpose of obtaining confidential or critical data from the legitimate user.

2. Wrapping Attacks:

In a wrapping attack scenario, the attacker duplicates the SOAP message in the course of the translation and sends it to the server as a legitimate user. Therefore, the attacker may interfere with the malicious code.

3. MITM Attacks:

In this type of attack, an attacker attempts to intrude on a mail exchange or continuous message between two users or clients of a cloud-based mobile application (client-server).

4. Cookie Poisoning:

This type of attack consists of replacing or modifying cookie content in ways to gain unauthorized access to applications or Web pages. # Availability

Refers to the property which ensures that a mobile device or system is accessible and usable upon demand by authorized entities. In other words the mobile cloud-based application need to be always available to access by authorized people.

Note: *This requirement is applied were the information is stored.*

Not addressing this requirement may lead to vulnerabilities explored by attacks such as:

1. DoS Attacks

In this type of attacks, the attacker attempts to prevent the provision of a service or resource that are signed by authorized users by launching various types of flood.

2. DDoS Attacks

It is an improved case of DoS attacks in terms of flooding the target server with server with a huge amount of packets.

Authenticity

Is the assurance that information transaction is from the source it claims to be from. The device authenticates itself prior to receiving or transmitting any information. It assures that the information received is authentic. It is assumed that communications may be intercepted by an unauthorized entity and data at rest may be subject to unauthorized access during transport and rest, taking into account the nature of the cloud and mobile ecosystem.

Note: *This security requirement is applied across all layers of the ecosystem under consideration, i.e., communication, transport and storage of information shared or exchanged between authorized entities.*

Security Verification Requirements

- If the app provides users access to a remote service, some form of authentication, such as username/password authentication, is perfumed at the remote endpoint;
- if stateful session management is used, the remote andpoint uses rendomly generated session identifiers to authenticate client requests without sending the user's crendentials;
- If stateless token-base authentication is used, the server provides a token that has been signed using a secure algorithm;
- The remote endpoint terminates the existing session when the user logs out;
- A password policy exists and is enforcer at the remote endpoint;
- The remote endpoint implements a mechanism to protect against the submission of credentials an excessive number of times;
- Sessions are invalidated at the remote endpoint after a predefined period of inactivity and access number of times;
- Biometric authentication, if any, is not event-bound (i.e. using an API that simply returns "true" or "false"). Instead, it is based on unlocking the keychain/keystore;
- A second factor of authentication exists at the remote endpoint and the 2FA requirements is consistently enforced;
- Sensitive transactions require set-up authentication;
- The app informas the user of all login activities with their account. Users are able view a list of devices used to access the account, and to block specific devices.

Not addressing this requirement may lead to vulnerabilities explored by attacks such as:

1. Botnet Attack

A botnet is a collection of compromised devices that can be remotely controlled by an attacker, i.e. the bot master. Its main purpose is to steal business information, remote access, online fraud, phishing, malware distribution, spam emails, etc.

2. Phishing Attack

In a scenario of this type of attack, when using cloud services, an attacker can conduct phishing attacks by manipulating the web link to redirect it to a false link and hijack the user account for the purpose of stealing the your sensitive data.

3. DNS Attack

DNS attacks always occur in the case where the attacker makes use of the translation of the domain name in an Internet Protocol (IP) address, in order to access the confidential data of the user in an unauthorized way

4. MITM Attack

In this type of attack, an attacker attempts to intrude on a mail exchange or continuous message between two users or clients of a cloud-based mobile application (client-server).

5. Reused IP Address Attack:

This type of attack occurs whenever a IP address is reused on a network. This occurs because in a network the number of IP addresses is usually limited, which causes an address assigned to one user to be assigned to another, so that it leaves the network.

6. Wrapping Attacks

In a wrapping attack scenario, the attacker duplicates the SOAP message in the course of the translation and sends it to the server as a legitimate user. Therefore, the attacker may interfere with the malicious code.

7. Cookie Poisoning Attack

This type of attack consists of replacing or modifying cookie content in ways to gain unauthorized access to applications or Web pages.

8. Google Hacking Attacks

This type of attack involves the use of the Google search engine for the purpose of discovering confidential information that a hacker or wrongdoer can use for their benefit by hacking the account of a used.

9. Hypervisor Attacks:

In this type of attack the attacker aims to compromise the authenticity of sensitive user data and the availability of services from the cloud at the VM level.

References

- In general - https://github.com/OWASP/owasp-mstg/blob/master/Document/0x04e-Testing-Authentication-and-Session-Management.md;
- For Android - https://github.com/OWASP/owasp-mstg/blob/master/Document/0x05f-Testing-Local-Authentication.md;
- For iOS - https://github.com/OWASP/owasp-mstg/blob/master/Document/0x06f-Testing-Local-Authentication.md.# Authorization

The property that determines whether the user or device has rights/privileges to access a resource, or issue commands.

Note: *These requirements or assumptions apply to the secure coding of PHP, C/C++, Java, C#, PHP, HTML, JavaScript, Swift programming languages in building mobile Android application and were the information might be accessed from and between the communications in the cloud and mobile ecosystem.*

Not addressing this requirement may lead to vulnerabilities explored by attacks such as:

1. SQL Injection Attack

In this attack the perpetrator injects malicious code in the system to gain access to information or even to gain control of the entire system.

2. XSS Attack

In this attack the perpetrator injects malicious code in the system to gain access to information or even to gain control of the entire system.

3. Reused IP Address

This type of attack occurs whenever a IP address is reused on a network. This occurs because in a network the number of IP addresses is usually limited, which causes an address assigned to one user to be assigned to another, so that it leaves the network.

4. Botnet Attacks

A botnet is a collection of compromised devices that can be remotely controlled by an attacker, i.e. the bot master. Its main purpose is to steal business information, remote access, online fraud, phishing, malware distribution, spam emails, etc.

5. Sniffing Attacks

This type of attack is carried out by attackers using applications that can capture data packets in transit on a network, and if they are not heavily encrypted, can be read or interpreted.

6. Wrapping Attacks

In this attack scenario, the attacker duplicates the SOAP message in the course of the translation and sends it to the server as a legitimate user. Therefore, the attacker may interfere with the malicious code.

7. Google Hacking Attacks

This type of attack involves the use of the Google search engine for the purpose of discovering confidential information that a hacker or wrongdoer can use for their benefit by hacking the account of a used.

8. Hypervisor Attacks

Neste tipo de ataque o atacante tem como alvo comprometer a autenticidade dos dados sensíveis dos utilizadores e a disponibilidade de serviços a partir da cloud ao nível das VMs.

9. OS Command Injection

Applications are considered vulnerable to the OS command injection attack if they utilize non validated user input in a system level command what can lead to the invocation of scripts injected by the attacker.

10. Buffer Overflows

Buffer overflows is an anomaly where a program, while writing data to a buffer, overruns the buffer's boundary and overwrites adjacent memory. It can be triggered by non-validated inputs that are designed to execute code.

11. Session Hijacking

An attacker impersonates a legitimate user through stealing or predicting a valid session ID.

12. Session Fixation

An attacker has a valid session ID and forces the victim to use this ID.

References

https://github.com/OWASP/CheatSheetSeries/blob/master/cheatsheets/Transaction_Authorization_Cheat_Sheet.md

Non-Repudiation

The security property that ensures that the transfer of messages or credentials between 2 mobile users entities is undeniable .

Note: *This requirement is applied between information transactions, between information transactions over the Internet in the Cloud and in the database.*

Accountability

The property that ensures that every action can be traced back to a single user or device.

Note: *This requirement is applied over Internet transactions.*

Not addressing this requirement may lead to vulnerabilities explored by attacks such as:

1. DNS Attacks

DNS attacks always occur in the case where the attacker makes use of the translation of the domain name in an Internet Protocol (IP) address, in order to access the confidential data of the user in an unauthorized way.

2. MITM Attacks

In this type of attack, an attacker attempts to intrude on a mail exchange or continuous message between two users or clients of a cloud-based mobile application (client-server). # Reliability Refers to the property that guarantees consistent intended behavior of an a general system, in this case applied to cloud and mobile ecosystem.

Note: *This requirement is applied over Internet transactions in the cloud and mobile ecosystem.*

Privacy

In the context of cloud and mobile, privacy refers to the control of the user over the disclosure of his data. In other words only the user has control of the sharing of is personal information and his data is only made public if the user allowed it.

Note: *This requirement is applied where the information is stored.*

Physical Security

Refers to the security measures designed to deny unauthorized physical access to mobile devices and equipment, and to protect them from damage or in other words gaining physical access to the device won't give access to it's information.

Note: *This requirement is applied were the information is stored in the device.*

Not addressing this requirement may lead to vulnerabilities explored by attacks such as:

1. Physical Attack

This type of attack occurred when the perpetrator gains physical access to the location where the system is operating and tries to gain information stored in the system using his physical access.

Forgery Resistance

Is the propriety that ensures that the contents shared between entities cannot be forged by a third party trying to damage or harm the system or its users. In other words no one can try to forge content and send it in the name of another entities.

Note: *This requirement is applied in the device, in the cloud, and in the database.*

Not addressing this requirement may lead to vulnerabilities explored by attacks such as:

1. Tampering

This type of attacks occurs when an attacker preforms physical modifications on the hardware where the software is implemented.

2. Reused IP Address Attack

In this attack some nods are made more attractive than others by tampering with the routing information, when arriving to the sinkhole node the messages may be dropped or altered.

Tamper Detection

Ensures all devices are physically secured, such that any tampering attempt is detected.

Note: *This requirement is applied were the information in the device.*

Not addressing this requirement may lead to vulnerabilities explored by attacks such as:

1. Tampering

Is when an attacker performs physical modifications on the hardware where the software is implemented.

Data Freshness

Status that ensures that data is the most recent, and that old messages are not mistakenly used as fresh or purposely replayed by perpetrators. In other words this requirement provides the guarantee that the data displayed is the most recent.

Note: *This requirement is applied to the cloud, since it says that messages sent between components of the cloud and mobile ecosystem can be captured and forwarded, by hypothesis and between the communications.*

Not addressing this requirement may lead to vulnerabilities explored by attacks such as:

1. Tampering

This type of attacks occurs when a attacker preforms physical modifications on the hardware where the software is implemented.

2. Reused IP Address Attack

In this attack some nods are made more attractive than others by tampering with the routing information, when arriving to the sinkhole node the messages may be dropped or altered.

Data Origin Authentication

Ensures that the data being received by the software comes from the source it claims to be. In other words it ensures that the data being received is authentic and from a trusted party.

Note: *This requirement is applied between the communications.*

Not addressing this requirement may lead to vulnerabilities explored by attacks such as:

1. MITM attack:

This type of attacks occurs when an attacker gains access to a packet and re-sends it when it’s beneficial to him, resulting in him gaining the trust of the system.

Final Security Good Practices

Architeture	IoT System
Application domain type	Smart Home
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Has DB	Yes
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Input Forms	Yes
Upload Files	No
The system has logs	Yes
The system has regular updates	No
The system has third-party	No
System Cloud Environments	Public Cloud
Hardware Specification	Yes
HW Authentication	TPM (Trusted Platform Module)
HW Wireless Tech	Wi-Fi ; Bluetooth
Data Center Phisical Access	Yes

IoT Security

Internet of Things (IoT) devices fall into three main categories:

- Sensors, which gather data
- Actuators, which effect actions
- Gateways, which act as communication hubs and may also implement some automation logic.

All these device types may stand alone or be embedded in a larger product. They may also be complemented by a web application or mobile device app and cloud based service. IoT devices, services and software, and the communication channels that connect them, are at risk of attack by a variety of malicious parties,

Malicious intent commonly takes advantage of poor design, but even unintentional leakage of data due to ineffective security controls can also bring dire consequences to consumers and vendors. Thus it is vital that IoT devices and services have security designed in from the outset.

Classification of Data

- Define a data classification scheme and document it.
- Assess every item of data stored, processed, transmitted or received by a device and apply a data classification rating to it.
- Ensure the security design protects every data item and collections of items against unauthorised viewing, changing or deletion,to at least its classification rating or higher.

Physical Security

- Any interface used for administrationor test purposes during development should be removed from a production device, disabled or made physically inaccessible.
- All test access points on production units must be disabled or locked, for example by blowing on-chip fuses to disable JTAG.
- If a production device must have an administration port, ensure it has effective access controls, e.g. strong credential management, restricted ports, secureprotocols etc.
- Make the device circuitry physically inaccessible to tampering, e.g. epoxy chips to circuit board, resin encapsulation, hiding data and address lines under thesecomponents etc.
- Provide secure protective casing and mounting options for deployment of devices in exposed locations.
- For high-security deployments, consider design measures such as active masking or shielding to protect against side-channel attacks

Device Secure Boot

- Make sure the ROM-based secure boot function is always used. Use a multi-stage bootloader initiated by a minimal amount of read-only code
- Use a hardware-based tamper-resistant capability (e.g. a microcontroller security subsystem, Secure Access Module (SAM) or Trusted Platform Module (TPM)) to store crucial data items and run the trusted authentication/cryptographic functions required for the boot process. Its limited secure storage capacity must hold the read-only first stage of the bootloader and all other data required to verify the authenticity of firmware.
- Check each stage of boot code is valid and trusted immediately before running that code. Validating code immediately before its use can reduce the risk of attacks
- At each stage of the boot sequence, wherever possible, check that only the expected hardware is present and matches the stage's configuration parameters.
- Do not boot the next stage of device functionality until the previous stage has been successfully booted.

- Ensure failures at any stage of the boot sequence fail gracefully into a secure state, to ensure no unauthorised access is gained to underlying systems, code or data. Any code run must have been previously authenticated.

Secure Operating System

- Include in the operating system (OS) only those components (libraries, modules, packages etc.) that are required to support the functions of the device.
- Shipment should include the latest stable OS component versions available.
- Devices should be designed and shipped with the most secure configuration in place.
- Continue to update OS components to the latest stable versions throughout the lifetime of a deployed device.
- Disable all ports, protocols and services that are not used.
- Set permissions so users/applications cannot write to the root file system.
- If required, accounts for ordinary users/applications must have minimum access rights to perform the necessary functions. Separate administrator accounts (if required)will have greater rights of access. Do not run anything as root unless genuinely unavoidable.
- Ensure all files and directories are given the minimum access rights to perform the required functions.
- Consider implementing an encrypted file system.

