Web Application Access Control with Java SE Security

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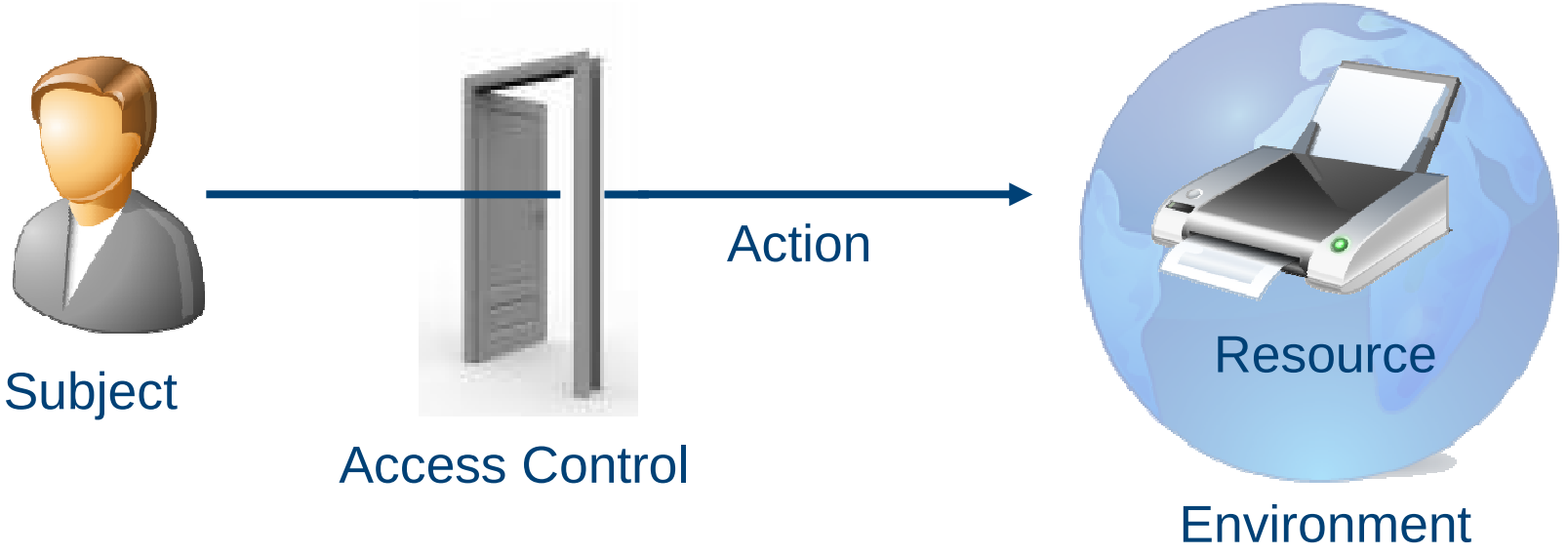
Agenda

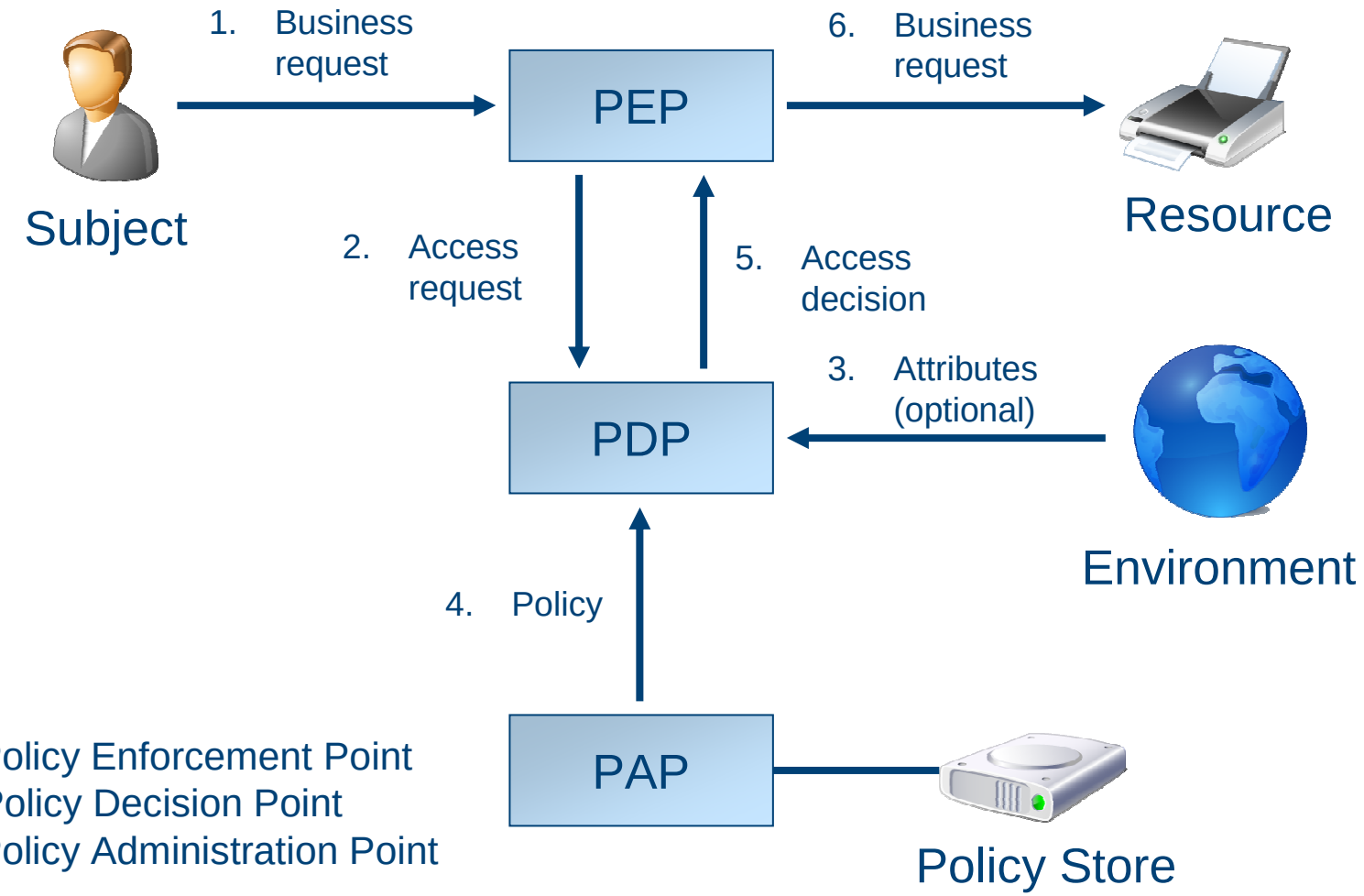
1. Access Control Basics
2. The Java Authentication and Authorization Service (JAAS)
3. Enhancement and Application of JAAS
4. Role-Based Access Control
5. Instance-Based Access Control
6. Sample Application: A Personal Health Record

