The Tools Hackers Are Using Against Your Oracle Database Webinar

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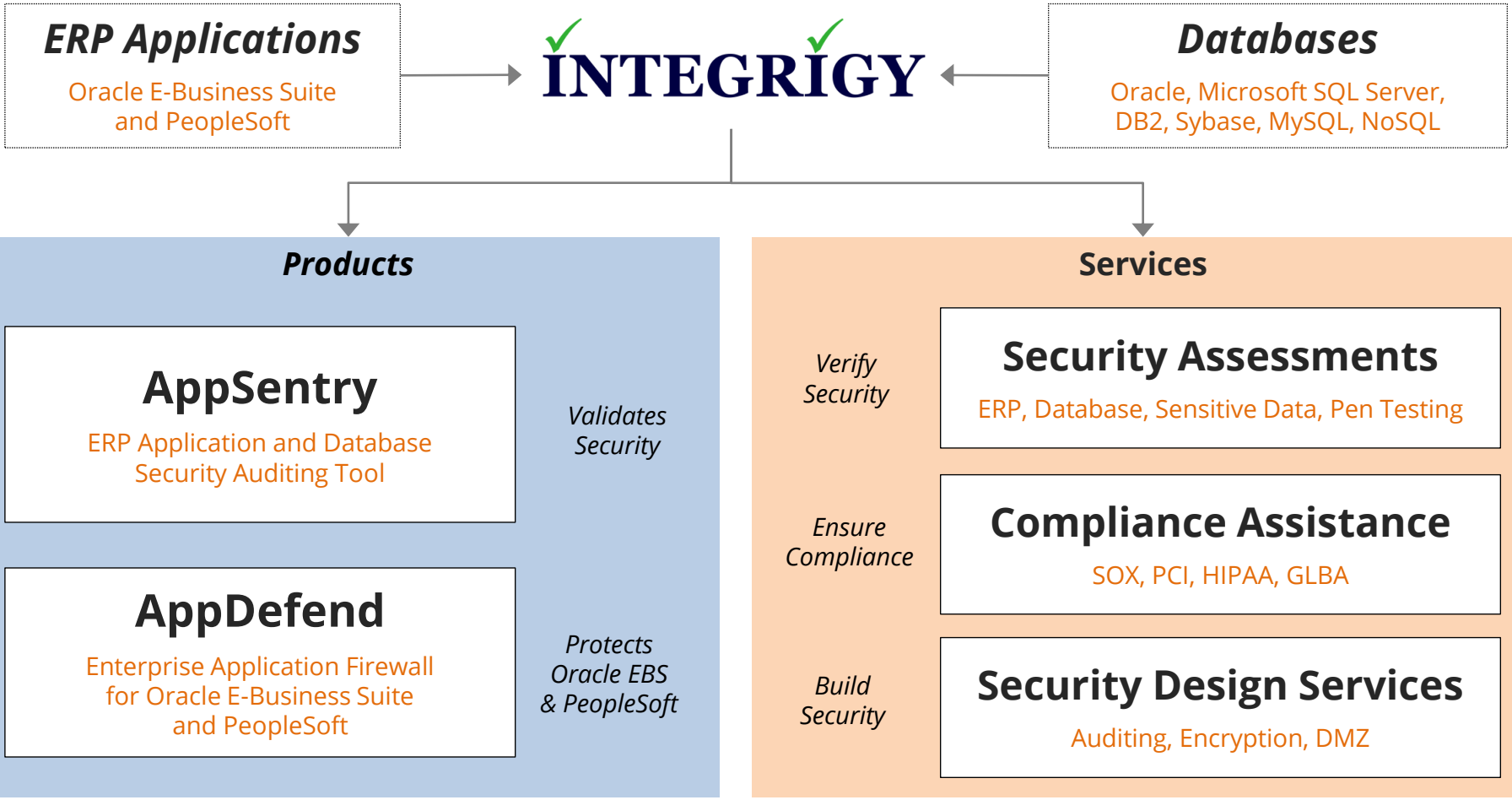
About Integrigy



Integrigy Research Team

ERP Application and Database Security Research

ORACLE Gold Partner

Agenda

1. Background
2. Tools and the Attack
3. Prevention
4. Detection
5. Q & A

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Targeted Attack

Targeted Attack

Advanced Persistent Threat (APT)

State Sponsored

Anonymous, LulzSec, Legion of Doom, ...