Application Security

- Applications must be operated at the lowest privilege level possible, not as root. Applications must only have access to those resources they need.
- Applications should be isolated from each other. For example, use sandboxing techniques such as virtual machines, containerisation, Secure Computing Mode (seccomp), etc
- Ensure compliance with in-country data processing regulations.
- Ensure all errors are handled gracefully and any messages produced do not reveal any sensitive information.
- Never hard-code credentials into an application. Credentials must be stored separately in secure trusted storage and must be updateable in a way that ensures security is maintained.
- Remove all default user accounts and passwords.
- Use the most recent stable version of the operating system and libraries.
- Never deploy debug versions of code. The distribution should not include compilers, files containing developer comments, sample code, etc.
- Consider the impact on the application/system if network connectivity is lost. Aim to maintain normal functionality and security wherever possible.

Credential Management

- A device should be uniquely identifiable by means of a factory-set tamper resistant hardware identifier if possible.
- Use good password management techniques, for example no blank or simple passwords allowed, never send passwords across a network (wired or wireless) in clear text, and employ a secure password reset process.
- Each password stored for authenticating credentials must use an industry standard hash function, along with a unique salt value that is not obvious (for example, not a username).
- Store credentials or encryption keys in a Secure Access Module (SAM), Trusted Platform Module (TPM), Hardware Security Module (HSM) or trusted key store if possible.
- Aim to use 2-factor authentication for accessing sensitive data if possible.
- Ensure a trusted & reliable time source is available where authentication methods require this, e.g. for digital certificates.
- A certificate used to identify a device must be unique and only used to identify that onedevice. Do not reuse the certificate across multiple devices.
- A "factory reset" function must fully remove all user data/credentials stored on a device.

Encryption

- When configuring a secure connection, if an encryption protocol offers a negotiable selection of algorithms, remove weaker options so they cannot be selected for use in a downgrade attack.
- Store encryption keys in a Secure Access Module (SAM), Trusted Platform Module (TPM), Hardware Security Module (HSM) or trusted key store if possible.
- Do not use insecure protocols, e.g. FTP, Telnet.
- It should be possible to securely replace encryption keys remotely
- If implementing public/private key cryptography, use unique keys per device and avoid using global keys. A device's private key should be generated by that device or supplied by an associated secure credential solution, e.g. smart card. It should remain on that device and never be shared/visible to elsewhere.

Network Connections

- Activate only those network interfaces that are required (wired, wireless - including Bluetooth etc.).
- Run only those services on the network that are required.
- Open up only those network ports that are required.
- Run a correctly configured software firewall on the device if possible.
- Always use secure protocols, e.g. HTTPS, SFTP.
- Never exchange credentials in clear text or over weak solutions such as HTTP Basic Authentication.
- Authenticate every incoming connection to ensure it comes from a legitimate source.
- Authenticate the destination before sending sensitive data.

Logging

- Ensure all logged data comply with prevailing data protection regulations.
- Run the logging function in its own operating system process, separate from other functions.
- Store log files in their own partition, separate from other system files.
- Set log file maximum size and rotate logs.
- Where logging capacity is limited, just log start-up and shutdown parameters, login/access attempts and anything unexpected.
- Restrict access rights to log files to the minimum required to function.
- If logging to a central repository, send log data over a secure channel if the logs carry sensitive data and/or protection against tampering of logs must be assured.
- Implement log "levels" so that lightweight logging can be the standard approach, but with the option to run more detailed logging when required.
- Monitor and analyse logs regularly to extract valuable information and insight.
- Passwords and other secret information should not ever be displayed in logs.

(https://www.iotsecurityfoundation.org/wp-content/uploads/2019/03/Best-Practice-Guides-Release-1.2.1.pdf)[https://www.iotsecurityfoundation.org/wp-content/uploads/201

Input Validation

Input validation is performed to ensure only properly formed data is entering the workflow in an information system, preventing malformed data from persisting in the database and triggering malfunction of various downstream components.

Implementing input validation

- Data type validators available natively in web application frameworks
- Validation against JSON Schema and XML Schema (XSD) for input in these formats.
- Type conversion (e.g. Integer.parseInt() in Java, int() in Python) with strict exception handling
- Minimum and maximum value range check for numerical parameters and dates
- Minimum and maximum length check for strings.
- Array of allowed values for small sets of string parameters (e.g. days of week).
- Regular expressions for any other structured data covering the whole input string (^...$) and not using "any character" wildcard (such as . or \S)

If it's well structured data, like dates, social security numbers, zip codes, e-mail addresses, etc. then the developer should be able to define a very strong validation pattern, usually based on regular expressions, for validating such input. If the input field comes from a fixed set of options, like a drop down list or radio buttons, then the input needs to match exactly one of the values offered to the user in the first place. Free-form text, especially with Unicode characters, is perceived as difficult to validate due to a relatively large space of characters that need to be whitelisted. The primary means of input validation for free-form text input should be:

- Normalization: Ensure canonical encoding is used across all the text and no invalid characters are present.
- Character category whitelisting: Unicode allows whitelisting categories such as "decimal digits" or "letters" which not only covers the Latin alphabet but also various other scripts used globally (e.g. Arabic, Cyryllic, CJK ideographs etc).
- Individual character whitelisting: If you allow letters and ideographs in names and also want to allow apostrophe ' for Irish names, but don't want to allow the whole punctuation category.

Client Side vs Server Side Validation
Be aware that any JavaScript input validation performed on the client can be bypassed by an attacker that disables JavaScript or uses a Web Proxy. Ensure that any input validation performed on the client is also performed on the server.

Email Validation Basics
Many web applications do not treat email addresses correctly due to common misconceptions about what constitutes a valid address. Specifically, it is completely valid to have an mailbox address which:

- Is case sensitive in the local portion of the address (left of the rightmost @ character).
- Has non-alphanumeric characters in the local-part (including + and @).
- Has zero or more labels.

Following RFC 5321, best practice for validating an email address would be to:

- Check for presence of at least one @ symbol in the address.
- Ensure the local-part is no longer than 64 octets.
- Ensure the domain is no longer than 255 octets.
- Ensure the address is deliverable.

https://github.com/OWASP/CheatSheetSeries/blob/master/cheatsheets/Input_Validation_Cheat_Sheet.md

Cryptography

An architectural decision must be made to determine the appropriate method to protect data at rest. There are such wide varieties of products, methods and mechanisms for cryptographic storage.The general practices and required minimum key length depending on the scenario listed below:

Good practices:

- Cryptographic algorithms are up to date and in-line with industry standards. This includes, but is not limited to outdated block ciphers (e.g. DES), stream ciphers (e.g. RC4), as well as hash functions (e.g. MD5) and broken random number generators like Dual_EC_DRBG (even if they are NIST certified). All of these should be marked as insecure and should not be used and removed from the application and server.
- Key lengths are in-line with industry standards and provide protection for sufficient amount of time. A comparison of different key lengths and protection they provide taking into account Moore's law is available online.
- Cryptographic means are not mixed with each other: e.g. you do not sign with a public key, or try to reuse a keypair used for a signature to do encryption.
- Cryptographic parameters are well defined within reasonable range. This includes, but is not limited to: cryptographic salt, which should be at least the same length as hash function output, reasonable choice of password derivation function and iteration count (e.g. PBKDF2, scrypt or bcrypt), IVs being random and unique, fit-for-purpose block encryption modes (e.g. ECB should not be used, except specific cases), key management being done properly (e.g. 3DES should have three independent keys) and so on.

Recommended Algorithms: * Confidentiality algorithms: AES-GCM-256 or ChaCha20-Poly1305; * Integrity algorithms: SHA-256, SHA-384, SHA-512, Blake2; * Digital signature algorithms: RSA (3072 bits and higher), ECDSA with NIST P-384; * Key establishment algorithms: RSA (3072 bits and higher), DH (3072 bits or higher), ECDH with NIST P-384; * Application must be capable of using end-to-end encryption via SSL / TLS in relation to sensitive data in transit and at rest.

Additionally, you should always rely on secure hardware (if available) for storing encryption keys, performing cryptographic operations, etc.

Secure Cryptographic Storage Design:

- All protocols and algorithms for authentication and secure communication should be well vetted by the cryptographic community.
- Ensure certificates are properly validated against the hostnames users whom they are meant for.
- Avoid using wildcard certificates unless there is a business need for it
- Maintain a cryptographic standard to ensure that the developer community knows about the approved ciphersuits for network security protocols, algorithms, permitted use, cryptoperiods and Key Management.
- Only store sensitive data that you need

Use strong approved Authenticated Encryption
CCM or GCM are approved Authenticated Encryption modes based on AES algorithm.

Use strong approved cryptographic algorithms

- Do not implement an existing cryptographic algorithm on your own, no matter how easy it appears. * Instead, use widely accepted algorithms and widely accepted implementations.
- Only use approved public algorithms such as AES, RSA public key cryptography, and SHA-256 or better for hashing.
- Do not use weak algorithms, such as MD5 or SHA1.
- Avoid hashing for password storage,instead use Argon2, PBKDF2, bcrypt or scrypt.
- See NIST approved algorithms or ISO TR 14742 "Recommendations on Cryptographic Algorithms or Algorithms", key size and parameters by European Union Agency for Network and Information Security.
- If a password is being used to protect keys then the password strength should be sufficient for the strength of the keys it is protecting. * When 3DES is used, ensure K1 != K2 != K3, and the minimum key length must be 192 bits .
- Do not use ECB mode for encrypting lots of data (the other modes are better because they chain the blocks of data together to improve the data security).

Use strong random numbers

- Ensure that all random numbers, especially those used for cryptographic parameters (keys, IV's, MAC tags), random file names, random GUIDs, and random strings are generated in a cryptographically strong fashion.
- Ensure that random algorithms are seeded with sufficient entropy.
- Tools like NIST RNG Test tool can be used to comprehensively assess the quality of a Random Number Generator by reading e.g. 128MB of data from the RNG source and then assessing its randomness properties with the tool.

The following libraries are considered weak random numbers generators and should not be used:

C library: random(), rand(), use getrandom(2) instead
Java library: java.util.Random() instead use java.security.SecureRandom instead
For secure random number generation, refer to NIST SP 800-90A. CTR-DRBG, HASH-DRBG, HMAC-DRBG are recommended

https://github.com/OWASP/CheatSheetSeries/blob/master/cheatsheets/Cryptographic_Storage_Cheat_Sheet.md

Authentication and Integrity

Introduction

This cheat sheet provides a simple model to follow when implementing transport layer protection for an application. Although the concept of SSL is known to many, the actual details and security specific decisions of implementation are often poorly understood and frequently result in insecure deployments. This article

establishes clear rules which provide guidance on securely designing and configuring transport layer security for an application. This article is focused on the use of SSL/TLS between a web application and a web browser, but we also encourage the use of SSL/TLS or other network encryption technologies, such as VPN, on back end and other non-browser based connections.

Architectural Decision

An architectural decision must be made to determine the appropriate method to protect data when it is being transmitted. The most common options available to corporations are Virtual Private Networks (VPN) or a SSL/TLS model commonly used by web applications. The selected model is determined by the business needs of the particular organization. For example, a VPN connection may be the best design for a partnership between two companies that includes mutual access to a shared server over a variety of protocols. Conversely, an Internet facing enterprise web application would likely be best served by a SSL/TLS model.

TLS is mainly a defence against man-in-the-middle attacks. An TLS Threat Model is one that starts with the question "What is the business impact of an attacker's ability to observe, intercept and manipulate the traffic between the client and the server".

This cheat sheet will focus on security considerations when the SSL/TLS model is selected. This is a frequently used model for publicly accessible web applications.

Providing Transport Layer Protection with SSL/TLS

Benefits *

The primary benefit of transport layer security is the protection of web application data from unauthorized disclosure and modification when it is transmitted between clients (web browsers) and the web application server, and between the web application server and back end and other non-browser based enterprise components.

The server validation component of TLS provides authentication of the server to the client. If configured to require client side certificates, TLS can also play a role in client authentication to the server. However, in practice client side certificates are not often used in lieu of username and password based authentication models for clients.

TLS also provides two additional benefits that are commonly overlooked; integrity guarantees and replay prevention. A TLS stream of communication contains built-in controls to prevent tampering with any portion of the encrypted data. In addition, controls are also built-in to prevent a captured stream of TLS data from being replayed at a later time.

It should be noted that TLS provides the above guarantees to data during transmission. TLS does not offer any of these security benefits to data that is at rest. Therefore appropriate security controls must be added to protect data while at rest within the application or within data stores.

Good Practices *

Use TLS, as SSL is no longer considered usable for security;

- All pages must be served over HTTPS. This includes css, scripts, images, AJAX requests, POST data and third party includes. Failure to do so creates a vector for man-in-the-middle attacks;
- Just protecting authenticated pages with HTTPS, is not enough. Once there is one request in HTTP, man-in-the-middle attacks are possible, with the attackers being able to prevent users from reaching the secured pages.

The HTTP Strict Transport Security Header must be used and pre loaded into browsers. This will instruct compatible browsers to only use HTTPS, even if requested to use HTTP. Cookies must be marked as Secure.

Basic Requirements *

Access to a Public Key Infrastructure (PKI) in order to obtain certificates;

- Access to a directory or an Online Certificate Status Protocol (OCSP) responder in order to check certificate revocation status;
- Agreement/ability to support a minimum configuration of protocol versions and protocol options for each version.

[https://github.com/OWASP/CheatSheetSeries/blob/master/cheatsheets/Transport_Layer_Protection_Cheat_Sheet.md]

File Uploading

Into web applications, when we expect upload of working documents from users, we can expose the application to submission of documents that we can categorize as malicious. We use the term "malicious" here to refer to documents that embed malicious code that will be executed when another user (admin, back office operator...) will open the document with the associated application reader.
Usually, when an application expect his user to upload a document, the application expect to receive a document for which the intended use will be for reading/printing/archiving. The document should not alter is content at opening time and should be in a final rendered state.