Access Control Basics



- **Subject**: A user, system, etc.
- **Resource**: A file, printer, domain object, etc.
- **Action**: An operation on a resource (read, print, create, etc.)
- **Environment**: Access control relevant attributes not available from Subject, Action or Resource (time, location, …)
- **Access Control**: Controls performing an Action in accordance with a Policy

Access Control Architecture



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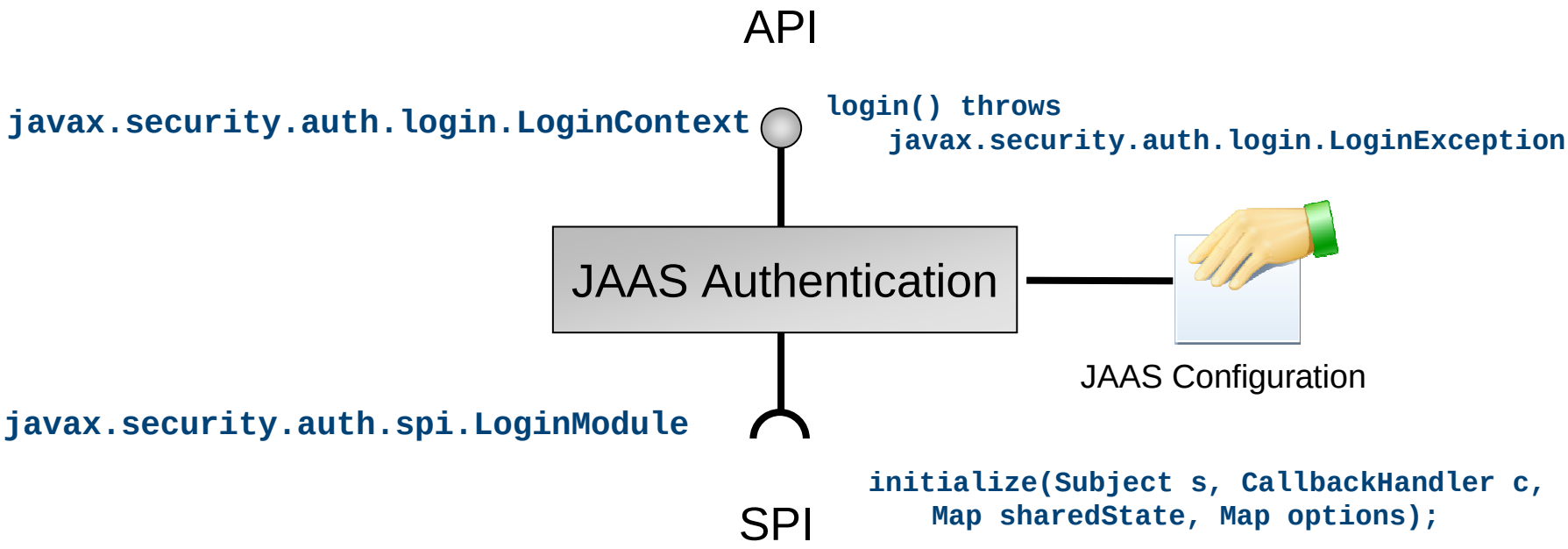
Limitations of JEE Security

- With the declarative JEE security model, it is difficult to change security policies when new requirements arise
- The declarative model limits the expressiveness of security policies
- Only one authentication method per application allowed
- Supports only limited set of authentication methods

Java Authentication and Authorization Service (JAAS)

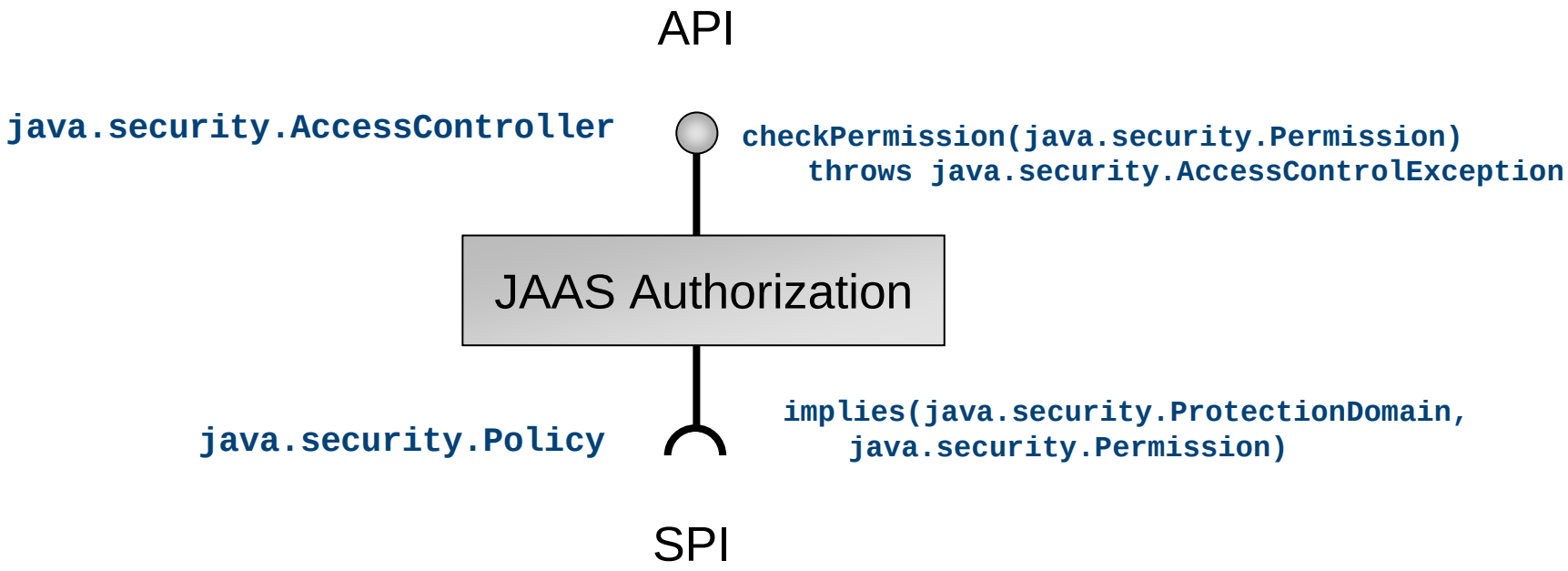
- Originally, Java SE Authorization was based exclusively on the code accessing resources and authentication was based on digital signatures applied to the code
- JAAS was designed to address this shortcoming and is part of Java SE since V. 1.4
- JAAS authentication is an implementation of the Pluggable Authentication Module (PAM) framework and allows applications to authenticate independently from the underlying technology (user/password, certificate,…)
- JAAS authorization allows access control based on who is executing the code