Bitcoin/Monero Mining

Sensitive Data in Databases

Credit Card Fraud
 	
Credit Card Data
	▪ Credit Card Number
	  ▪ *Primary Account Number (PAN)*
	▪ CVV/CV2/CID
	  ▪ *3 digits on the back for Visa/MC*
	  ▪ *4 digits on the front for AMEX*
	▪ Magnetic Stripe Data (very rare)

Identify Theft/Tax Fraud
 	
Personally Identifiable Information (PII)
	▪ First and last name
	▪ Date of Birth
	▪ Plus one of the following:
	  ▪ **Social security number**
	  ▪ Bank account number
	  ▪ Financial account number
	  ▪ Driver license or state ID number

Health Insurance Fraud
 	
Health Information
	▪ First and last name
	▪ Plus one of the following (Protected Health Information)
	  ▪ "the past, present, or future physical or mental health, or condition of an individual"
	  ▪ "provision of health care to an individual"
	  ▪ "payment for the provision of health care to an individual"

Last three years, the health care industry accounted for 42.5% of all breaches

- Identity Theft Resource Center

What is your data worth? Identify Theft

$1 – $5	▪ First and last name ▪ Social Security number	**Tax information (e.g., 1099)**
$20 – $40	▪ First and last name ▪ Social Security number ▪ Current address ▪ Date of birth	**Health care** **Human Resources**
$30 – $100	▪ First and last name ▪ Social Security number ▪ Current address ▪ Date of birth ▪ Bank account number or credit card number ▪ Salary	**Payroll**

- **2017 – 1.1 million potentially fraudulent tax returns**
- **2017 – IRS paid $4.4 billion in fraudulent tax refunds**
- **3,000 IRS employees dedicated to tax Fraud**

- General Accounting Office (GAO) Report

Database Valuation

Calculate the black-market value of the data contained in your database to help evaluate risk.

Data Type	*Formula*
Credit Cards	**(number of unique, unexpired cards) * $10**
Social Security Numbers	**(number of unique SSN + Name + DoB) * $20 or (number of unique SSN + Bank) * $50**

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Oracle Database Attack Tools

Nmap	**nmap.org** ▪ Database discovery, version, SID enumeration/brute force, password guessing, limited exploits
ODAT	**github.com/quentinhardy/odat** ▪ SID enumeration/brute force, password guessing, common exploits, Oracle OS attacks
Metasploit	**www.metasploit.com** ▪ SID enumeration/brute force, password guessing, limited exploits
Hydra	**github.com/vanhauser-thc/thc-hydra** ▪ SID enumeration/brute force, password guessing
Oscanner	**gitlab.com/kalilinux/packages/oscanner (7 years old)** ▪ SID enumeration/brute force, password guessing

Anatomy of the Targeted Attack

1 **Point of Entry**	Breach the perimeter network through a network compromise, phishing attack, or social engineering.
2 **Persistence**	Once inside, establish a “beach-head” and maintain the compromise over time (days, months, years).
3 **Lateral Movement**	Expand the compromise to more devices and systems.
4 **Asset Discovery**	The **Targeted Attack** has already identified “data of interest” and will being searching for it. *How to discover assets this without detection?*
5 **Asset Compromise**	The database is attacked in order to gain unauthorized access to “data of interest”. *How to compromise asset this without detection?*
6 **Data Exfiltration**	Once the “data of interest” has been gathered, it must be transferred externally without being detected. *How do you quietly steal gigabytes or terabytes of data?*

Database Discovery Techniques

Passive	▪ Search internal knowledge repositories for architecture diagrams, design documents, code repositories, etc. ▪ Find TNSNAMES.ORA files
Active	▪ Compromise DBA credentials through phishing or social engineering attacks ▪ Install malware on DBA machines and steal credentials, such as saved in SQL Developer ▪ Use Nmap to scan internal network for Oracle Databases on default port 1521 – very noisy

Demo – Search Engine (Internal)

- Findings tnsnames.ora files using internal search engines

- www.google.com
- search: `tnsnames filetype:ora`

Demo – Source Code Repositories

Obtaining passwords from internal source code repositories

www.github.com

search: `"alter user" "identified by"`

http://www.github.com

Note: To search all code repositories must be signed into Github with an account (including free accounts).

