Towards ABAC

Oct 9, 2023

Community Over Code, Halifax 2023

Intro

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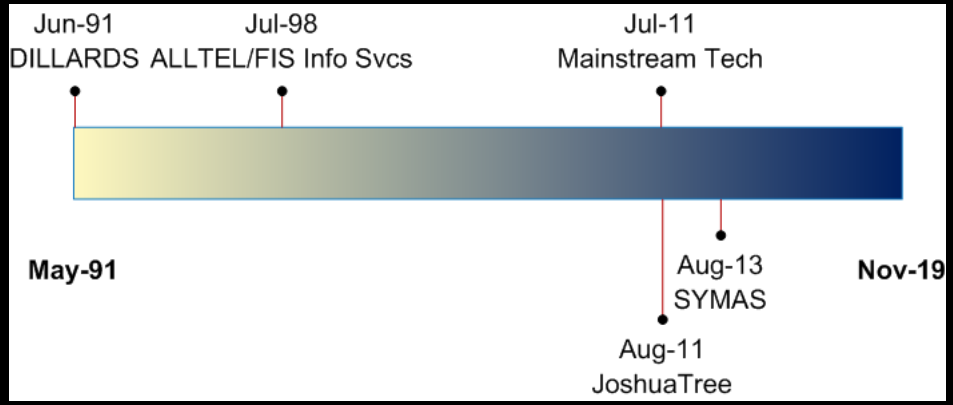
github/shawnmckinney

Code Monkey



symas Software Architect

Apache Directory PMC

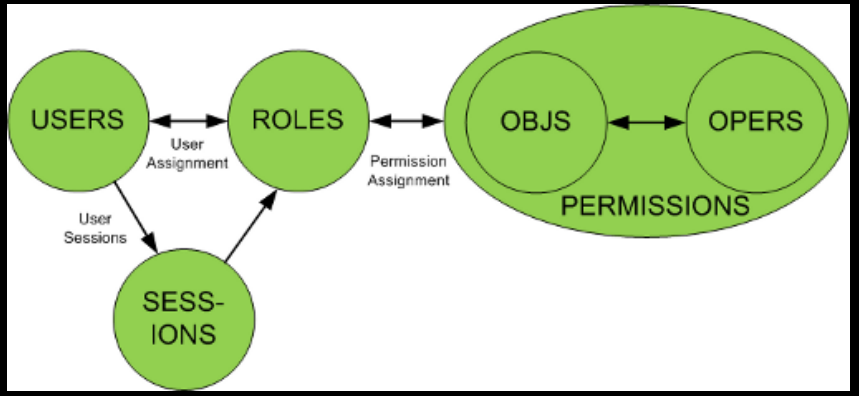
OpenLDAP™ PROJECT Engineering Team

Agenda

1. Discuss a bit on Access Control
2. Look at Apache Fortress RBAC Demo
3. " " ABAC Demo(s)
4. Next Steps

ANSI INCITS 359

Role-Based Access Control Standard



Kuhn, Ferraiolo and Sandhu
https://www.facebook.com/ieeecomputersociety/posts

Early Years

- The Role-Based Access Control model was formally introduced in 1992 by David Ferraiolo and Richard Kuhn of National Institute of Standards and Technology.

- Their model, already in use for some time, was meant to address critical shortcomings of the Discretionary Access Control. DAC was not meeting the needs of non-DoD organizations.

- In particular integrity was lacking, defined by them, as the requirement for data and process to be modified only in authorized ways by authorized users.

Middle Years

- Eight years later, in 2000, they teamed with Ravi Sandhu and produced another influential paper entitled ‘The NIST Model for a Role-Based Access Control: Towards a Unified Standard’.

- Later the team released the RBAC formal model. One that laid out in discrete terms how these types of systems were to work. The specifications, written in Z-notation, left no ambiguity whatsoever.

- This model formed the basis for the standard that followed:
  - ANSI INCITS 359

Current Years

- INCITS 359-2012 RBAC also known as Core.
- INCITS 494-2012 RBAC Policy Enhanced allows attribute modifiers on permissions specifically to provide support for fine-grained authorization.

