Java & Secure Programming

(Bad Examples found in JDK)

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Illegalaccess.org

The speaker

- **Marc Schönefeld, Diplom-Wirtschaftsinformatiker**
  - **For Science: External doctoral student @ Lehrstuhl für praktische Informatik at University of Bamberg, Bavaria, Germany**
    - **Thesis project:**
      REFACTORING OF SECURITY ANTIPATTERNS IN DISTRIBUTED JAVA COMPONENTS
  - **For Living: Department for Operational Security Management**
    at computing site for large financial group in Germany
    - **Java, J2EE, CORBA [CSMR 2002]**
      - **design and development**
      - **Security Hardening (code audit)**

The situation

- **Java (we cover J2SE here, some aspects also apply to J2EE)**
  - **is designed as a programming language with inherent security features [Gong, Oaks]**
    - **JVM-Level: Type Safety, Bytecode integrity checks**
    - **API-Level: SecurityManager, ClassLoader, CertPath, JAAS**
    - **Crypto-Support: JCA/JCE, JSSE**
  - **So what's the problem ?**

Selected Java Security Alerts in 2003/2004:

- **Java Runtime Environment May Allow Untrusted Applets to Escalate Privileges**
- **A Vulnerability in JRE May Allow an Untrusted Applet to Escalate Privileges**
- **...Java Virtual Machine (JVM) May Crash Due to Vulnerability in the Java Media Framework (JMF)...**
- **...Java Runtime Environment Remote Denial-of-Service (DoS) Vulnerability ...**

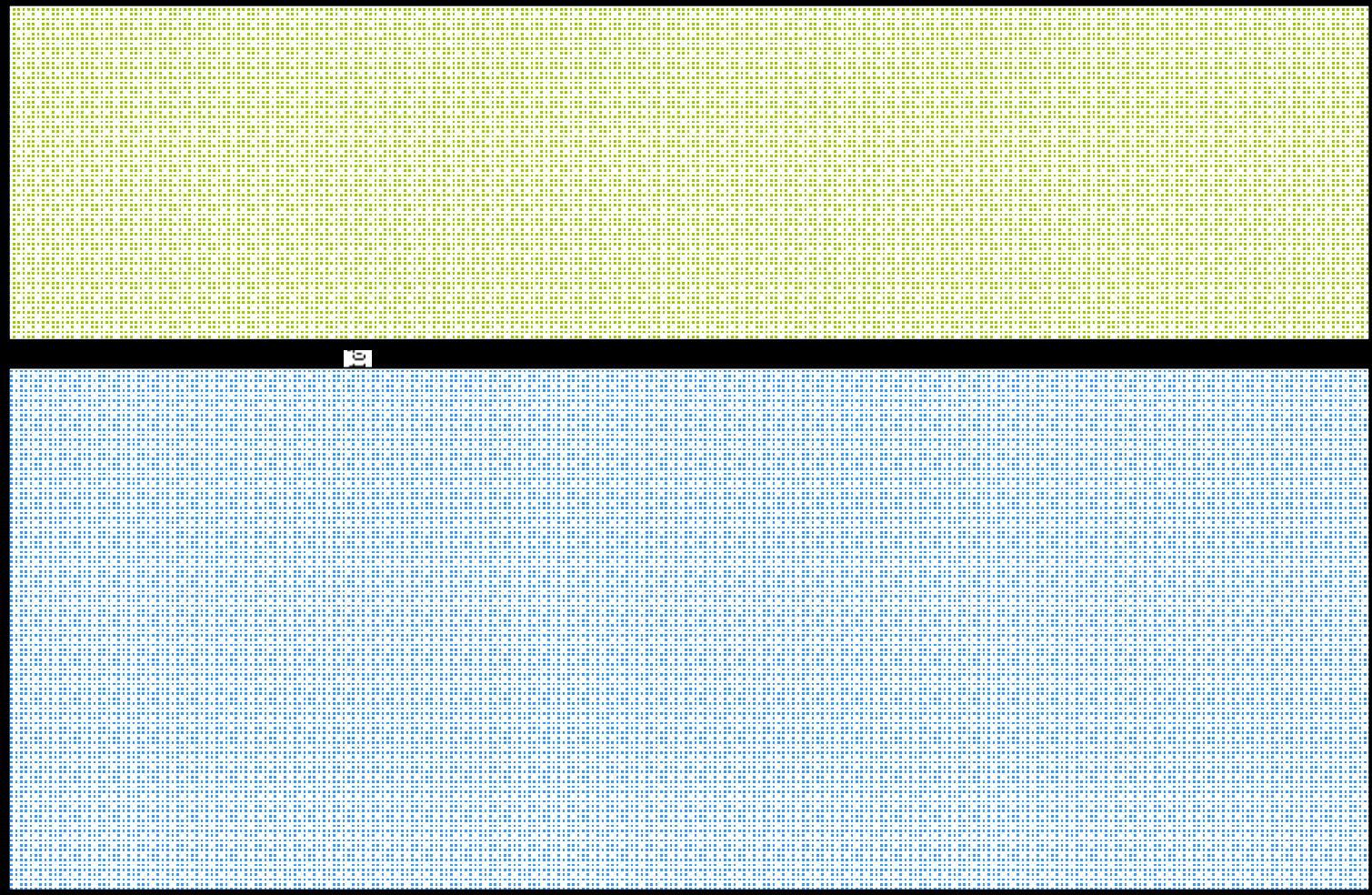
Despite of the precautions of the Java Security Architecture, a lot of attack potential ...

what's the cause?

The problem

- **A platform (like the Java runtime environment) can only support the programmer's intent**
- **What is programmer's intent ? Reflects different perspectives …**
  - **Functionality [application programmer]**
    - Java has a large API with lots of predefined functions (sockets, files, …)
  - **Quality and ReUse [middleware programmer]**
    - Java provides communication and marshalling on different semantic levels (Sockets, RMI, CORBA, Raw-Serialisation, XML-Serialisation, …)
  - **Safety [security architect]**
    - Java provides Isolation Support, Crypto-Objects and Secure Sockets out of the box
  - **Malicious Intent [adversary]**
    - Undermine security by finding the weak spots
    - Java VM and core libraries have (lots of?) vulnerabilities

