OWASP „Stammtisch“/MUC-SEC Meetup Munich
15/09/2015

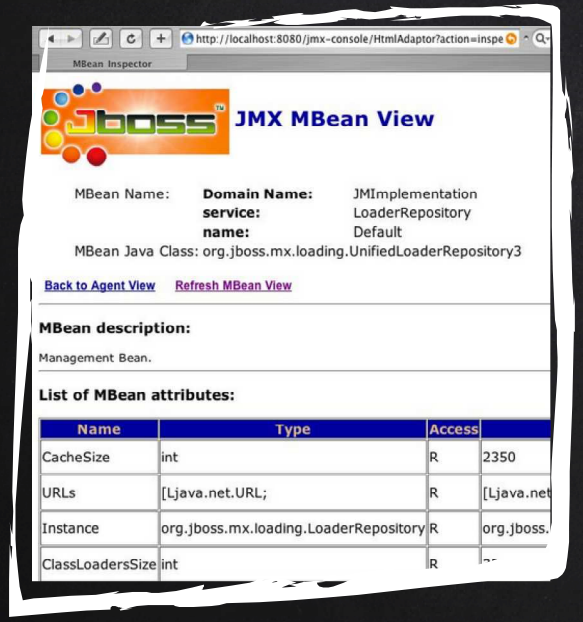
HELLO!

I am Hans-Martin Münch

I am here to talk about JMX...

Why bother??

Most Penetration Testers know this...



JBoss JMX Console

Tons of tools to pOwn the system

Happy hacker !!!

JEE services with JMX support

JMX

- Tomcat
- JBoss
- Jetty
- Sonatype Nexus
- SAP Netweaver
- Active MQ
- Hazelcast
- Weblogic
- Citrix Command Center

What is JMX?

...or the „JMX elevator pitch“...

Java Management Extensions (JMX) is a Java technology that supplies tools for managing and monitoring applications, system objects, devices (e.g. printers) and service-oriented networks.

Simplified:
JMX is SNMP on steroids
for Java Applications

JMX Fundamentals

it is all about fundamentals, fundamentals, fundamentals


Let's start
with Beans...

Managed Bean (MBean)

What it is:

- ✘ The stuff that you manage via JMX (Ressource)
- ✘ The model in MVC concept
- ✘ Just a Java class

Class must follow some Rules:

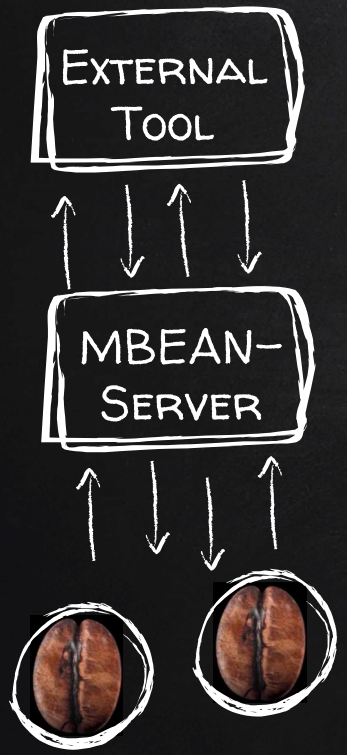
- ✘ Implement a interface
- ✘ Default Constructor (No parameters)
- ✘ Naming Conventions

MBean Example – Interface

```
public interface HelloMBean {

    // Attribute „name“
    public String getName();
    public void setName(String newName);

    // Methods
    public String sayHello();
}
```

MBean Example – Code

```
public class Hello implements HelloMBean {

 private String name = "OWASP Munich";

 // Attribute „name“
 public String getName() { return this.name;}
 public void setName(String newName) { this.name = newName;}

 // Methods
 public String sayHello() { return "hello: " + name;}
}
```



MBean-Server

- ✘ Service for MBean management
- ✘ Registration of MBeans
- ✘ Forwards messages to MBeans
- ✘ Forwards events from MBeans to external components

Registration/Access:

- ✘ Requires a distinct name (like a url)
- ✘ Format: Domain-Name:Key/Property
- ✘ Example: De.Mogwaisecurity:Type=OWASPDemo