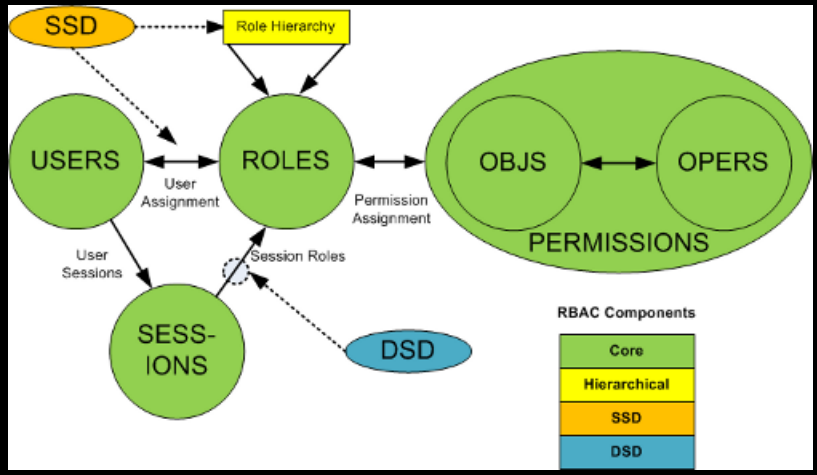
ANSI RBAC INCITS 359 Specification

RBAC0:
- Users, Roles, Perms, Sessions

RBAC1:
- Hierarchical Roles

RBAC2:
- Static Separation of Duties

RBAC3:
- Dynamic Separation of Duties



RBAC Object Model

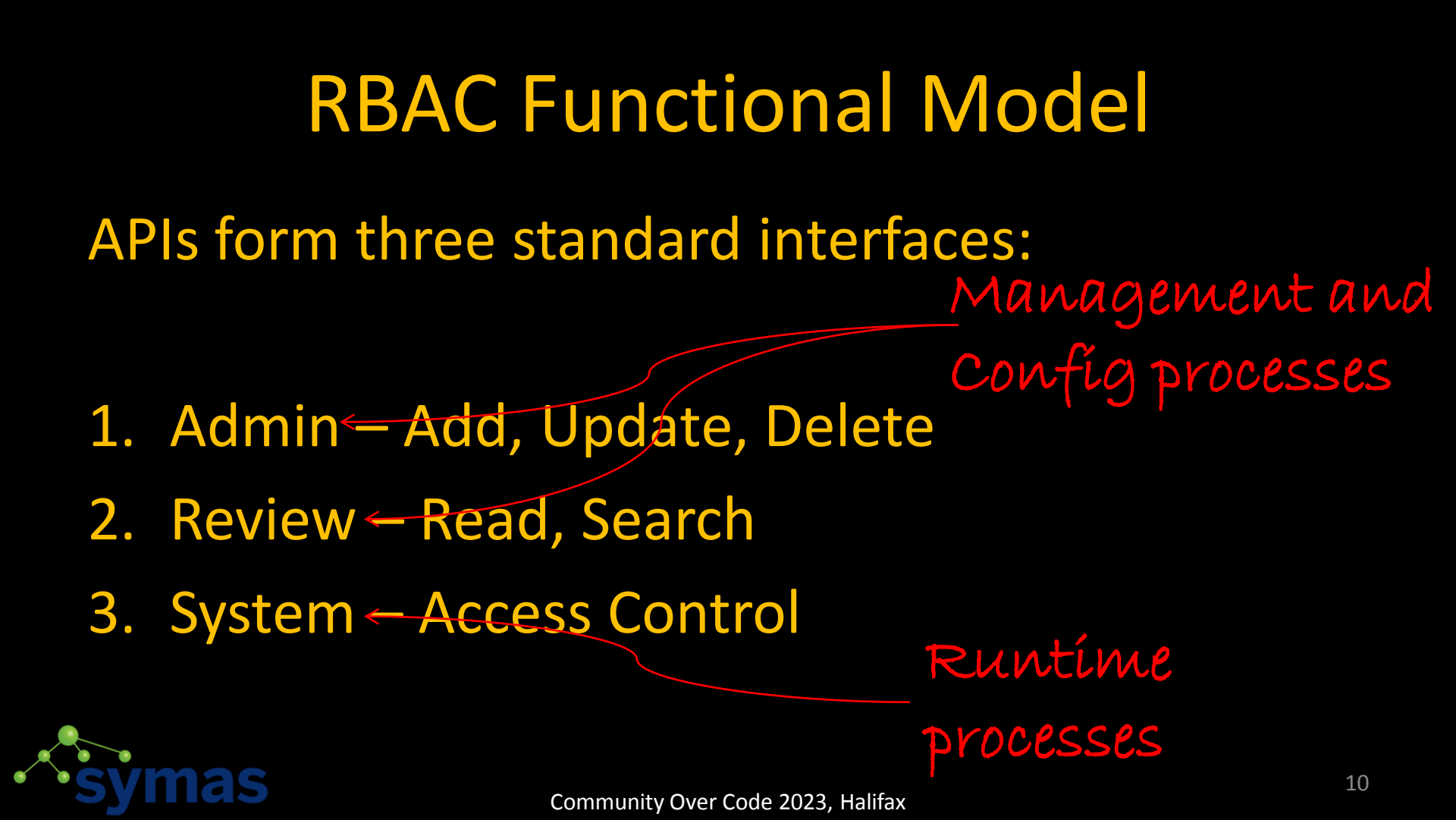
Six basic elements:

1. **User** – human or machine entity
2. **Role** – a job function within an organization
3. **Object** – maps to system resources
4. **Operation** – executable image of program
5. **Permission** – approval to perform an Operation on one or more Objects
6. **Session** – contains set of activated roles for User

RBAC Functional Model

APIs form three standard interfaces:

1. Admin – Add, Update, Delete
2. Review – Read, Search
3. System – Access Control



RBAC Functional Model

System Manager APIs:

http://directory.apache.org/fortress/gen-docs/latest/apidocs/org/apache/directory/fortress/core/impl/AccessMgrImpl.html

1. createSession – authenticate, activate roles
2. checkAccess – permission check
3. sessionPermissions – all perms active for user
4. sessionRoles – return all roles active
5. addActiveRole – add new role to session
6. dropActiveRole – remove role from session

