



Interested in learning
more about security?

SANS Institute InfoSec Reading Room

This paper is from the SANS Institute Reading Room site. Reposting is not permitted without express written permission.

Security Features Overview of Merlin (J2SE Version 1.4)

This paper provides an overview of the security feature of Java™ 2 Standard Edition version 1.4.

Copyright SANS Institute
Author Retains Full Rights

AD

Veriato

Unmatched visibility into the computer
activity of employees and contractors



Try Now

Security Features Overview of Merlin (J2SE Version 1.4)

Craig Walker

December 1, 2001

Introduction

All the safeguards that we, as security professionals, employ are rendered useless if the foundation upon which they are laid is not sound. That is why Java™ has become the language of choice for the security minded application developer. From its inception, security was one of the primary tenets of the Java™ distributed computing platform. The language implemented several features to enforce secure programming including range checking on strings and arrays, garbage collection and automatic memory management. Runtime code legitimacy is insured by the byte code verifier and the Java™ Virtual Machine (JVM). The security manager in conjunction with the class loader enforce strict access policy for code operating on a machine. The Java™ 'sandbox' of JDK 1.0 created a new trust model for distributed and potentially malicious code. That model has been extended and redefined in subsequent JDK versions.

Building security in is preferred to bolting something on to protect an inherently insecure application. By providing the tools and infrastructure to easily create secure applications, Java will help 'sell' security as a cost effective and marketable solution. By making security cheap and easy, it is easier to justify in today's rapid time to market software economy. Consider how our jobs would change if we no longer had to worry about defending against the easily avoidable buffer overflow exploits; one attack method with so many targets.

Java™ 2 Standard Edition Security Features

The soon to be released Java™ 2 Standard Edition version 1.4 takes security to a new plateau by combining, in the language core, security features to support confidentiality, integrity, and availability. The following security features renew Sun's commitment to secure computing through Java.

- Java Cryptographic Extensions (JCE)
- Java Secure Socket Extensions (JSSE)
- Java Authentication and Authorization Service (JAAS)
- Generic Security Services Application Program Interface (GSS-API)
- Java Certification Path API

Java Cryptographic Extensions (JCE)

The JCE provides an extensible framework for implementing various cryptographic operations and algorithms. JCE provides functionality to support encryption, key generation and agreement, and message authentication code (MAC).

The Java Cryptographic Extension provider implementations that ship with J2SE 1.4 include:

- Key generation algorithms for DES, Triple DES, Blowfish, MD5, and SHA1
- Symmetric encryption algorithms for DES, Triple DES, and Blowfish
- Diffie-Hellman implementation that includes key agreement algorithm, key pair generator, and an algorithm parameter generator.
- Hashing algorithms MD5 and SHA1.
- A padding scheme for PKCS#5
- A keystore implementation type named JCEKS

JCE uses the notion of a service provider architecture to create a very open and flexible cryptographic infrastructure. This architecture which is depicted in

Figure 1, has become the norm for providing independent and extensible services. The cryptographic services are defined very generically in the service provider interface (SPI) layer and then implemented as a provider of that service. This allows for the simple insertion or removal of cryptographic providers. Clients may configure their runtimes with different providers (acceptable algorithms for instance) and specify a preference order. This preference order can be used to help the application select the strongest supported algorithm. As new algorithms are created, they simply need to be implemented as a service provider and plugged in to the architecture, having little or no effect on the applications that are using the service.