The most common file types used to transmit malicious code into file upload feature are the following:

- Microsoft Office document: Word/Excel/Powerpoint
- Adobe PDF document: Insert malicious code as attachment.
- Images: Malicious code embedded into the file or use of binary file with image file extension.

For Word/Excel/Powerpoint/Pdf documents:

Detect when a document contains "code"/OLE package, if it's the case then block the upload process. For Images document: Sanitize incoming image using re-writing approach and then disable/remove any "code" present (this approach also handle case in which the file sent is not an image).

Upload Verification

- Use input validation to ensure the uploaded filename uses an expected extension type
- Ensure the uploaded file is not larger than a defined maximum file size

Upload Storage

- Use a new filename to store the file on the OS. Do not use any user controlled text for this filename or for the temporary filename.
- Store all user uploaded files on a separate domain. Archives should be analyzed for malicious content (anti-malware, static analysis, etc).

Public Serving of Uploaded Content

- Ensure the image is served with the correct content-type (e.g. image/jpeg, application/x-xpinstall)

Beware of "special" files

The upload feature should be using a whitelist approach to only allow specific file types and extensions. However, it is important to be aware of the following file types that, if allowed, could result in security vulnerabilities.

"crossdomain.xml" allows cross-domain data loading in Flash, Java and Silverlight. If permitted on sites with authentication this can permit cross-domain data theft and CSRF attacks. Note this can get pretty complicated depending on the specific plugin version in question, so its best to just prohibit files named "crossdomain.xml" or "clientaccesspolicy.xml".

".htaccess" and ".htpasswd" provides server configuration options on a per-directory basis, and should not be permitted.

Application Regular Updates

Mobile devices and platforms, such as, for example, smartphones, typically provide the capability for operating system (OS), firmware (FW) and applications updates or re-installations with reduced user involvement. The user involvement may often be limited to clicking an icon or accepting an agreement. While this reduced level of involvement may provide convenience and an improved user experience, it fails to address the issue of secure user authentication.

Mobile devices and platforms, such as smartphones, typically provide features for operating system (OS), firmware (FW) upgrades, and applications or reinstallations with reduced user engagement. User engagement may be limited to clicking an icon or accepting a contract. While this reduced level of engagement can provide convenience and enhance the user experience, it does not address the issue of secure user authentication. Thus, it is necessary to create a secure channel that provides confidentiality, integrity, authentication and data updating.

Requirements for a secure software update:

Data Confidentiality: the contents of transmitted data should be kept confidential. This also includes software updates. Thus, secure channels between the mobile device and the network manager must be set up. The standard approach to keep sensitive data secret is to encrypt the data with a key that is shared only between the intended receivers;

Data integrity: it must be possible to ensure that data packets have not been modified in transit. For mobile devices, control requests, and software updates it is critically important to verify that the contents in the packets have not been tampered with;

Data Authentication: To prevent an attacker from injecting packets it is important to make sure that the receiver can verify the sender of the packets. Data authentication ensures this property such that the re- ceiver can verify that the received packets really are from the claimed sender. For example, for software updates, data authentication is needed such that the device can verify that the received software comes from a trusted source. Data authentication can be achieved using a MAC or Digital Signature;

Data Freshness: to protect against replay attacks, e.g., during the key establishment phase, the proto- col must ensure that the messages are fresh. Data freshness ensures the security property that the data is recent and that an attacker is not replaying old data.

Final Attack Models Report

Architeture	IoT System
Application domain type	Smart Home
Authentication	Username and Password
Has DB	Yes
Type of data storage	SQL
Which DB	MySQL
Type of data stored	Personal Information ; Critical Data
User Registration	Yes
Type of Registration	Will be a administrator that will register the users
Programming Languages	C/C++
Input Forms	Yes
Upload Files	No
The system has logs	Yes
The system has regular updates	No
The system has third-party	No
System Cloud Environments	Public Cloud
Hardware Specification	Yes
HW Authentication	TPM (Trusted Platform Module)
HW Wireless Tech	Wi-Fi ; Bluetooth
Data Center Phisical Access	Yes

Man-in-the-Middle Attack

In this type of attack an active man listen and change communications between Mobile Device and Cloud. In other hand, in this attack an intruder enters in the ongoing conversation between sender and the receiver and makes them believe that conversation is taking place between them only.

Definition

This type of attack occurs whenever an attacker intends to intercept communications in order to interpret or alter the original data in transit between the sender and the receiver establishing a conversation.

Attacker Powers

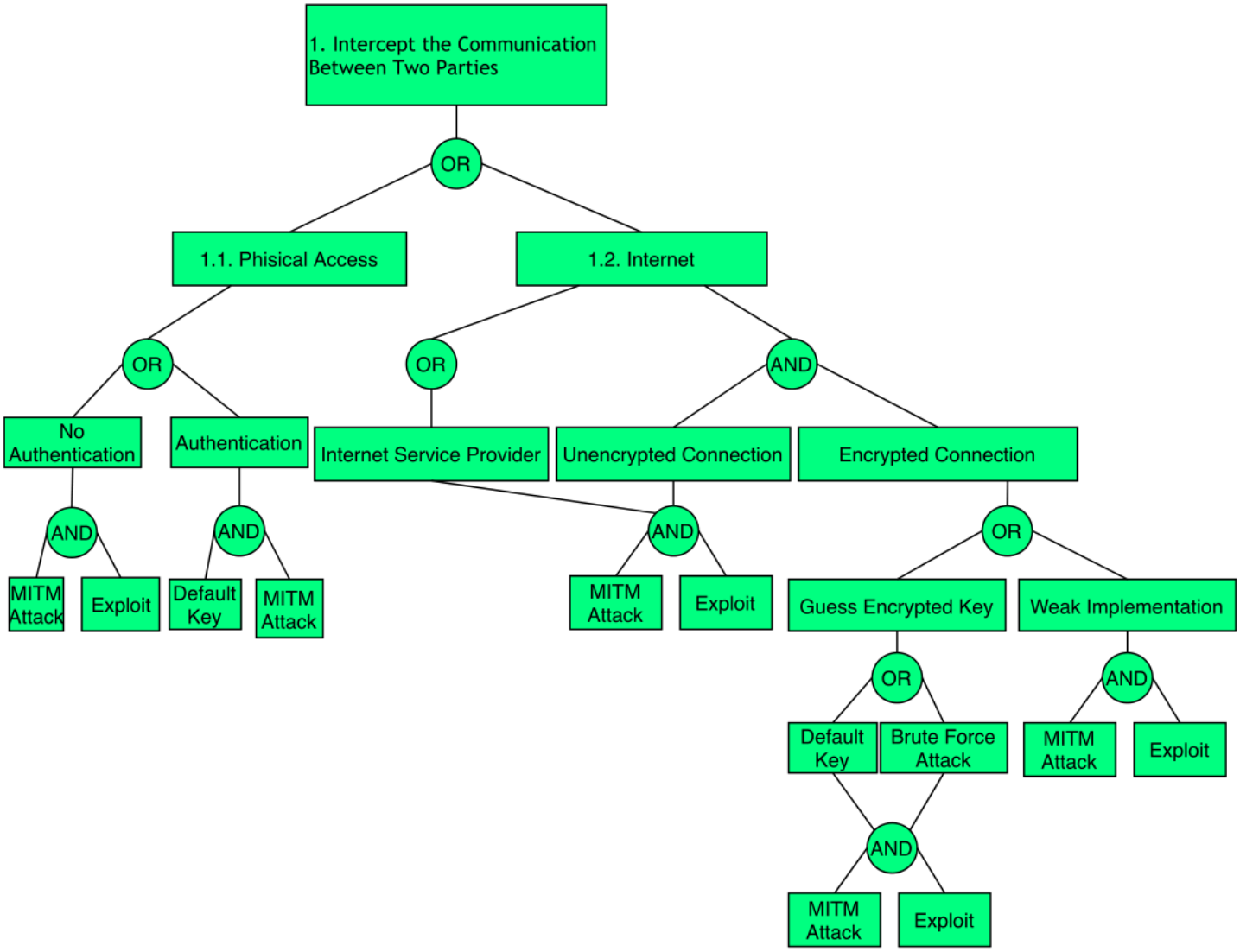
The attacker generally and depending on whether the communication situation is encrypted or not, is able to modify the cryptographically unprotected communication or modify the cryptographically protected communication. More specifically, it will have the following powers:

- Steal encryption key;
- Discover cryptographic key using cryptanalysis;
- Exploit vulnerabilities in cryptographic algorithm;
- Exploit vulnerabilities in cryptographic protocol.

Recommendations

To ensure that the mobile application is resilient or immune to malicious MitM attacks, it is recommended that the measures described in the good practice report and the security tests present in the full report are followed to ensure authenticity, integrity, privacy and authenticity of the data.

Man-in-the-Middle Attack Diagram



Cross Site Scripting Attacks

In short, Cross Site Scripting (XSS) allows an attacker to execute a browser script bypassing access control mechanisms such as the same origin policy. During this attack a malicious script is injected into web content and user considering it to be authentic executes it over its own machine, thus giving either control of the machine or exposure of confidential information to the attacker.

Definition

Being an attack that exploits vulnerabilities in web applications, the attacker in this type of attack executes malicious database claims, exploiting improper validation of data flowing from the user to the database. The attacker's goal is to access the intended party's confidential data by inserting malicious code into the user's web page in order to redirect them to their site. There are two ways to forge this type of attack:

- Stored XSS (uninterruptedly stores malicious code in a resource managed by the web application);
- Reflective XSS (promptly reflects malicious code against the user and therefore does not store it permanently;
- XSS based on DOM (Document Object Model).

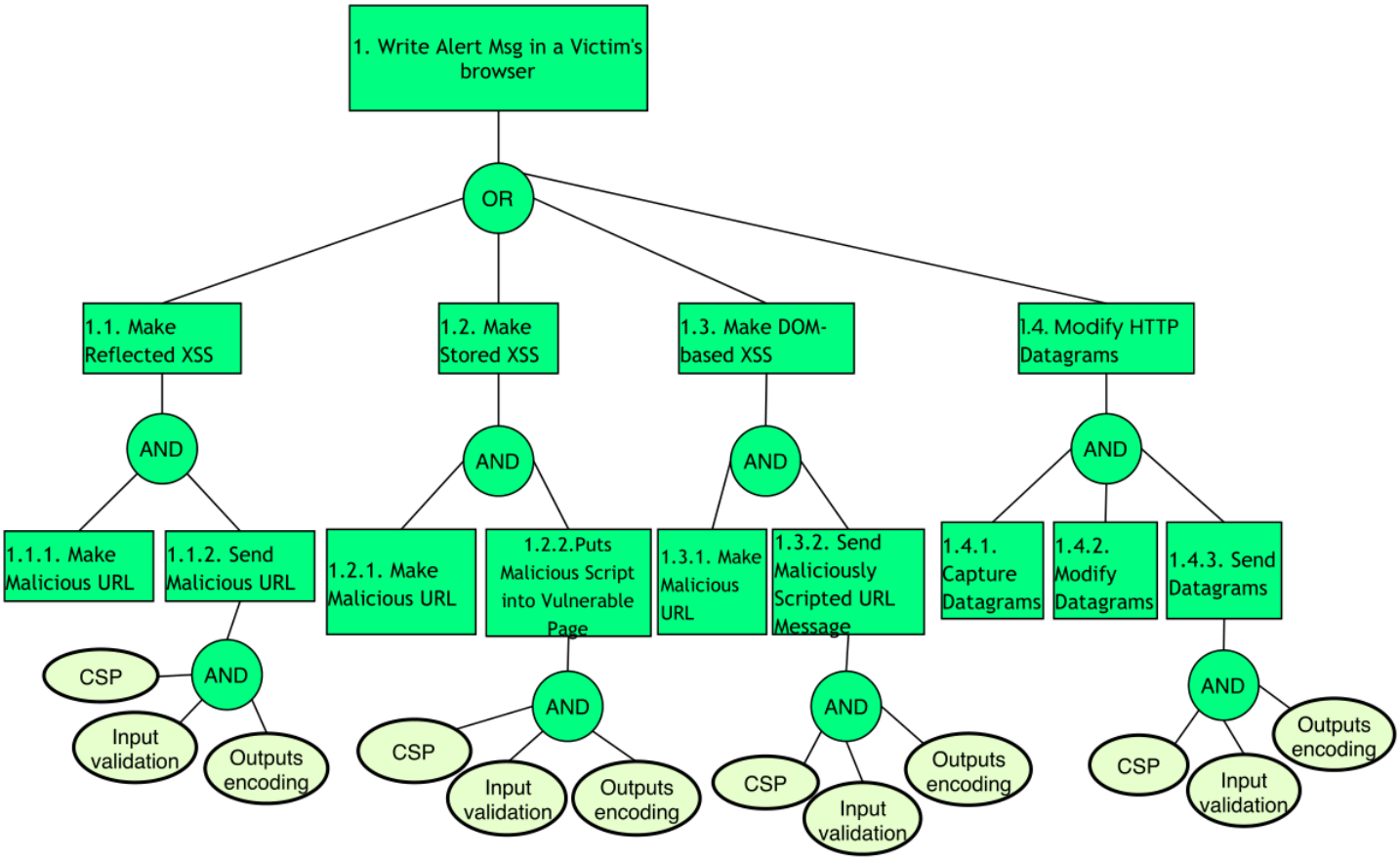
Attacker Powers

- Circumvent the policy of same origin;
- Impersonate you to websites and/or web applications you regularly use by obtaining/altering/destroying various types of content.

Recommendations

To ensure that the mobile application is resilient or immune to XSS attacks, it is recommended that the measures described in the good practice report and the security tests present in the full report are followed to ensure authenticity, integrity, privacy and authenticity of the data.

Cross Site Scripting Attacks Diagram



DNS Poisoning Attacks

DNS poisoning attack is tricking the domain name server (DNS) to send traffic in the wrong direction by modifying DNS cache content maliciously. The cloud customers must ensure that cloud service providers are taking proper steps to secure their DNS infrastructure.