JAAS Authentication




```
initialize(Subject s, CallbackHandler c,
    Map sharedState, Map options);

login() throws LoginException;

commit() throws LoginException;

abort() throws LoginException;

logout() throws LoginException;
```

JAAS Authorization



Permission: encapsulates access control relevant attributes of Action and Resource
AccessControlException: thrown if access to Resource is denied
ProtectionDomain: provides Subject

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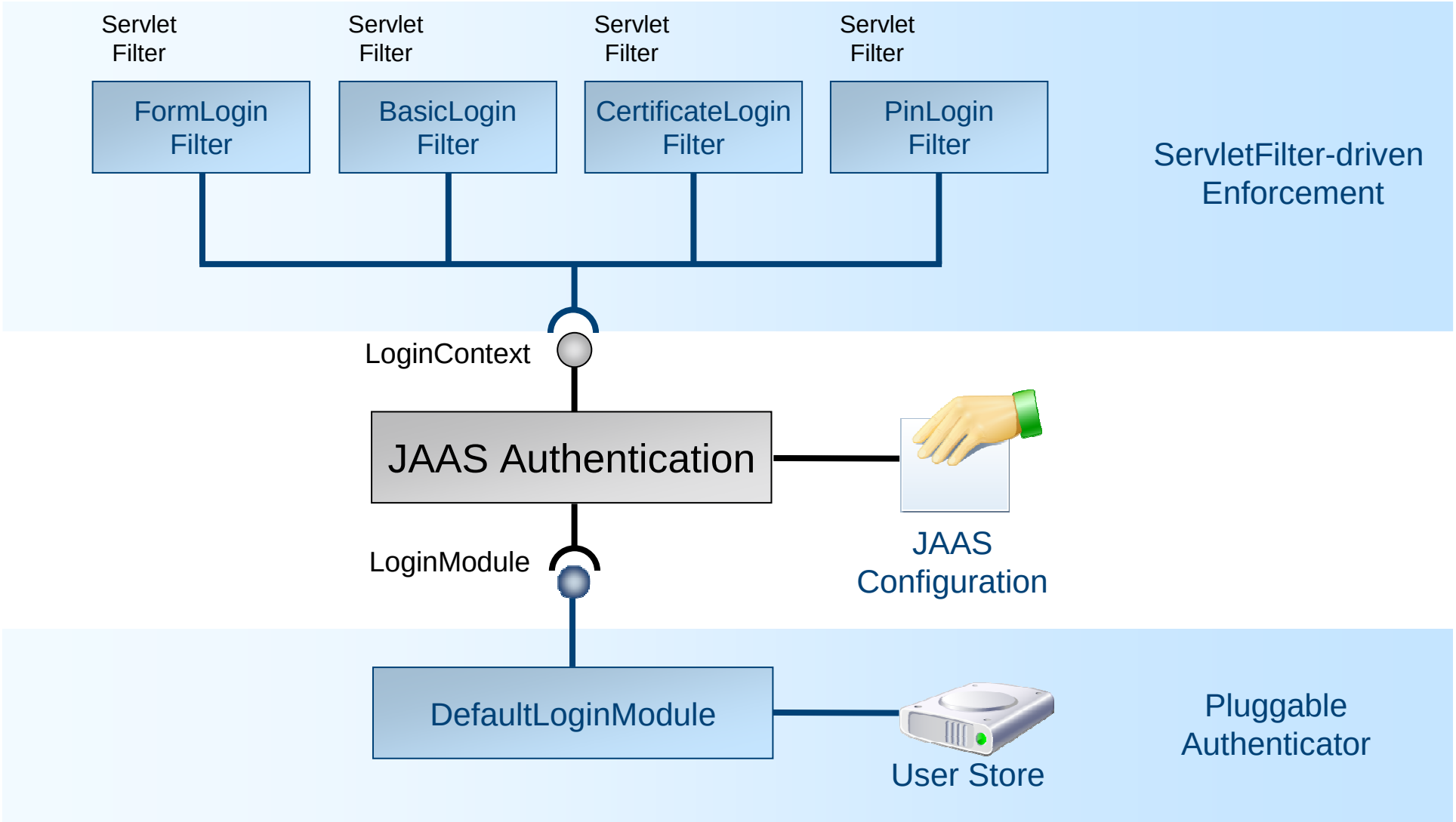
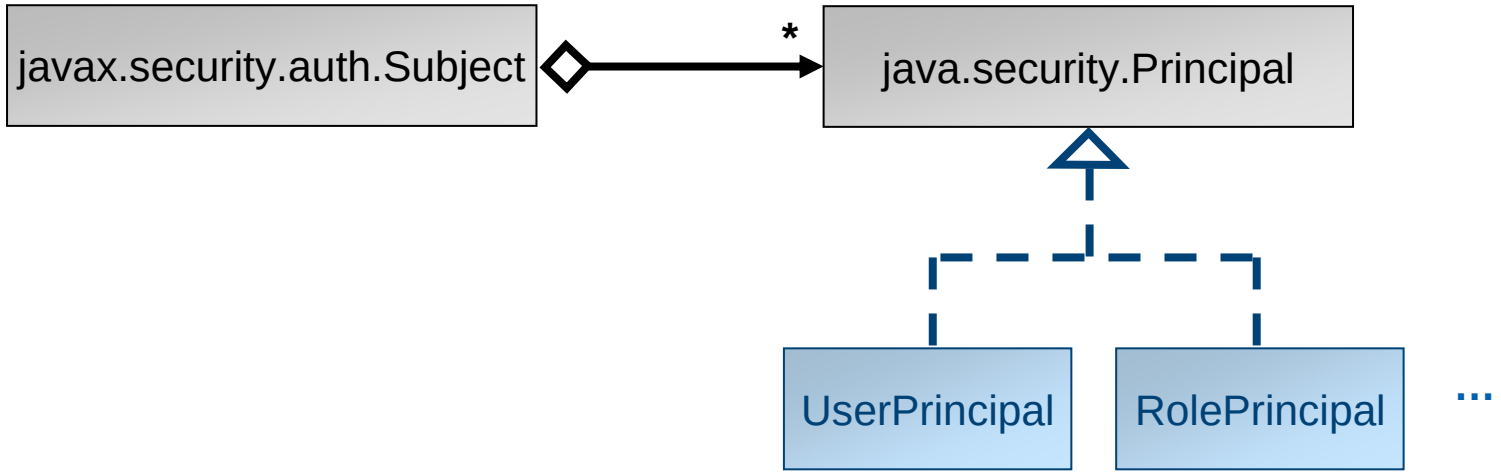
Application of JAAS Authentication

