

Security Management Introduction

Arquitectura de servidores con software libre

GSyC

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Security Management: Introduction

- Primary Concepts: C-I-A
- Confidentiality: Information Classification
- Integrity: Data cannot be altered without being detected
- Availability: Fault tolerance, Single point of failure, backups, etc.

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Security Management: Introduction

- Security is a comprehensive area, including:
 - Risk Management
 - Information Security Policies
 - Guidelines, Baselines, Procedures and Standards
 - Security organisation and education, etc
- The aim of security is to protect the company/entity and its assets

Security Management: Concepts

- **Identification:** means by which users identify themselves to the system
- **Authentication:** testing or reconciliation of evidence of users identity
- **Accountability:** system ability to determine actions of users within the system and identify the user
- **Authorisation:** rights and permissions granted to a user or process
- **Privacy:** Level of confidentiality and privacy protection of a user

Before talking more about security...

- Libre software and Security
- More or Less secure?



Security in Libre Software: Myths and facts

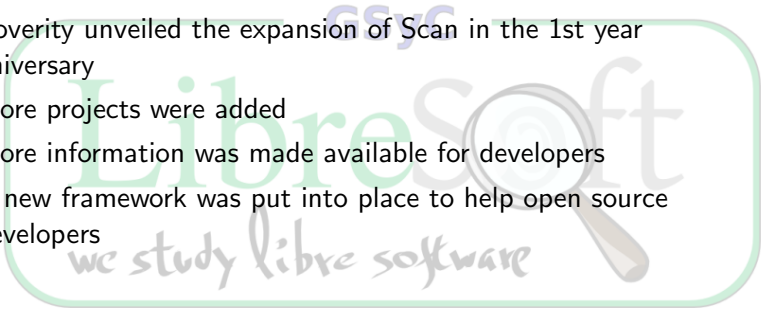
- Is Open Source Good for Security?
<http://www.dwheeler.com/secure-programs/Secure-Programs-HOWTO/open-source-security.html>
- Risky business: Keeping security a secret
<http://www.zdnet.com/news/risky-business-keeping-security-a-secret/127072>

FLOSS Security: facts

- Coverity Scan Initiative
- Launched on March 6, 2006
- In the first year of operation, over 6,000 software defects were fixed
- FLOSS developers use the analysis results from the Coverity Scan service
- In the first year, 50 open source projects written in C and C++ were included.

Coverity Scan

- Coverity unveiled the expansion of Scan in the 1st year anniversary
- More projects were added
- More information was made available for developers
- A new framework was put into place to help open source developers



Coverity Scan 2010

- Coverity Scan 2010 experiment another transformation
- Up to 291 projects
- 191 out of 291 with active developer support
- Over 61 million unique lines of code were tested
- 49.654 defects identified
- ... and the open source community has fixed 15.278 of them.

Coverity Scan 2010. Defects

TABLE 2: MOST COMMONLY FOUND DEFECTS

Defect Type	2008 Frequency	2009 Frequency	2010 Frequency	% Difference from 2009	Risk/Impact Category
NULL Pointer Dereference	27.95%	27.81%	27.60%	0.19% ↓	Medium
Resource Leak	25.73%	23.34%	23.19%	0.15% ↓	High
Unintentional Ignored Expressions	9.76%	9.71%	9.76%	0.05% ↑	Medium
Use Before Test (NULL)	8.09%	8.35%	8.86%	0.51% ↑	Medium
Uninitialized Values Read	5.50%	8.41%	8.30%	0.09% ↓	High
Use After Free	6.46%	5.91%	5.64%	0.27% ↓	High
Buffer Overflow (statically allocated)	6.14%	5.79%	5.52%	0.27% ↓	High
Unsafe Use of Returned NULL	5.85%	5.30%	5.37%	0.07% ↑	Medium
Unsafe Use of Returned Negative	3.72%	3.90%	3.73%	0.17% ↓	Medium
Type and Allocation Size Mismatch	.62%	1.10%	1.56%	0.46% ↑	High
Buffer Overflow (dynamically allocated)	.31%	.21%	.29%	0.08% ↑	High
Use Before Test (negative)	.21%	.18%	.17%	0.01% ↓	Medium

Coverity Scan. Integrity Levels

- Coverity Integrity Level 1
 - Defect density equals or less than 1 defect/kloc
- Coverity Integrity Level 2
 - Defect density equals or less than 0.1 defect/kloc
 - 90th industry percentile
- Coverity Integrity Level 3
 - Defect density equals or less than 0.01 defect/kloc (99th industry percentile)
 - Less than 20 % of the results
 - Zero high defects
- Level Not Achieved
 - Too many unresolved defects

Coverity Scan 2010

- Several popular projects (Firefox, Linux and PHP) were included before
- Android kernel 2.6.32 (Froyo) was included in 2010
 - Lines of Code Inspected: 765,642
 - Project Defect Density: 0.47 (defects per thousand lines of code)
 - High and Medium Impact Defects: 359

Coverity Scan 2010: Android Froyo

High-Risk Defects

High-impact defects that cause crashes, program instability, and performance problems.