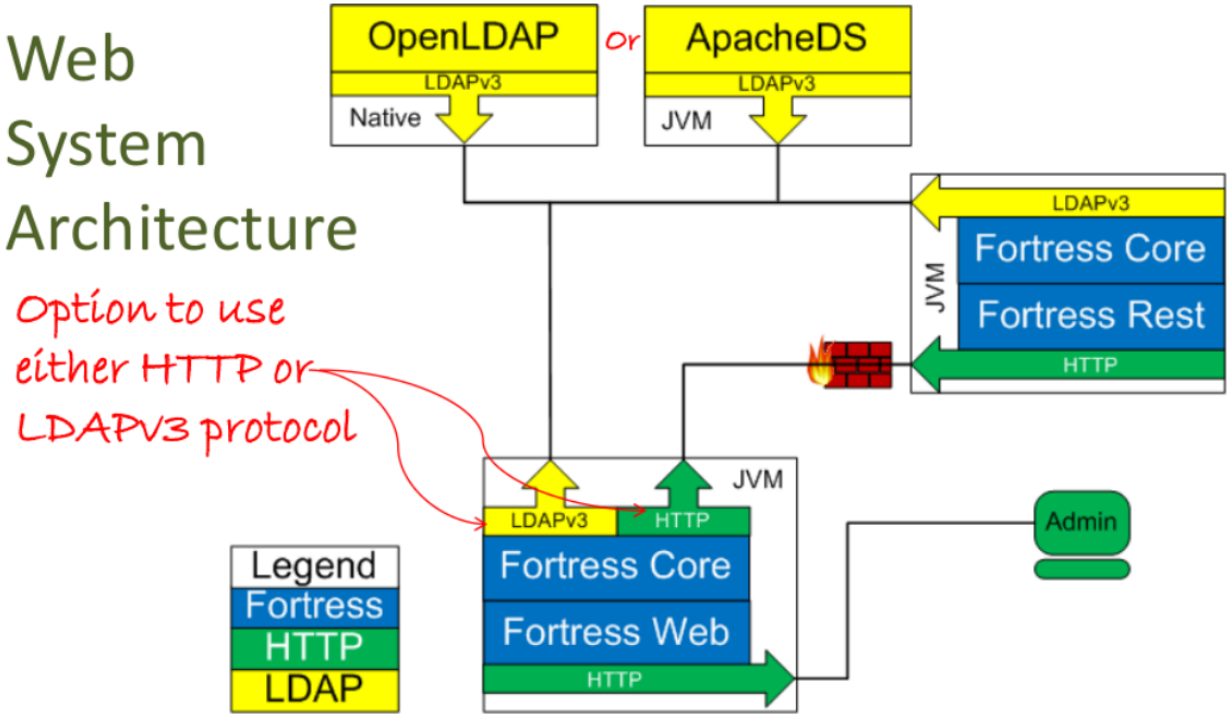
Apache Fortress™

https://directory.apache.org/fortress

Access Management SDK and Web Components

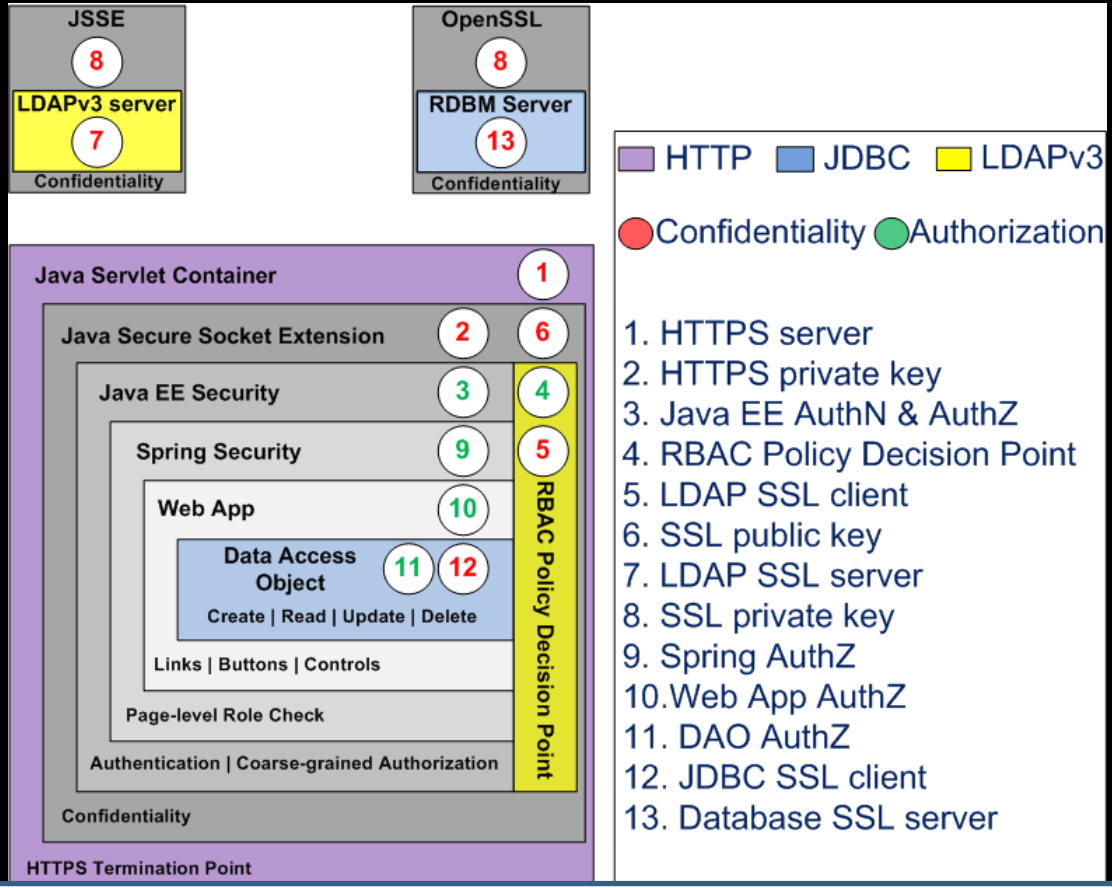
A standards-based access management system, written in Java, supports ANSI INCITS 359 RBAC and more.