MBean Server - Code

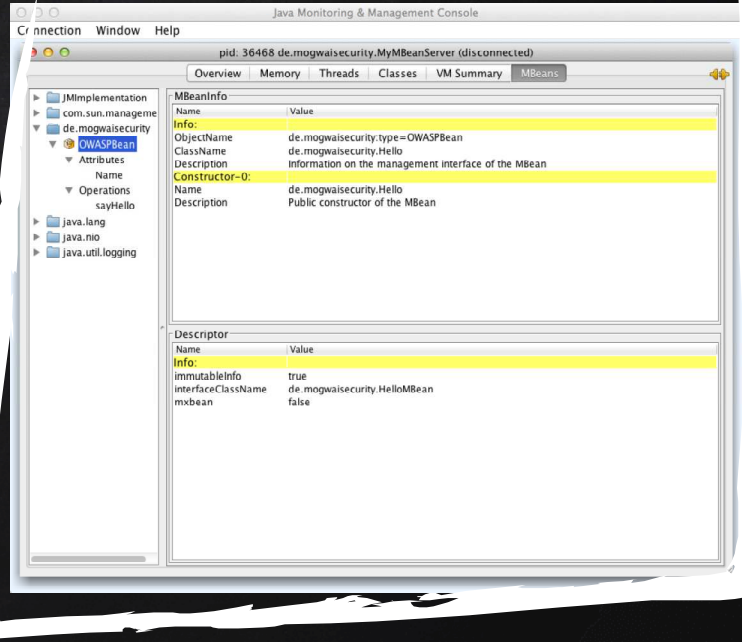
```
// Get local mbean server
MBeanServer mbs = ManagementFactory.getPlatformMBeanServer();

// Create a name and MBean Instance
Hello owaspBean = new Hello();

ObjectName mbeanName = new
ObjectName("de.mogwaisecurity:type=OWASPBean");

// Register the name and MBean at the local server
mbs.registerMBean(owaspBean, mbeanName);
```

JConsole

- ✘ Graphical tool (Part of the JDK)
- ✘ Really useful ☺

What it can do:

- ✘ Connect to a Mbean/JMX server
- ✘ Graphical Bean overview
- ✘ Local – via process ID
- ✘ Remote – via Java RMI

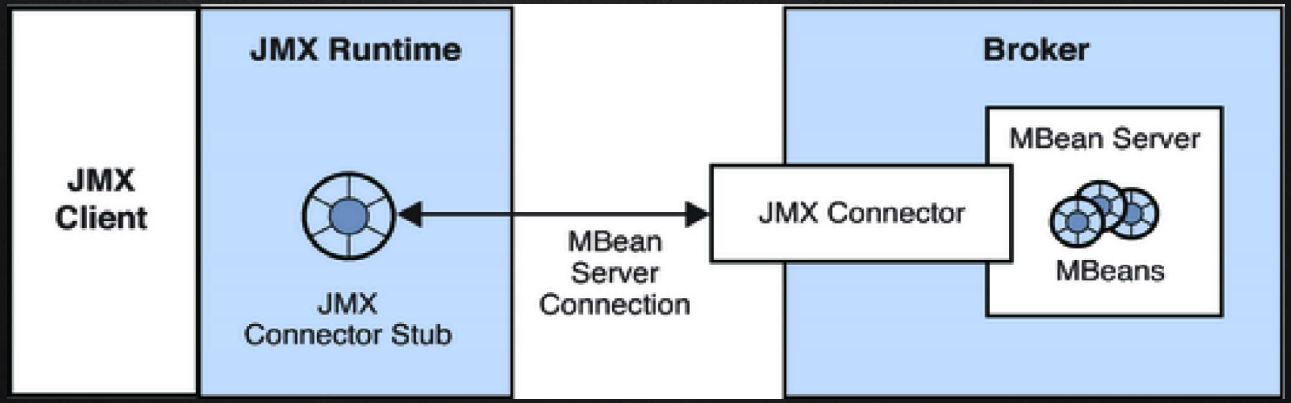


Demo

Local Mbean Connection

JMX Connectors

- ✘ Provides remote Access to a Mbean Server
- ✘ Basically a Client-/Server Stub
- ✘ No real difference between local/Remote communication
- ✘ You can change transfer protocols (http/morse code/)