Memory - corruptions

20

Memory - illegal accesses

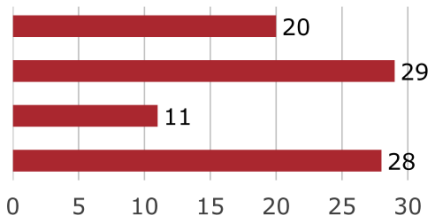
29

Resource leaks

11

Uninitialized variables

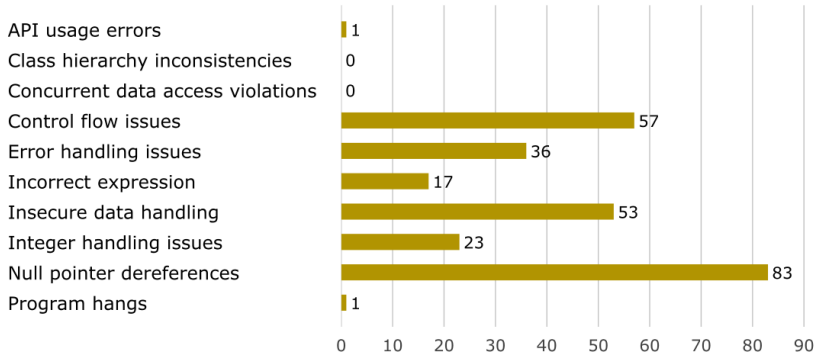
28



Coverity Scan 2010: Android Froyo

Medium-Risk Defects

Medium-impact defects that cause incorrect results, concurrency problems, and system freezes.



Coverity Scan 2010: Android Froyo

- The Android kernel used in the HTC Droid Incredible has approximately half the defects that would be expected for average software of the same size.
- Android-specific code that differs from the Linux kernel had about twice the defect density of the core Linux kernel components.

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Coverity Scan

- For more information and details, check out the 2008, 2009 and 2010 reports.

Questions? / Comments?

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Risk Management: Introduction

- The aim of security is to protect the company/entity and its assets
- Risk management
 - Identifies these assets
 - Point to the threats putting them in peril
 - Estimates the potential loss and harm if the threat becomes reality
 - Identify action plans to mitigate those risks
 - Provide an economic balance between the safeguard implemented and the impact of the threat

Security Management: Definitions

- Vulnerability
 - Absence or weakness of a safeguard
 - Is a HW or SW weakness that may provide an attacker a way to compromise our (CIA) system.
 - Could be an open port, unpatched applications, unrestricted modem dial-in access, no physical security, etc,
- Threat
 - Any event that causes an undesirable impact on our organisation.
 - Any potential danger to the system or to the information.
 - Could be a Tsunami, an unintentional mistake leading to confidential data exposure, a process reading data violating our data policy, etc

Security Management: Definitions

- Risk
 - Is the probability of a threat agent exploiting a vulnerability and the corresponding business impact
 - Potential lost or harm to a system.
 - If there is no IDS, the risk (likelihood) of unnoticed attacks would be high
 - If there is no awareness training, the risk of unintentional mistakes causing information deletion/exposure would be high
- Exposure
 - Is an instance of being exposed to harm or lost from an entity that takes advantage of a vulnerability

Security Management: Definitions

- Safeguard

- Is the countermeasure to put in place to mitigate the potential risk
- Could be a procedure, a piece of HW or SW, etc
- Access Controls, strong password management policies, awareness training, etc

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Security Management: Risk Management

- Information Risk Management (IRM)
 - The prime objective of security controls is to reduce effects of threats and vulnerabilities to a level that is tolerable
 - We have to implement the right mechanism to set and keep that level of risk
- Types of Risk
 - There are many risk categories: Physical damage, Human interaction, Equipment malfunction, Inside and outside attacks, Misuse of data, Loss of data and Application errors.