Definition

In this kind of attack, the contents of the cookie are changed to get access to an unauthorized application or web page. The cookie contains sensitive credentials about user's data and when the hacker gains access to these contents then he also gains access to the content within these and can perform illegal activities.

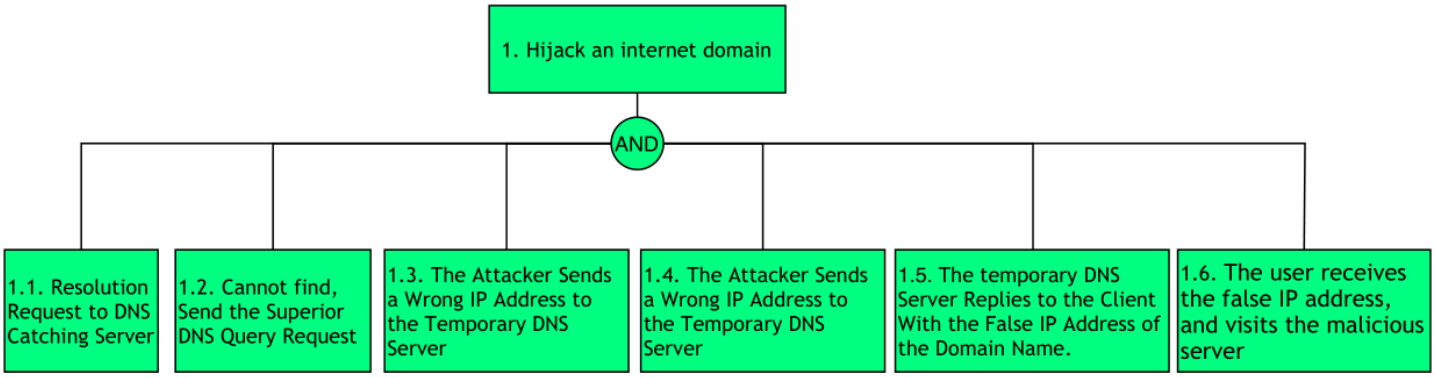
Attacker Powers

- Access confidential information from legitimate/authorized users; * Perpetrate other types of attacks like Main-in-the-Middle.

Recommendations

In order to ensure that the mobile application is resilient or immune to the DNS Poisoning attacks, it is recommended that the measures described in the good practice report and the security tests present in the full report are followed.

DNS Poisoning Attacks Diagram



Malicious QR Code Attacks

In this type of attack, one of the strategies used by the attackers, after coding the malicious links, is to take them to phishing sites or execute fraudulent codes. In addition, in order to end this type of attack, the attackers often print the malicious QR codes on small stickers that are pasted on pre-existing QR codes. On the other hand, attackers often change selected modules from white to black and vice versa in order to replace the original encoded content.

Definition

QR code-based attack is defined as an attack that attempts to lure victims into scanning a QR code that directs them to malicious websites. The key idea behind QR code attacks is that victims might trust the web page or the printed material on which the QR code is displayed, and assume that the associated code is harmless. In addition, attackers use malicious QR codes to direct users to fraudulent web sites, which masquerade as legitimate web sites aiming to steal sensitive personal information such as usernames, passwords or credit card information.

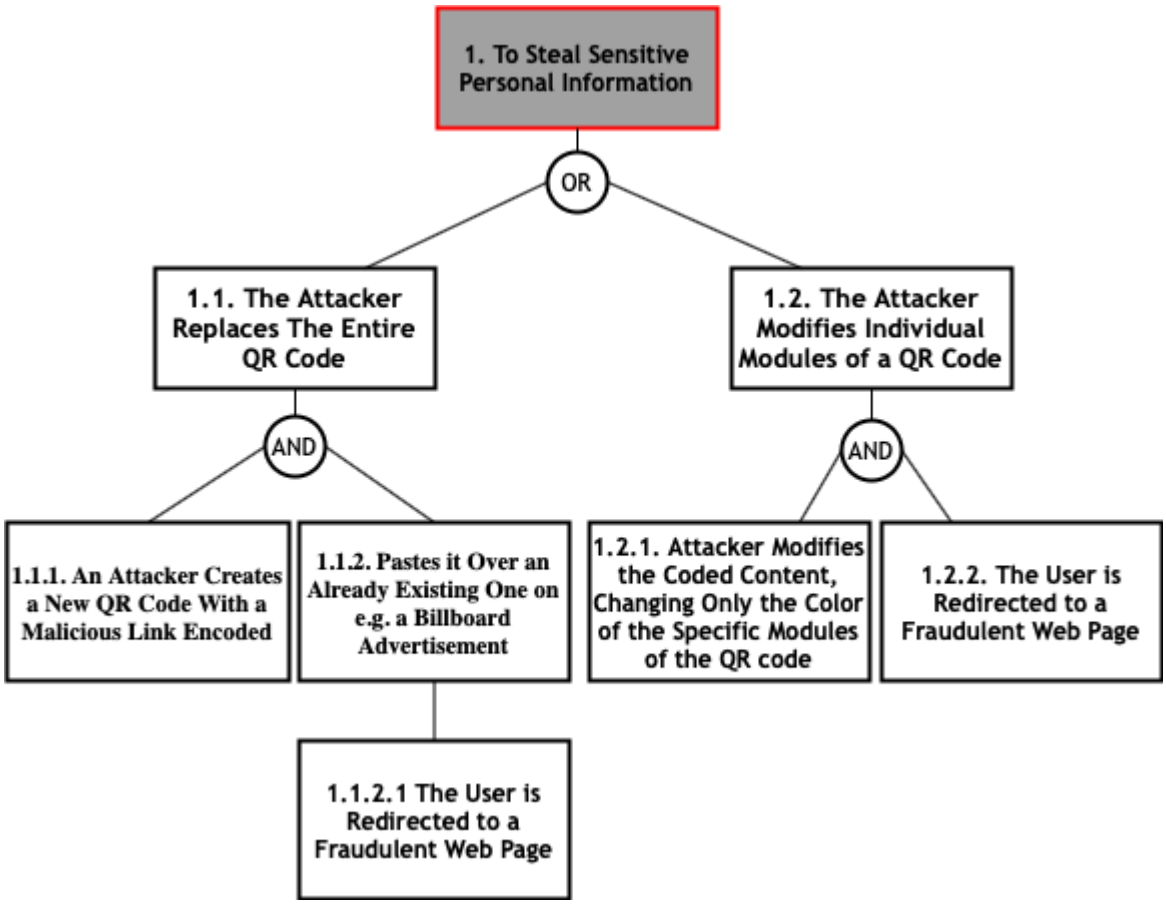
Attacker Powers

- Direct the user to an exploit or phishing site;
- Perform other attacks such as phishing, farming and botnet; * Distribute malware; * Extraction of personal and confidential data from smartphones and tablets via command injection or traditional buffer overflows by reader software;
- Steal users' Money via fraud;
- Social Engineering attacks via spear phishing e.g. leaving a poster of a QR Code on the parking lot of a company (instead of the traditional attack with an USB drive) offering discount in a nearby restaurant is a new attack vector which is likely to be successful.

Recommendations

To ensure that the mobile application is resilient or immune to malicious QR Code attacks, it is recommended that the measures described in the good practice report and the security tests present in the full report are followed to ensure authenticity, integrity and authenticity of the data.

Malicious QR Code Attacks Diagram



CAPTCHA Breaking Attacks

CAPTCHAs were developed in order to prevent the usage of internet resources by bots or computers. They are used to prevent spam and overexploitation of network resources by bots. But recently, it has been found that the spammers (attackers) are able to break the CAPTCHA. In this case, we will be in the presence of an attack of this nature, Captcha Breaking.

Definition

In this type of attacks, the attacker can break the CAPTCHAs by using an audio system, can read the CAPTCHAs by using speech to text conversion software and can also break image-based scheme and video-based scheme.

Attacker Powers

- Spamming;
- Conducting DoS and DDoS attacks;
- Excessive exploitation of network resources by bots.

Recommendations

In order to ensure that the mobile application is resilient or immune to the CAPTCHA Breaking attacks, it is recommended that the measures described in the good practice report and the security tests present in the full report are followed.

CAPTCHA Breaking Attacks Diagram

Denial of Services

In a DoS attack scenario, the attacker attempts to disrupt the network or disable services provisioned by a server by sending uninterrupted data packets to the target server and without changing nodes, data packets, or decrypting encrypted data. Typically, these data packets take up bandwidth and consume server resources.

Definition

In such attacks, the attacker attempts to prevent a service or feature that is signed by authorized users from being released by launching various types of floods - SYN flooding, User Datagram Protocol (UDP) flooding, Internet Control Message Protocol (ICMP) attacks) flooding, etc - on the server.

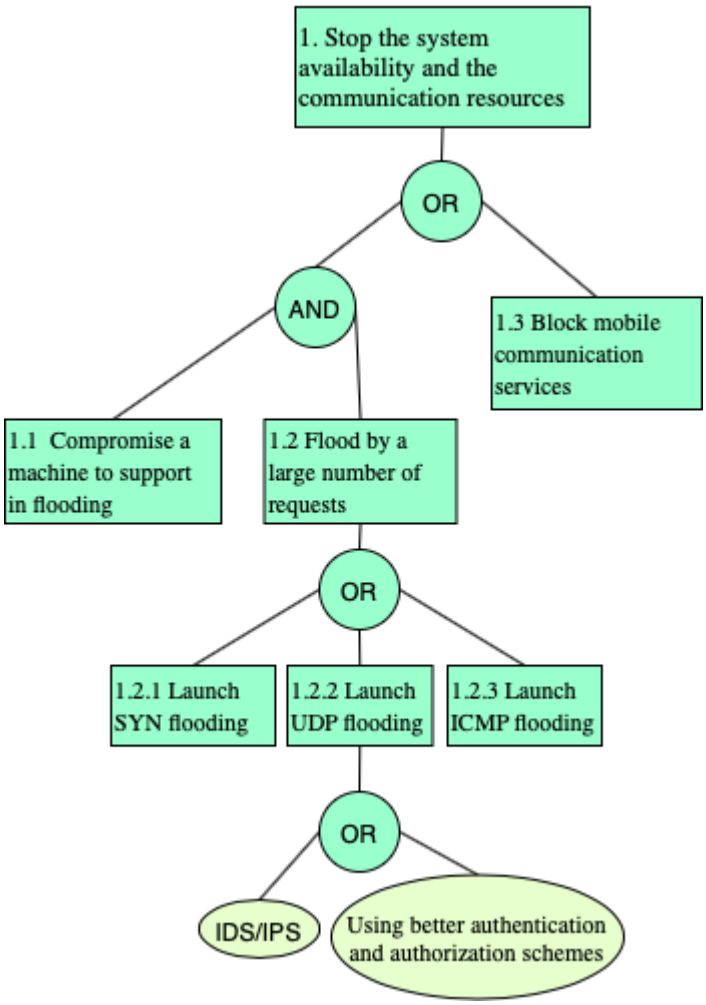
Attacker Powers

- Prevent the availability of a service or resource to authorized users;
- Perpetrating other types of attacks while services or features are unavailable, such as Spoofing.

Recommendations

In order to ensure that the mobile application is resilient or immune to the DoS attacks, it is recommended that the measures described in the good practice report and the security tests present in the full report are followed.

Denial of Services Attacks Diagram



Distributed Denial of Services Attacks

Distributed Denial of Services (DDoS) is an enhanced DoS attack type, originating from multiple network attack surfaces that were previously compromised to disrupt the services or resources provided by the target server. It differs from DoS in that it generates more traffic, so that the targeted server cannot handle requests.

Definition

The DDoS attack attempts to make a service unavailable to intended users by draining the system or network resource. Attackers can now launch various DDoS attacks, including resource-focused attacks (eg, network bandwidth, memory, and CPU) and app-focused attacks (eg, mobile applications, database service) from almost every attack. places.

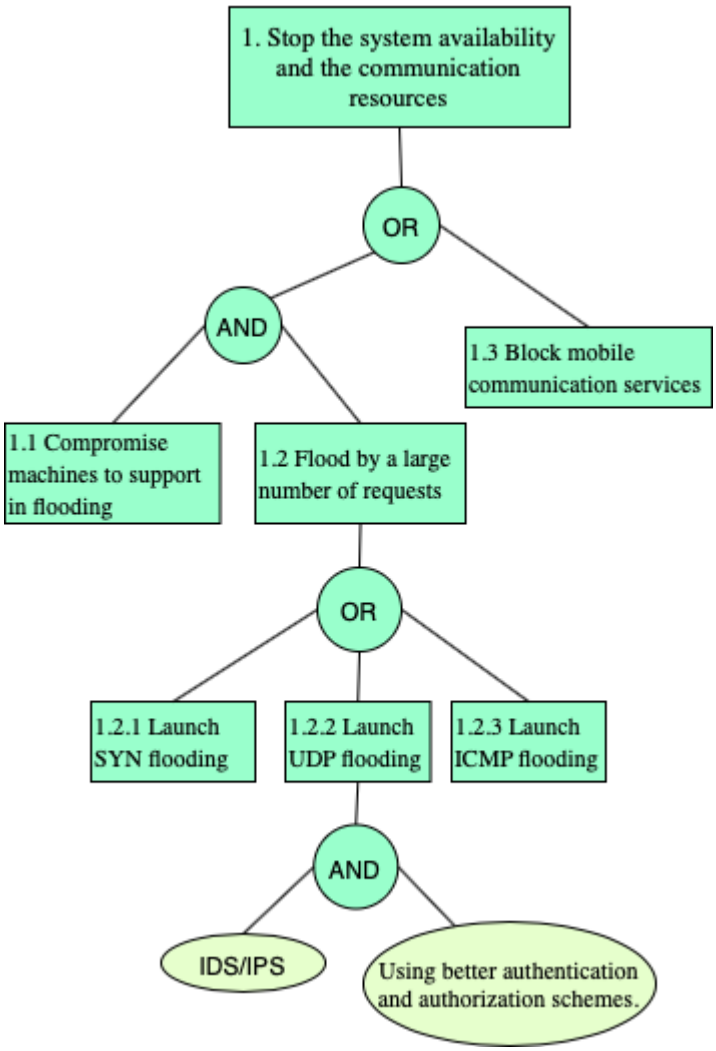
Attacker Powers

- Make features and services unavailable to authorized users; * Perpetrate other types of attacks and even extract sensitive and critical data.