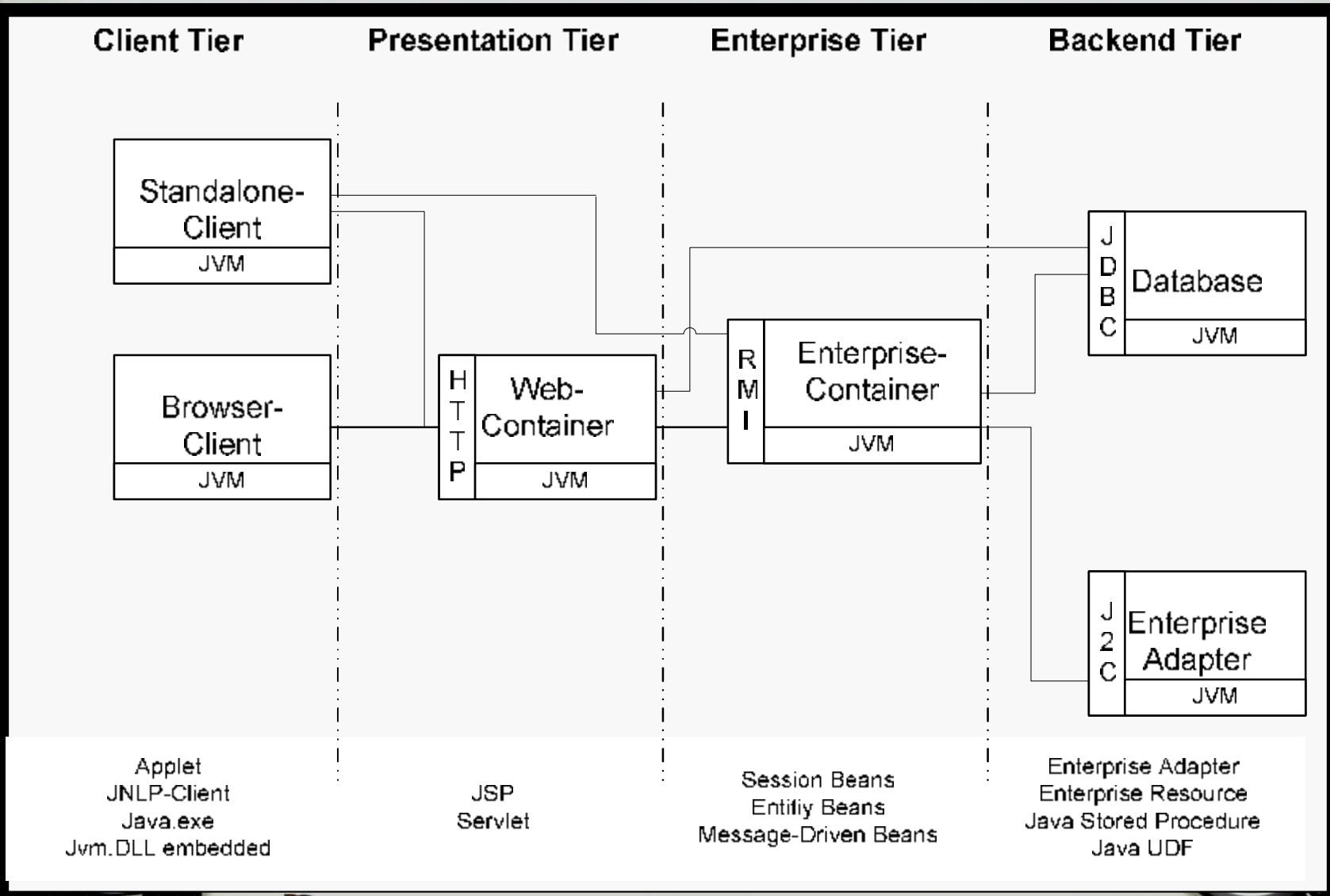
Classloaders and Protection Domains



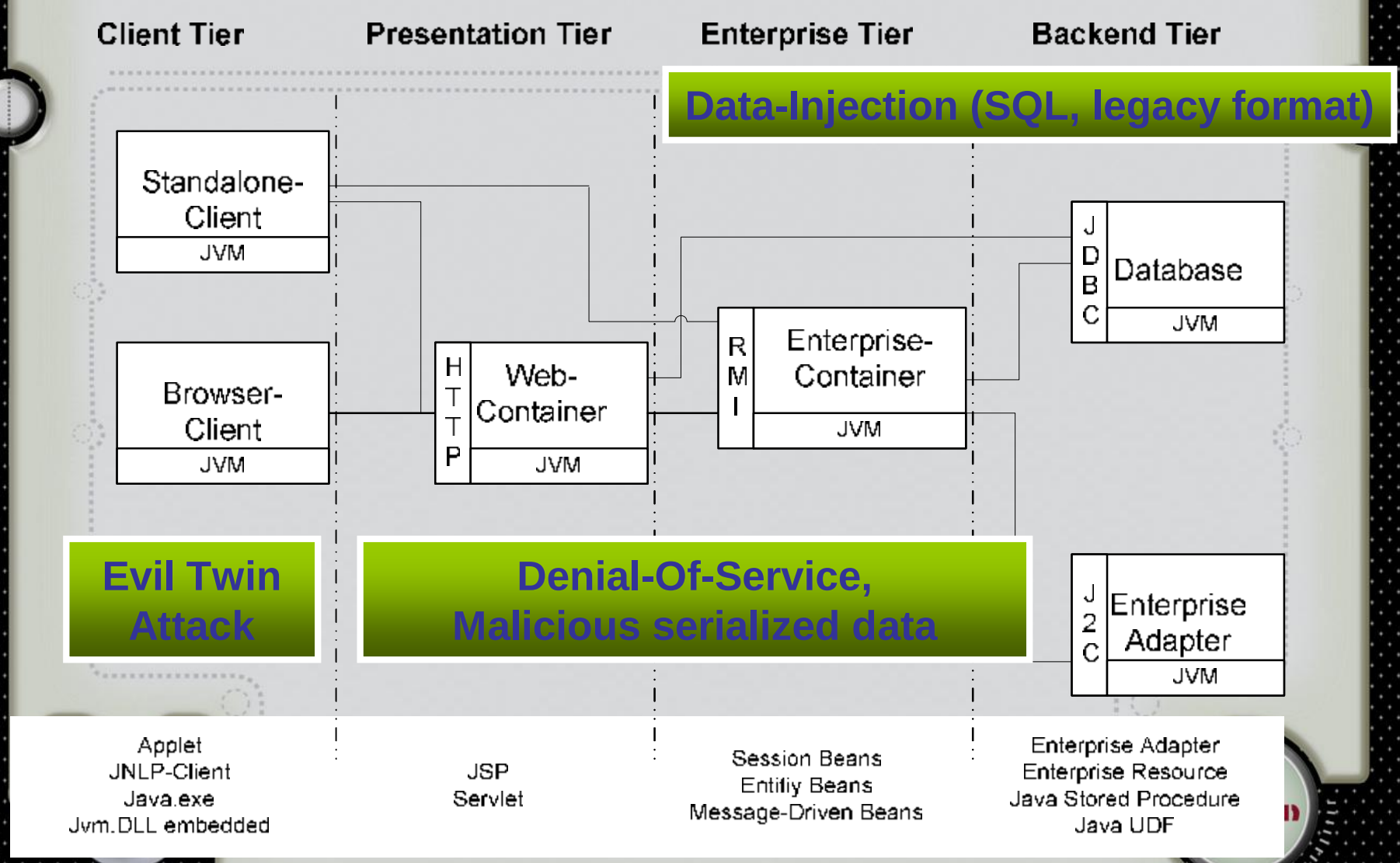
Why search for security bugs in java code ?

- **Component based software development**
  - **3rd party middleware components (web servers, graphics libraries, PDF renderer, …) are all over the place**
  - **We REUSE many of them in trusted places (bootclassloader)**
  - **But can we really trust them ?**
- **Questions:**
  - **Does my super duper 3rd-party graphics library include vulnerable object implementation that can be triggered by an attacker ?**
  - **Is the JDK secure in isolating my confidential XML data from other malicious applets loaded into the same VM ?**
  - **Object serialisation is safe, isn't it ?**

J2EE multi-tier application types



J2EE multi-tier attack types



Java Security Patterns

- **Sun's Security Code Guidelines (last update Feb 2, 2000!) :**
  1. **Careful usage of privileged code**
  2. **Careful handling of Static fields**
  3. **Reduced scope**
  4. **Careful selected public methods and fields**
  5. **Appropriate package protection**
  6. **If possible Use immutable objects**
  7. **Never return a reference to an internal array that contains sensitive data**
  8. **Never store user-supplied arrays directly**
  9. **Careful Serialization**
  10. **Careful use native methods**
  11. **Clear sensitive information**

http://java.sun.com/security/seccodeguide.html

Java Security Antipatterns

- **Security unaware coding create vulnerability by ignoring the security patterns**
- **Typical Java Secure Coding Antipatterns:**
  - **Ignoring Language Characteristics (like Integer Overflow)**
  - **Careless Serialisation , careless use of privileged code**
  - **Inappropriate Field and Method Visibility**
  - **Covert Channels in non-final Static Fields**
- **They hide in your own code and the libraries you use**
- **Due to academic interest we audited parts of the Sun JDK 1.4.x and present the findings on the following slides:**

How to search for security bugs in java code ?