Web System Architecture



Example 1

Apache Fortress Demo



https://github.com/shawnmckinney/apache-fortress-demo

Apache Fortress Demo

- Three Pages and Three Customers
- One role for every page to customer combo
- Users may be assigned to one or more roles
- One and only one role may be activated

Pages	Customer 123	Customer 456	Customer 789
Page One	PAGE1_123	PAGE1_456	PAGE1_789
Page Two	PAGE2_123	PAGE2_456	PAGE2_789
Page Three	PAGE3_123	PAGE3_456	PAGE3_789

User123	Customer 123	Customer 456	Customer 789
Page1	True	False	False
Page2	True	False	False
Page3	True	False	False

User1	Customer 123	Customer 456	Customer 789
Page1	True	True	True
Page2	False	False	False
Page3	False	False	False

User1_123	Customer 123	Customer 456	Customer 789
Page1	True	False	False
Page2	False	False	False
Page3	False	False	False

RBAC Demo

http://www.wright-brothers.org/Information_Desk/Help_with_Homework/Wright_Photos/Wright_Photos_images/1902_Glider_Flying.jpg

Apache Fortress Demo

- https://github.com/shawnmckinney/apache-fortress-demo

User Foo	Customer 123	Customer 456	Customer 789
Page1	False	True	True
Page2	True	False	False
Page3	True	False	False

Number of Roles = sizeof(A) * sizeof(B)

Roles (A)		Relationships (B)
Role1		Customer 123
Role2	*	Customer 456
Role3		Customer 789

=>

Roles

1. Role1-123
2. Role1-456
3. Role1-789
4. Role2-123
5. Role2-456
6. Role2-789
7. Role3-123
8. Role3-456
9. Role3-789

Role Explosion: Acknowledging the Problem

A. A. Elliott and G. S. Knight
Math and Computer Science, Royal Military College, Kingston, Ontario, Canada

https://pdfs.semanticscholar.org/143e/25f527eedecdf0a4f1b11646144fdfe694d5.pdf

Adding Attributes to Role-Based Access Control

D. Richard Kuhn, *National Institute of Standards and Technology*
Edward J. Coyne, *Science Applications International Corp.*
Timothy R. Weil, *Raytheon Polar Services Company*

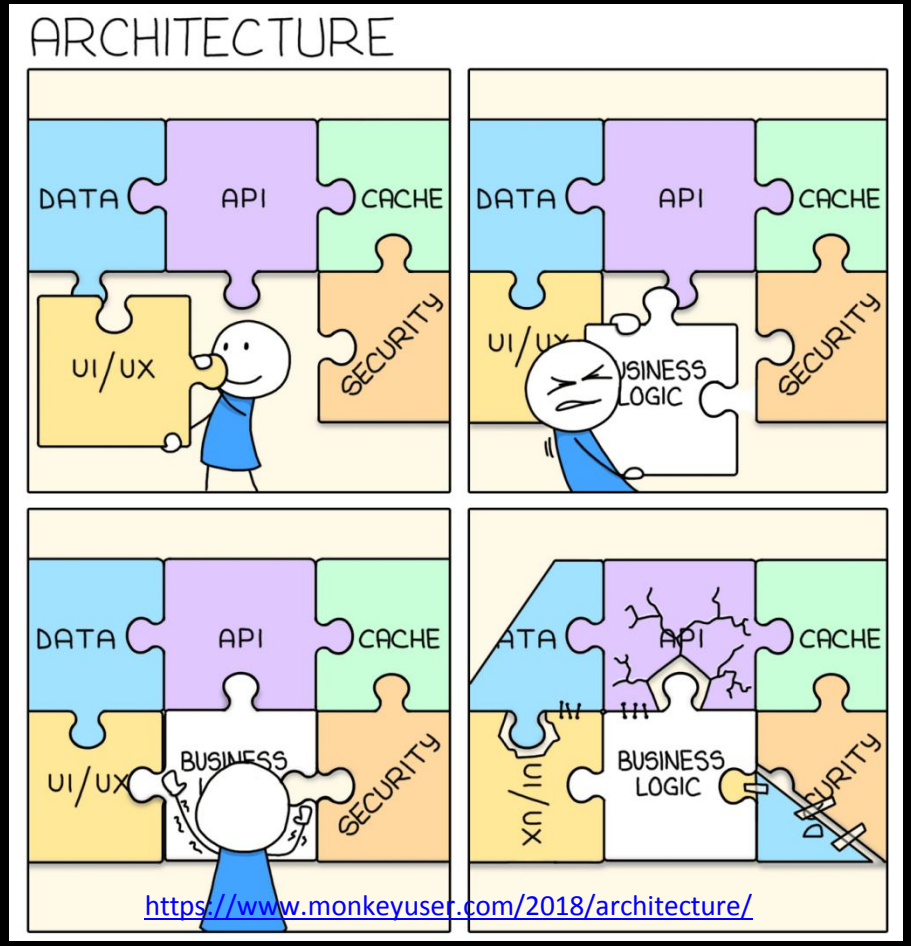
To support dynamic attributes, particularly in large organizations, a "role explosion" can result in thousands of separate roles being fashioned for different collections of permissions. Recent interest in attribute-based access control (ABAC) suggests that attributes and rules could either replace RBAC or make it more simple and flexible.