Recommendations

n order to ensure that the mobile application is resilient or immune to the DDoS attacks, it is recommended that the measures described in the good practice report and the security tests present in the full report are followed.

Distributed Denial of Services Attacks Diagram



Eavesdropping or Sniffing

This type of attack is carried out by attackers who use applications that can capture data packets in transit over a network, and if they are not heavily encrypted, can be read or interpreted. The goal of the attacker is to spy on all kinds of conversations and recordings and to listen to communication channels.

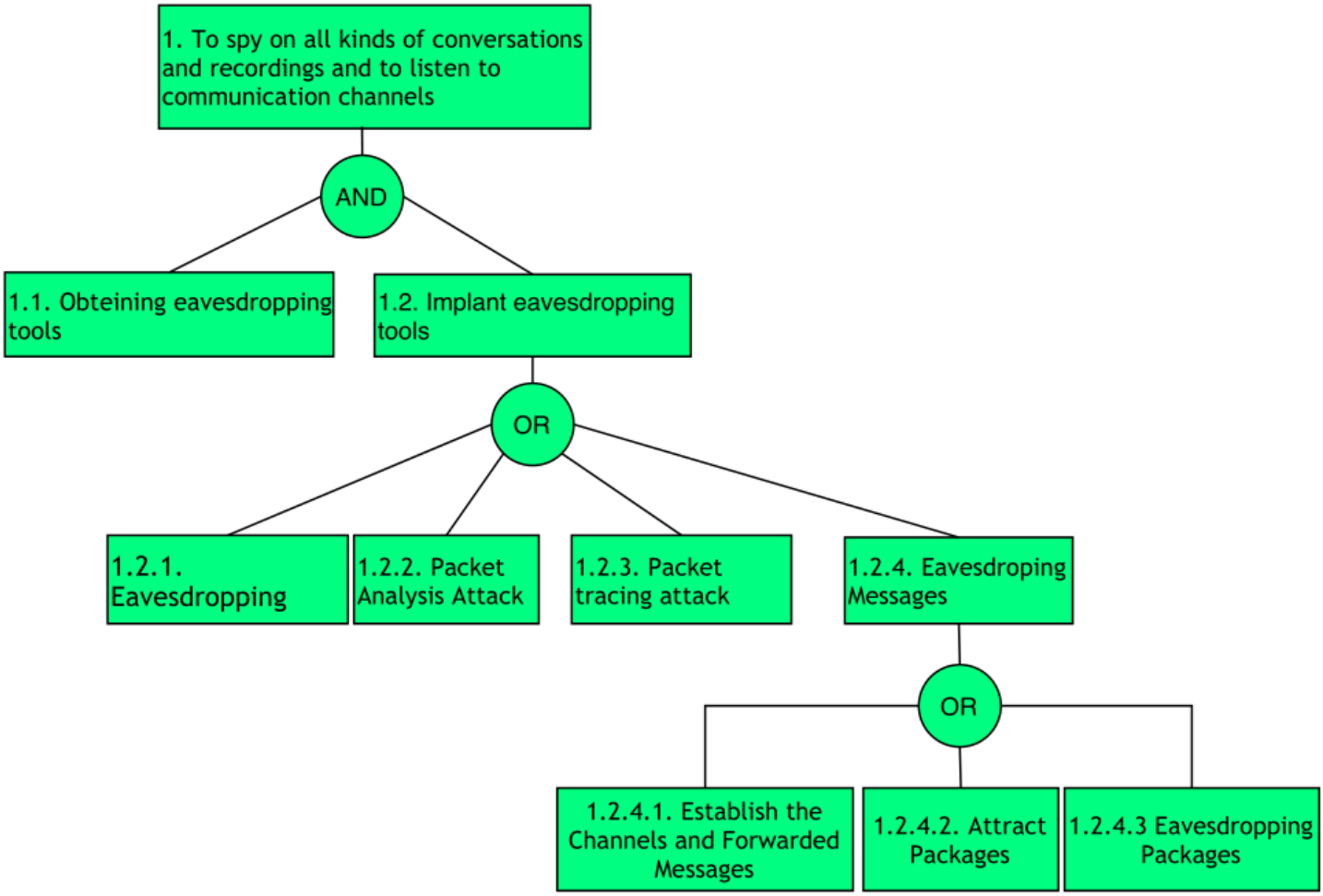
Definition

This type of attack consists of implant eavesdropping tools in specific network for spying on communication channels, capturing the network traffic behavior and getting the network map. Eavesdropping is dangerous threat that leads to break down the integrity and confidentiality which causes financial and personal failures. There are several ways to get a sniffing attack on a smartphone, as there is a vulnerability in GSM's encryption function for call and SMS privacy, A5 / 1 (it can be stopped second). This vulnerability puts all GSM subscribers at risk of sniffing attacks.

Attacker Powers

- Tracking, capture and theft of confidential information;

Sniffing Attacks Diagram



Domain Name Server Attacks

In this type of attack the attacker uses DNS to convert the domain name to an IP address for the purpose of accessing the user's confidential data. On the other hand, sender and a receiver get rerouted through some evil connection.

Definition

In DNS reflection attacks, attackers send DNS requests toward multiple open DNS servers with spoofed source address of the target, which results in a large number of DNS responses to the target from DNS servers. Since the cloud has its own DNS servers to answer DNS queries from hosted tenants, there should not be any DNS responses from the Internet to the cloud. Therefore, any activity of inbound DNS responses may signify a potential DNS reflection attack. Inbound DNS reflection attacks often come from up to 6K distinct sources (with 1500 byte full-size packets). We only observed outbound DNS responses from a single VIP hosting a DNS server at 5666 packets per second for a couple of days repeatedly.

Attacker Powers

- Access confidential information from legitimate/authorized users; * Perpetrate other types of attacks like DDoS and Main-in-the-Middle.

Recommendations

In order to ensure that the mobile application is resilient or immune to the DNS attacks, it is recommended that the measures described in the good practice report and the security tests present in the full report are followed.

DNS Attacks Diagram

Reused IP Address Attacks

IP address is reassigned and reused by other customer. The address still exists in the DNS cache, it violating the privacy of the original user.

Definition

Each node of a network has an IP address which is allocated to a particular user when that user leaves the network, the IP address associated with him is assigned to a new user. The chances of accessing previous user data by the new user exist as the address still exist in DNS cache and hence the data belonging to one person can be accessed by another.

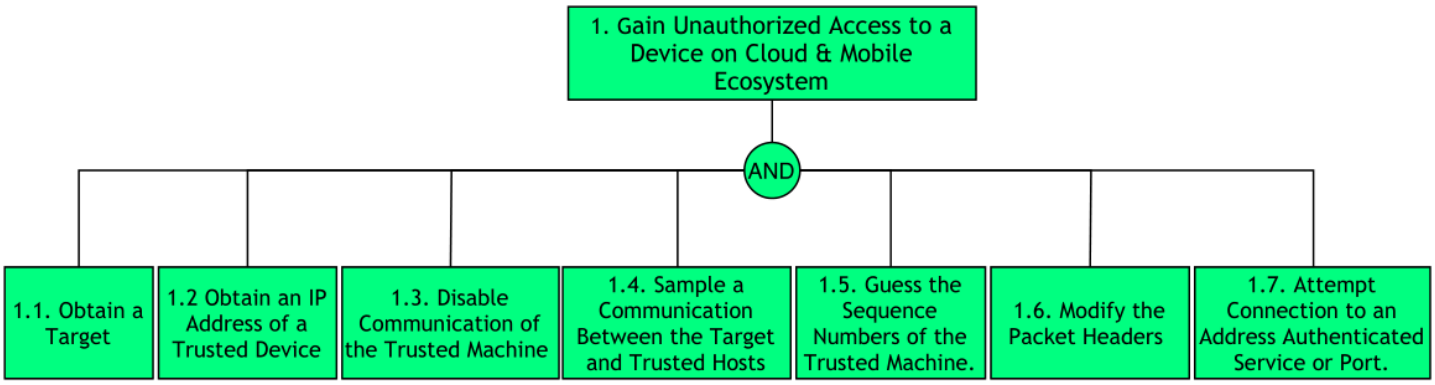
Attacker Powers

- Access confidential information from legitimate/authorized users.

Recommendations

To ensure that the mobile application is resilient or immune to malicious Reused IP Address attacks, it is recommended that the measures described in the good practice report and the security tests present in the full report are followed to ensure authenticity, integrity, privacy and authenticity of the data.

Reused IP Address Attacks Diagram



Phishing Attack

In phishing attack, an adversary sets up a fake URL identical to real Web application fooling the users to enter a valid credentials and certificates.

Definition

Phishing is the attempt to acquire sensitive information or to make somebody act in a desired way by masquerading as a trustworthy entity in an electronic communication medium. They are usually targeted at large groups of people. Phishing attacks can be performed over almost any channel, from physical presence of the attacker to websites, social networks or even cloud services. On the other hand, phishing attacks are typically fraudulent email messages which directs to spoofed website. In PaaS cloud environment, these attacks affect both enterprise and users. This is a type of social engineering attack. These attackers convince the customers to reveal their most important data like password or other sensitive information by using bogus web pages, emails, or bloggers.

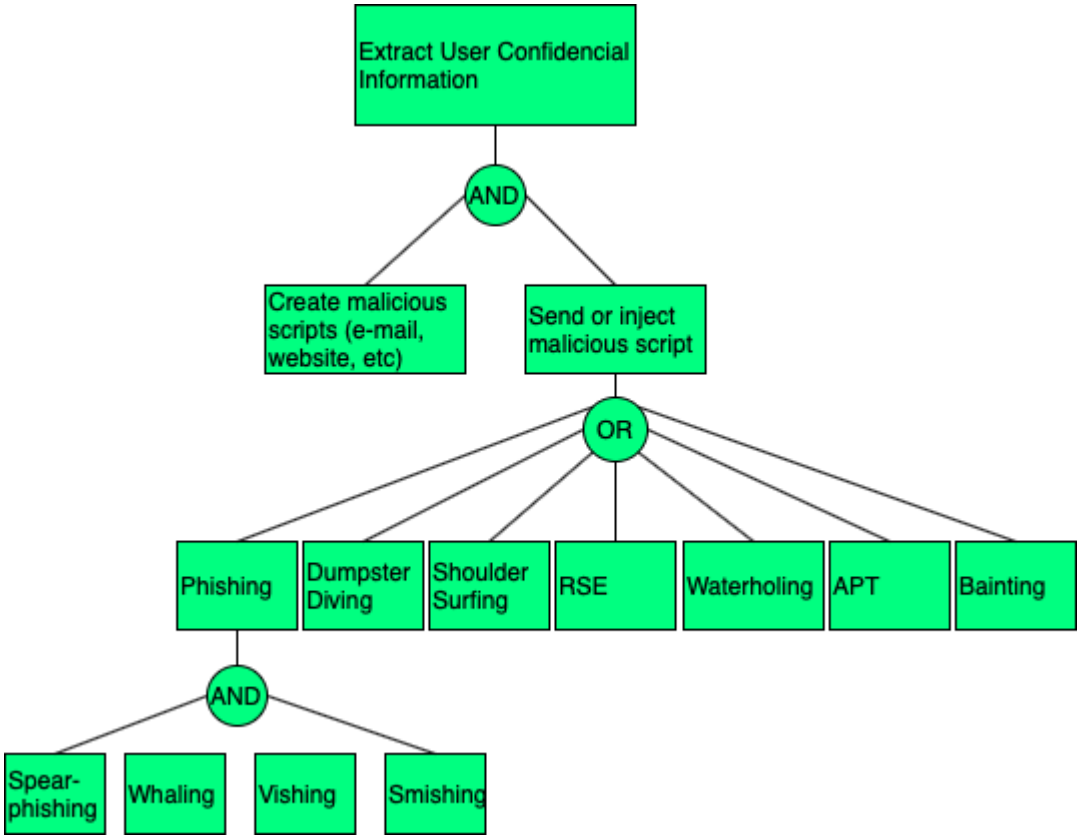
Attacker Powers

- Access confidential information from legitimate users by collecting data through malware; * Perpetrate other types of attacks like Botnet.

Recommendations

To ensure that the mobile application is resilient or immune to malicious Phishing attacks, it is recommended that the measures described in the good practice report and the security tests present in the full report are followed to ensure authenticity, integrity, privacy and authenticity of the data.

Phishing Attack Diagram



Botnet Attacks

In a nutshell, in a botnet attack scenario the attacker hijacks a set of mobile devices, creating a network of remote controlled zombie devices. This network is called Botnet, from which various types of attacks can be carried out, such as denial of service attacks, malware distribution, phishing, etc.