JMX Connectors

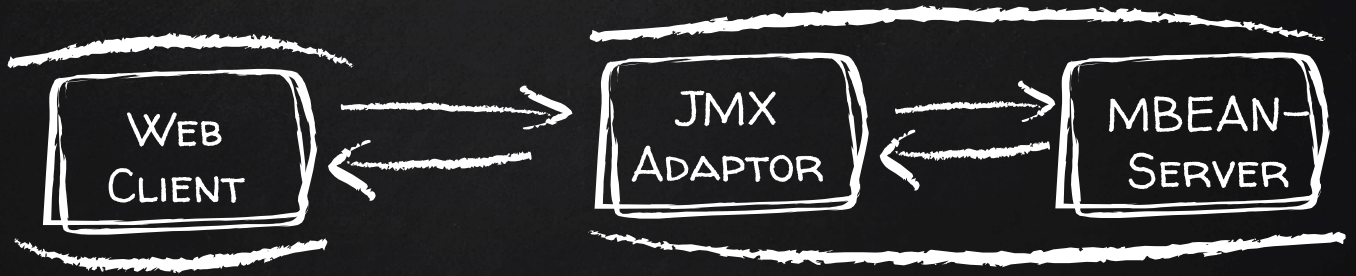
- ✘ Normally Java RMI (Remote Method Invocation) is used
- ✘ Enabled via command line parameters

Example with no Authentication:

```
-Djava.rmi.server.hostname=192.168.0.32
-Dcom.sun.management.jmxremote
-Dcom.sun.management.jmxremote.port=8888
-Dcom.sun.management.jmxremote.ssl=false
-Dcom.sun.management.jmxremote.authenticate=false
```

JMX Adaptors

- ✘ Similar to JMX Connector
- ✘ But – Provides what the client expects (for example HTTP)
- ✘ No „Client Stub“
- ✘ You can't use everything (like complex java objects)
- ✘ Commonly used by non-Java Software



Demo

JMX on Tomcat 7

Tomcat 7

JMX Connector via RMI

- ✘ enabled at Java start via command line parameters
- ✘ Example for debian: /etc/defaults/tomcat7

JMX http adaptor a.k.a. Proxy Servlet

- ✘ Part of the Tomcat admin application
- ✘ Requires dedicated user role (manager-jmx)
- ✘ /manager/jmxproxy

No Authentication ?

Secure your RMI connections:

- ✘ TLS/SSL Encryption
- ✘ Username/Passwords
- ✘ Support for roles/groups, for example readonly access
- ✘ Most installations use only one account

Attacking JMX

...give me some shells bro...

JMX Pownage through MLet Loading

- ✘ „Discovered“ by Braden Thomas (Accuvant – now optiv)
- ✘ He reads documentation ☺

