Ovaldroid: an OVAL-based Vulnerability Assessment Framework for Android

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1. Introduction

- Overwhelming development of mobile technologies and services [1].
- Large-scale deployment of Android-based devices [2].
- However, security issues require special attention.
  - x Hostile environments involving vulnerabilities and malware.
  - x Lack of standard and mature means for exchanging Android related security information.
  - x Limited resources on mobile devices.

The Big Question

How do we increase the vulnerability awareness of Android-based devices?

⇒ We propose a lightweight OVAL-based framework to efficiently increase vulnerability detection capabilities in the Android platform. ✓

2. The OVAL Language

- Open Vulnerability and Assessment Language [3].
- Information security standard for assessing and reporting the machine state of computer systems.
  - Representing system configuration information for testing.
  - Analyzing the system for the presence of the specified machine state.
  - Reporting the results of the assessment.

3. The Model

- $P = \{p_1, p_2, \ldots, p_n\}$. Set of atomic properties to observe on target systems.
- $V = \{v_1, v_2, \ldots, v_m\}$. Set of vulnerabilities composed of a logical combination of properties p_i.

Vulnerability pattern matrix (n=5, m=3) example:

$$\left.\begin{array}{l} v_1 = (p_1, p_3, p_5) \\ v_2 = (p_2, p_4) \\ v_3 = (p_1, p_2, p_5) \end{array}\right\} \quad PM_{3,5} = \begin{pmatrix} 1 & 0 & 1 & 0 & 1 \\ 0 & 1 & 0 & 1 & 0 \\ 1 & 1 & 0 & 0 & 1 \end{pmatrix}$$

System state properties encoded as:

$$s = (s_1, s_2, \ldots, s_n) \quad s_i \in \{0, 1\}$$

We define the $hflatten$ operator as follows:

$$hflatten(PM) = (\sum_{j=1}^{n} a_{1j}, \sum_{j=1}^{n} a_{2j}, \ldots, \sum_{j=1}^{n} a_{mj})^T$$