Source Code Detectors	PMD , Checkstyle	useful only if source code is available and complete [in most of the cases it isn't]
Decompilers	JAD (!), JODE	Time consuming analysis, needs experience
Bytecode audit analyzers	Findbugs (bases on Apache BCEL)	Bytecode detectors (visitor pattern): - predefined (software quality) - Self-written (for security audit)
Policy evaluation tools	jChains (http://jchains.dev.java.net)	- Test if program needs specific permissions Useful to reverse engineer protection domains

Bytecode analyzers

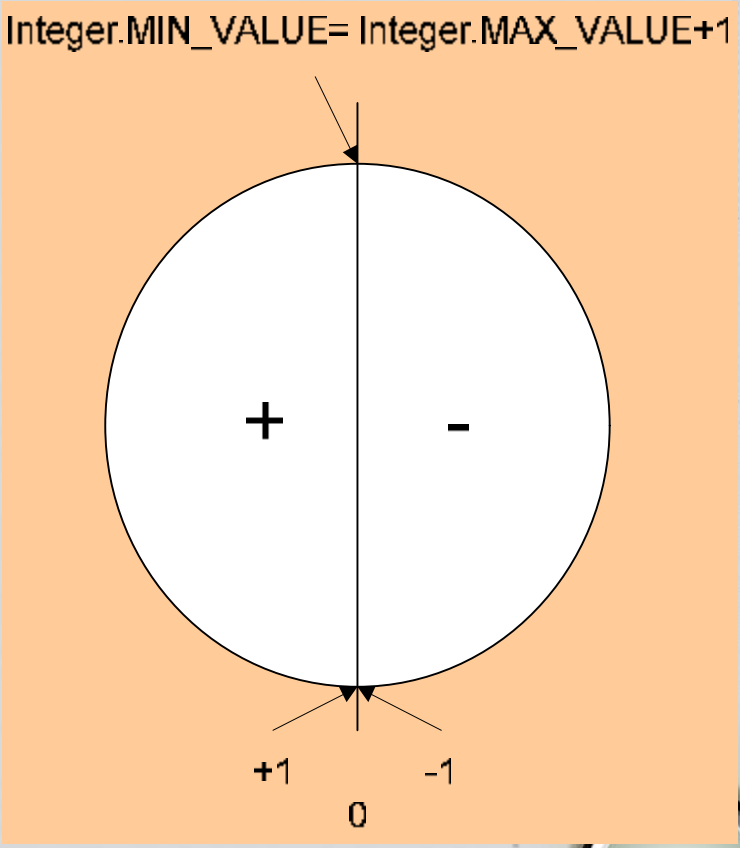
- **The following discussion bases on JVM bytecode analysis**
- **Findbugs (http://findbugs.sourceforge.net)**
  - **Statical Detector for bug patterns in java code**
  - **Developed by the University of Maryland (Puth and Hovemeyer)**
  - **Open Source**
    - **based on the BCEL (Apache Bytecode Engineering Library)**
    - **Visitor-pattern analysis of**
      - **class structure and inheritance**
      - **control and data flow**
    - **GUI/command line**
    - **And: Extensible, allows to write own detectors**

Java Security Antipatterns

- **Antipatterns (bugs, flaws) in trusted code (like rt.jar) cause Vulnerabilities**
  - **Availability:**
    - **AP1: Integer, the Unknown Type**(`java.util.zip.*`)
    - **AP2: Serialisation side effects** (`java.io.*`)
  - **Integrity:**
    - **AP3: Privileged code side effects (Luring attacks break sandbox)**
    - **AP4: Inappropriate Scope (Access control violation)**
    - **AP5: Non-Final Static Variables (Covert channels between applets)**
  - **Secrecy:**
    - **AP6: Insecure Component Reuse (**`org.apache.*` **, Sniff private XML data between applets)**
- **Goal: Define a binary audit toolset to detect the antipatterns in your own and the 3rd-party components to be able to fix the vulnerabilities**

Java Antipattern 1: Integer overflow

- **According to *blexim* (Phrack #60) , integer overflows are a serious problem in C/C++, so they are in Java:**
  - **All Java integers are bounded in the [-2^{31},$+2^{31}-1$] range**
  - **In Java this is true: $-2^{31}=2^{31}+1$**
  - **Silent Overflow is a problem: Sign changes are not reported to the user, no JVM flag set**
- **Code of JDK `1.4.1_01` was based on the false assumption that java integers are unbounded, which led to a range of problems in the `java.util.zip` package**



Java Antipattern 1: Integer overflow

The crash is caused by a parameter tuple (`new byte [0],x,Integer.MAX_VALUE-y`), where `x>y x,y≥0`

è silent overflow in the trusted JDK routines by fooling the parameter checks, so the overflow is neither detected by the core libraries nor the JVM.

è The native call `updateBytes` to access a byte array leads to an illegal memory access. Consequently the JVM crashes.

```
D:\ > java CRCCrash
An unexpected exception has been detected in native code outside the VM.
Unexpected Signal : EXCEPTION_ACCESS_VIOLATION occurred at PC=0 x6D3220A4
Function= Java_java_util_zip_ZipEntry_initFields+0x288
Library=c:\java\1.4.1\01\jre\bin\zip.dll
Current Java thread :
at java.util.zip.CRC32.updateBytes(Native Method )
at java.util.zip.CRC32.update(CRC32.java:53)
at CRCCrash.main(CRCCrash.java :3)
Dynamic libraries:
0x00400000 - 0x00406000 c:\java\1.4.1\01\jre\bin\java.exe
[... lines omitted ...]
0x76BB0000 - 0x76BBB000 C:\WINDOWS\System32\PSAPI.DLL
Local Time = Mon Mar 17 14:57:47 2003
Elapsed Time = 3
#
# The exception above was detected in native code outside the VM
#
# Java VM : Java HotSpot(TM ) Client VM (1.4.1_01 -b01 mixed mode)
#
```

Java Antipattern 1: Integer overflow

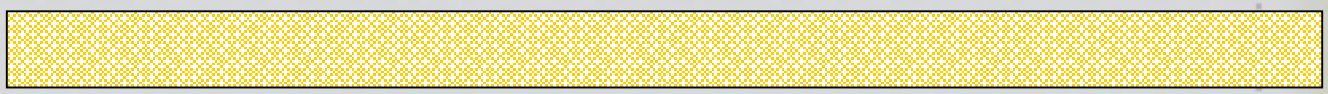
The CRC32 class allows to calculate a checksum over a buffer:

If you have a byte buffer (1,2,3,4) and want to calculate the checksum over it you need to call:

```
CRC32 c = new java.util.zip.CRC32 ();
c.update (new byte []{1,2,3} ,0 ,3);
```

But if you do the following:

```
c.update
```



You will crash the JVM of JDK 1.4.1_01 and some versions of JDK 1.3.1

Java Antipattern 1: Integer overflow, Risk and extent

Risk:

If the attacker manages to exploit this function in an environment were multiple users share a single JVM (like a Lotus Domino server or a Tomcat HTTP server) he may cause a denial-of-service condition.