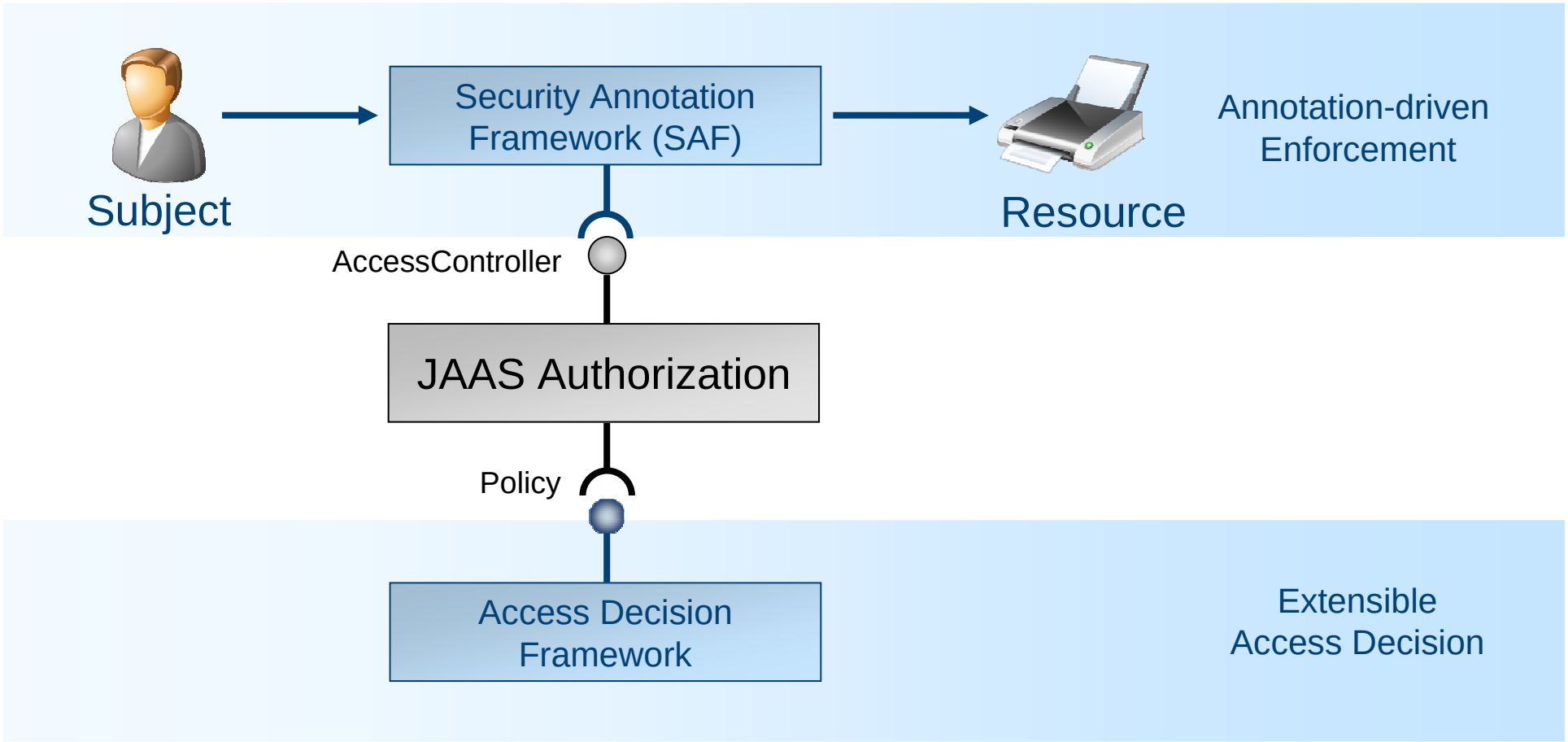


Subject and Principals

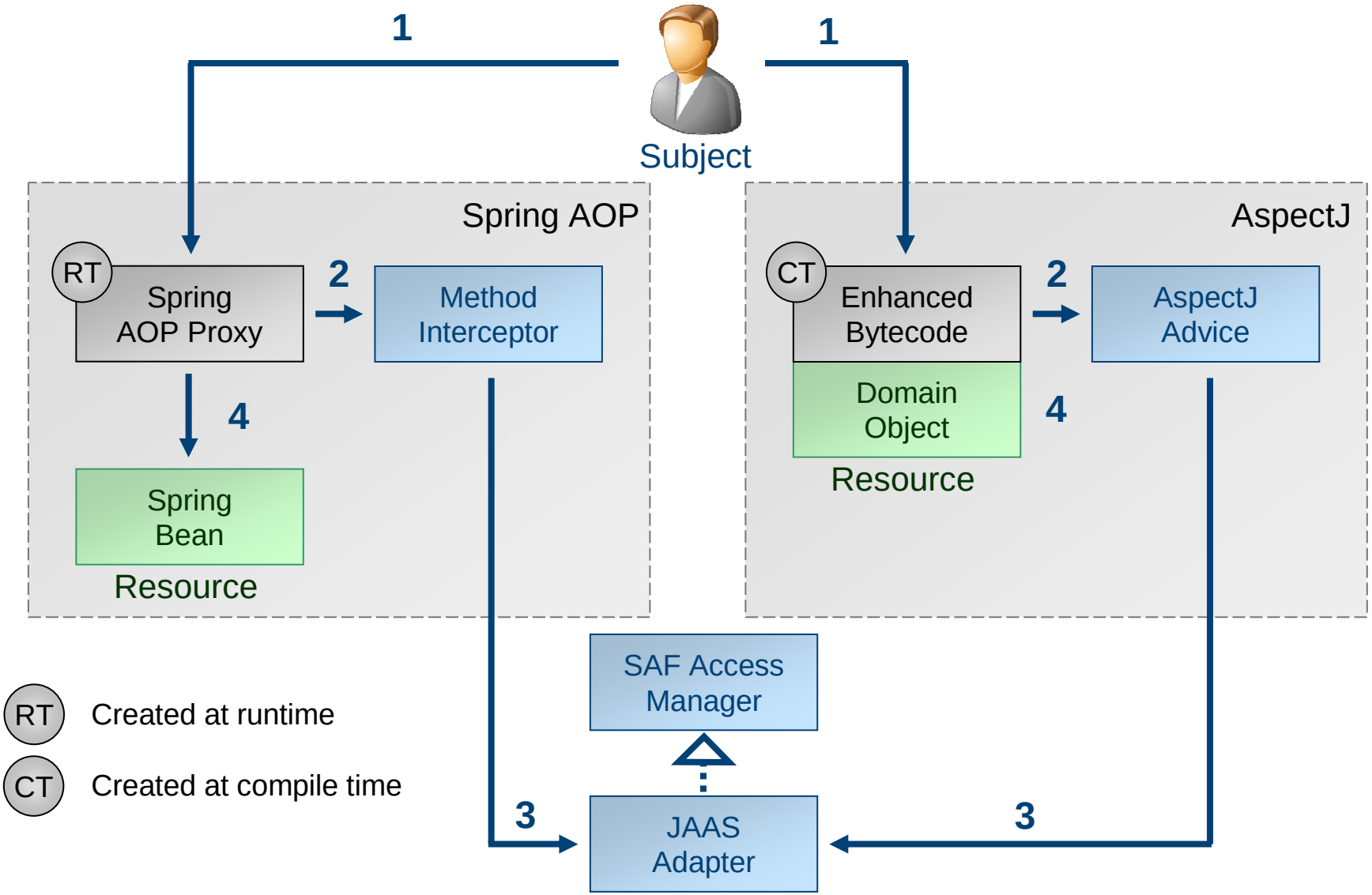
- A successful authenticated subject is represented in Java by a javax.security.auth.Subject instance
- A subject is associated with identities. In Java an identity is represented by the java.security.Principal interface
- An application provides Principal implementations



