Vetting the Security of Mobile Applications

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DARPA Transformative Applications (TransApps)

DARPA TransApps focused on the use of smartphone applications (apps) for tactical use.

TA Apps:

- Provided mission-critical, leading-edge capabilities:
  - Weaponry
  - Medical/First-Aid
  - Cultural/Language
  - Mapping/Recon/Logistics
  - Tactical Information Sharing
- Deployed on latest smartphone devices
- Significantly improved combat operations
- Saved the lives of U.S. soldiers
TransApps Security

Security of smartphone technologies was crucial for protecting sensitive information and ensuring proper operation.

Security Needed to Prevent:
- Unauthorized access to PII, geo-location, or other sensitive information
- Unauthorized network communication
- Unauthorized audio/video recording
- Unintended app or device behavior
- Resource (memory, CPU, etc.) exhaustion
- Shortened battery life
- Mission failure
App Vulnerabilities

• Thousands of vulnerabilities exist for Android and Apple iOS apps
• On average, an app contains 14 vulnerabilities*
• Types of vulnerabilities include:
  – Exposed Communication
  – Incorrect Permissions
  – Dangerous or Hidden Functionality
  – Traditional Software Vulnerabilities

• TA Apps include:
  – Commercial/COTS (no source code)
  – Government-Developed/GOTS
  – Open-Source

Hardware/OS Security

*Focused on the development of hardened COTS Android devices (referred to as PANTHR devices).*

- Modified Android OS
- Hardware Security Stack
  - CVE Patched Linux Kernel
  - Data At Rest Protections
  - Data In Transit Protections
  - Device Integrity Checks
  - Device Authentication
Application Security

Focused on securing software applications

- **App Functional Testing**: Ensure that apps provided the intended functionality
- **App Vetting (NIST/CSD)**:
  - Investigate apps for vulnerabilities and malware
  - Determine if apps are in accordance with organizational security policies and requirements
- **App Acquisition**: Develop an app store for deploying *only vetted* apps onto PANTHR devices.
NIST App Vetting Contributions

1. Formulated the *App Vetting Process*

2. Developed and deployed a system called the *App Testing Portal* (ATP) for managing and automating the TransApps app vetting process
   - Afghanistan (2011-Present)
   - Presidential Inauguration (2013)
   - Boston Marathon (2013-2014)
   - Other USG operations (2011-Present)

3. Published NIST SP800-163, *Vetting the Security of Mobile Applications*, that described the app vetting process as well as issues, recommendations and lessons-learned during the development and deployment of ATP
SP800-163 is intended to help organizations:

• understand the process for vetting the security of mobile applications
• plan for the implementation of an app vetting process
• develop app security policies and requirements
• understand the types of app vulnerabilities and the testing methods used to detect those vulnerabilities
• determine if an app is acceptable for deployment on the organization’s mobile devices

The app vetting process is a sequence of activities:

- for investigating the security, reliability, and efficiency of apps (i.e., testing for vulnerabilities and malware)
- for determining if apps are in accordance with organizational security policies and requirements (usually regarding usage)
- that is performed after apps have been developed and released for distribution but prior to deployment
App Vetting Process

Workflow

1. App Submission
   - Developer
   - Administrator/MDM

2. App Testing
   - Analyzer
   - Auditor
   - Approver

3. Report & Risk Auditing
   - Code Analysts
   - Testing Services
   - Testing Tools

4. App Approval/Rejection
   - Policies
   - Recommendation

5. App Deployment
   - Approved App
   - User

App Store

Actor
Activity
Artifact
App vetting process benefits include:

- **Adaptable**: Can be modified to fit organizational needs
- **Implementation-Agnostic**: Can be implemented as a manual or automatic system (e.g., ATP)
- **Simple but Powerful**: Simple and intuitive process provides framework for uncovering a host of issues (e.g., aggregation of disparate tool reports)
- **Monitoring**: Sequence of activities can be monitored for performance, efficiency, etc.
Planning involves:

• specifying the organization’s app security policies and requirements:
  – General requirements (vulnerabilities and malware)
  – Context-Sensitive (usage)

• procuring an appropriate budget and staff

• understanding the limitations of app vetting
Specifying General (Vulnerability/Malware) Requirements

- Specify software characteristics or behavior that an app should or should not (e.g., specific vulnerabilities) exhibit
- Examples:
  - Apps must not leak personally identifiable information (PII)
  - Apps should include only those permissions required to perform their intended functionality
- The satisfaction or violation of a general requirement must be determined by an Analyzer (e.g., test tool). If an Analyzer detects a software behavior or characteristics that the app should not exhibit (e.g., vulnerability), the app is considered to be in violation of a general requirement of the organization.
Specify how an app should be used by the organization to ensure the organization’s security posture

Examples:
- Apps that access a network must not be used in a sensitive compartmented information facility (SCIF)
- Apps that record audio or video must only be used by classified personnel

The satisfaction or violation of a context-sensitive requirement must be determined by an Auditor using organization-specific vetting criteria

Examples of organization-specific vetting criteria:
- The app’s intended set of users
- The app’s intended deployment environment
Procuring Budget and Staff

- Ensure Auditors are properly trained in software assurance, analyzer reports/risk assessments, and the organization’s security policies and requirements.

- Budget:
  - Equipment, licensing (Analyzer Tools and Services)
  - Salaries (Auditors, Administrators, etc.)

- Review the organization’s mobile hardware and OS for security controls that might already address security/privacy requirements (e.g., encrypted file system)
Limitations of App Vetting

- May be difficult to ascertain the degree to which app vetting improves the organization’s security posture.
- Results will vary depending on the quality of the Analyzers, Auditors, etc.
App Testing

- Involves the testing of apps for software vulnerabilities by Analyzers that may be internal or external to the organization
- Involves generating reports and risk assessments
- Risk assessments:
  - estimate the likelihood that a detected vulnerability will be exploited by an attacker
  - estimate the impact that a detected vulnerability may have on the app or its related device or network
  - are often represented as ordinal values indicating the severity of the risk (e.g., low-, moderate-, and high-risk)
Testing Approaches

• Correctness Testing
• Source Code vs. Binary Code
• Static vs. Dynamic Analysis
• Automated Tools
  – Disclaimer: NIST is prohibited from recommending or endorsing commercial testing entities, products, equipment, or materials
• Sharing Results/Leveraging Existing Reports
  – Significantly reduces cost and effort
  – Reference vulnerability repositories including the National Vulnerability Database (NVD)
Recommendations

• Ensure that Analyzers detect vulnerabilities that satisfy or violate the organization’s general app security requirements
• Leverage existing test results if possible
• Leverage multiple analyzers to increase vulnerability detection coverage
• Understand security implications (integrity, IP, and licensing issues) of sending app file to third-party analyzers
Auditing/Approval

• Involves Auditors that examine reports and risk assessments from Analyzers, as well as organization-specific vetting criteria against context-sensitive requirements to generate recommendations

• Organization-specific vetting criteria includes:
  – Target set of users
  – Target deployment environment
  – Provenance (Identity of developer, developer’s organization/reputation, app store consumer reviews, etc.)

• An Approver assesses recommendations from Auditors and considers other non security-related issues to determine the official approval or rejection of an app
Recommendations

• Identify organization-specific vetting criteria
• Ensure that organization-specific vetting criteria can be used to determine the satisfaction or violation of context-specific requirements
• Ensure sufficient training of auditors on organizational security requirements and interpretation of analyzers’ results
• Monitor vulnerability repositories to keep abreast of new developments
Questions