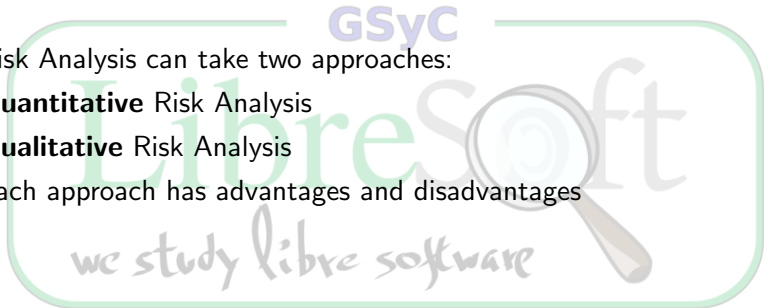
Security Management: Risk Analysis

- Risk Analysis Objectives

- Identify assets and their values
- Identify vulnerabilities and threats
- Quantifying the probability and business impact of these potential threats
- Provide an economic balance between the impact of the threat and the cost of the countermeasure

Security Management: Risk Analysis

- Risk Analysis can take two approaches:
- **Quantitative** Risk Analysis
- **Qualitative** Risk Analysis
- Each approach has advantages and disadvantages



Security Management: Risk Analysis

- Risk Analysis Steps

- Assign Value to Assets
- Estimate potential loss per threat
- Carry out a threat analysis
- Derive the Overall Loss Potential per Threat
- Reduce, Transfer or Accept the risk

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Security Management: Risk Analysis

- Value of Assets
 - Quantitative and Qualitative measures
 - The actual value of an asset is determined by the cost to acquire, develop and maintain it.
 - Value of the asset to owners and users
 - Value of the asset to competitors
 - Intellectual property issues
 - Liability issues (Data protection)
 - It is critical to take into account the business impact!

Security Management: Risk Analysis

- Identifying Threats

- Viruses, Attacks, Intruders
- Physical Threats
- Employees / Users / Contractors
- Gather information about the probability of each threat
- Calculate the annualised rate of occurrence (ARO)

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Security Management: Risk Analysis

- Reduce, Transfer or Accept the Risk
 - Reducing the risk:
 - Set controls
 - Improve procedures
 - Security awareness training
 - ...
 - Transferring the risk:
 - Insurance
 - Accepting the risks:
 - Stop using resources for protection and live with the risk

Security Management: Risk Analysis

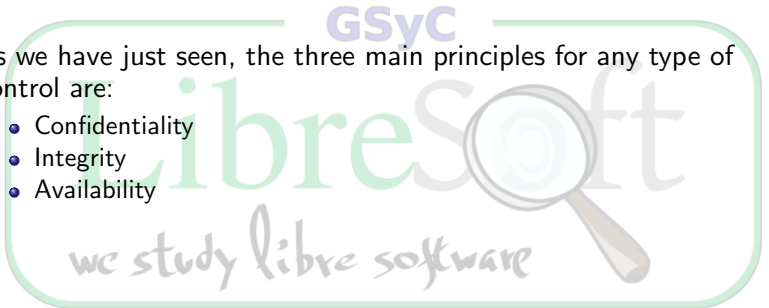
- Risk Analysis Results
 - Monetary values assigned to assets
 - Comprehensive list of all possible and significant threats
 - Likelihood of the occurrence rate (for each threat)
 - Potential loss that the company/entity can endure per threat in a timely basis
 - Recommended safeguards, remediation actions, countermeasures
- Residual Risk

Access Control Definition

- Set of procedures performed by hardware, software and administrative items
- Aimed to:
 - Monitor access
 - Identify user requesting access
 - Record access attempts
 - Grant or deny access based on a pre-established rules

Access Control Principles

- As we have just seen, the three main principles for any type of control are:
 - Confidentiality
 - Integrity
 - Availability



Access Control Models: MAC

- Mandatory Access Control
 - Subjects have a **clearance**
 - Objects have a **classification**
 - Subjects must have a **need to know** over the Objects
 - Subjects can access Objects with the same or below clearance level and a need to know for the Objects
 - Rule-based access control is a type of MAC (access is not based on identity)
 - Unclassified, confidential, secret and top secret **sensitivity**
 - SELinux, TrustedBSD are examples of Free OS implementing MAC

Access Control Models: DAC

- Discretionary Access Control
 - The subject can specify (with limitations) what objects are accessible
 - Access Control Lists (ACL) can be set up
 - ACL shows what subjects can use what objects with what privileges
 - Common Unix system of users, groups, and read-write-execute permissions
 - Identity-based access controls

Access Control Models: Non DAC

- Non-Discretionary Access Control
 - Also known as Role-based access control (RBAC)
 - Assigning a user to a role is imposed (Always)
 - A central Authority determines access between subjects and objects
 - Access controls can be role-based or task-based
 - These kind of control do not need to be updated if there is a role change in the company
 - is RBAC a type of MAC?
 - <http://csrc.nist.gov/rbac>

Access Control Models Wrap up

- **MAC:** Operating Systems, using security labels, enforce the model and therefore their security system
- **DAC:** Data owners decide which subjects has access to which objects
- **RBAC:** Access to objects is determined by the role of each subject