Application of JAAS Authorization



Security Annotation Framework (SAF)



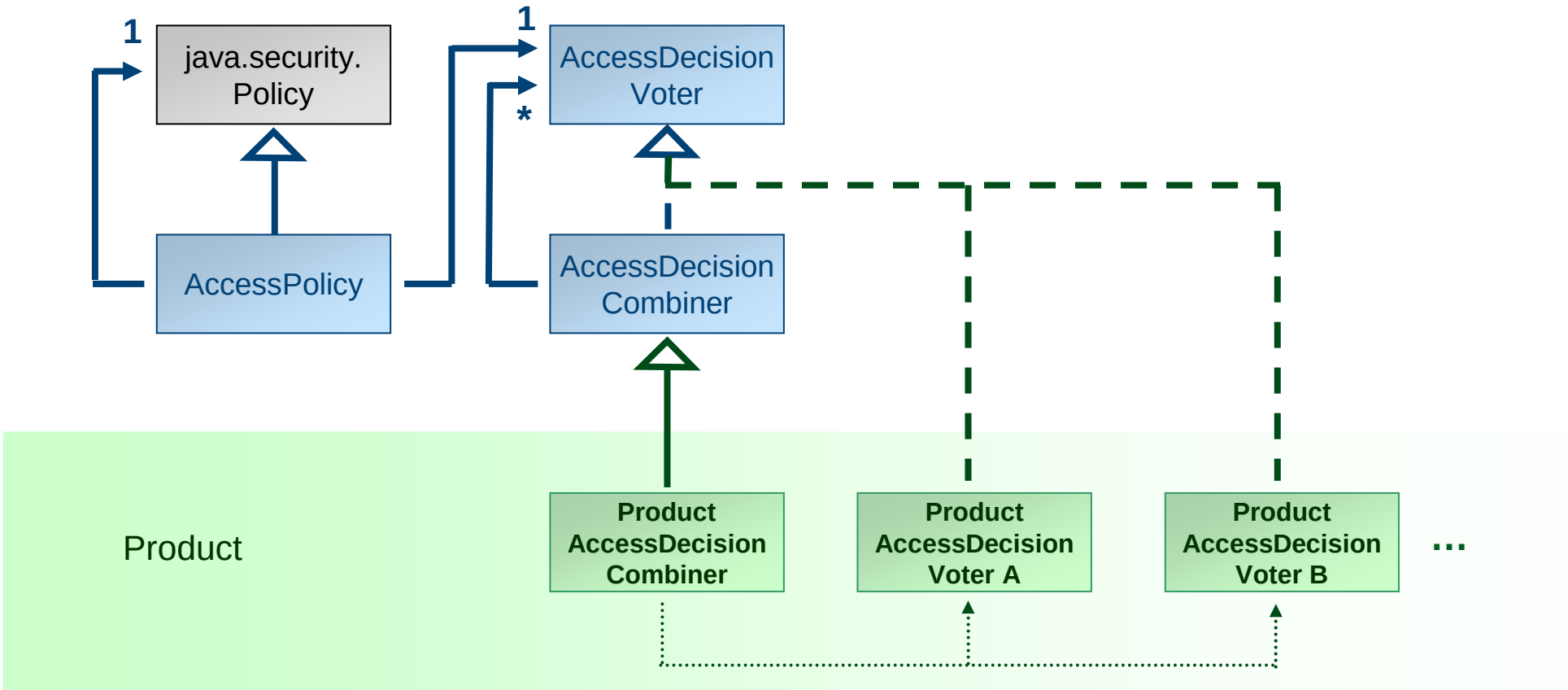
SAF Service Annotations

```
public interface RecordService {
   @Filter
    public Set<Record> findAll();

    public Record create (@Secure (SecureAction.CREATE) Record record);
}
```

SAF Domain Object Annotations

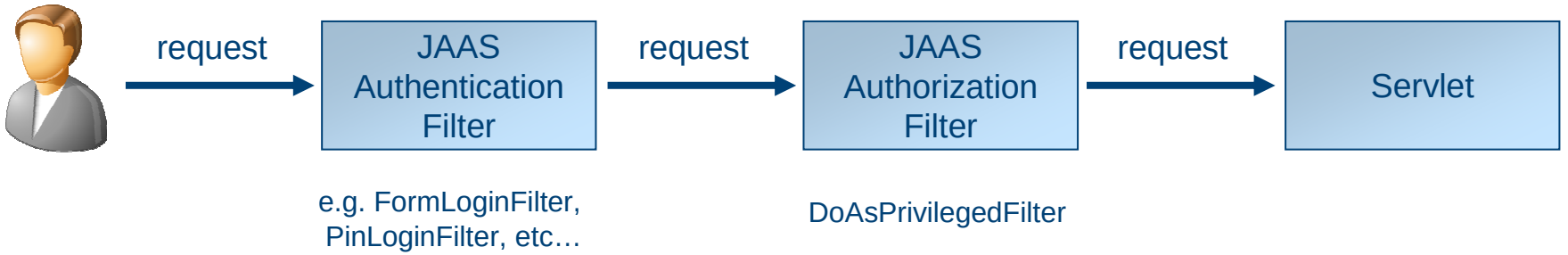
```
@SecureObject
public class Record {
    private Set<Medication> medications;

    @Secure (SecureAction.UPDATE)
    public void addMedication(Medication medication) {
         medications.add(medication);
    }
    ...
}
```