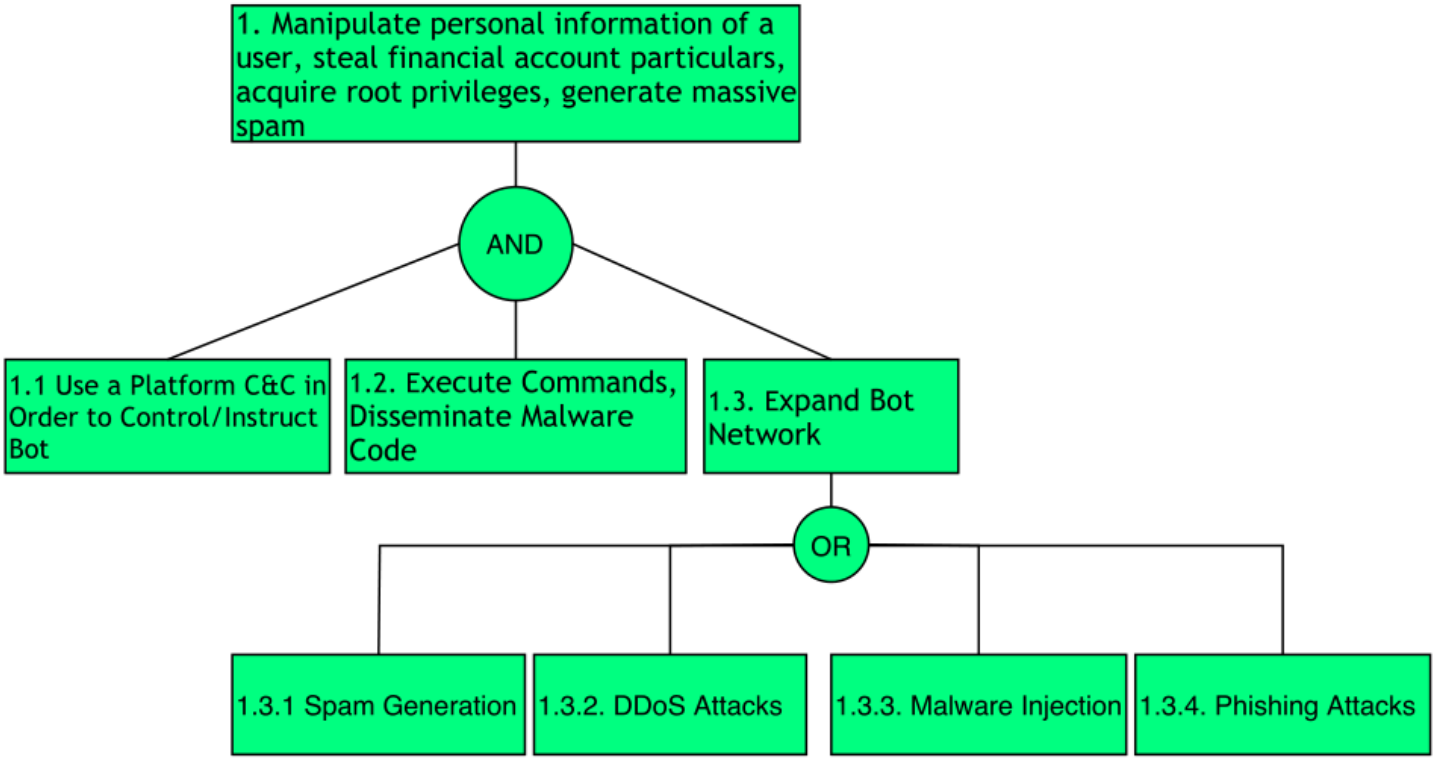
Definition

A botnet is a set of compromised mobile devices. A necessary condition for these devices to be compromised is their infection by malware. This allows attackers/hackers to remotely control this botnet and launch other types of attacks, such as DoS, Phishing, malware injection, etc.

Attacker Powers

- Sending spam;
- Perform attacks like DoS;
- Collecting information that can be used for illegal purposes;

Botnet Attacks Diagram



XML Injection Attacks

It is an attacking technique used against XML-based applications to modify or compromise their normal operation.

Definition **

XML Injection (XMLi) attacks are carried out by injecting pieces of XML code along with malicious content into user inputs in order to produce harmful XML messages. The aim of this type of attacks is to compromise the system or system component that receives user inputs, making it malfunction (e.g. crash), or to attack other systems or subsequent components that process those injected XML messages. This type of attack can be classified into 4 categories:

- Deforming: Attack input values of Type 1 are XML meta-characters, such as <, >,]] >, that are intro- duced to compromise the structure of generated XML messages;
- Random closing tags: Attack input values of Type 2 are random XML closing tags (e.g., < /test>), aiming at deforming the generated XML messages to reveal their structure;
- Replicating: Attack input values of Type 3 are strings of characters consisting of XML tag names and malicious content;
- Replacing: Attack input values of Type 4 are similar to those of Type 3 but they involve multiple input fields in order to comment out some existing XML elements and inject new ones with malicious content.

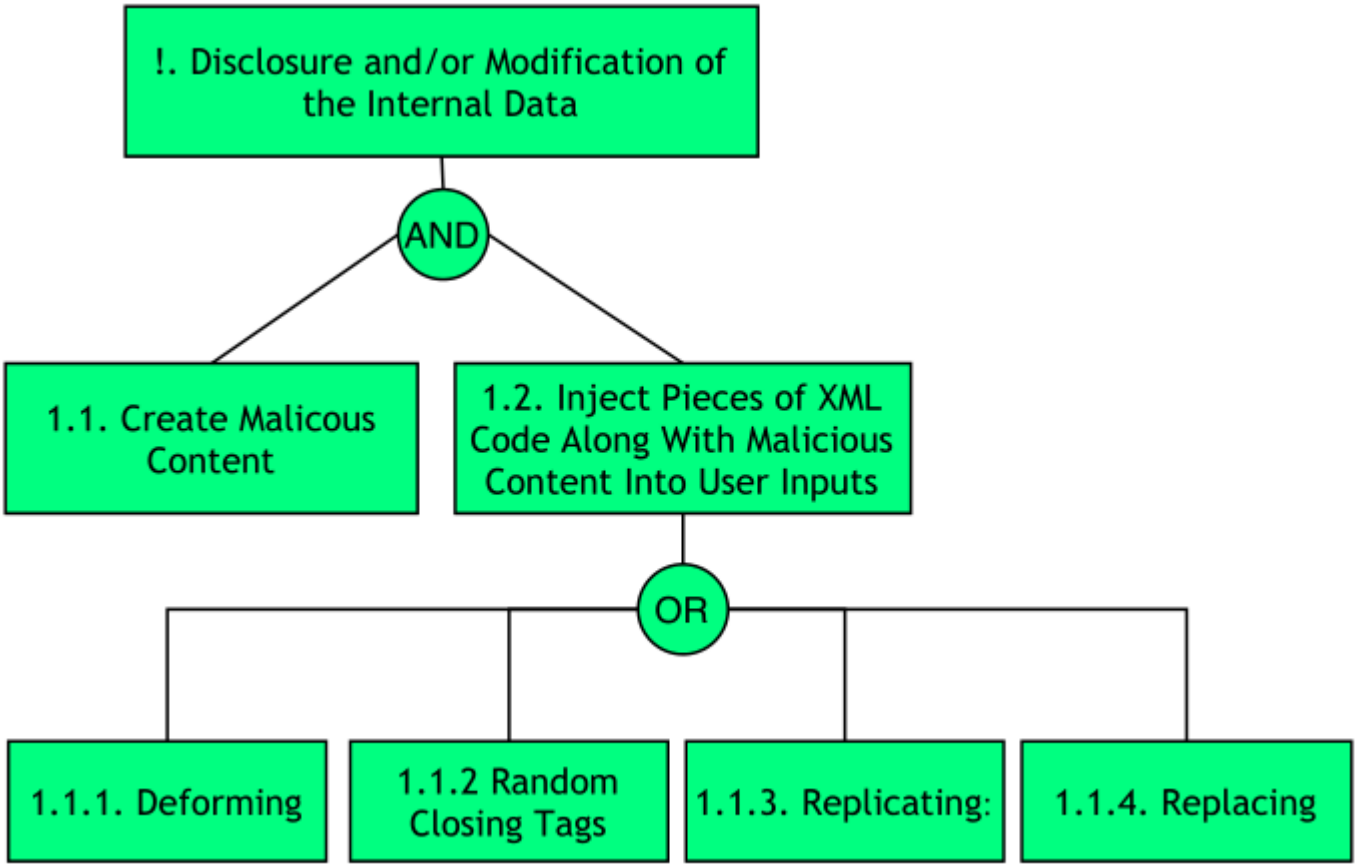
Attacker Powers

- Obtain confidential information;
- Change the underlying business logic of the destination.

Recommendations

To ensure that the mobile application is resilient or immune to Spoofing attacks, it is recommended that the measures described in the good practice report and the security tests present in the full report are followed to ensure authenticity, integrity, privacy and authenticity of the data.

XML Injection Attacks Diagram



Buffer Overflows Attack

As its name implies, buffer overflows occur when data exceeding its capacity is placed in a buffer. This occurs in programs implemented in C or C++, as these programming languages do not check if buffer limits are violated.

Definition

Buffer overflows is an anomaly where a program, while writing data to a buffer, overruns the buffer's boundary and overwrites adjacent memory. It can be triggered by non-validated inputs that are designed to execute code. Buffer overflow may result in erratic program behavior, including memory access errors, incorrect results, a crash, or a breach of system security.

Attacker Powers

- Overwrite the return address of a procedure call;
- Obtain control of a system;
- Launch more virulent attacks, such DoS or DDoS.

Recommendations

In order to ensure that the mobile application is resilient or immune to the buffer overflows attack, it is recommended that the measures described in the good practice report and the security tests present in the full report are followed.

Buffer Overflows Attack Diagram

Spoofing Attacks

In a nutshell, spoofing attacks consist of spoofing the caller ID in order to impersonate a trusted entity and thus obtain confidential information in a disguised manner.

Definition

In this type of attack, the attacker can spoof the "Caller ID" and impersonate him as a legitimate user, i.e., an attacker could spoof the "Caller ID" and impersonate a trusted party. Recent studies have also shown how to spoof MMS messages that appeared to be messages from a number that operators use to send alerts or update notifications. In addition, base stations can also be counterfeited. On the other hand, there is also the mobile application spoofing attack, which consists of an attack where a malicious mobile application mimics the visual appearance of another one. The goal of the adversary is to trick the user into believing that she is interacting with a genuine application while she interacts with one controlled by the adversary. If such an attack is successful, the integrity of what the user sees

as well as the confidentiality of what she inputs into the system can be violated by the adversary.

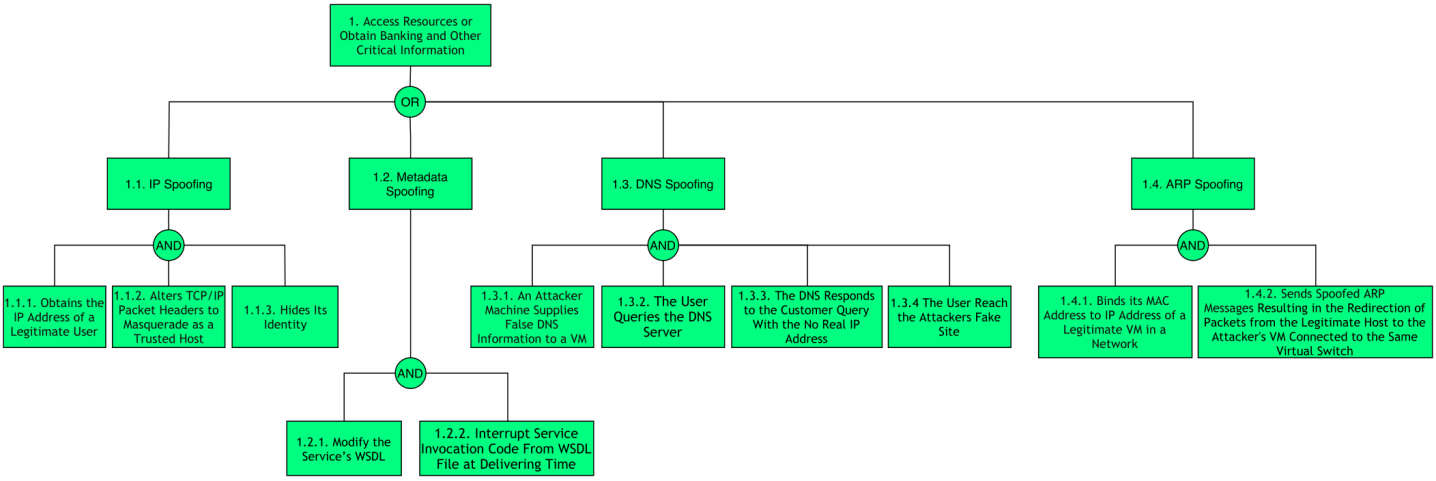
Attacker Powers

- Faker caller ID;
- Monitoring of calls and access to the confidential information of legitimate users from voice or text messages.

Recommendations

To ensure that the mobile application is resilient or immune to Spoofing attacks, it is recommended that the measures described in the good practice report and the security tests present in the full report are followed to ensure authenticity, integrity, privacy and authenticity of the data.

Spoofing Attacks Diagram



VM Migration Attacks

A malicious user can start or redirect the migration process to a different network in which he has access or untrusted host, or it can just be copied and used elsewhere, which compromise the VM with the passwords, credentials on it and in case of coping it makes it difficult to trace the attacker.

Definition

VMs roll back to their previous state if an error occurs. Unfortunately, this factor can re-expose them to security vulnerabilities, and attackers can gain benefit to attack on this compromised hypervisor. It is important to protect the data during migration. In fact, this is the defending of data privacy and integrity from various network attacks during migration. Live migration might be susceptible to many attacks like ”man-in-the-middle”, ”denial-of-service” and ”replay. The data during the migration can be sniffed or tampered easily as it is not encrypted.