IEEE Computer, vol. 43, no. 6 (June, 2010) , pp. 79-81

RBAC has also been criticized for leading to role explosion,[12] a problem in large enterprise systems which require access control of finer granularity than what RBAC can provide as roles are inherently assigned to operations and data types.

wikipedia/Role-based_access_control

What Now?



https://www.monkeyuser.com/2018/architecture/

Attribute-Based Access Control (ABAC)

An access control method where subject requests to perform operations on objects are granted or denied based on assigned attributes of the subject, assigned attributes of the object, environment conditions, and a set of policies that are specified in terms of those attributes and conditions.

https://nvlpubs.nist.gov/nistpubs/specialpublications/NIST.SP.800-162.pdf

What is ABAC

Although the concept itself existed for many years, ABAC is considered a "next generation" authorization model because it provides dynamic, context-aware and risk-intelligent access control to resources allowing access control policies that include specific attributes from many different information systems…

https://en.wikipedia.org/wiki/Attribute-based_access_control

Examples of ABAC

- Extensible Access Control Markup Language (XACML)

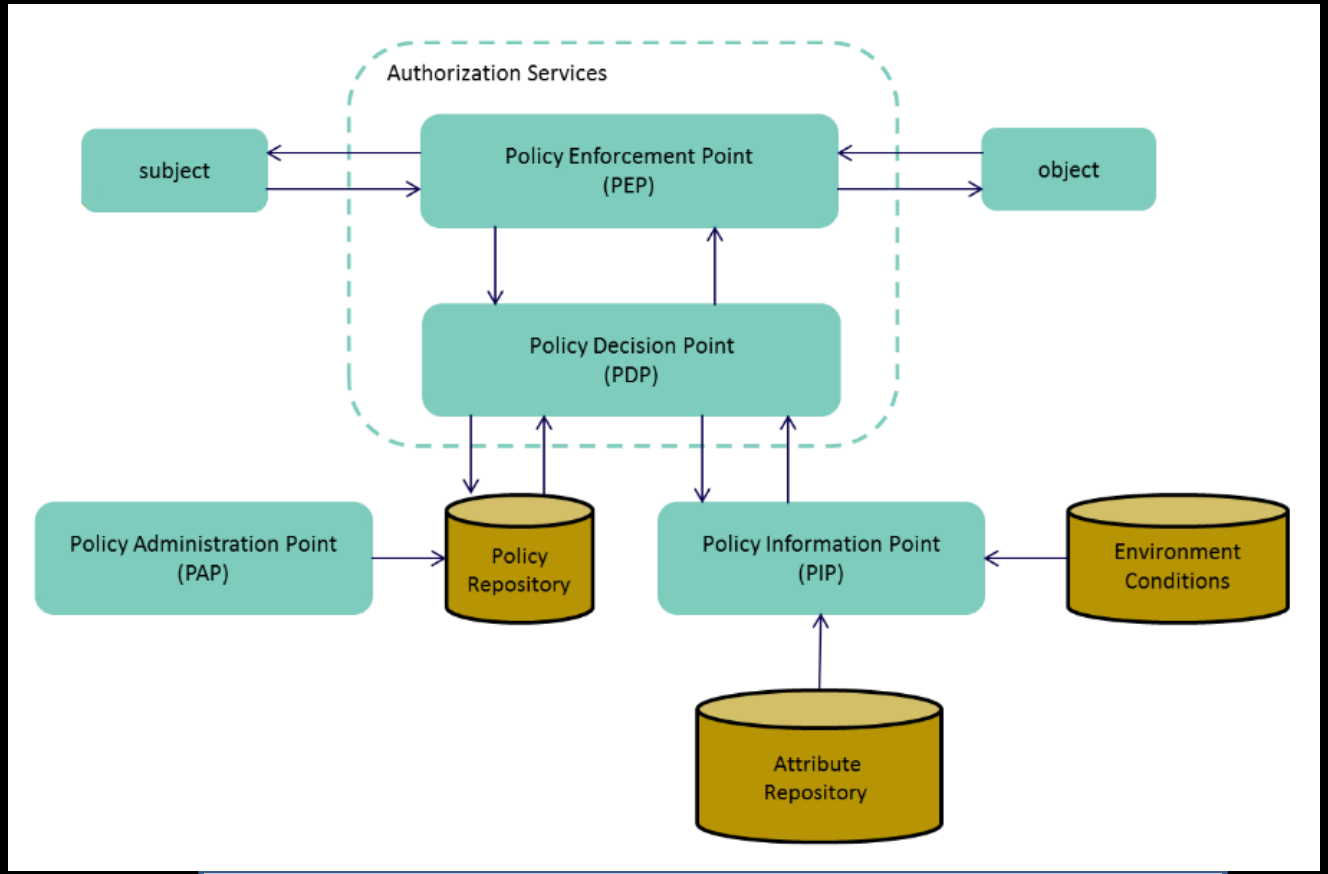
- Next Generation Access Control standard [ANSI499]