Access Decision Framework



Enabling JAAS in a Web Application

- A JEE-compliant Web Application Server (WAS) is required to support JAAS
- However, the JEE specification does not require a WAS to use JAAS as its own authentication and authorization mechanism
- JAAS has to be enabled by the web application itself:
  - Set the JAAS policy during application startup,
    i.e. call java.security.Policy.*setPolicy(*customPolicy*)* in the ContextListener
  - Use one (or more) JAAS authentication servlet filter/s
  - Use a JAAS authorization servlet filter that adds a Subject to the JAAS access control context (i.e. call javax.security.auth.Subject.doAsPrivileged(…)



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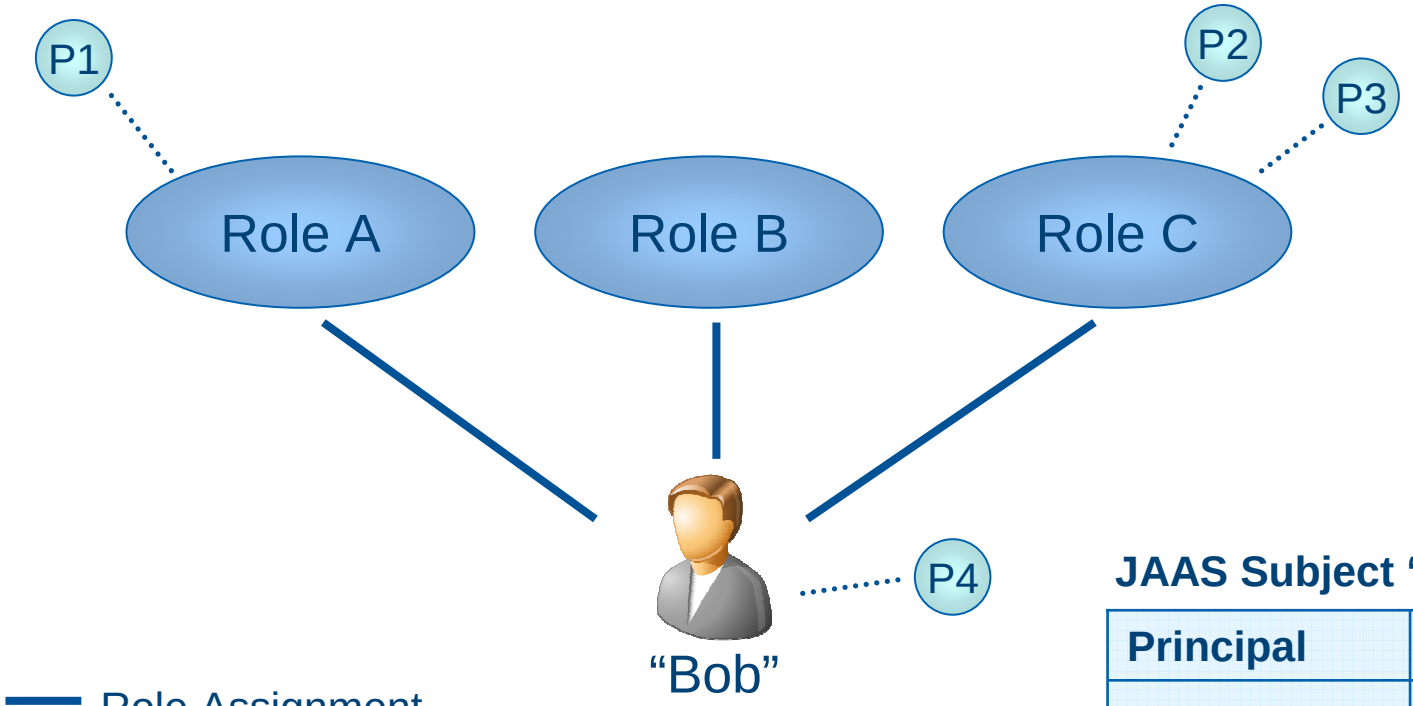
Role-Based Access Control (RBAC)