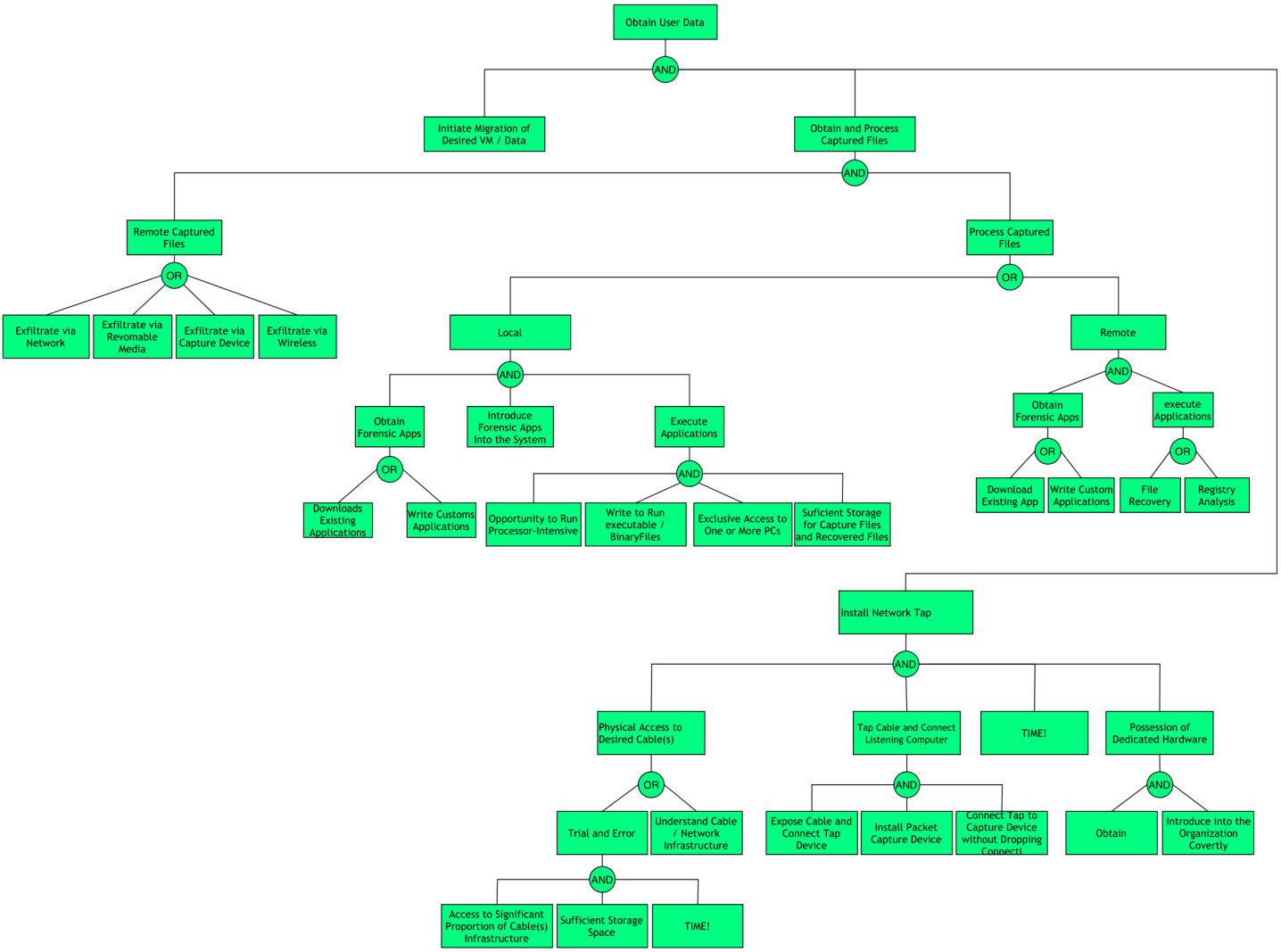
Attacker Powers

- Launch attacks such as man-in-the-middle, DoS and replay;
- Detect or tamper with data during migration as it is not encrypted.

Recommendations

To ensure that the mobile application is resilient or immune to VM Migration attacks, it is recommended that the measures described in the good practice report and the security tests present in the full report are followed to ensure authenticity, integrity, privacy, confinement, and authenticity of the data.

VM Migration Attacks Diagram



Malicious Insiders Attacks

This type of attacks ocurre when there is a malicious entity (client, employee, Hypervisor, Cloud Provider/Broker, etc.) takes advantage of its privileges to covertly carry out any malicious activity such as information theft and data destruction or physical infrastructures.

Definition

Malicious Hypervisor, Malicious Clients, Malicious Cloud Provider/Broker, etc. are all the other terms which can also be used as an alternative to malicious insiders. This kind of attack occurs from client to server when the person, employee or staffs who know how the system runs, can implant malicious codes to destroy everything in the cloud system.

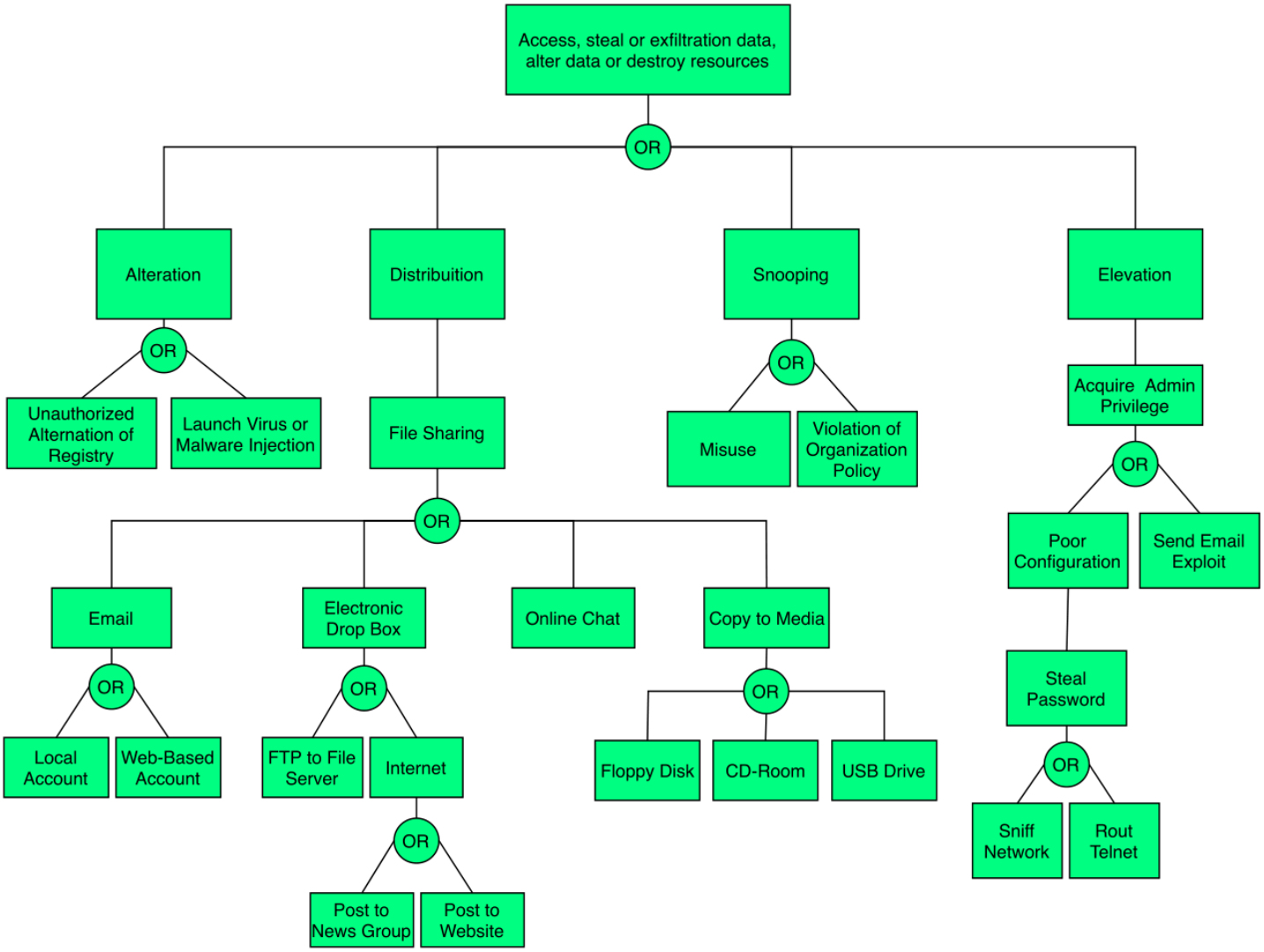
Attacker Powers

- Implants malicious codes to destroy everything in the cloud system; * Steals confidential data.

Recommendations

In order to ensure that the mobile application is resilient or immune to Malicious Insiders attacks, it is recommended that the measures described in the good practice report and the security tests present in the full report are followed.

Malicious Insiders Attacks Diagram



VM Escape Attacks

This type of attack occurs when an application escapes from the VM and gains control of VMM, as it escapes the VM privilege and obtains the root privilege.

Definition

VM escape is where an application running on a VM can directly have access to the host machine by bypassing the hypervisor, being the root of the system it makes this application escape the VM privilege and gain the root privilege. In this type of attack the attackers attempt to break down the guest OS in order to access the hypervisor or to penetrate the functionalities of other guest OS and underlying host OS. This breaking of the guest OS is called as escape. If the attackers escapes the guest OS it may compromise the hypervisor and as a result it may control over the entire guest OS. In this way the security breach in single point in hypervisor may break down all the hypervisor. If the attacker controls the hypervisor, it can do anything to the VM on the host system.

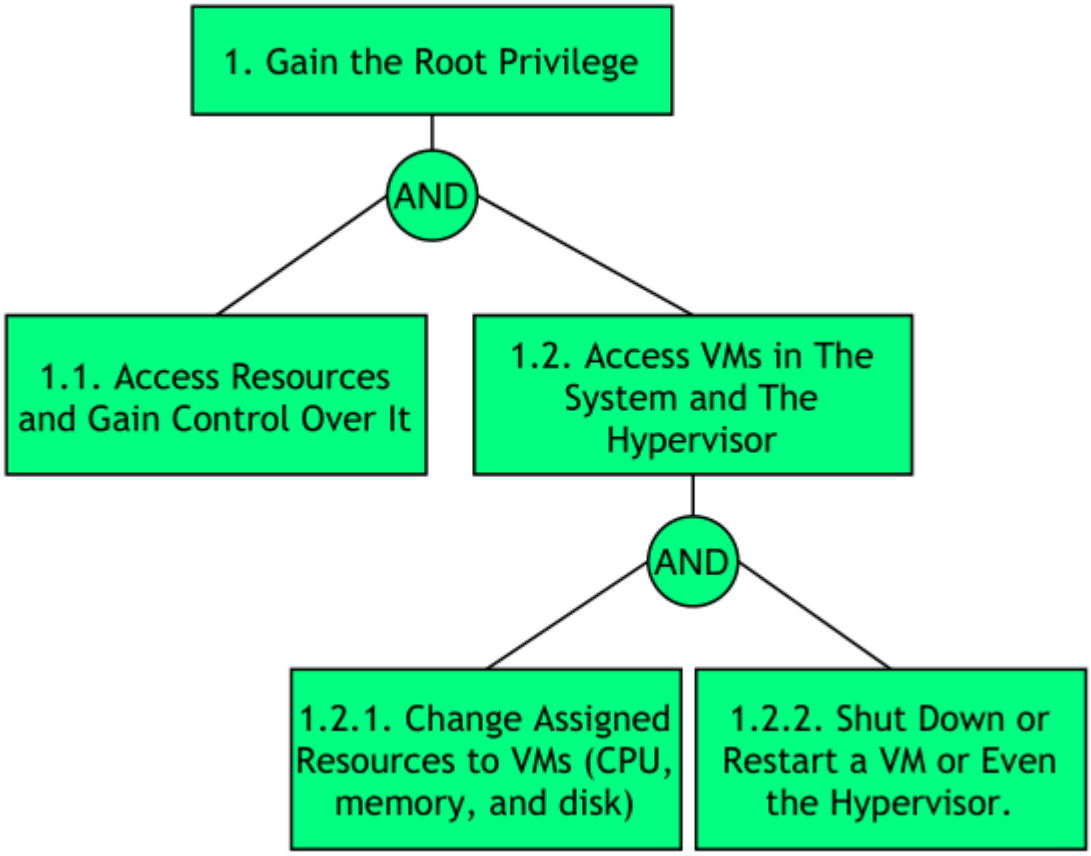
Attacker Powers

- Shutdown and eliminate target or victim VMs, resulting in the loss and destruction of data or information;
- Compromise the hypervisor and other resources.

Recommendations

To ensure that the mobile application is resilient or immune to VM Escape attacks, it is recommended that the measures described in the good practice report and the security tests present in the full report are followed to ensure authenticity, integrity, privacy, authenticity and confinement of the data.

VM Escape Attacks Diagram



Cross VM Attacks (Side channel attacks)

Side-channel attacks are used to extract cryptographic keys from a victim device or process in a virtualized layer of the cloud ecosystem where a Cross-VM attack exploits the nature of multi-tenancy, which enables that VMs belonging to different customers may co-reside on the same physical machine.

Definition

The side-channel attack takes advantage of low-bandwidth message channels in a system to leak sensitive security information. There is no doubt that this type of attack exists and is real for today's computer systems, including modern smartphones and tablets. Here we highlight the cache-based side-channel attacks that have been used to steal cryptographic information from a single OS. Furthermore, the weak link is in the fact that cryptographic algorithms usually have data-dependent memory access patterns, giving the possibility of being revealed by the observation and statistical analysis of hits / errors from the associated cache. Recent research has shown attackers can build up cross-VM side channels to obtain sensitive information. However, currently these channels are mostly based on shared CPU cache, networks, CPU loads and so on. These attacks are generally categorized into one of three classes:

- Time-driven side-channel attack;
- Trace-driven side-channel attacks;
- Access-driven side-channel attacks.

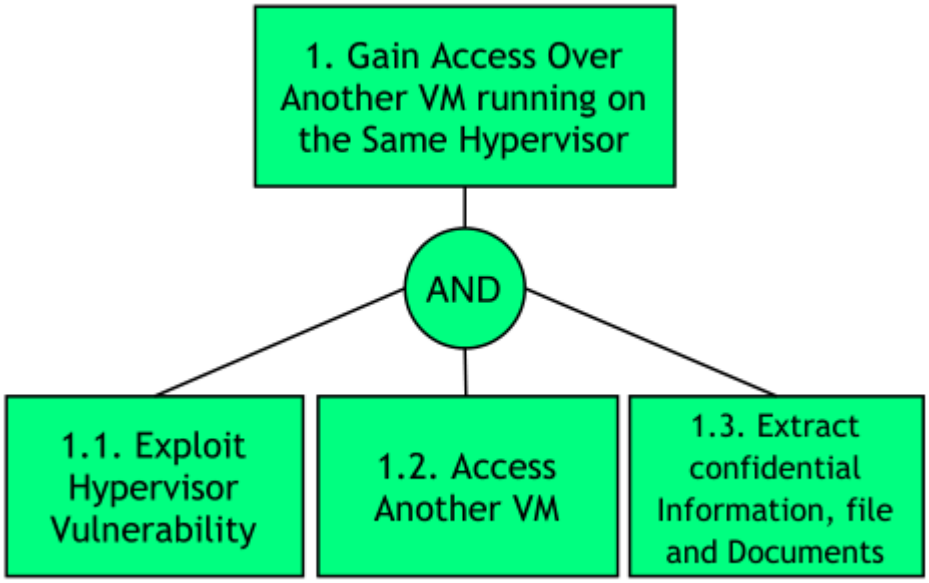
Attacker Powers

- Steal cryptographic information;
- Extract cryptographic key; * Obtains confidential data or sensitive information.