Examples of ABAC

The AuthZForce project provides an Attribute-Based Access Control (ABAC) framework compliant with the OASIS XACML standard v3.0, that mostly consists of an authorization policy engine and a RESTful authorization server. It was primarily developed to provide advanced access control for Web Services or APIs, but is generic enough to address all kinds of access control use cases.

https://authzforce.ow2.org

ABAC



https://nvlpubs.nist.gov/nistpubs/specialpublications/NIST.SP.800-162.pdf

Drawbacks of ABAC

- Traction
- Complexity
- Performance

Enterprise ABAC

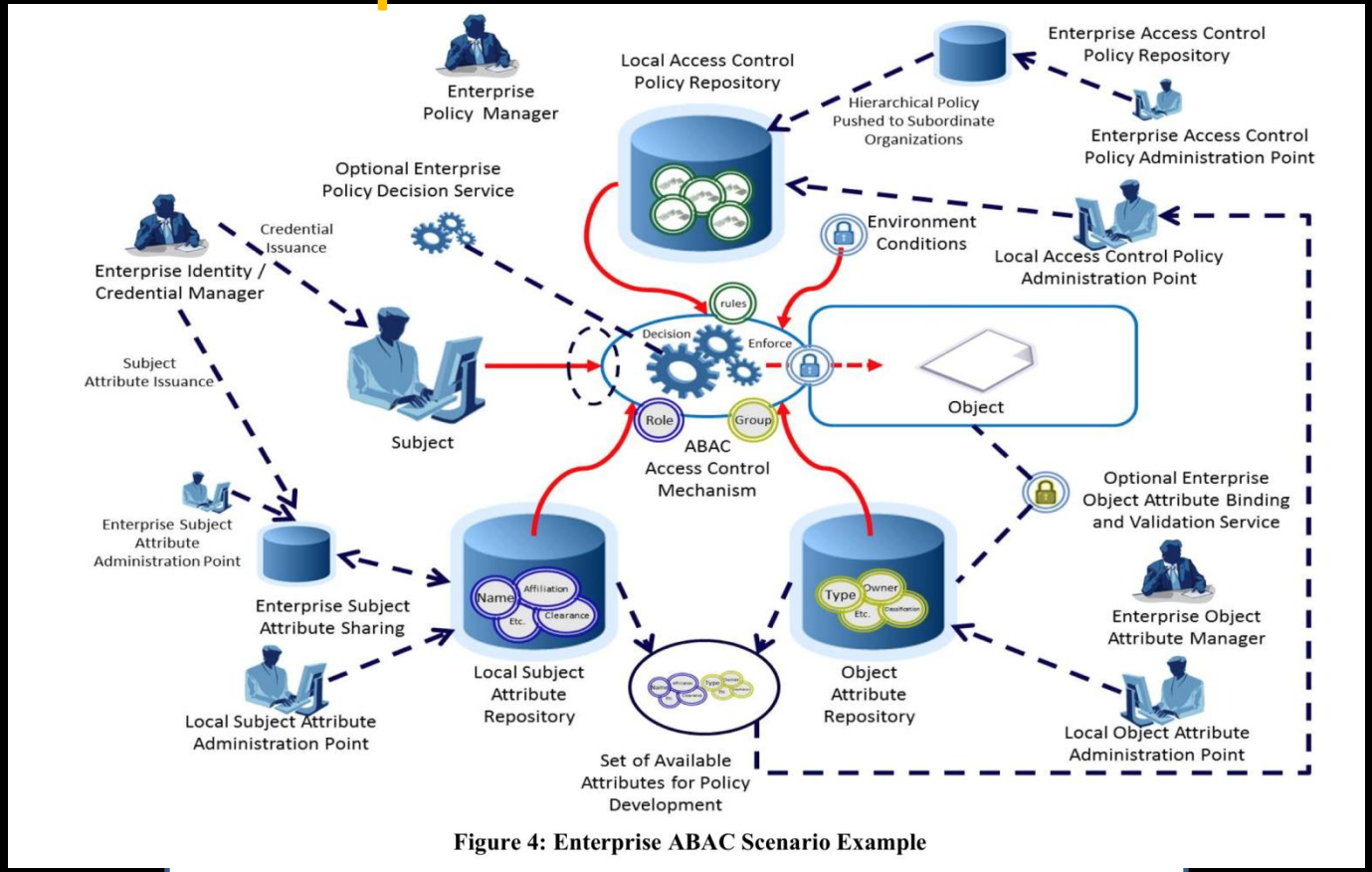


Figure 4: Enterprise ABAC Scenario Example

https://nvlpubs.nist.gov/nistpubs/specialpublications/NIST.SP.800-162.pdf

Let’s Have Another Look

Can RBAC be enhanced for some of it?

Adding Attributes to Role-Based Access Control

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Attribute-Based Access Control

This approach might be more flexible than RBAC because it does not require separate roles for relevant sets of subject attributes, and rules can be implemented quickly to accommodate changing needs. The trade-off for this flexibility is the complexity of cases that must be considered: for n Boolean attributes or n conditions using attributes, there are 2^n possible combinations.