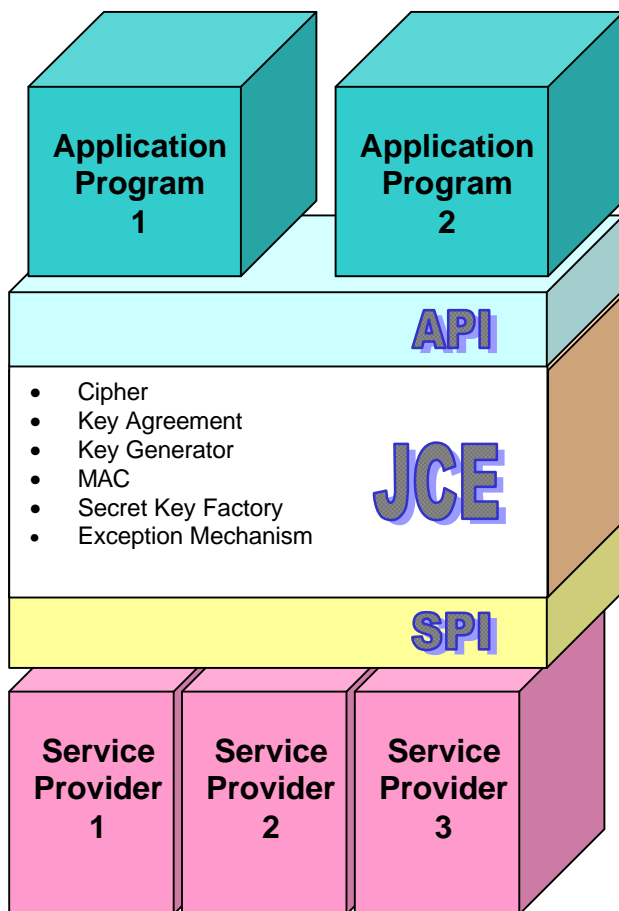


Figure 1

The Java Secure Sockets Extension

J2SE 1.4 will also include the Java Secure Sockets Extension (JSSE). JSSE provides implementations and support for Secure Sockets Layer version 3 as well as Transport Layer Security (TLS) version 1. The inclusion of the `SSLSocket` and `SSLServerSocket` classes provides an easy transition to secure channel programming. As you can see from the code fragments in Code Sample 1, it is a trivial matter to convert a socket based application to a secure communication channel.ⁱ

```
// A sample socket program fragment to get a page from port 80
Socket socket = new Socket "www.someNONsecuresite.com", 80);
PrintWriter out = new PrintWriter(
    new BufferedWriter(
        new OutputStreamWriter(socket.getOutputStream())));
out.println("GET http://www.someNONsecuresite.com/index.html HTTP/ 1.1"
out.flush());

// The same program fragment over a secure socket
SSLSocketFactory factory = (SSLSocketFactory) SSLSocketFactory.getDefault();
SSLSocket socket = (SSLSocket) factory.createSocket("www.someSECUREsite.com", 443);
PrintWriter out = new PrintWriter(
    new BufferedWriter(
        new OutputStreamWriter(socket.getOutputStream())));
out.println("GET http://www.someSECUREsite.com/index.html HTTP/ 1.1"
out.flush());
```

Code Sample 1

JSSE additionally provides support utilities for key and certificate management, cipher negotiation, and client and server authentication. Table 1 outlines the cryptographic suites along with the cipher strengths supported.

Cryptographic Suite	Key Lengths (Bits)
RSA (authentication and key exchange)	2048 (authentication)
	2048 (key exchange)
	512 (key exchange)
RC4 (bulk encryption)	128
	128 (40 effective)
DES (bulk encryption)	64 (56 effective)
	64 (40 effective)
Triple DES (bulk encryption)	192 (112 effective)
Diffie-Hellman (key agreement)	1024
	512
DSA (authentication)	1024

Table 1

JSSE implements the mechanism for cipher negotiation through the SSL 'handshake'. This process involves:

1. The client sends its version number, cipher settings, and some session specific information.
2. The server responds with the same information along with its certificate.
3. The client authenticates the server certificate with the appropriate Certificate Authority.
4. Using the agreed upon information thus far, the client generates the pre-master secret key and encrypts it with the server public key. It then sends the encrypted key back to the server to be used in subsequent transmittals.
5. The server can then optionally validate the client (if it has requested a client certificate in the previous step).
6. Both the client and the server then generate the session key from the pre-master secret. This session key will be used to encrypt all further secure communications during this session.
7. Both systems then exchange an SSL handshake complete message and begin secure communications.

Java Authentication and Authorization Service (JAAS)

JAAS, as the name implies, is intended to be used for the authentication of users as well as resource access control (authorization). It is implemented (similar to the JCE described above) in a modular fashion, isolating applications from the underlying authentication services.