Role Assignment

Pn Permission n

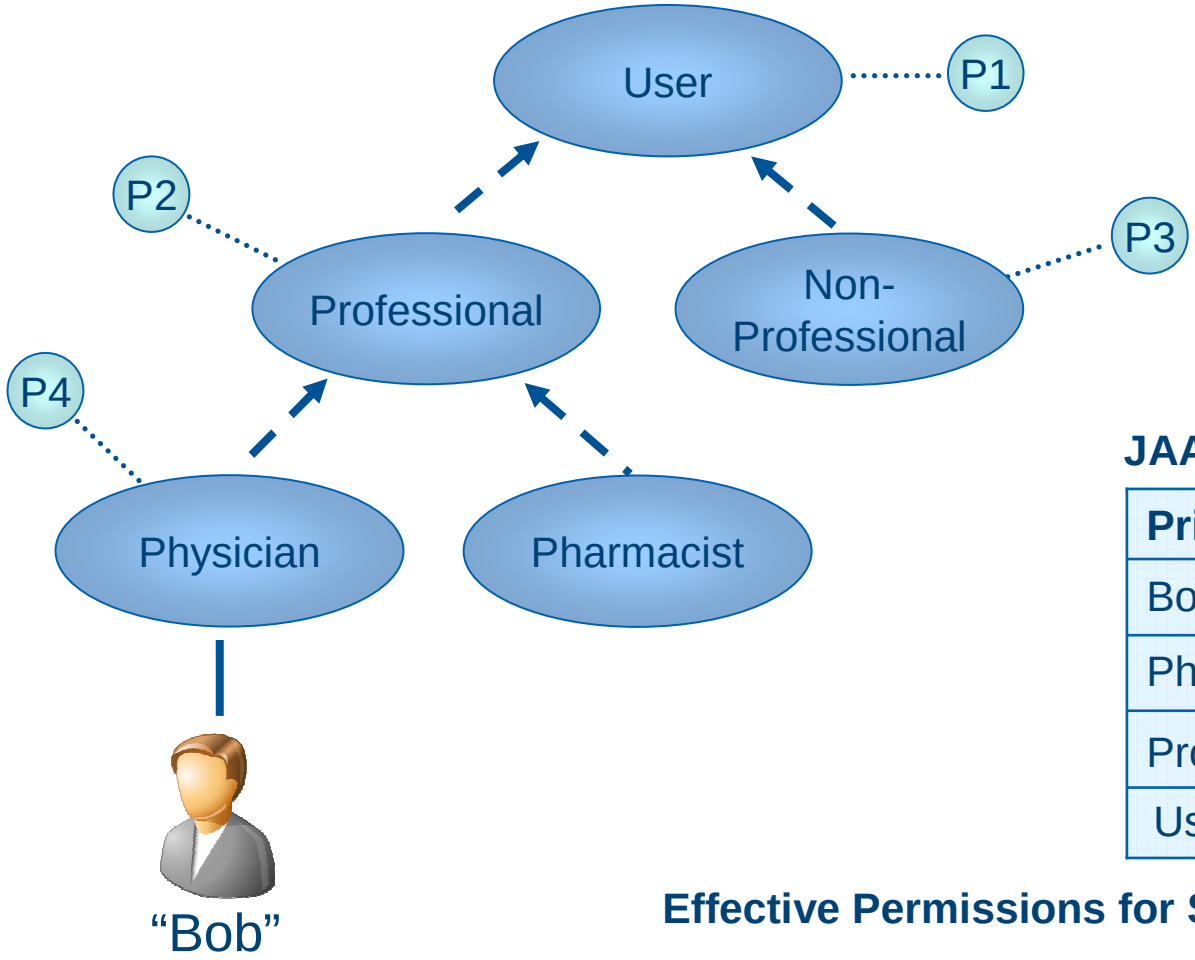
Permission Assignment

JAAS Subject "Bob":

Principal	Permission
Bob	P4
Role A	P1
Role B	-
Role C	P2,P3

Effective Permissions for Subject "Bob": P1,P2,P3,P4

Hierarchical Role-Based Access Control (HRBAC)



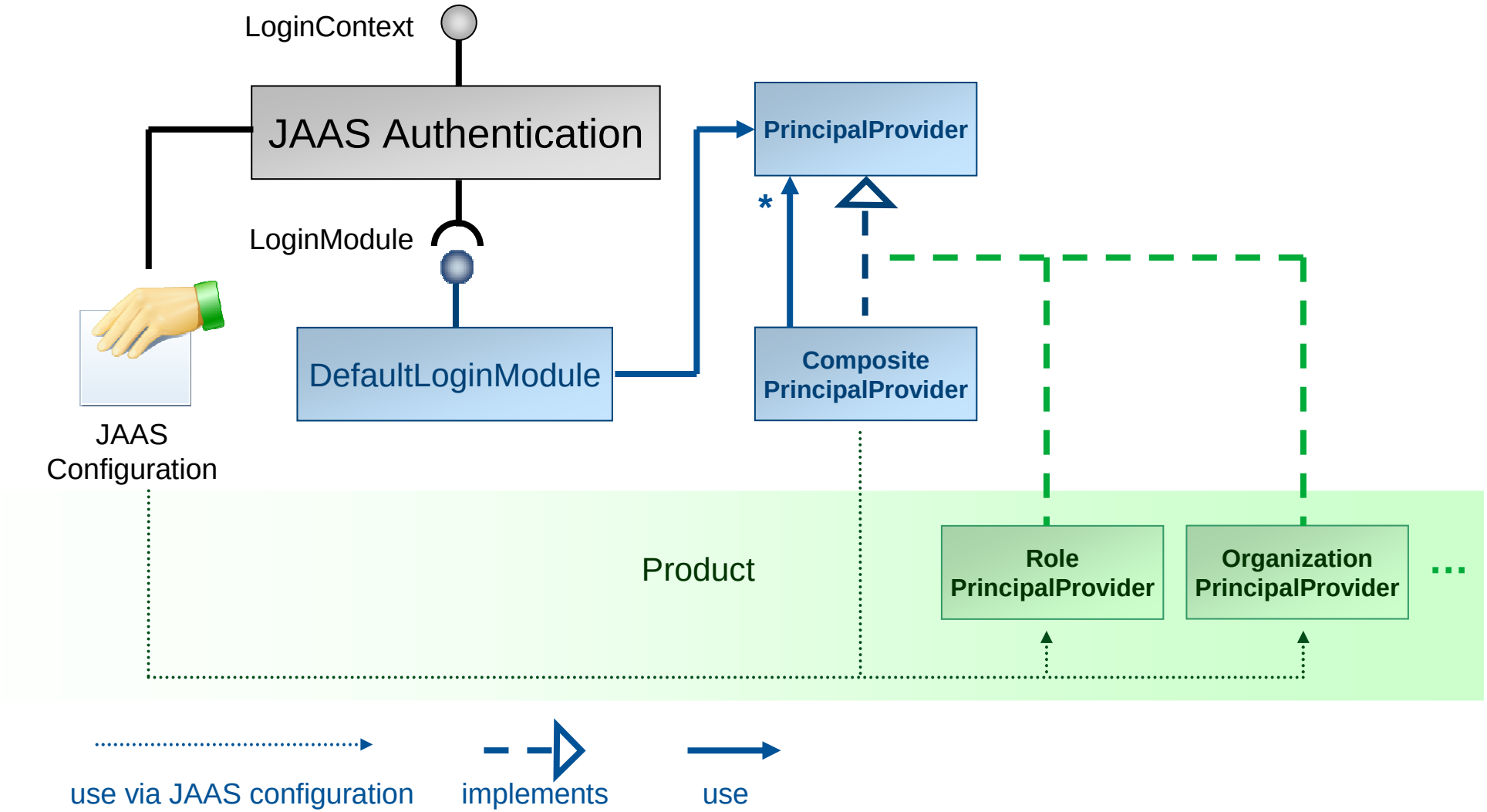
JAAS Subject "Bob":