IEEE Computer, vol. 43, no. 6 (June, 2010) , pp. 79-81

INCITS 494

Policy Enhanced RBAC

Two Phases of Activation

Attributes checked during two separate phases:

1. User-Role Activation
   - e.g., user may only activate the cashier role at store 314.

2. Role-Permission Activation
   - e.g., the action may only be performed on account 456789.

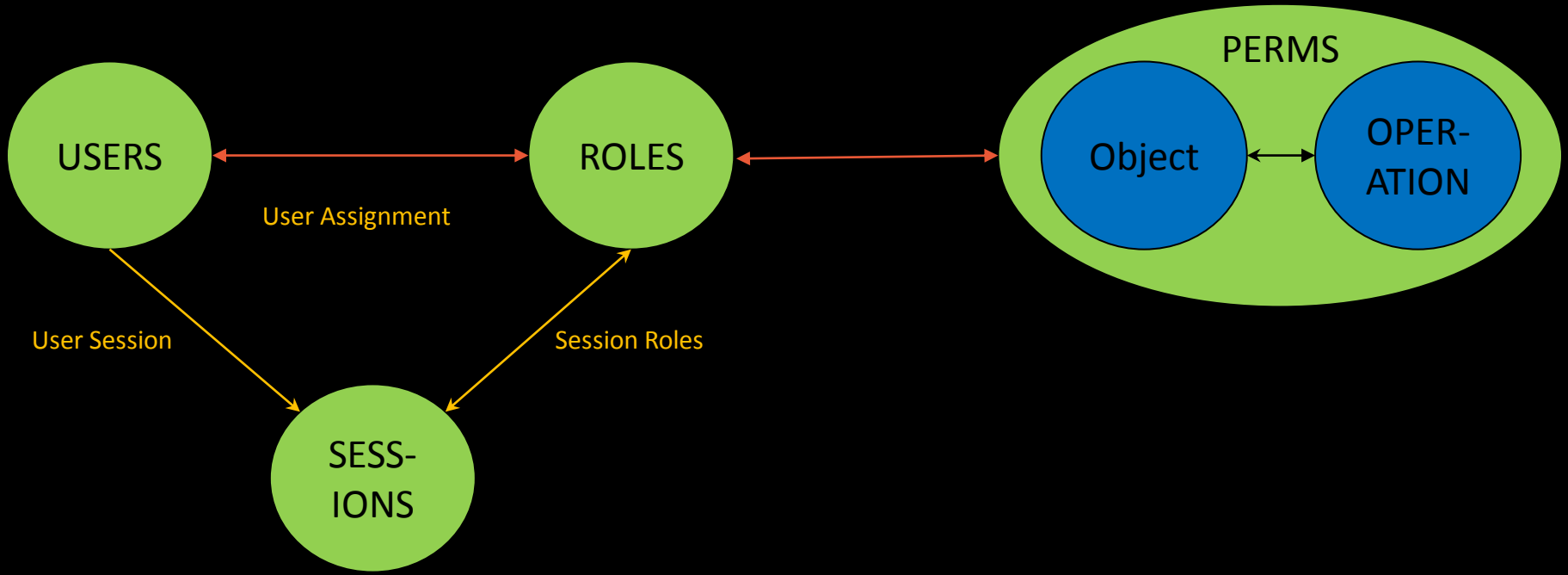
User-Role Activation

- Apache Fortress Temporal Constraints
- Apache Fortress Dynamic Constraints (New)

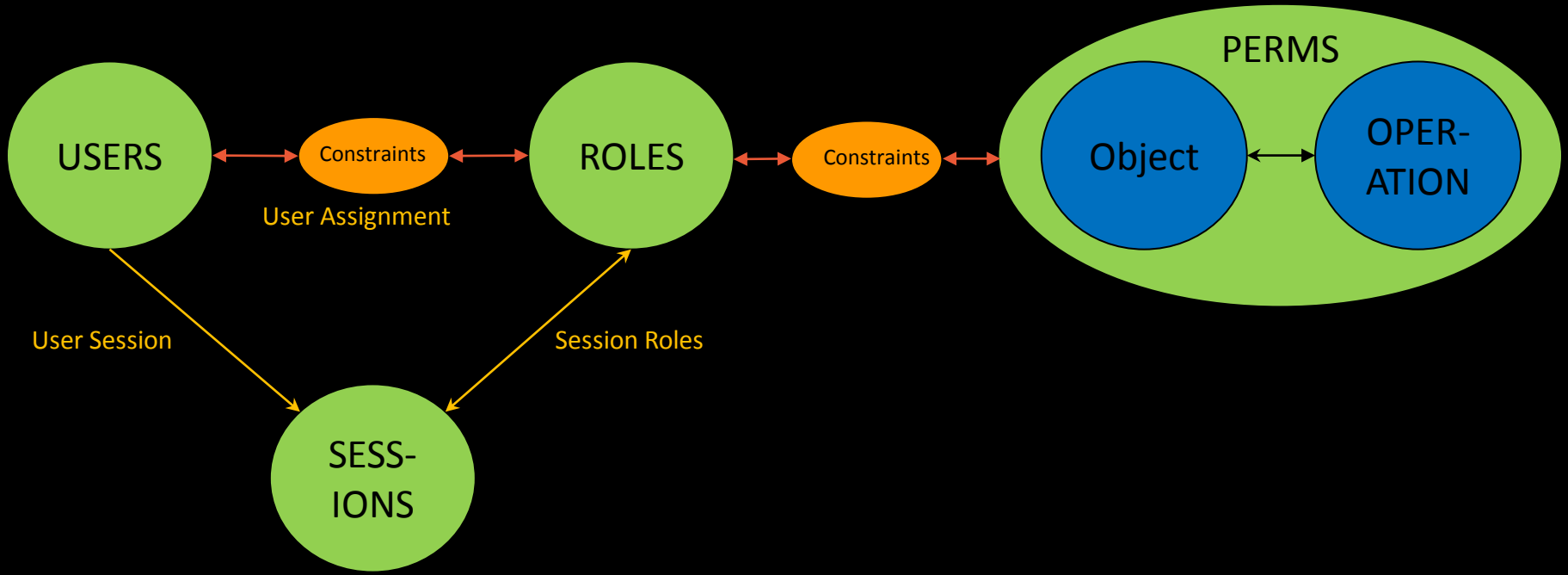
Use User-Role Constraint

- Store the contextual information on the user entry's role assignments.
- ftRC: teller@type@key@value
  - e.g. ftRC: teller@user@location@north