Braden Thomas

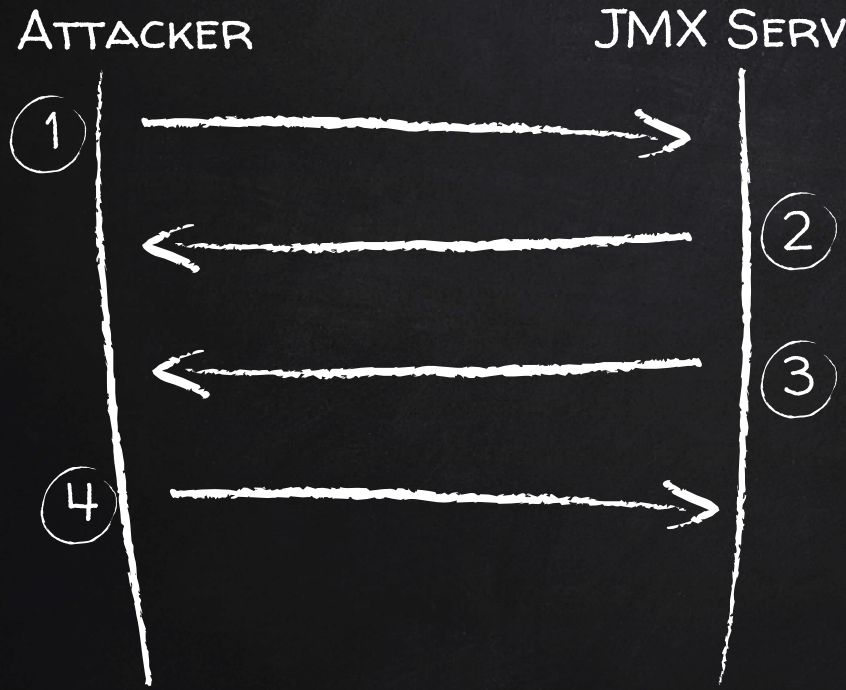
Senior Research Consultant

Braden Thomas is a senior research consultant with Accuvant LABS' research consulting practice. Braden has expertise in vulnerability discovery, fuzzing, exploitation techniques, malware analysis and protocol analysis.

A remote client could create a **javax.management.loading.MLet MBean** and use it to create new MBeans from arbitrary URLs, at least if there is no security manager.

In other words, a rogue remote client could make your Java application execute arbitrary code.

Attack flow



1. Invoke Loading.Mlet
2. Loading.Mlet parses Mlet Configuration file (HTML)
3. Loads and instances Mbean from Mlet File => Attacker Code

4. Attacker invokes malicious MBean

I Wrote a Tool for that...

MJET - Mogwai JMX Exploitation Toolkit

Two parts:

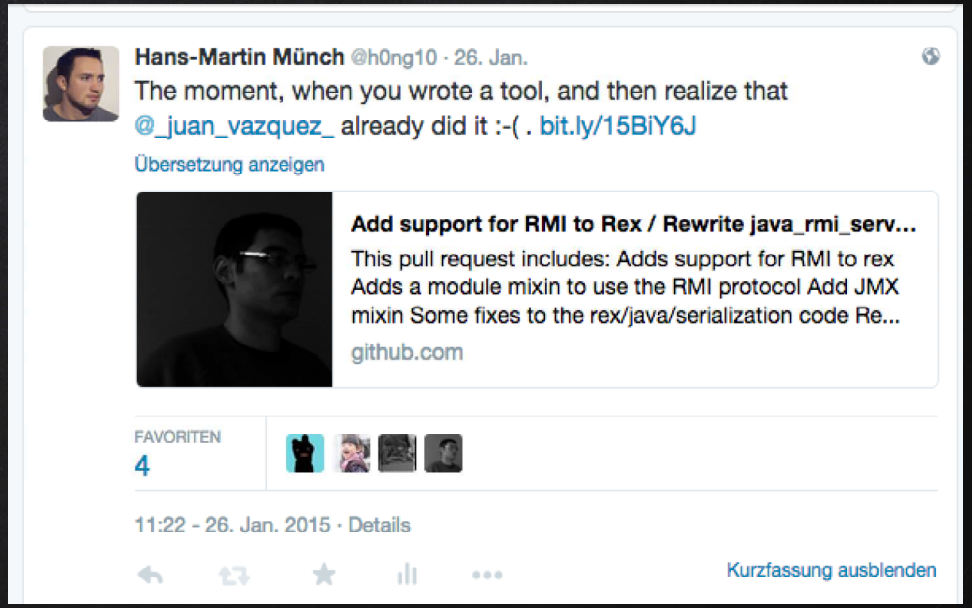
- ✘ Metasploit-module (Mlet-Webserver, Payloads as Mbeans)
- ✘ Java-Part (RMI/JMX communication)

You can download MJET from my github account...

...But you can just use Metasploit

Juan Vazquez added RMI/JMX support to Metasploit including an exploit for insecure JMX Services/Mlet loading

...awesome wtf work...



Demo

Exploiting JMX via Metasploit

Is this common?

No

JMX over RMI is not enabled by default

Only works if authentication is disabled

Yes

Monitoring gets more important. Maybe someone forgot to enable Auth.