Demo – Developer Tools – Compromised Desktop

Decrypt SQL Developer passwords

`https://github.com/tomecode/show-me-password-sqldev-jdev`

Use extension in SQL Developer

Demo – Network Scanning – Find Databases

If the attacker can't find databases through other means, then the old-fashioned way by scanning the network.

Using Nmap to find Oracle databases

www.nmap.com

```
nmap -sT -sV -p 1521-1529 -T4 -v -n -Pn –open 192.168.2.11-50
```

Demo – Determine the SID if Unknown

To connect to a database need IP address/hostname, TNS port number, and SID/Service Name.

Using Nmap to brute force SID

www.nmap.com

```
nmap -p 1521 -v --script oracle-sid-brute 192.168.56.10
```

Database Compromise – Login into Database

Database Account	Default Password	Exists in Database %	Default Password %
SYS	CHANGE_ON_INSTALL	100%	3%
SYSTEM	MANAGER	100%	4%
DBSNMP	**DBSNMP**	**99%**	**52%**
OUTLN	**OUTLN**	**98%**	**43%**
MDSYS	MDSYS	77%	18%
ORDPLUGINS	ORDPLUGINS	77%	16%
ORDSYS	ORDSYS	77%	16%
XDB	CHANGE_ON_INSTALL	75%	15%
DIP	DIP	63%	19%
WMSYS	WMSYS	63%	12%
CTXSYS	**CTXSYS**	**54%**	**32%**

* Sample of 120 production databases – mostly production ERP databases such as SAP, Oracle EBS, and PeopleSoft

Demo – Brute Force Database Accounts

Using Nmap for Database Password Guessing

www.nmap.com

```
nmap -p 1521 -v --script oracle-brute
--script-args oracle-brute.sid=ORCL 192.168.56.10
```

Demo – Able to Connect and Access USER$

Brute forcing Oracle Database Passwords

Integrigy internal tool

google: `oracle password cracker`

free tools: woraauthbf, orabf

Final Step – Privilege Escalation

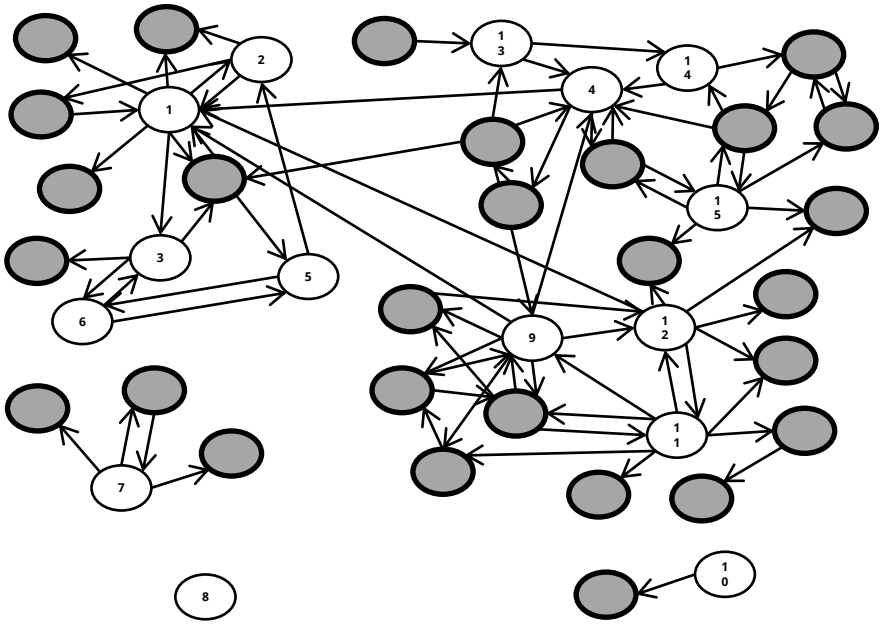
Last step is to escalate privileges by exploiting an unpatched vulnerability.

