onapsis
Securing Business Essentials

SAP® Backdoors

A ghost at the heart of your business

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September 16, 2010

Ekoparty Security Conference

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Who is Onapsis?

- Specialized company focused in the **security of ERP and Business-critical Applications** (**SAP®,** Siebel®, Oracle® E-Business Suite™, JD Edwards® …).
- Core business areas:
  - ERP Security software (**Onapsis X1™**, **Onapsis Bizploit**).
  - Security consultancy services.
  - Trainings on business-critical systems security.

Who am I?

- **Director of Research and Development at Onapsis.**
- Degree in Computer System Engineering.
- Originally devoted to **Penetration Testing** and **Vulnerability Research**.
- Discovered **vulnerabilities** in Microsoft, Oracle, SAP, IBM, …
- **Speaker/Trainer** at Black Hat, HITB, Sec-T, Hack.lu, DeepSec, Ekoparty..

Agenda

- Introduction
- A Ghost in the User Master
- Backdoors in SAP Business Modules
- Backdoors in the Authentication Procedure
- Onapsis Integrity Analyzer for SAP
- Conclusions

Introduction

What is SAP?

- **Largest** provider of **business management solutions** in the world.
  - More than 140.000 implementations around the globe.
  - More than 90.000 customers in 120 countries.

- Used by **Fortune-500 world-wide companies**, **governmental organizations** and **defense facilities** to **run their every-day business processes.**
  - Such as Revenue / Production / Expenditure business cycles.

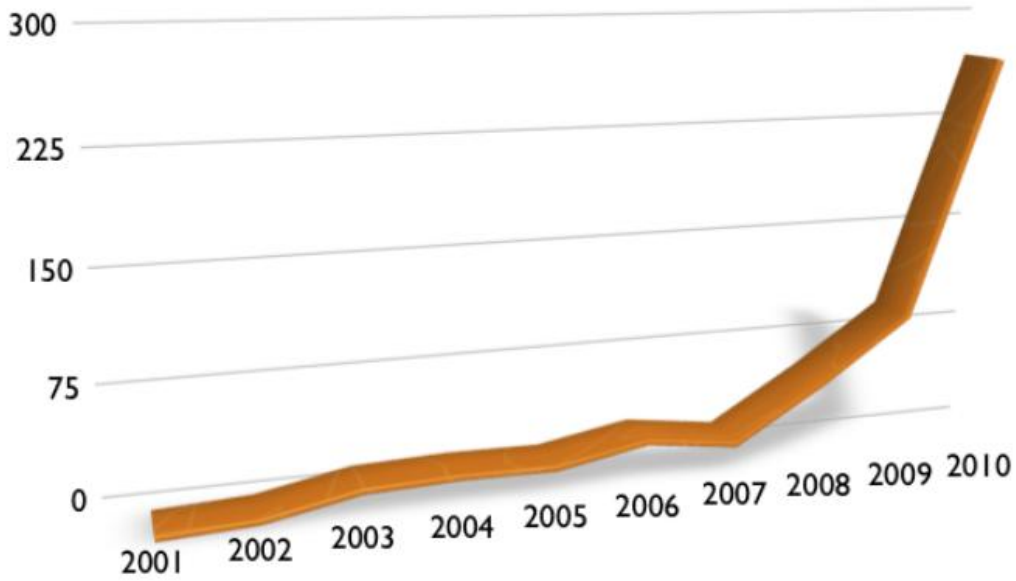
Why are SAP Backdoors special?

- Backdoors have been known since the origins of computer systems.
- However, there is very little (no) public information about how they can affect SAP platforms.
- **"Not Public" != "Not currently being exploited"**

- The biggest mis-conception in the term "SAP Security": **SAP Security is much more than Segregation of Duties!**
  - Most standards & regulations still don't get it.
  - Most Auditing companies still don't get it.
  - Some customers still don't get it.

Why are we talking about SAP security?

- SAP Vulnerabilities are in the rise.



- By default, **anyone** with network connectivity with an SAP Application Server can take **complete control** of the business information. No user, No password, No problems :P

SoD is not enough to prevent Backdoors!

From the trenches:

During an assessment, a "SoD compliant" SAP system (which had cost $$$$^n to implement), could be remotely compromised in a matter of seconds through the exploitation of a vulnerability in a technological component.

With that kind of privilege, a backdoor could have been installed.

Ok, but… which is the real risk?