Principal	Permission
Bob	-
Physician	P4
Professional	P2
User	P1

Effective Permissions for Subject "Bob": P1,P2,P4

Pn Permission n ····· Permission Assignment – → Parent ═══ Role Assignment

Principal Provider Pattern



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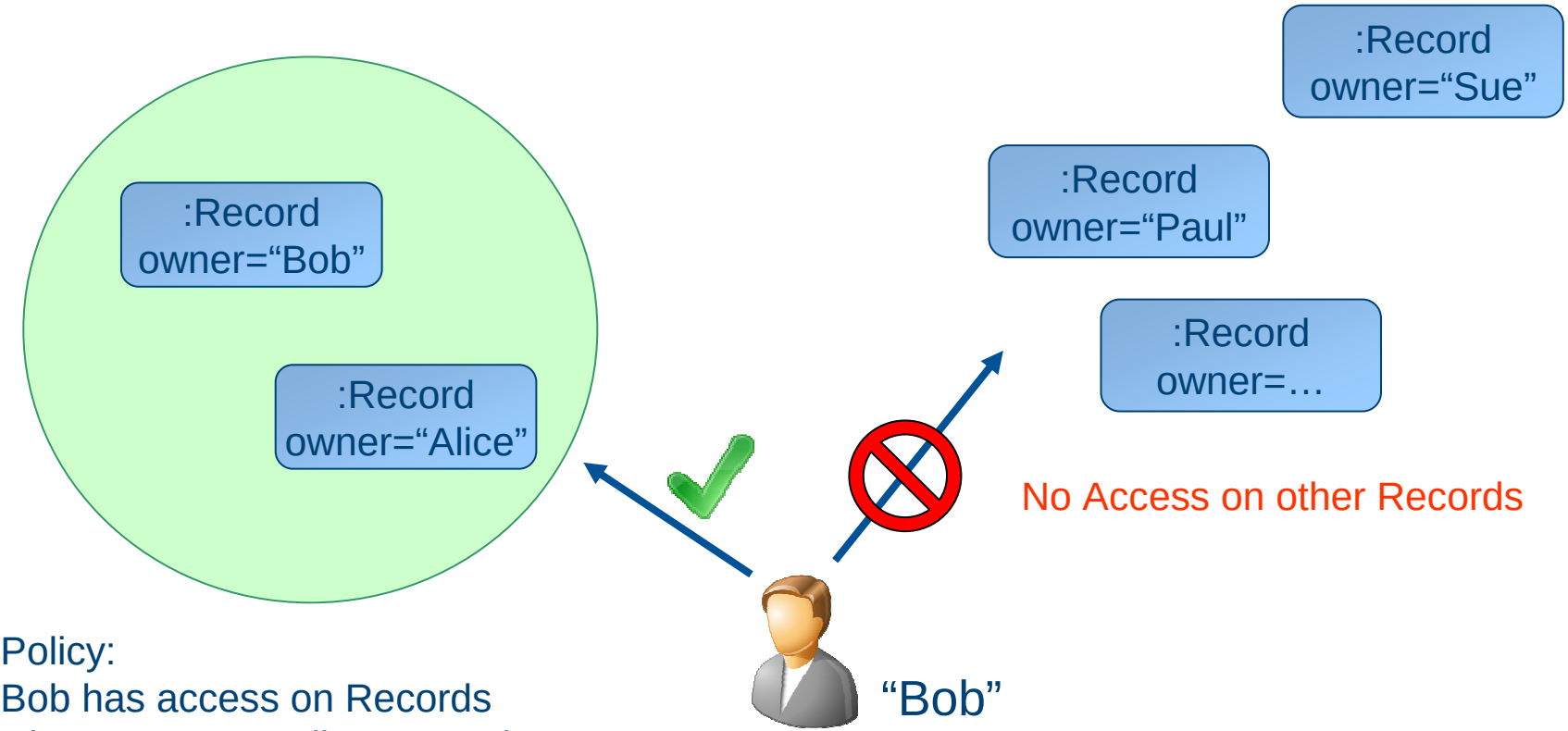
Instance-Based Access Control (IBAC)

- Instances of domain objects are secured resources
- Access decisions are based on the state of the instances



Policy:
Bob has access on Records
where owner = "Alice" or "Bob"

Annotation-Driven IBAC

```
@SecureObject
public class Record {
    ...

    @SecurityRelevant
    private String owner;

    ...
}
```

- The PEP extracts all security relevant attributes from the domain object instance and puts them into a java.security.Permission implementation.

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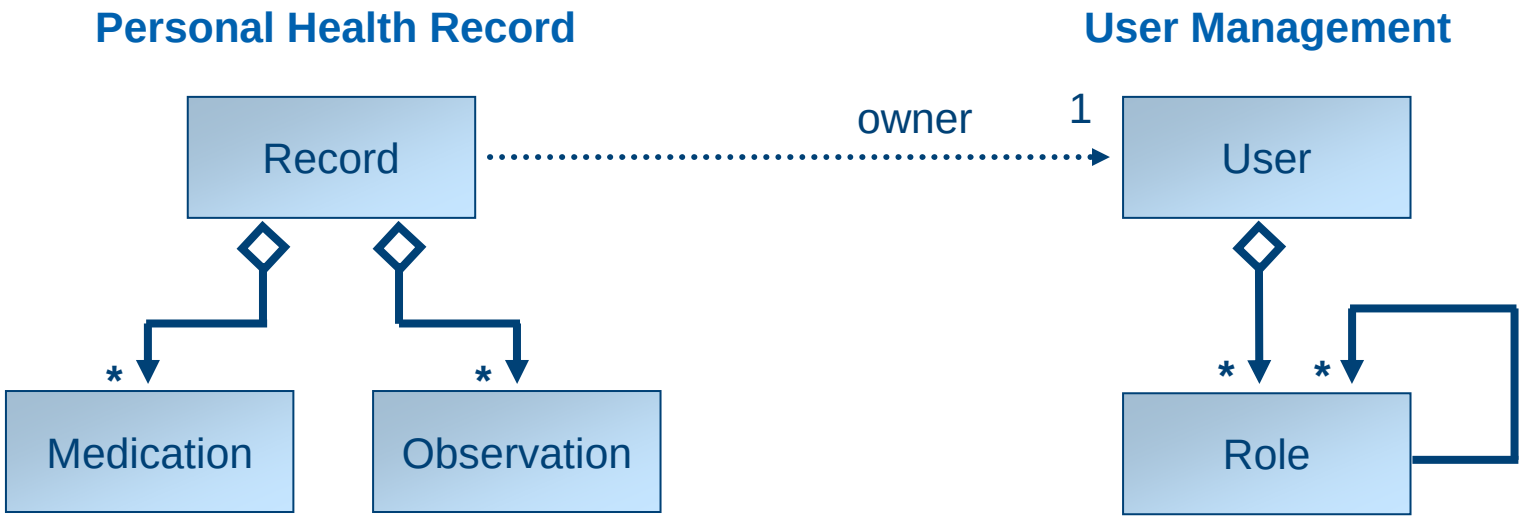
Sample Application

- Domain Model



- Use Cases
  - Create a new user with roles and an associated new record
  - Grant access rights to a user
  - Add medications and observations to a record

Sample Application Technology

- Libraries:
  - Java SE 6
  - Spring IOC / AOP / MVC V. 2.5
  - Security Annotation Framework (SAF) V. 0.9
  - Servlets V. 2.5
  - AspectJ V. 1.6
- Testing
  - JUnit V. 4.4
  - EasyMock V.2.4
- Build
  - Maven V. 2.0
- Platform
  - Tomcat V. 6.0

Resources

- Java SE Security
  http://java.sun.com/javase/technologies/security/
- Security Annotation Platform (SAF)
  http://safr.sourceforge.net/
- OASIS eXtensible Access Control Markup Language (XACML)
  http://www.oasis-open.org/committees/tc_home.php?wg_abbrev=xacml
- Enterprise Java Security: Building Secure J2EE Applications
  by Marco Pistoia et al., Addison Wesley, 2004
- Creative Commons Icons
  http://creativecommons.org/licenses/by-nd/3.0/

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