Recommendations

In order to ensure that the mobile application is resilient or immune to the side-channel attacks, it is recommended that the measures described in the good practice report and the security tests present in the full report are followed.

Cross VM Attacks Diagram



Malware Injection Attacks

This type of attack occurs whenever a user can install malware on a mobile device. In addition, this type of attack can be carried out remotely or locally.

Definition

Attacks on the cloud and mobile application-level ecosystem can affect the integrity and confidentiality of data and applications through different strategies. E.g., by injecting malware. Malware can be virus, worm, trojan, rootkit and botnet.

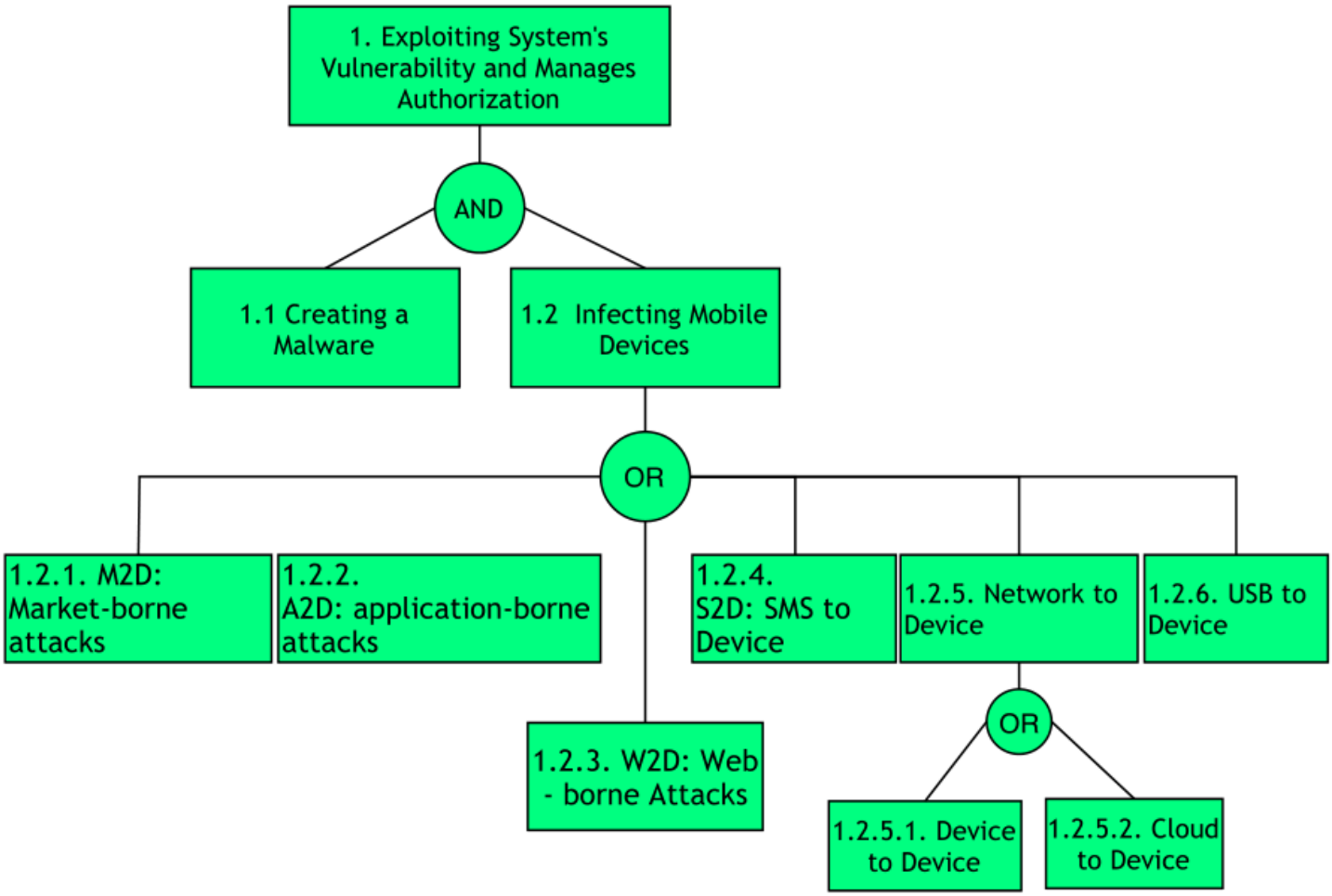
Attacker Powers

- Access and steal users confidential data;
- Obtain root permissions on mobile devices and control the mobile device;
- Directly affect the computational integrity of mobile platforms along with the application.

Recommendations

To ensure that the mobile application is resilient or immune to malicious Malware Injection attacks, it is recommended that the measures described in the good practice report and the security tests present in the full report are followed to ensure authenticity, integrity and authenticity of the data.

Malware Injection Attacks Diagram



Tampering Attacks

In this type of attack an attacker preforms physical modifications on the hardware where the software is implemented.

Definition

This type of attack occurs whenever an unauthorized user has physical access to the device. When this access is realized, it is possible to loss, leakage, access or unintentionally disclose of the data or applications to unauthorized users, if the mobile devices are misplaced, lost or theft.

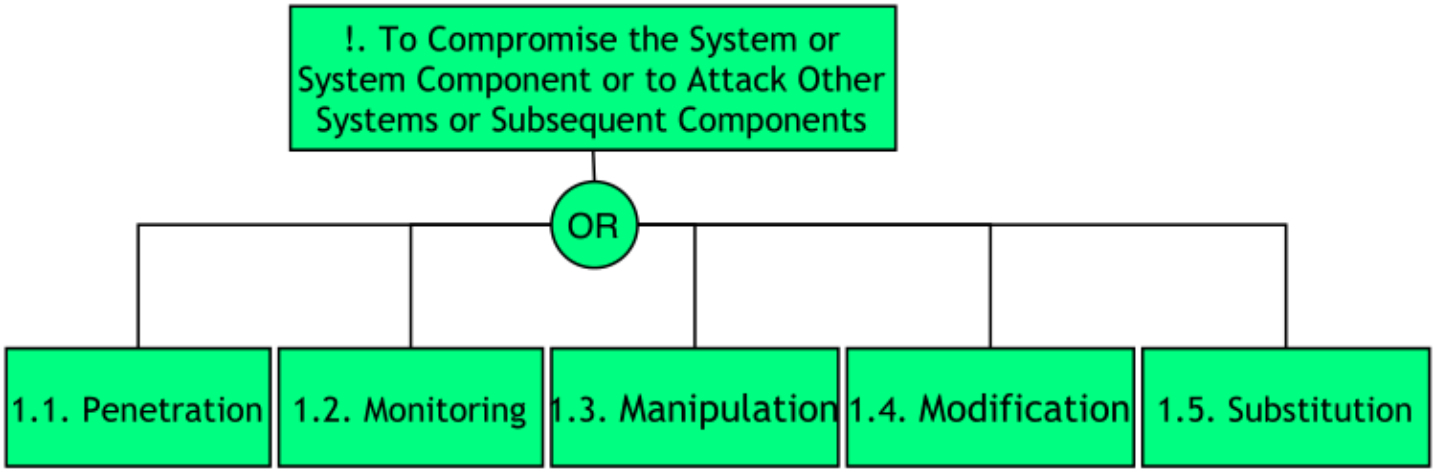
Attacker Powers

- Sending high malicious traffic stream;
- Huge messages to targeting mobile devices to make unused or reducing the capability;
- Access and steal users confidential data.

Recommendations

To ensure that the mobile application is resilient or immune to malicious Tampering attack, it is recommended that the measures described in the good practice report and the security tests present in the full report are followed to ensure authenticity, integrity, privacy and authenticity of the data.

Tampering Attacks Diagram


!. To Compromise the System or System Component or to Attack Other Systems or Subsequent Components
OR
1.1. Penetration
1.2. Monitoring
1.3. Manipulation
1.4. Modification
1.5. Substitution

Final Security Test Specification and Tools Report

Architeture	IoT System
Application domain type	Smart Home
Authentication	Username and Password
Has DB	Yes
Type of data storage	SQL
Which DB	MySQL
Type of data stored	Personal Information ; Critical Data
User Registration	Yes
Type of Registration	Will be a administrator that will register the users
Programming Languages	C/C++
Input Forms	Yes
Upload Files	No
The system has logs	Yes
The system has regular updates	No
The system has third-party	No
System Cloud Environments	Public Cloud
Hardware Specification	Yes
HW Authentication	TPM (Trusted Platform Module)
HW Wireless Tech	Wi-Fi ; Bluetooth
Data Center Phisical Access	Yes

In order to avoid or prevent *Botnet, DoS and DDoS Attacks*, the following security tests should be performed.

Test Parameter	Testing Types	Testing Methods	Tools		
			Both	**Android**	**iOS**
Add-ons	White Box	Static Analysis via Forensic Mobile		Addons Detector	
DoS, DDoS Attacks	Black Box	Dinamic Analysis via Penetration Test	NMAP, SlowBot Net, MetaSploit, LOlC and Kali Linux		

In order to avoid or prevent *Botnet, DoS, DDoS, Phishing, MITM, Spoofing and Sniffing Attacks* , the following security tests should be performed.

Test Parameter	Testing Types	Testing Methods	Tools		
			Both	**Android**	**iOS**
Mobile decryption, unpacking & conversion	White Box	Static Analysis via Test Penetration		Dex2jar	Clutch
Secure backup and logging	Grey Box	Dinamica Analysis via Proxies		adb	
Data leakage and Breach	Grey Box	Dinamic analysis via Proxies	Wireshark	tPacketCapturepro, DroidWall,	
	Grey Box	Dinamic Analysis via Penetration Testing	VASTO		
	White Box	Dnamic Analysis via Stressing Testing (fuzzing)	Webfuzz, SPI Fuzzer, Wfuzz		

In order to avoid or prevent *Sniffing, Botnet, Phishing and Spoofing Attacks* , the following security tests should be performed.

Test Parameter	Testing Types	Testing Methods	Tools		
			Both	**Android**	**iOS**
Use of encryption	White Box	Static Analysis via Forensic Mobile	OpenSSL		
Poor use of certificate parameters	Grey Box	Dinamic analysis via Vulnerability Scanner	Acunetix, Web3af, Nikto, IBM Security AppScan Standard and HP WebInspect		
	Grey Box	Dinamic Analysis via Penetration Test	TCPDump, Wireshak		idb tool
Secure backup and logging	Black Box	Dinamic Analysis via Proxies		adb	

In order to avoid or prevent *Botnet, Spoofing and Sniffing attacks*, the following security tests should be performed.

Test Parameter	Testing Types	Testing Methods	Tools		
			Both	**Android**	**iOS**
Exploit Database Vulnerabilities	White Box	Manual Dinamic Analysis via Penetration Test	SQLite browser		Xcode

Proper SSL usage and Use of encryption	Black Box	Dinamic Analysis via Proxies	WebScarab		
Database frangibility scanner	Grey Box	Dinamic Analisys via Vulnerability Scanner	Database Scanner of Internet Security Systems Co. and MetaCortex		
Find Bugs	White Box	Static Analysis via Bytecode Scanner	FindBugs, BugScan of LogicLab Co.		
	White Box	Static Analysis via source code Analyser	C++Test, RATS, C Code Analyzer(CCA)		
	White Box	Static Analysis via Binary code Scanner	BugScan of Logi- cLab Co. and Fx- Cop;BugScam		
Input validation of user SID	Grey Box	Manual Dinamic Analysis Checking input fields in GUI			

Test Parameter	**Testing Types**	**Testing Methods**	**Tools**		
			Both	**Android**	**iOS**
Runtime manipulation: code injection, patching	Grey Box	Static Analysis via Test Penetration	Cydia Substrate		Cycript

In order to avoid or prevent *Buffer overflows*, the following security tests should be performed.

Test Parameter	**Testing Types**	**Testing Methods**	**Tools**		
			Both	**Android**	**iOS**
Input validation	Grey Box	Dinamic Analysis via Fuzzers	Sharefuzz		

In order to avoid or prevent *Malicious Insider and VM-Migration attacks*, the following security tests should be performed.

Test Parameter	**Testing Types**	**Testing Methods**	**Tools**		
			Both	**Android**	**iOS**
Input validation	Grey Box	Static Analysis via Forensic Mobile	Slueth Kit+Autopsy Browser	AndroGuard, Drozer, apktool	

In order to avoid or prevent *Malware injection and Side-channel Attacks* , the following security tests should be performed.

Test Parameter	**Testing Types**	**Testing Methods**	**Tools**		
			Both	**Android**	**iOS**
Debug flag	White Box	Static Analysis via Forensic Mobile	BlackBag Blacklight, Encase forensics	AndroGuard, Drozer, FindBugs, Andriller	
Content providers	White Box	Static Analysis via Forensic Mobile	Slueth Kit+Autopsy Browser	AndroGuard, Drozer, apktool	
Code quality	White Box	Static Analysis via Byte-code Scanner	FindBugs, BugScan of LogicLab Co.		
	White Box	Static Analysis via source code Analyser	C++Test, RATS, C Code Analyzer(CCA)		
	White Box	Static Analysis via source code Analyser	BugScan of LogicLab Co. and Fx- Cop, BugScam		class-dump-z

In order to avoid or prevent *physical attacks*, the following security tests should be performed.

Test Parameter	**Test Approach**	Test Method	Tools		
			Both	Android	iOS
Debug flag, Content providers, Code quality	White Box	Static Analysis via Forensic Mobile		AndroGuard, Drozer, FindBugs	
Leak, Breach and data Loss	Black Box	Manual Dinamic Analysis Checking input fields from device and GUI			