CONFIDENTIALITY

AVAILABILITY

INTEGRITY

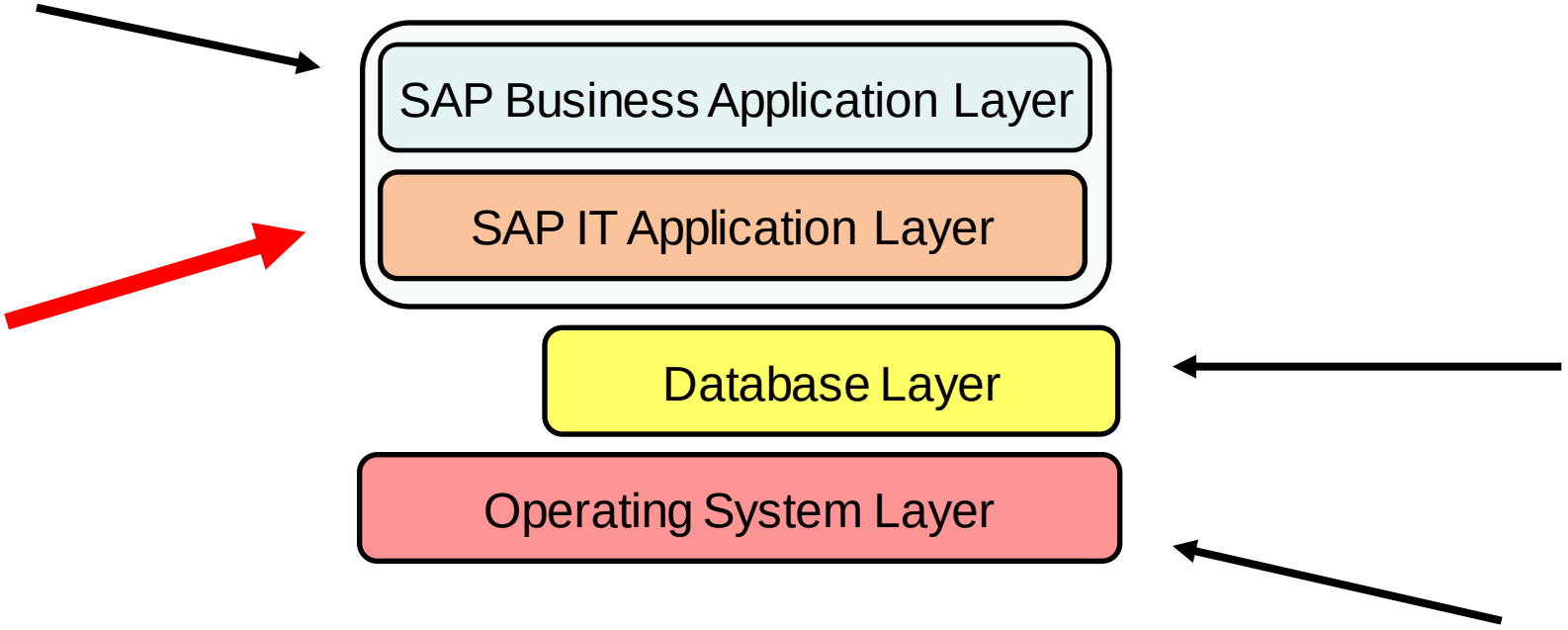
ESPIONAGE

SABOTAGE

FRAUD

The Initial Compromise

- In order to install a backdoor, the attacker **needs to compromise the system first**, and obtain high privileges.
- The Threat Model map includes the following components:



A Ghost in the User Master

Welcome to the SAP world…

- You connect to your company's Production SAP system through SAPGUI.
- **You have to specify access credentials**:
  - Client (logical "independent" unit in the SAP system)
  - Username
  - Password
- The system checks your saved password from the User Master.
- If your provided passwords matches the stored one… access granted.
- You start performing business processes and making the company earn billions.

Oops! Downwards compatibility…

- SAP has implemented different password hashing mechanisms to make systems stronger (from 8-characters MD5 to 40-characters SHA-1)

- The problem happens when a "weak" system wants to connect with a "strong" one… **integration fails -> business fails**.

- **Workaround: By default, the User Master shall contain the downwards-compatible hashes, as well as the strong one.**

- More than one password hash per user.

- This opens room for several attacks. Check Onapsis's "SAP Security In-Depth" Publication, issue #2 [2]

Oops! Downwards compatibility…

- **Which** password hash to use for comparison?
- Controlled through profile parameter **login/password_downwards_compatibility**

Value	Impact
0	Downwards-compatibility disabled. No weak hashes are generated.
1	Downwards-compatibility enabled. Weak hashes generated for integration with older releases. Weak hashes not evaluated.
2	If the logon attempt using the downwards-incompatible password fails, check if the downwards-compatible would work. Log and deny access.
3	The same as with 2, but **the logon is considered as successful**. This is registered in the system log.
4	The same as with 3, but **no system log entry is written**.