Extent:

More trusted functions were found vulnerable:

- **java.util.zip.Adler32().update();**
- **java.util.zip.Deflater().setDictionary();**
- **java.util.zip.CRC32 ().update();**
- **java.util.zip.Deflater().deflate();**
- **java.util.zip.CheckedOutputStream().write();**
- **java.util.zip.CheckedInputStream().read();**
- **java.text.Bidi.<init >;**

- **http://developer.java.sun.com/developer/bugParade/bugs/4811913.html**
  - **also bugnr = {4811913, 4812181, 4812006 , 4811927 , 4811917, 4982415, 4944300, 4827312,4823885}**

Java Antipattern 1: Integer overflow, the Refactoring

Before JDK 1.4.101

```
public void update(byte[] b, int off, int len) {
        if (b == null) {        throw new
NullPointerException(); }

        if (off < 0 || len < 0 || off + len > b.length) {
                throw new ArrayIndexOutOfBoundsException();
        }
        crc = updateBytes(crc, b, off, len);
}
```

After JDK 1.4.102

```
public void update(byte[] b, int off, int len) {
        if (b == null) {    throw new NullPointerException(); }

        if (off < 0 || len < 0 || off > b.length - len) {
                        throw new
ArrayIndexOutOfBoundsException();
        }
        crc = updateBytes(crc, b, off, len);
}
```

Java Antipattern 1: Integer overflow, the Refactoring (bytecode)

Before (1.4.1_01)		After (1.4.1_02)	
12: iload_2		12: iload_2	
13: iflt 28		13: iflt 28	
16: iload_3		16: iload_3	
17: iflt 28		17: iflt 28	
20: iload_2	Integer Overflow Bytecode Pattern	20: iload_2	Bytecode of Refactoring
21: iload_3		21: aload_1	
22: iadd		22: arraylength	
23: aload_1		23: iload_3	
24: arraylength		24: isub	
25: if_icmple 36		25: if_icmple 36	

Java Antipattern 1: Harmful integer overflow, How to find during auditing ?

1. **find candidate methods by detecting `iadd` opcodes**
2. **Does the `iadd` use user-supplied data (does it use data from the stack supplied by `iload` ?) to perform a range check**
3. **Is a native method called afterwards (`invokevirtual`, `invokestatic`), that takes the same data**

This process can be implemented by a `Findbugs` bytecode detector

AP1: Conclusion and Suggestions

- **The JVM does not provide an overflow flag like a normal x86 processor (designed in 1978), so there is no way to detect those conditions during runtime. The JVM in Java 1.5 (aka 5.0 aka Tiger) 27 years later does not improve this shortcoming**
- **Suggestions for JDK 6.0:**
  - **To avoid burdening the (security unaware) programmer, a bounded primitive integers (like in Ada) is helpful**
    `subtype Month_Type is Integer range 1..12;`
  - **If this is all too complex for the java compiler to handle, it could at least list a potential overflow as compiler warning (maybe in Java 6.0?)**

Antipattern 2: Serialisation side effects

- The normal way to create a java object is to use the `new` instruction, which calls the constructor of a class
- But: The Java serialisation API (part of `java.io` package) allows to bypass constructors and create new instances of an object type by simply sending them to an `java.io.ObjectInputStream` (OIS), which is bound to a socket, a file or a byte array
- OIS objects are commonly used by remote communications such as RMI or persistency frameworks to import pre-built objects into the JVM
- When an object is read from an OIS the most derived `readObject` method of the class is called

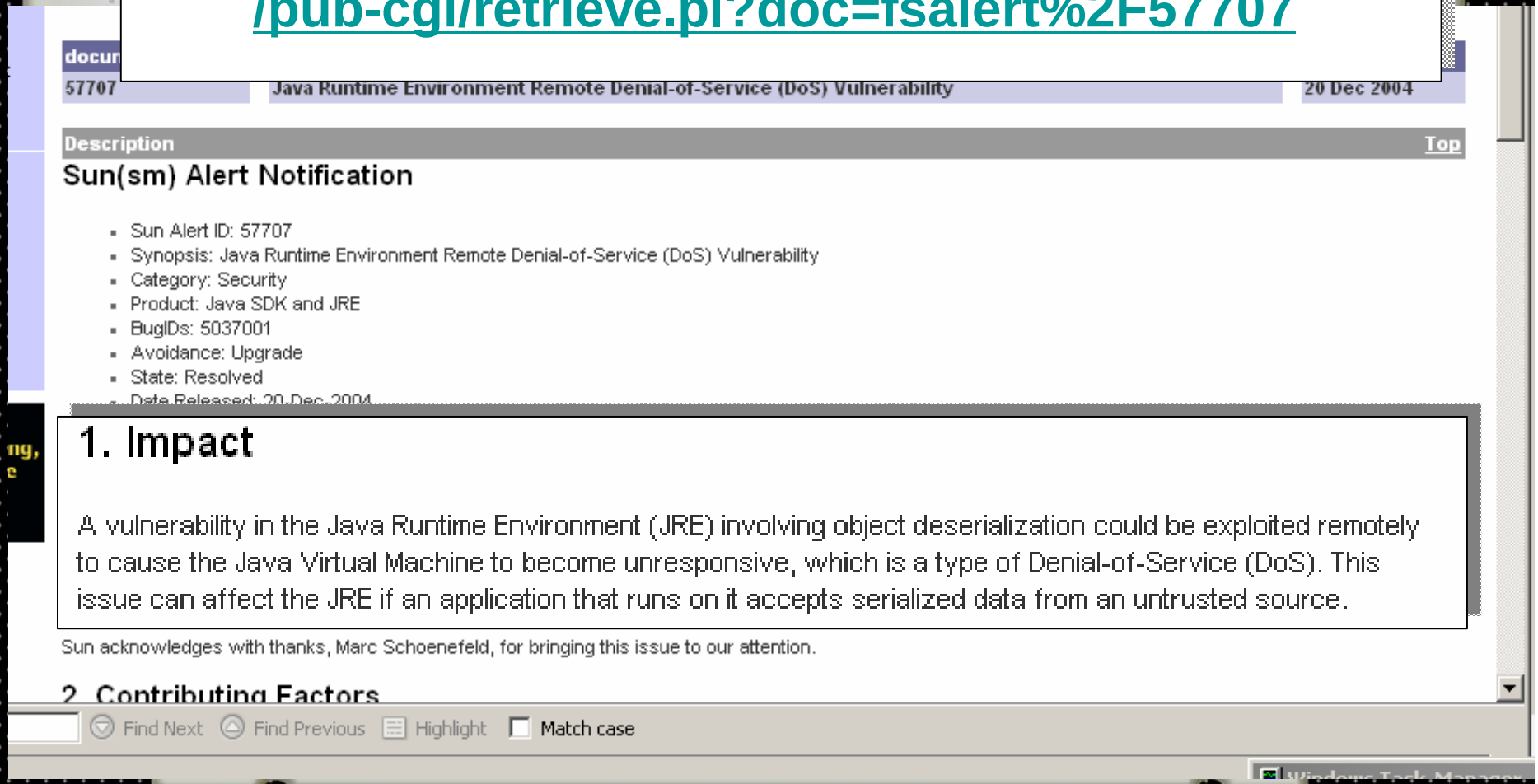
AP 2: Risk and Extent

- **Risk**
  - Reading serialized objects may force the JVM to branch into complex or vulnerable code regions that are called in the `readObject` method
  - `readObject` methods may linger in in your own code, the JDK classes and any 3rd party library you use
  - Attacker may prepare special handcrafted data packets with serialized data
- **Extent**

`java.util.regex.Pattern`	Triggers complex computation, „JVM may become `unresponsive`“ [Sun Alert 57707]
`java.awt.font.ICC_Profile`	Causes JVM `crash` on Win32
`java.util.HashMap`	Triggers an unexpected `OutOfMemoryError` which may kill the current listening thread and disable the service (as an error it bypasses most try/catch checks)

AP 2: Risk and Extent

http://classic.sunsolve.sun.com/pub-cgi/retrieve.pl?doc=fsalert%2F57707



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57707 | Java Runtime Environment Remote Denial-of-Service (DoS) Vulnerability | 20 Dec 2004

Description Top

Sun(sm) Alert Notification

- Sun Alert ID: 57707
- Synopsis: Java Runtime Environment Remote Denial-of-Service (DoS) Vulnerability
- Category: Security
- Product: Java SDK and JRE
- BugIDs: 5037001
- Avoidance: Upgrade
- State: Resolved
- Date Released: 20 Dec 2004

1. Impact

A vulnerability in the Java Runtime Environment (JRE) involving object deserialization could be exploited remotely to cause the Java Virtual Machine to become unresponsive, which is a type of Denial-of-Service (DoS). This issue can affect the JRE if an application that runs on it accepts serialized data from an untrusted source.