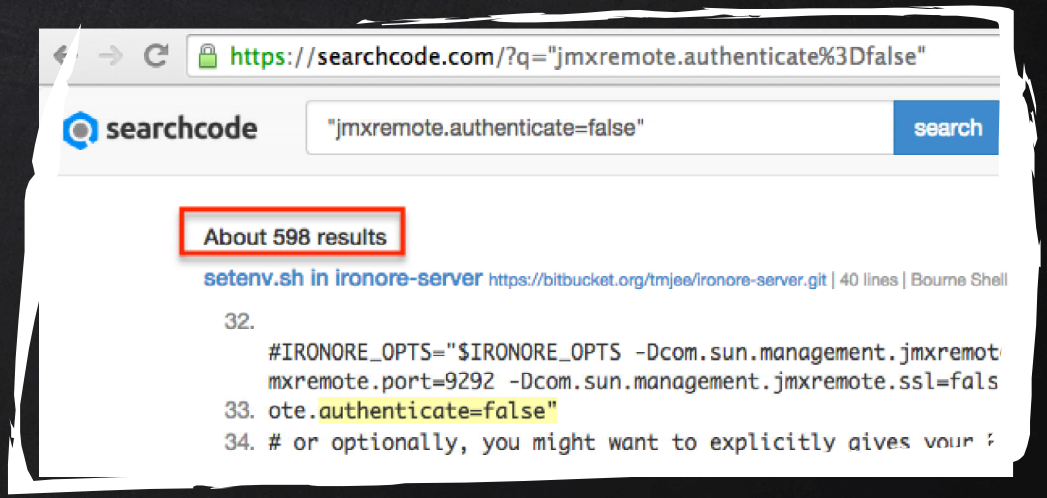
JMX is part of Java, not a product..

after all you only need to succeed once..

Is this common?

Let's ask searchcode

- ✘ 598 results
- ✘ Many „test" scripts...



Is this common?

hazelcast Documentation Version: 3.5.2 - Publication Date : Aug 27, 2015

Search

Monitoring with JMX

You can monitor your Hazelcast members via the JMX protocol.

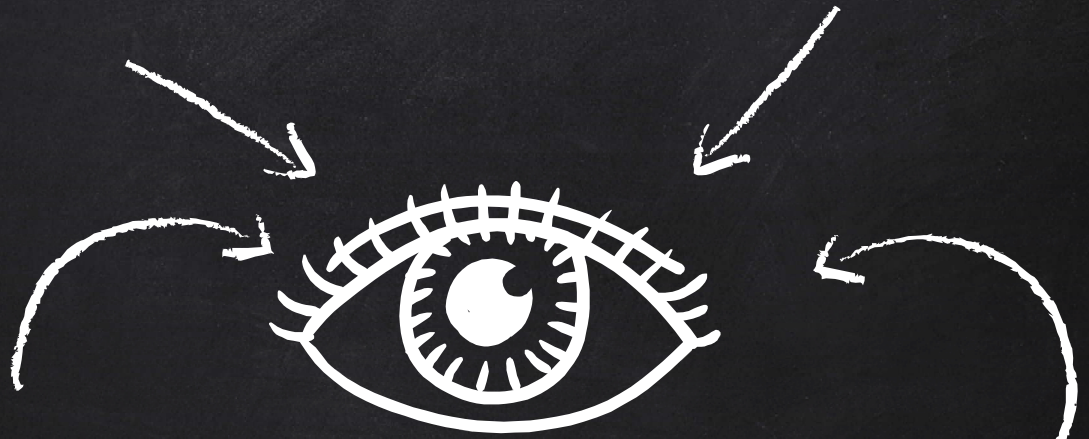
- Add the following system properties to enable JMX agent:
  - `-Dcom.sun.management.jmxremote`
  - `-Dcom.sun.management.jmxremote.port=\_portNo\_` (to specify JMX port) (*optional*)
  - `-Dcom.sun.management.jmxremote.authenticate=false` (to disable JMX auth) (*optional*)
- Enable the Hazelcast property `hazelcast.jmx` (please refer to the System Properties section):
  - using Hazelcast configuration (API, XML, Spring).
  - or by setting the system property `-Dhazelcast.jmx=true`
- Use jconsole, jvisualvm (with mbean plugin) or another JMX compliant monitoring tool.

Some people just follow the official documenation ☺

What authentication is enabled ?

- ✘ You need to find/brute force credentials

- ✘ Loading Mlets is no longer possible if authentiction is enabled
- ✘ You can still use the available Mbeans
- ✘ After all you are talking to a Management Interface



Demo

Exploiting tomcat via JMX methods

What authentication is enabled ?