- Parameter can be modified dynamically! (No SAP restart required)

Live demo

Backdoors in SAP Business Modules

("Fraude", en criollo)

Welcome (back) to the SAP World…

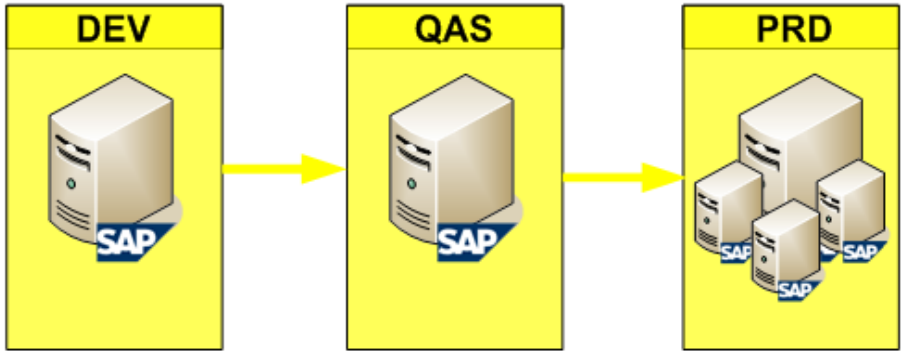
- Once logged-in, you interact with the system running Transactions.
- In fact, **you are running ABAP Programs/Reports**.
- ABAP Programs can be divided in:
  - **Standard** (Developed and Shipped by SAP A.G)
  - Custom (Developed in-house by the company. Starts with Z* or Y*)

- Standard programs can be modified, but strongly discouraged.
- **SSCR** steps in =>You must ask SAP A.G for a special key.

- ABAP Programs are stored in the **system's database**.
  - Table **REPOSRC** contains compressed source-code.
  - Table **REPOLOAD** contains ABAP load (~ bytecode).

The Change and Transport System

- Typical SAP system landscape:



- Developments and changes "can only be done in the DEV system".
- **The PRD system is configured to block any attempt to modify programs directly in the system.**

- Through this procedure, it is expected that *"the quality and availability of the SAP production systems is maximized".*

Unauthorized modification of ABAP Programs directly in the Production System is possible.

SAP's Heart: The Database

- Unauthorized modification at the SAP layer **may be possible**, **but not trivial.**
- What about the usually **mis-configured-left-by-default-LAN-accesible Database**??
  - SAP + Oracle Authentication Weakness.
  - Default *SAP Database user's* credentials.
  - Database exploits.
- The attacker can still get to the Database through the SAP system, due to the **intrinsic Trust relationships**!

- No CRC or signature check on the stored ABAP code.
- **Simple SQL queries will do the trick!**

Live demo

Backdoors in the Authentication Procedure

Protection for Critical ABAP Programs

- Certain **critical standard ABAP programs are protected** to prevent access to their source code from the SAP System, i.e. using transaction SE80.

- Started researching on **how this feature was implemented**:
  - REPOSRC.SQLX = 'X' ? No noticeable results.
  - **Special ABAP "Magic String": *@#@@[SAP]**

- If the source code contains the magic string, **the SAP Kernel rejects access to the source code**.

- However, there seems to be something else…

SAPMSYST – The SAP's Cop

- Probably **the most critical ABAP piece of code in an SAP system**.
- Handles the **User Authentication Procedure**.

- **This program is protected** through a specific, hard-coded **Kernel check**!

- The check is performed on the ABAP program's name…

- **Bypass is possible by pivoting the program in the Database.**

Live demo

Onapsis Integrity Analyzer for SAP

Onapsis Integrity Analyzer for SAP

- Purpose: **Detect modifications of ABAP code in an SAP system**.
- **Free** download from http://www.onapsis.com/ianalyzer (upcoming...)
- **Proof-of-concept**: Only working for SAP/Oracle 10g.
- Developed by Jordan Santarsieri and me @ the Onapsis Research Labs.

- Why you need it? **It's not feasible to detect backdoors from inside the SAP system itself:**
  - Backdoors can leave the Program's "Last modified date" untouched.
  - The analysis programs may have also been manipulated to hide the backdoor's presence!

Onapsis Integrity Analyzer for SAP

- Want to do it manually? Number of SAP programs are measured in hundred of thousands (and even more).
- *Onapsis Integrity Analyzer* connects with the **Database** and **performs "snapshots" of sensitive ABAP report tables.**
- Periodically, new snapshots are compared with older snapshots and modified programs are identified.
- Tracking of SAP Notes is also considered.

The detection of suspicious modifications should trigger a special investigation.

Conclusions

Some Thoughts on SAP Backdoors

- **The Backdoor threat** affects every information system; **it's not a specific SAP platform's risk**.
- Once an attacker obtained maximum privileges over an information system, it is **really** difficult to restrict his activities, and **SAP is not the exception.**
- **It's possible to modify ABAP programs directly in Production.**
- **SAP Backdoors can have devastating impacts over Business.**
- Attacks are possible through other vectors than DB access.
- These backdoors won't be installed for fun, **it's about MONEY.**

- **Onapsis's Integrity Analyzer for SAP** can help you to implement more in-depth reactive controls.

Some Thoughts on SAP Backdoors

- The best cost/effective protection: **Minimize probability of the initial compromise.**
  - Automated controls.
  - **Periodic technical security assessments of SAP platforms.**
    - Vulnerability Assessments.
    - Penetration Tests.
    - Security Audits.

Questions?

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Thank you!

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