Sun acknowledges with thanks, Marc Schoenefeld, for bringing this issue to our attention.

2. Contributing Factors

Find Next Find Previous Highlight Match case

AP2: Serialisation side effects, a refactoring

Before

JDK 1.4.2 05

```
private void readObject(java.io.ObjectInputStream s)throws… {
  s.defaultReadObject();        // Initialize counts
  groupCount = 1;
  localCount = 0;  // Recompile object tree
  if (pattern.length() > 0)
    compile();// so we compile for the next 1600 years
  else
    root = new Start(lastAccept);
}
```

After

JDK 1.4.2 06

```
private void readObject(java.io.ObjectInputStream s)throws… {
 s.defaultReadObject();    // Initialize counts
 groupCount = 1;           // if length > 0,
 localCount = 0;           // the Pattern is lazily compiled
 compiled = false;
 if (pattern.length() == 0) {
    root = new Start(lastAccept);
    matchRoot = lastAccept;
    compiled = true;
 }
}
```

AP2: How to find during code audit ?

1. **find candidate classes by detecting `readObject` definitions**
2. **For these classes determine if the control flow branch into harmful code**
   I. **Search for algorithmic complexity (does it compile a regex for the next 800 years?)**
   II. **Search for endless loops (bytecode backward branches)**
   III. **Does to code call into vulnerable native code and propagates the total or some part of the payload ?**

This process can be implemented by a `Findbugs` bytecode detector

AP2: Conclusion and Suggestions

- The `readObject` method is designed primarily for accepting and checking `Serializable` data
- Nested `readObject` invocations occur for nested `Serializable` classes, so the malicious payload does not have to be in the root object
- Try to defer complex operations from the time of creation to the time of first usage
- Similar considerations apply for the `readExternal` method which implements the receiving part of the `Externalizable` interface

AP3: Privileged Code Side Effects

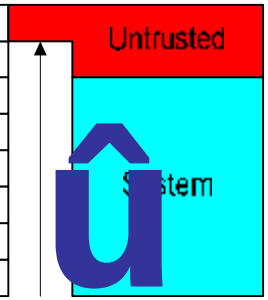
- **The Basic Java Access Algorithm:**
  - **A request for access is granted if, and only if every protection domain in the current execution context has been granted the said permission, that is, if the code and principals specified by each protection domain are granted the permission.**
  - **A permission is only granted when all protection domain D_i contain the permission *p***

$$p \in \left\{ \bigcap_{i=1}^{n} D_i \right\}$$

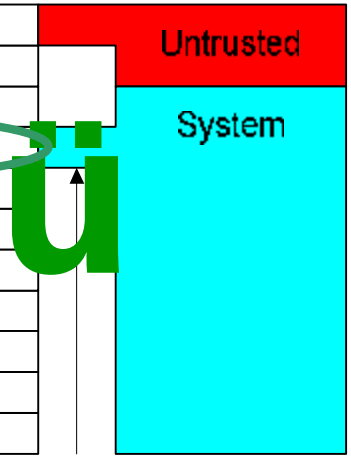
AP3: Privileged Code Side Effects

- **Privileged code (`doPrivileged`) is used to break out of the stack inspection algorithm**
- **Needed where the permissions on the application level (user classes) do not match the needed permissions to perform necessary operations on the middleware/system level (`rt.jar`)**

Graphics application	initializeDocument
A graphics routine	generateTmpFile
Java.io.File	createTempFile
Java.io.File	checkAndCreate
java.lang.Security.Manager	checkWrite
java.lang.Security.Manager	checkPermission
java.security.AccessController	checkPermission
java.security.AccessControlContext	checkPermission



Graphics application	initializeDocument
Some graphics library	generateSymbolFont
Java.awt.Font	createFont
java.security.AccessController	doPrivileged
Java.awt.Font$1	run
Java.io.File	createTempFile
Java.io.File	checkAndCreate
java.lang.Security.Manager	checkWrite
java.lang.Security.Manager	checkPermission
java.security.AccessController	checkPermission
java.security.AccessControlContext	checkPermission