Tomcat example:

- ✘ No Mbean to deploy Remote Web Applications (not like jboss)
- ✘ But you can add users and Groups ☺

Detection

...Finding JMX services...

Detecting JMX Endpoints

nmap detects JMX RMI Services as normal Java RMI Services

```
nmap -sV 192.168.178.236 -p 1099

Starting Nmap 6.47 ( http://nmap.org ) at 2015-09-09 23:19 CEST
Nmap scan report for 192.168.178.236
Host is up (0.00060s latency).
PORT     STATE SERVICE     VERSION
1099/tcp open  rmiregistry Java RMI

Service detection performed. Please report any incorrect results at
http://nmap.org/submit/ .
Nmap done: 1 IP address (1 host up) scanned in 20.46 seconds
```

Detecting JMX Endpoints

some nmap hints

- ✘ Default: RMI detection works only on common ports
- ✘ Use Option „--version-all“
- ✘ Use nmap script „rmi-dumpregistry.nse“, search for „jmxrmi“
- ✘ To be safe: use jconsole

Detecting JMX Endpoints

```
nmap --script rmi-dumpregistry.nse -sV --version-all -p 1099 192.168.178.236

Starting Nmap 6.47 ( http://nmap.org ) at 2015-09-09 22:21 CEST
Nmap scan report for 192.168.178.236
Host is up (0.0015s latency).
PORT     STATE SERVICE  VERSION
1099/tcp open  java-rmi Java RMI Registry
| rmi-dumpregistry:
|   jmxrmi
|     javax.management.remote.rmi.RMIServerImpl_Stub
|     @192.168.178.236:33701
|     extends
|       java.rmi.server.RemoteStub
|       extends
|_        java.rmi.server.RemoteObject
```

Vulnerability Scanners

What about Nessus (and others) ?

Search results:

ID	Name	Family
23842	JBoss JMX Console Unrestricted Access	CGI abuses
23843	JBoss Application Server (jbossas) JMX Console DeploymentFileRepository Traversal Arbitrary File Manipulation	CGI abuses
53337	JBoss Enterprise Application Platform '/jmx-console' Authentication Bypass	Web Servers
70414	Apache Tomcat / JBoss EJBInvokerServlet / JMXInvokerServlet Marshalled Object Remote Code Execution	CGI abuses

Detecting JMX Endpoints

- ✘ Nessus detects RMI registry endpoints
- ✘ Again: Search for jmxrmi

Output

```
Here is a list of objects the remote RMI registry is currently
aware of :
  rmi://192.168.178.236:37666/jmxrmi
```

Port	Hosts
1099 / tcp / rmi_registry	192.168.178.236

Summary

...what you should take away...

Summary

- ✘ JMX endpoints are often admin-Interfaces
- ✘ Comes in many flavours (RMI/HTTP)
- ✘ Often allow remote code execution
- ✘ Might be missed by the security team
- ✘ We need better tools...

We need better tools...

Metasploit provides native support for RMI, just look at the existing modules for examples....

Some ideas:

- ✘ Auxiliary module for RMI/JMX detection
- ✘ Loginscanner for RMI Brute force attacks
- ✘ Auxiliary modules to add/extract tomcat users via RMI

A nmap or nessus nasl script would also be handy ☺

That's all!

Any questions?

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https://www.mogwaisecurity.de

References

- Wikipedia Article about JMX
  https://en.wikipedia.org/wiki/Java_Management_Extensions
- Authentication and Authorization in JMX RMI connectors
  https://blogs.oracle.com/lmalventosa/entry/jmx_authentication_authorization
- Accuvant blog – Exploiting JMX RMI
  https://www.accuvant.com/blog/exploiting-jmx-rmi
- Oracle Documentation: Monitoring and Management using JMX Technology
  https://docs.oracle.com/javase/6/docs/technotes/guides/management/agent.html
- MJET – Mogwai JMX exploitation toolkit
  https://github.com/mogwaisec/mjet

Credits

Special thanks to all the people who made and released these awesome resources for free:

- ✘ Presentation template by SlidesCarnival
- ✘ Photographs by Unsplash