Authentication involves a user providing some proof that they are indeed who they claim to be. This proof may take the form of something they have (smartcard or token), something they know (password), something they are (biometric), or a combination of these methods. As authentication methods change, it is important to minimize the impact on dependent application. The modular nature of JAAS provides just such an independence. Dual (or even triple) mode authentication can also be implemented easily in JAAS through the notion of stackable authentication modules, similar to the UNIX Pluggable Authentication Modules (PAM). These modules use a two phase commit to ensure that either all authentication methods pass or they all fail. In the first phase (login phase), each module is instructed to do authentication only. The second phase (commit phase) is only invoked if all modules pass authentication. In the commit phase all modules are called once again to provide the appropriate credentials for the subject.

Once identity has been established through authentication, a system needs to determine whether the principal has the appropriate authority to use the protected resources. This authorization mechanism is implemented through the Java SecurityManager when untrusted code requires sensitive system resources. The security policy for JAAS is consistent with but extends the Java 2 Codesource-based security model (code signing) by adding principal based authorization. The current and default implementation uses a local file to define the security policy.

Generic Security Services Application Program Interface (GSS-API)

The Java GSS-API is the mechanism for secure message exchange between applications providing principal authentication, delegation, and message confidentiality and integrity assurance. The GSS-API is defined in [RFC 2853](#). The two mechanisms defined in RFC 2853 are the simple public-key GSS-API mechanism and the Kerberos version 5 GSS-API mechanism.

GSS-API and JSSE contain very similar security functionality. There are, however, several factors that determine the best choice for a given application. If your target platform includes a Kerberos Version 5 implementation that you want to use for authentication, GSS-API may be a better choice since JSSE does not support it. If you are converting a socket based application to a secure socket version, JSSE is probably the right choice. If, on the other hand, your application communicates via UDP or it passes both encrypted and non-encrypted messages, GSS-API is probably more appropriate. GSS-API allows client delegation and impersonation, features not in JSSE.

There are four steps involved in setting up a secure communication with GSS-API. In the first step, the application acquires a credential that will identify it to another application. These two applications then develop a shared security context using GSSContext. This context contains mutual information including cryptographic keys and message sequence numbers. The third step involves using the methods of GSSContext to invoke per message services for authentication, integrity, and confidentiality. The final step 'cleans up' any resources that were used during the communication and releases the context.

Java Certification Path API

The Java Certification Path API provides certificate validation and mapping functions. It can be used to create, build, and validate certification paths. It uses a similar modular architecture to the JCE, employing a provider-based architecture. This is an important API because the entire trust model upon which our e-commerce world is based upon relies on the effective traversal of a list of certificates until an appropriate authority is located.

The API includes interfaces and implementations for four certificate functions, Basic, Validation, Building, and Storage. The basic certification path classes contain the core functionality for representing and encoding certificate paths. The validation classes, as the name implies, handle certificate path validation. The building classes are for creating or automating the discovery of certificate paths. And finally, the storage classes allow for the storage of certificates and revocation list discovery.

Conclusion

Included in the upcoming release of the J2SE version 1.4, the security provider architecture creates a desirable independence between system services and applications. It will also provide application programmers with many of the tools

necessary to implement secure services. We can only hope that this heralds a new era of secure applications.

References

1. Sun Microsystems Inc., "Java™ Secure Socket Extensions"
<http://java.sun.com/products/jsse/index-14.html> (Jun 29, 2001)
2. Sun Microsystems Inc., "Java™ Cryptography Extension (JCE)"
<http://java.sun.com/products/jce/index-14.html> (September 11, 2001)
3. Sun Microsystems Inc., "Java™ Certification Path API Programmer's Guide"
<http://java.sun.com/j2se/1.4/docs/guide/security/certpath/CertPathProgGuide.html>
(October 22, 2001)
4. The Internet Engineering Task Force (IETF), "Generic Security Service API Version 2 : Java Bindings" <http://www.ietf.org/rfc/rfc2853.txt> (June, 2000)
5. Sun Microsystems Inc., "When to use Java GSS-API vs. JSSE"
<http://java.sun.com/j2se/1.4/docs/guide/security/jgss/tutorials/JGSSvsJSSE.html>
(November 30, 2001)
6. Charlie Lai, Li Gong, Larry Koved, Anthony Nadalin, and Roland Schemers, "USER AUTHENTICATION AND AUTHORIZATION IN THE JAVA(TM) PLATFORM"
<http://java.sun.com/security/jaas/doc/acsac.html> (December, 1999)
7. Microsoft Corporation, "Description of the Secure Sockets Layer (SSL) Handshake"
<http://support.microsoft.com/default.aspx?scid=kb;EN-US;q257591> (April 6, 2000)

ⁱ The code is meant to highlight the similarities between socket and secure socket programs. There are many underlying details that have been excluded for clarity.