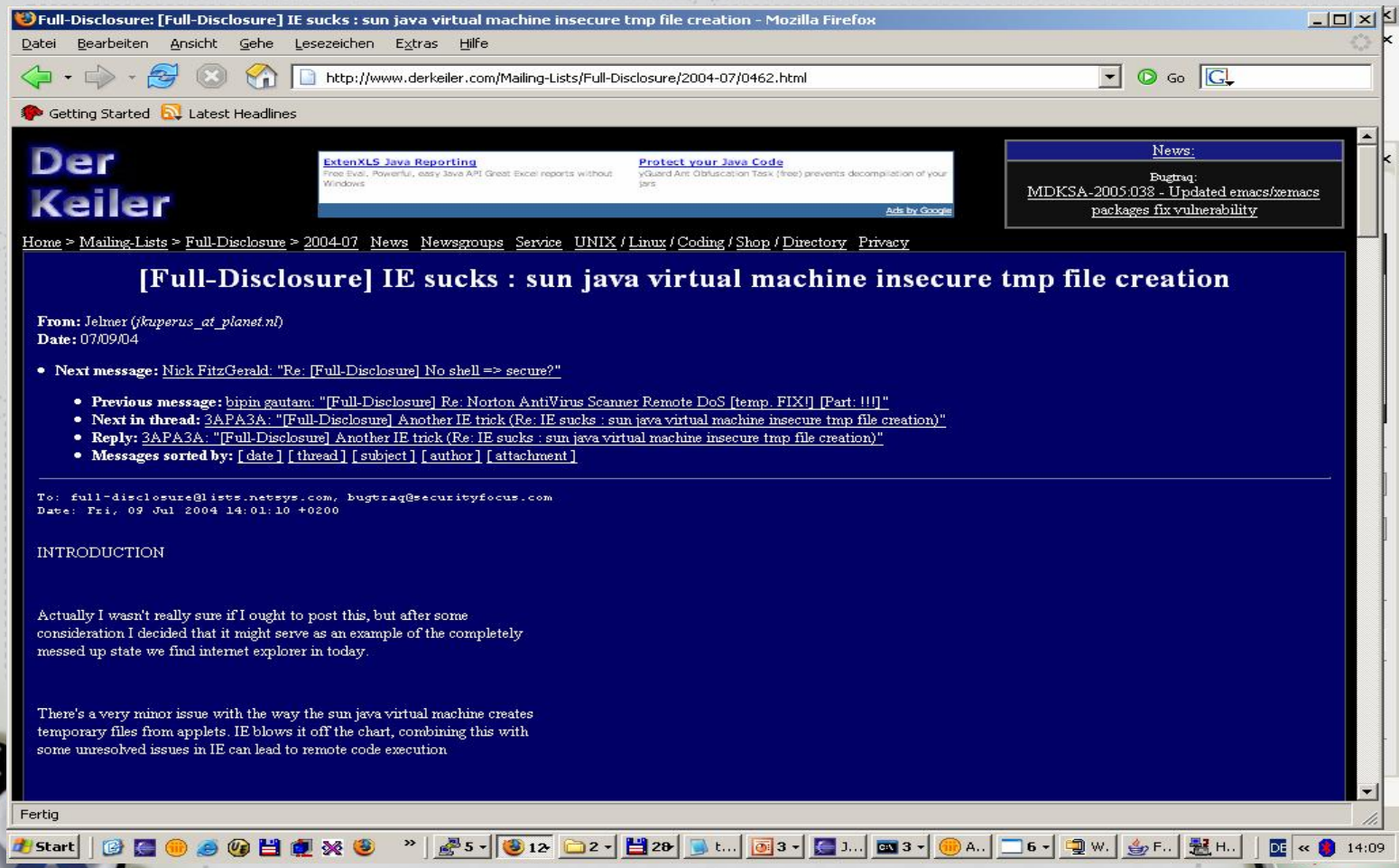


AP3: Privileged Code Side Effects: Risk and Extent

- **Risk**
  - **An attacker may misuse this condition to escalate privileges and escape a limited protection domain (such as the JNLP or applet sandbox)**
    - **he knows the privileged code blocks in the JDK and the privileged codesources of the application**
    - **by a luring attack he tries to trick control into privileged code blocks and force that block to use parts of his injected payload**
- **Extent**

java.awt.font.ICC_Profile	**escape the applet sandbox and test existence of files on the client's machine**
java.awt.Font (i)	**transport temporary files (such as executables) to the client's machine, which can be launched later (http://www.derkeiler.com/Mailing-Lists/Full-Disclosure/2004-07/0462.html)**
Java.awt.Font(ii)	**fill up the remaining free space of file system of the client machine with a large file containing zero bytes**
…	….

AP3: Privileged Code Side Effects: Risk and Extent



AP3: Refactorings

- **No refactorings available**
  - **The described bugs are still in the JDK , so unfortunately no refactorings available**
  - **Although most of those were reported to Sun in Q2/2004 or earlier**

AP3: Privileged Code Side Effects: How to audit ?

1. **find candidate classes by detecting `doPrivileged` calls**
2. **For these classes determine if user-supplied data is propagated to the privileged code block that causes to**
   I. **Pass access to protected resources**
   II. **leak secret data**
   III. **Perform unwanted modifications to untrusted code**

This process can be partially implemented by a `Findbugs` bytecode detector

AP3: Conclusion and Suggestions

- **Conclusion**
  - **doPrivileged is a powerful but dangerous construct to tweak protection domains**
- **Suggestion**
  - **To Sun:**
    - **Please fix bugs in privileged code JDK blocks**
  - **To Component Users:**
    - **Check 3rd party libraries for vulnerable doPrivileged blocks before usage, as they may break your security policy**
  - **To Middleware Developers:**
    - **Keep privileged code in own code as short as possible [http://java.sun.com/security/seccodeguide.html]**
    - **Detaint user-supplied data before propagating it to privileged code**

AP4: Inappropriate Scope

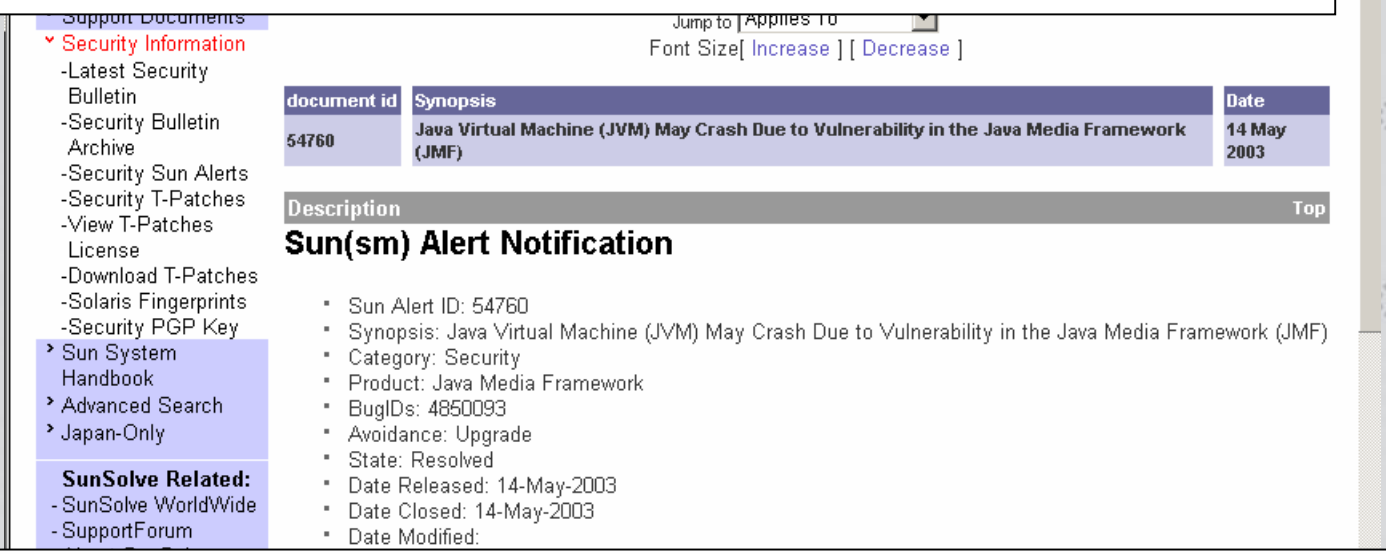
- ***As a rule, reduce the scope of methods and fields as much as possible. Check whether package-private members could be made private, whether protected members could be made package-private/private, etc. [Sun Security Code Guidelines]***
- ***This should be especially true when you design trusted JDK extensions, such as the Java Media Framework (JMF)***

AP4: Inappropriate Scope: Risk and Extent

- **Risk**
  - **An attacker can exploit the trusted protection domain "AllPermissions" of a java extension in jre/lib/ext to escalate privileges. For example the JMF**
    - **installs extra trusted classes to jre/lib/ext**
    - **accesses system memory via native routines**
    - **The public JMF class com.sun.media.NBA exposes a public pointer to physical memory [long value data]**
    - **So untrusted applets may read your system memory**

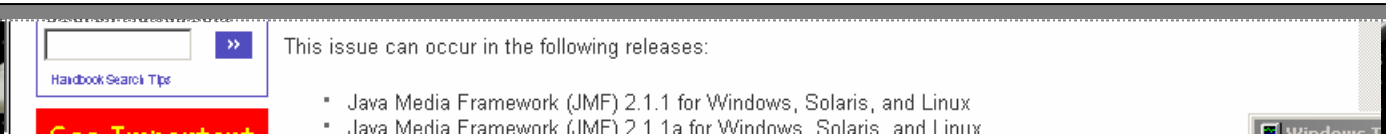
AP4: Inappropriate Scope: Risk and Extent

http://classic.sunsolve.sun.com/pub-cgi/retrieve.pl?doc=fsalert%2F54760



1. Impact

A vulnerability in the Java(TM) Media Framework (JMF) may potentially allow an untrusted applet to exit unexpectedly ("crash") the Java Virtual Machine (JVM) or gain unauthorized privileges..