Access Control Types

- Preventive (Inhibit)
- Detective (Discover)
- Corrective (Restoring)



Access Control Implementation

- Access Controls can be implemented with a set of measures:
 - **Administrative**
 - Policies, procedures, staff training, reviews.
 - **Logical/Technical**
 - ACL, Firewalls, Smart Card Access, Encryption, etc
 - **Physical**
 - Server Facilities locking, backing up, cable protection, etc

Access Control Attacks

- Denial of Service
 - Compromises the availability
 - Buffer Overflows, SYN Attack, etc
 - Authorisation
- Back Door
 - Bypasses access control mechanisms
- Spoofing, Man in the Middle, Session Hijacking, Social Engineering.
- Dumpster diving
- Password guessing, Brute Force, Dictionary Attacks
- Software exploits, Trojan Horses, etc

Access Accountability

- Access Controls provide Access Accountability
- Access Accountability needs:
 - Identification
 - Authentication
 - Authorisation



Identification, Authentication and Authorisation

- **Identification** sets a method of ensuring that a user, program or process (any subject) is the entity it claims to be.
 - Usernames, Account numbers are ways to identify a subject
- **Authentication** is the fact of confirming an identity claim made by or about the subject
 - Passwords, PINs, Criptographic key, etc are usually authentication methods
- **Authorisation** is the procedure of specifying access rights to a set of resources
 - Usually the system checks an access control matrix or an ACL

Strong Authentication

- There are 3 general aspects to prove be authenticated:
 - Something you **KNOW**
 - Usually a PIN, password, etc
 - Easy and cheap to implement
 - Something you **HAVE**
 - Usually a key, a badge, etc
 - Normally used for physical access, but can be required for logical access
 - Something you **ARE**
 - Biometrics
 - Complex and expensive implementation.
 - False positives/negatives (Type I/II errors). Crossover rate
- **Strong Authentication** contains 2 out of 3 aspects. Also know as **two-factor authentication**

Passwords

- Most common authentication method: User id bound with a reusable password.
- Also weakest method!
- Therefore, usually access control relies on password strength
- Becomes very important the password management policy
- Is an important target in attacks
- Tools to analyse the targeted social network profiles to create custom dicts
- Tools to create non-dictionary typical human variations

Password gathering techniques

- Monitoring
- Accessing the password file
- Brute force attacks
- Dictionary attacks
- Social engineering



Password protection measures

- Set a clipping Level (user will be locked out for a fixed time)
- Limit the number of failed logon attempts
- Awareness training
- Password checkers
- Password hashing and Encryption
- Password aging
- Cognitive passwords
- One-Time passwords (dynamic passwords)
- Token devices
 - Synchronous
 - Asynchronous (challenge/response)

Access Control Assignment

- Password strength audit
- Using a well known GPL password cracker: John the ripper
- Add test users with increasing password complexity
- Perform a password strength audit in your own system
- Measure the time needed to crack the password with the password complexity

Access Control Assignment

- Download John the ripper software
- Download "SHA-512" patch, so hashes can be loaded (Recent Ubuntu and Fedora)
- Apply the patch and compile the patched john source code
- Unshadow the password file
- Proceed to audit the file

Access Control Assignment

- Of course, there are other good alternatives password audit FLOSS:

- **THC Indra**
- <http://www.thc.org/thc-hydra/>
- **Aircrack**
- <http://www.aircrack-ng.org/>
- **Airsnort**
- <http://airsnort.shmoo.com/>

John the ripper: GPL Password Audit Tool screenshot

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```
pcoca@chipiron:~/john-1.7.3.1/run$ sudo ./unshadow /etc/passwd /etc/shadow > crack.me
pcoca@chipiron:~/john-1.7.3.1/run$ ./john crack.me
Loaded 10 password hashes with 10 different salts (generic crypt(3) [?(/32])
test1 (test1)
test2 (test2)
abc (test3)
butterfly===== (test9)
dontknow (test8)
maria (test5)
guesses: 6 time: 0:00:17:22 7% (2) c/s: 47.01 trying: cookie1
```

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Access Control Questions

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How can the cheap and easy access to compute power in the cloud change the access control landscape?

Access Control Questions

- Cloud Cracking Suite presentation at Black Hat EU 2011:
 - https://stacksmashing.net/stuff/bh_eu_2011.pdf
- Cracking Passwords In The Cloud: Amazon's New EC2 GPU Instances
 - <http://stacksmashing.net/2010/11/15/cracking-in-the-cloud-amazons-new-ec2-gpu-instances/>
- Researcher uses AWS cloud to crack Wi-Fi passwords
 - <http://www.zdnet.co.uk/news/cloud/2011/01/14/researcher-uses-aws-cloud-to-crack-wi-fi-passwords-4009>

Questions?