⇒ **Vulnerability assessment process:**

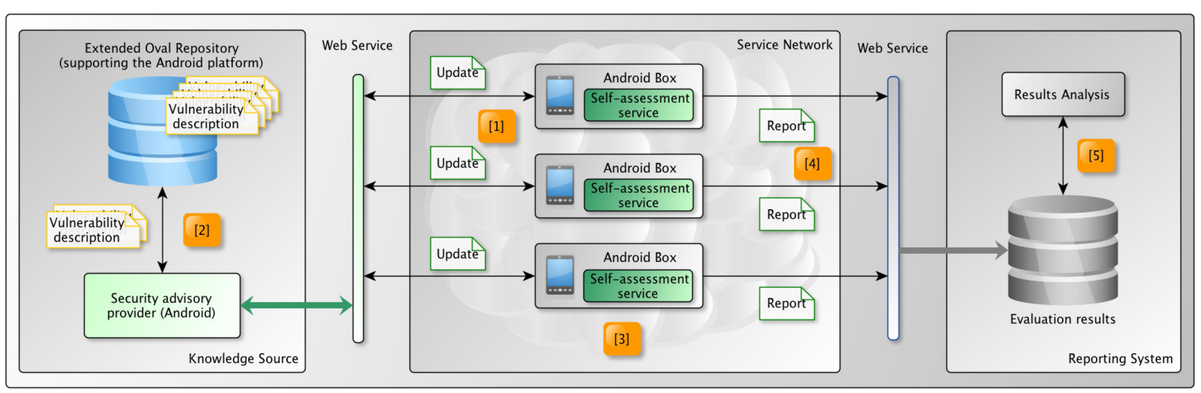
$$w = hflatten(PM) - [PM * s^T]$$

$$\Downarrow$$

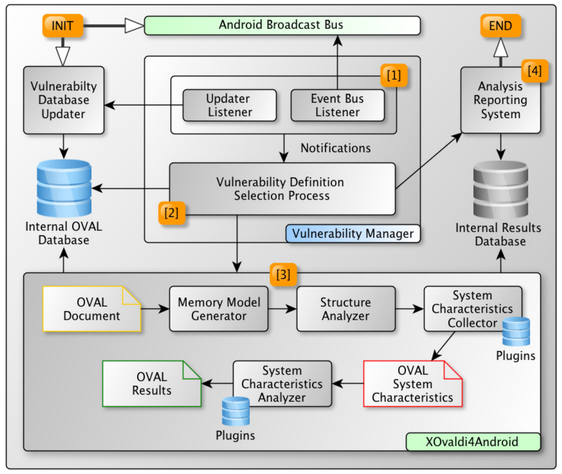
$$w = \begin{pmatrix} \sum_{j=1}^{n} a_{1j} \\ \sum_{j=1}^{n} a_{2j} \\ \vdots \\ \sum_{j=1}^{n} a_{mj} \end{pmatrix} - \left[\begin{pmatrix} a_{1,1} & a_{1,2} & \cdots & a_{1,n} \\ a_{2,1} & a_{2,2} & \cdots & a_{2,n} \\ \vdots & \vdots & \ddots & \vdots \\ a_{m,1} & a_{m,2} & \cdots & a_{m,n} \end{pmatrix} \times \begin{pmatrix} s_1 \\ s_2 \\ \vdots \\ s_n \end{pmatrix} \right]$$

Vector $w = (w_1, w_2, \ldots, w_m)$ denotes the status of each vulnerability v_i in the target system. A null entry w_i indicates that vulnerability v_i is present in the system while a non null value denotes its absence.

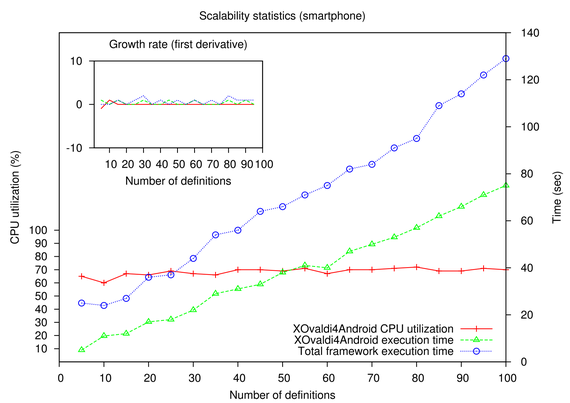
4. The Architecture

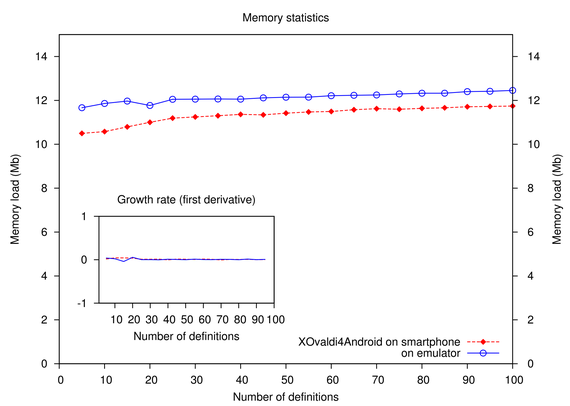


5. Self-assessment Internals



6. Scalability Statistics





The Important Fact

Real autonomy can only be achieved if we are able to ensure safe mobile configurations.

7. Conclusions and Outlook

- Mathematical model for supporting the vulnerability assessment process.
- Lightweight distributed OVAL-based framework for efficiently detecting vulnerable mobile configurations.
- Comprehensive set of experiments that show the feasibility of the proposed approach.
- Future work.
  - Protection mechanisms within the assessment framework.
  - Security advisory exchange between neighboring devices.
  - Integration of distributed vulnerabilities descriptions to detect mobile massive attack scenarios [4].
  - Closure of the vulnerability management lifecycle by performing corrective tasks thus getting closer to real autonomic solutions [5].

References

[1] M. Barrère, G. Hurel, R. Badonnel, and O. Festor. Increasing Android Security using a Lightweight OVAL-based Vulnerability Assessment Framework. In Proceedings of the 5th Symposium on Configuration Analytics and Automation (SafeConfig'12), October 2012.

[2] Android. `http://www.android.com/`. Cited May 2013.

[3] The OVAL Language. `http://oval.mitre.org/`. Cited May 2013.

[4] M. Barrère, R. Badonnel, and O. Festor. Towards the Assessment of Distributed Vulnerabilities in Autonomic Networks and Systems. In Proceedings of the IEEE/IFIP Network Operations and Management Symposium (NOMS'12), April 2012.

[5] N. Ziring and S. D. Quinn. Specification for the Extensible Configuration Checklist Description Format (XCCDF). NIST, March 2012.

Acknowledgements

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