AP4: Inappropriate Scope: Refactoring

Before (JMF 2.1.1c)		After (JMF 2.1.1e)

public class NBA {
public void finalize()
public Object getData()
public Object clone()
public void copyTo(NBA nba)
public void copyTo(byte javadata[])
 	
public long data;
public int size;
public Class type;
}
	1
	
	2
	
	3
		public final class NBA {
		
		protected final synchronized void finalize()
		public synchronized Object getData()
		public synchronized Object clone()
		public synchronized void copyTo(NBA nba)
		public synchronized void copyTo(byte javadata[])
		private long data;
		private int size;
		private Class type;
		}

1) Creation of subclasses is forbidden, to prevent leaking of secret data by new methods

2) Scope of public finalize method degraded to protected, so no class can overwrite it

3) Data fields were moved to appropriate private (class local) scope

AP4: Inappropriate Scope Side Effects: How to audit ?

1. **find candidate classes by detecting `public` classes**
2. **For these classes determine if**
   I. **Data fields are declared as `public`**
   II. **Methods are declared as `public`**
   III. **Internal references to private, protected data are returned by a `public` method**

The candidate selection can be implemented by using the predefined detectors of Findbugs

AP4: Conclusion and Suggestions

- **Conclusion**
  - **Inappropriate Scope on fields and methods may allow to bypass access control mechanisms**
- **Suggestion [http://java.sun.com/security/seccodeguide.html]**
  - ***Refrain from using public variables. Instead, let the interface to your variables be through accessor methods. In this way it is possible to add centralized security checks, if required.***
  - ***Make sure that any public method that has access to and/or modifies any sensitive internal states includes a security check.***

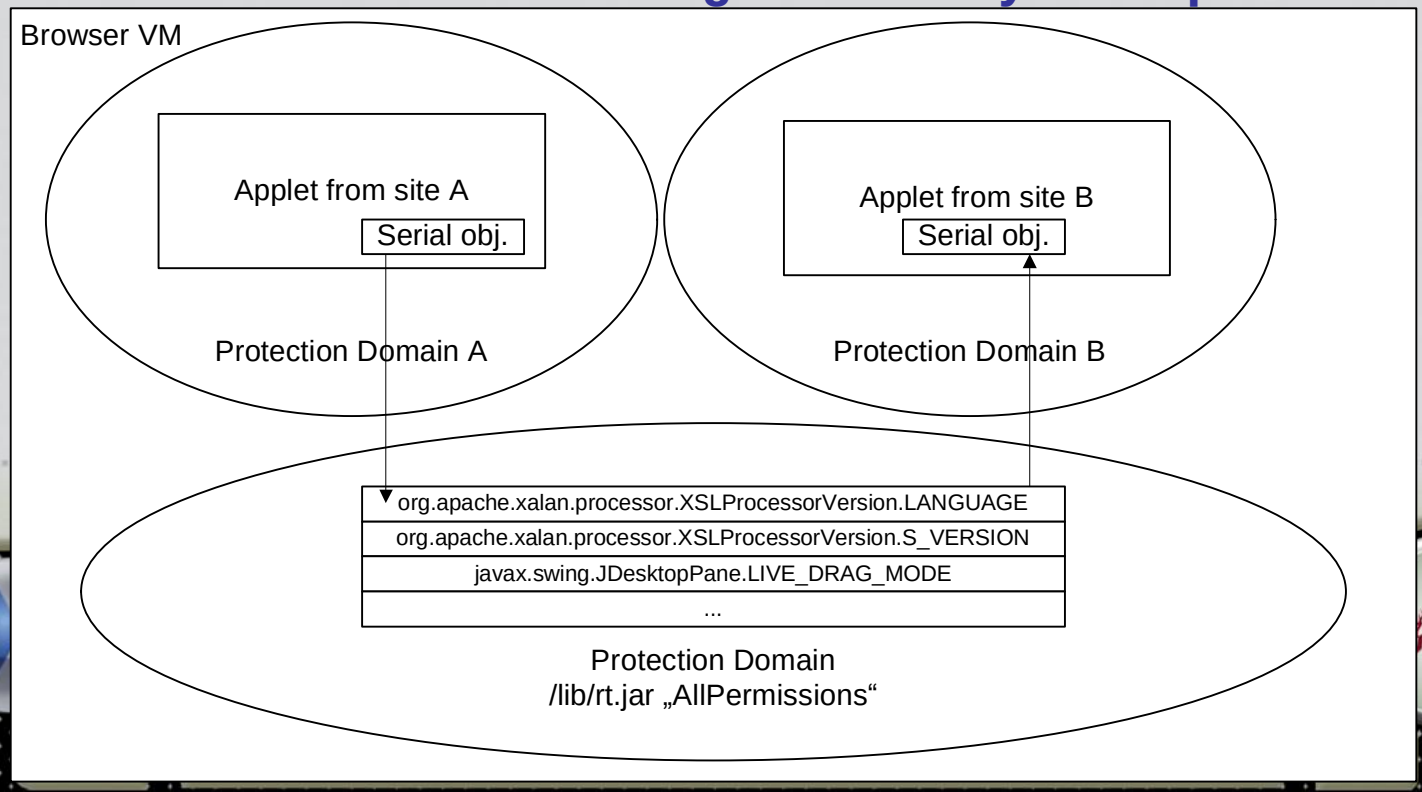
AP5: Non-Final Static Fields

- *„Refrain from using non-final public static variables*
  - **To the extent possible, refrain from using non-final public static variables because there is no way to check whether the code that changes such variables has appropriate permissions.**
  - **In general, be careful with any mutable static states that can cause unintended interactions between supposedly independent subsystems“**

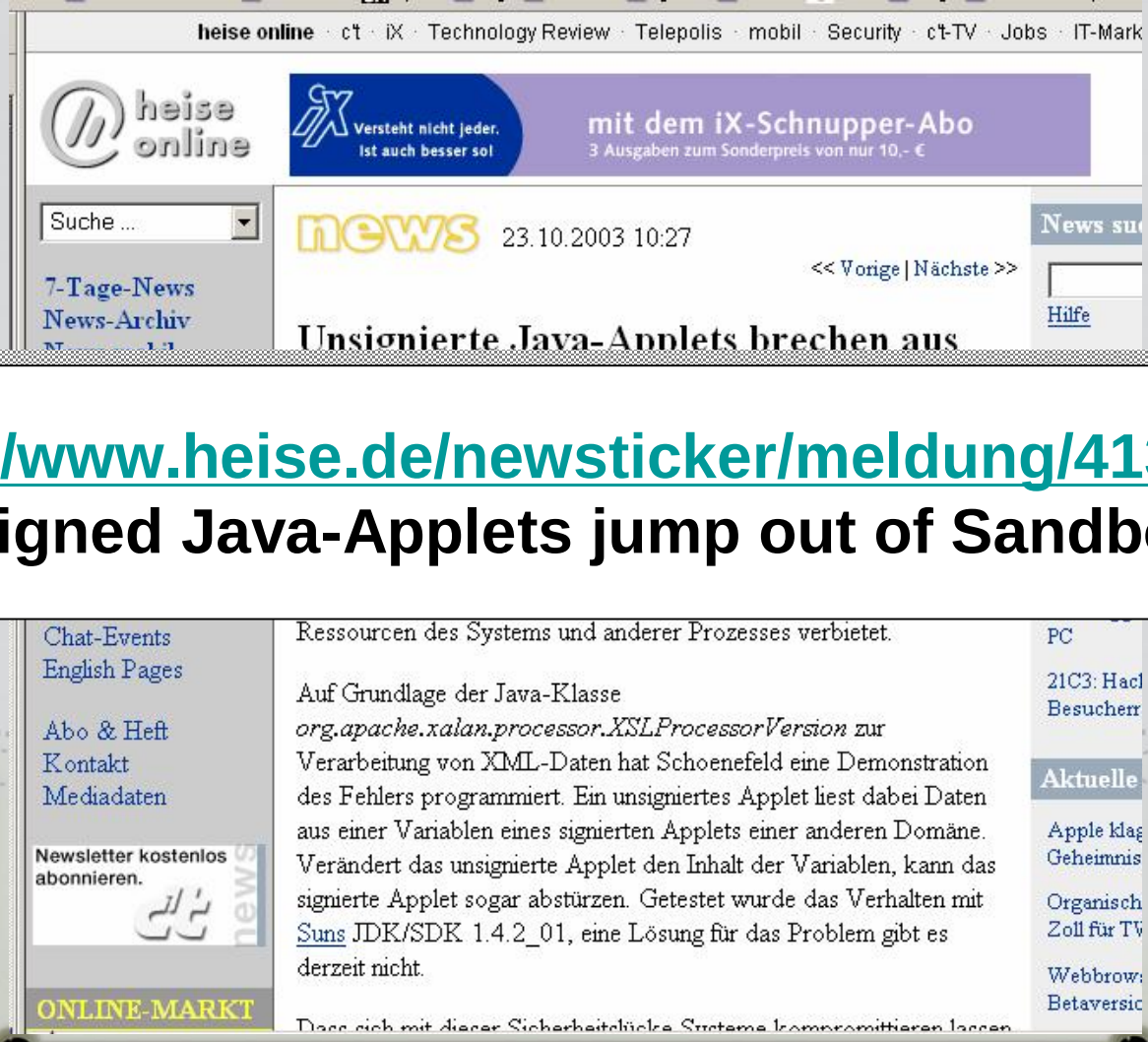
  [Sun Security Code Guidelines]
  - **According to Sun Microsystems [http://www.sun.com/software/security/glossary.html] the term covert channel has the following definition:**
    - **A communication channel that is not normally intended for data communication. It allows a process to transfer information indirectly in a manner that violates the intent of the security policy.**
  - **We will show that the Antipattern careless use of Static Variables allows malicious code to exploit covert channels between protection domains**