Upcoming SANS Training

[Click Here for a full list of all Upcoming SANS Events by Location](#)

SANS San Francisco Winter 2017	San Francisco, CAUS	Nov 27, 2017 - Dec 02, 2017	Live Event
SIEM & Tactical Analytics Summit & Training	Scottsdale, AZUS	Nov 28, 2017 - Dec 05, 2017	Live Event
SANS Khobar 2017	Khobar, SA	Dec 02, 2017 - Dec 07, 2017	Live Event
SANS Munich December 2017	Munich, DE	Dec 04, 2017 - Dec 09, 2017	Live Event
European Security Awareness Summit & Training 2017	London, GB	Dec 04, 2017 - Dec 07, 2017	Live Event
SANS Austin Winter 2017	Austin, TXUS	Dec 04, 2017 - Dec 09, 2017	Live Event
SANS Frankfurt 2017	Frankfurt, DE	Dec 11, 2017 - Dec 16, 2017	Live Event
SANS Bangalore 2017	Bangalore, IN	Dec 11, 2017 - Dec 16, 2017	Live Event
SANS Cyber Defense Initiative 2017	Washington, DCUS	Dec 12, 2017 - Dec 19, 2017	Live Event
SANS Security East 2018	New Orleans, LAUS	Jan 08, 2018 - Jan 13, 2018	Live Event
SANS SEC460: Enterprise Threat Beta	San Diego, CAUS	Jan 08, 2018 - Jan 13, 2018	Live Event
SEC599: Defeat Advanced Adversaries	San Francisco, CAUS	Jan 15, 2018 - Jan 20, 2018	Live Event
SANS Amsterdam January 2018	Amsterdam, NL	Jan 15, 2018 - Jan 20, 2018	Live Event
Northern VA Winter - Reston 2018	Reston, VAUS	Jan 15, 2018 - Jan 20, 2018	Live Event
SANS Dubai 2018	Dubai, AE	Jan 27, 2018 - Feb 01, 2018	Live Event
SANS Las Vegas 2018	Las Vegas, NVUS	Jan 28, 2018 - Feb 02, 2018	Live Event
Cyber Threat Intelligence Summit & Training 2018	Bethesda, MDUS	Jan 29, 2018 - Feb 05, 2018	Live Event
SANS Miami 2018	Miami, FLUS	Jan 29, 2018 - Feb 03, 2018	Live Event
SANS London February 2018	London, GB	Feb 05, 2018 - Feb 10, 2018	Live Event
SANS Scottsdale 2018	Scottsdale, AZUS	Feb 05, 2018 - Feb 10, 2018	Live Event
SANS Secure India 2018	Bangalore, IN	Feb 12, 2018 - Feb 17, 2018	Live Event
SANS Southern California- Anaheim 2018	Anaheim, CAUS	Feb 12, 2018 - Feb 17, 2018	Live Event
SANS Dallas 2018	Dallas, TXUS	Feb 19, 2018 - Feb 24, 2018	Live Event
SANS Secure Japan 2018	Tokyo, JP	Feb 19, 2018 - Mar 03, 2018	Live Event
Cloud Security Summit & Training 2018	San Diego, CAUS	Feb 19, 2018 - Feb 26, 2018	Live Event
SANS Brussels February 2018	Brussels, BE	Feb 19, 2018 - Feb 24, 2018	Live Event
SANS London November 2017	OnlineGB	Nov 27, 2017 - Dec 02, 2017	Live Event
SANS OnDemand	Books & MP3s OnlyUS	Anytime	Self Paced