- Applying Critical Patch Updates (CPU) provided little protection until this point. CPU security patches matter at this point.
- Database hardening and configuration are as important.

The compromised database account privileges and the skill and creativity of the attacker matter most for this last step.

google: `oracle database privilege escalation`

Lateral Movement After Database Compromise



Overview

- Organization with about 150 production Oracle Databases
- Assessed15 key SOX and PCI compliance Oracle databases
- Reviewed database links for connectivity and appropriateness

Conclusion

- Compromised 28 other databases just through database links.

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Integrigy #1 Security Recommendation

- **Limit direct database access whenever possible**
  - Much harder to hack database if an attacker can not connect to it
  - Would have to use another avenue such as a web application or reporting tool (e.g., OBIEE)
- **Use firewalls in front of data center, network ACLs, TNS invited nodes, Oracle Connection Manager, Oracle Database Firewall, etc.**
  - DBAs should use bastion hosts to manage databases

Database Security Preventative Controls

- **Apply Oracle Critical Patch Updates on a regular basis on all databases**
  - Reduce risk of compromise and escalation of privileges
- **Check for default and weak passwords constantly**
  - Use multiple tools to check passwords
  - Install database profiles to enforce strong passwords
- **Harden database configurations**
  - Validate configurations on regular basis

Routinely Check for Default Passwords

- **Use Oracle's DBA_USERS_WITH_DEFPWD**
  - Limited set of accounts
  - Single password for each account

- **Command line tools (orabf, etc.)**
  - Difficult to run – command line only

- **AppSentry**
  - Checks all database accounts
  - Uses passwords lists - > 1 million passwords
  - Allows custom passwords

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Auditing Design

Use Integrigy Database Auditing and Logging Framework as starting point!

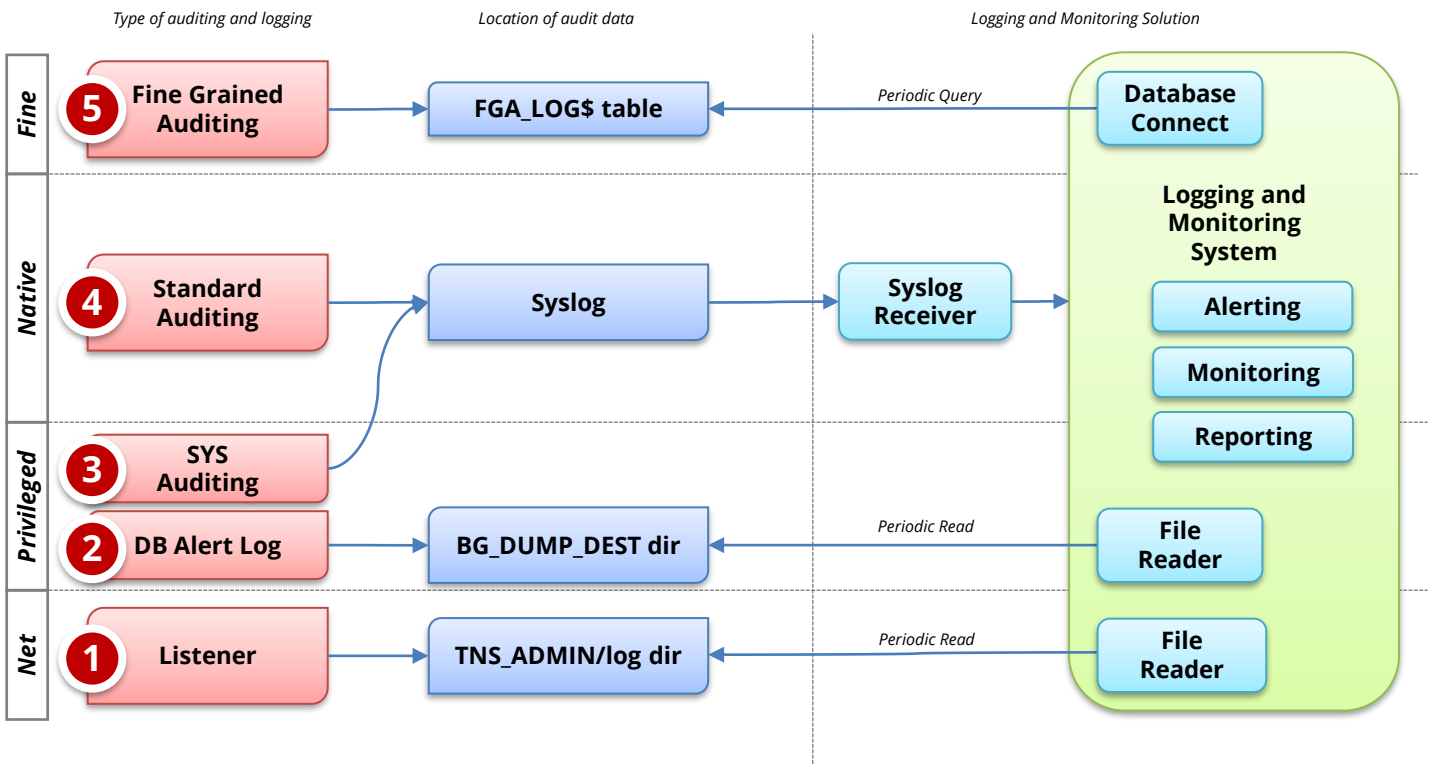
E1 - **Login**	*E8* - **Modify role**
E2 - **Logoff**	*E9* - **Grant/revoke user privileges**
E3 - **Unsuccessful login**	*E10* - **Grant/revoke role privileges**
E4 - **Modify auth mechanisms**	*E11* - **Privileged commands**
E5 - **Create user account**	*E12* - **Modify audit and logging**
E6 - **Modify user account**	*E13* - **Create, modify or delete object**
E7 - **Create role**	*E14* - **Modify configuration settings**