AP5: Non-Final Static Variables, Risk & Extent

- **Risk**
  - **Static Variables that are loaded by the boot classloader (like the ones in rt.jar) or by the extension classloader are singleton objects in a JVM**
  - **Non-final static String fields may transport**



AP5: Non-Final Static Variables, Risk & Extent



AP5: Non-Final Static Variables: Refactoring

Before (JDK1.42_04)	After (JDK1.42_05)

public class org.apache.xalan.processor.
XSLProcessorVersion {
public static final java.lang.String
PRODUCT;
public static java.lang.String
LANGUAGE;
public static int VERSION;
public static int RELEASE;
public static int MAINTENANCE;
public static int DEVELOPMENT;
public static java.lang.String
S_VERSION;
}
	public class org.apache.xalan.processor.
	XSLProcessorVersion {
	public static final java.lang.String
	PRODUCT;
	public static final java.lang.String
	LANGUAGE;
	public static final int VERSION;
	public static final int RELEASE;
	public static final int MAINTENANCE;
	public static final int DEVELOPMENT;
	public static final java.lang.String
	S_VERSION;
	}

The final modifier prohibits modification of a variable after initial value was set. Initially they only used it to protect their product name J

AP5: Non-Final Static Variables: How to audit ?

1. **Via a built-in `findbugs` detector find candidate classes by searching for `public` classes**
2. **For these classes find**
   I. **Primitive Data fields and Strings are declared as `public static`, non-`final`**
   II. **Object Type Data fields, Arrays and Containers are declared as `public static`**
   III. **Methods that allow access on non-public instances of (I + II)**

AP5: Conclusion and Suggestions

- **Conclusion**
  - **Non-final static final fields allow to establish covert channels between protection domains and bypass restrictions such as the applet sandbox .**
- **Suggestion [http://java.sun.com/security/seccodeguide.html]**
  - **To the extent possible, refrain from using non-final public static variables because there is no way to check whether the code that changes such variables has appropriate permissions.**
  - **In general, be careful with any mutable static states that can cause unintended interactions between supposedly independent subsystems.**

Antipattern 6: Insecure component reuse

- **„Distributed component-structured applications can consist of software components which are supplied by different vendors. Therefore one has to distinguish between application owners and software component vendors and there is a needs for corresponding protection“: [Hermann, Krumm]**
- **3rd – party components might be built with a functionality based programmer intend, whereas the control of the confined execution models of the JDK require a security based programmer intend.**
- **JDK as a component-structured middleware application uses a lot of XML functionality from the Apache foundation. Is there enough protection against vulnerabilities of these 3rd-party components embedded in JDK ?**

AP6: Insecure component reuse, Risk & Extent

- **Risk**
  - **The XSLT parser embedded in JDK is directly taken from a previous apache XALAN standalone version, downloadable from http://xml.apache.org**
  - **It is highly configurable, especially it allows to customize the functions that may be employed during XSLT (extensible stylesheet language transformations)**
  - **Non-final static arrays in trusted libraries may contain objects that are allowed to process data throughout the entire JVM**
  - **We will show that the Antipattern insecure component reuse allows malicious code to exploit visibilities granted to trusted code by inserting malicious callbacks**

AP5: Non-Final Static Variables, Risk & Extend

http://classic.sunsolve.sun.com/pub-cgi/retrieve.pl?doc=fsalert%2F57613

[Printer-Friendly Page]

Document Audience: PUBLIC
Document ID: 57613
Title: Document ID 57613
Synopsis: Java Runtime Environment May Allow Untrusted Applets to Escalate Privileges
Update Date: 2004-08-02

Description Top

Sun(sm) Alert Notification

- Sun Alert ID: 57613
- Synopsis: Java Runtime Environment May Allow Untrusted Applets to Escalate Privileges
- Category: Security
- Product: Java JRE/SDK

1. Impact The XSLT processor included with the Java Runtime Environment (JRE) may allow an untrusted applet to read data from another applet that is processed using the XSLT processor and may allow the untrusted applet to escalate privileges.

the XSLT processor and may allow the untrusted applet to escalate privileges.

Sun acknowledges, with thanks, Marc Schoenefeld for bringing these issues to our attention.

AP6: Insecure component reuse: Refactoring

Before (JDK1.42_05)	After (JDK1.42_06)
public class org.apache.xpath.compiler.FunctionTable { public static org.apache.xpath.compiler.FuncLoader[] m_functions; [...] }	public class org.apache.xpath.compiler.FunctionTable { private static org.apache.xpath.compiler.FuncLoader[] m_functions; [...] }

This refactoring is **adjusting** the enhanced functionality of the component to the level needed **for running the component securely** in confined execution models. Technically the refactoring cures an antipattern 4 and an antipattern 5.

The **private** modifier prohibits malicious code to modify the table consisting the built-in functions of the XSLT parser.

AP6: Insecure component reuse: How to audit ?

1. **3rd-party components may include all types of antipatterns, from our experience check at least for the antipatterns presented here**
   1. **Check for Integer Overflow**
   2. **Check for proper Serialisation, watch for side effects**
   3. **Check for defensive use of privileged code, especially when using privileged or "AllPermission" protection domains**
   4. **Adjust inappropriate scope to the level needed and add security checks to public available fields and functionality**
   5. **Close covert channels in static non-final fields and static mutable container types (also indirect uses)**

AP6: Conclusion and Suggestions

- **Conclusion**
  - **Even if your own code is secure, 3rd – party components may ruin your security concept**
- **Suggestion**
  - **Ask the vendor of the components you reuse , whether they check their components with findbugs or similar tools**
  - **Ask for a findbugs report before buying, this may increase your trust to component**
  - **A lot of open source projects already include such a report,**
    but some closed source guys still have to learn

finally{}

Q & A

Contact	**Send me an eMail** **marc@marc-schoenefeld.com**
Detectors presented	**Download at** **www.illegalaccess.org**