https://www.integrigy.com/security-resources/integrigy-guide-database-auditing-and-logging

Foundation Security Events Mapping

Security Events and Actions	PCI DSS 10.2	SOX (COBIT)	HIPAA (NIST 800-66)	IT Security (ISO 27001)	FISMA (NIST 800-53)
E1 - Login	10.2.5	A12.3	164.312(c)(2)	A 10.10.1	AU-2
E2 - Logoff	10.2.5	DS5.5	164.312(c)(2)	A 10.10.1	AU-2
E3 - Unsuccessful login	10.2.4	DS5.5	164.312(c)(2)	A 10.10.1 A.11.5.1	AC-7
E4 - Modify authentication mechanisms	10.2.5	DS5.5	164.312(c)(2)	A 10.10.1	AU-2
E5 – Create user account	10.2.5	DS5.5	164.312(c)(2)	A 10.10.1	AU-2
E6 - Modify user account	10.2.5	DS5.5	164.312(c)(2)	A 10.10.1	AU-2
E7 - Create role	10.2.5	DS5.5	164.312(c)(2)	A 10.10.1	AU-2
E8 - Modify role	10.2.5	DS5.5	164.312(c)(2)	A 10.10.1	AU-2
E9 - Grant/revoke user privileges	10.2.5	DS5.5	164.312(c)(2)	A 10.10.1	AU-2
E10 - Grant/revoke role privileges	10.2.5	DS5.5	164.312(c)(2)	A 10.10.1	AU-2
E11 - Privileged commands	10.2.2	DS5.5	164.312(c)(2)	A 10.10.1	AU-2
E12 - Modify audit and logging	10.2.6	DS5.5	164.312(c)(2)	A 10.10.1	AU-2 AU-9
E13 - Objects Create/Modify/Delete	10.2.7	DS5.5	164.312(c)(2)	A 10.10.1	AU-2 AU-14
E14 - Modify configuration settings	10.2.2	DS5.5	164.312(c)(2)	A 10.10.1	AU-2

Traditional Database Auditing (pre 12c, 12c Mixed Mode)



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