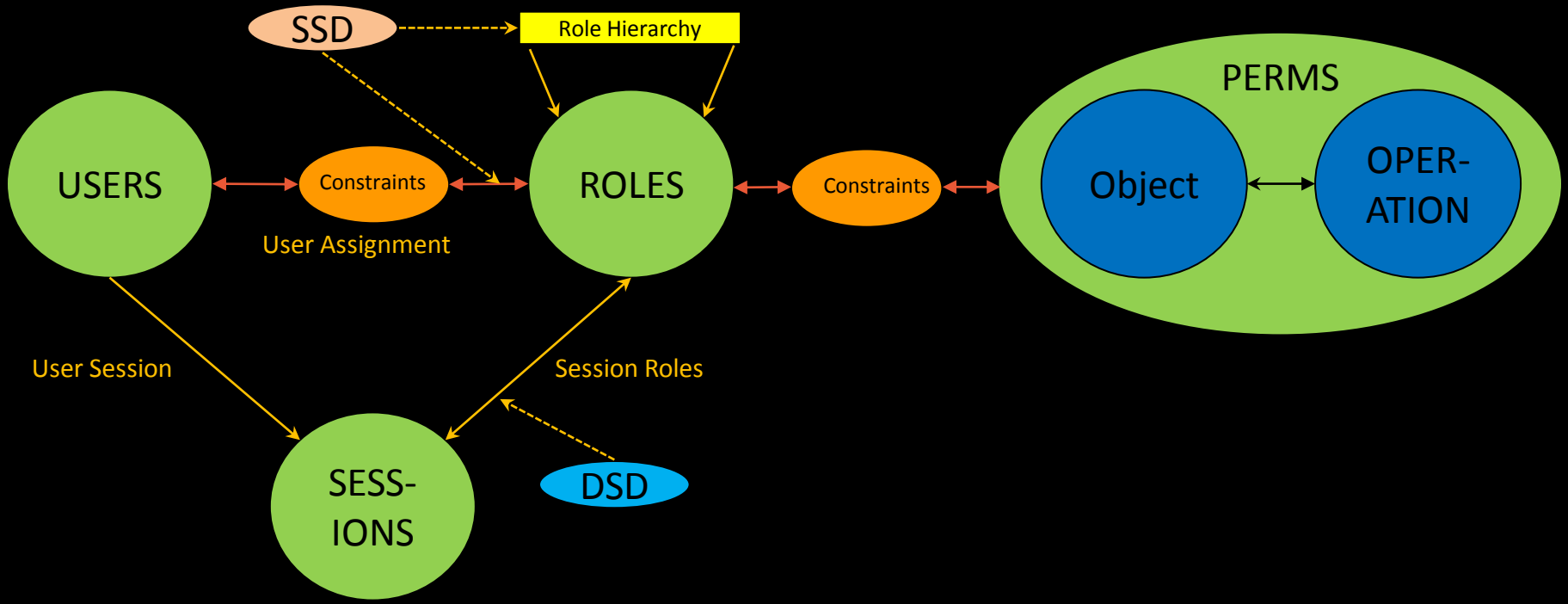
Core RBAC


USERS
ROLES
PERMS
Object
OPER-
ATION
User Assignment
User Session
Session Roles
SESS-
IONS

+ ABAC Constraints



All Together Now



RBAC w/ ABAC

- Opportunity to introduce arbitrary attributes into the Role activation phase.
- The Role is ‘special’ in that it will only be activated if conditions match.

Advantages

- Fixed the ‘Role explosion’ problem.
- We can continue to use our RBAC systems.
- Simpler to implement and maintain.
- No limit to the types of attributes.

e.g.

Roles:

- Teller
- Coin Washer

Constraints:

- Location

e.g. User-Role-Constraint

- Curly
  - Coin Washer: North
  - Coin Washer: South
  - Teller: East
- Moe
  - Coin Washer: East
  - Coin Washer: South
  - Teller: North
- Larry
  - Coin Washer: North
  - Coin Washer: East
  - Teller: South

Number of Roles = sizeof(A) * sizeof(B)

Roles (A)

Teller

Washer

*

Relationships (B)

North

South

East

West

=>

~~Roles~~

1. Teller-North
2. Teller-South
3. Teller-East
4. Teller-West
5. Washer-North
6. Washer-South
7. Washer-East
8. Washer-West

Just stop

Role Constraints

```
constraint role="Coin Washer"
  key="location"
constraint role="Teller"
  key="location"
```

https://github.com/shawnmckinney/fortress-abac-demo/blob/master/src/main/resources/fortress-abac-demo-load-policy.xml

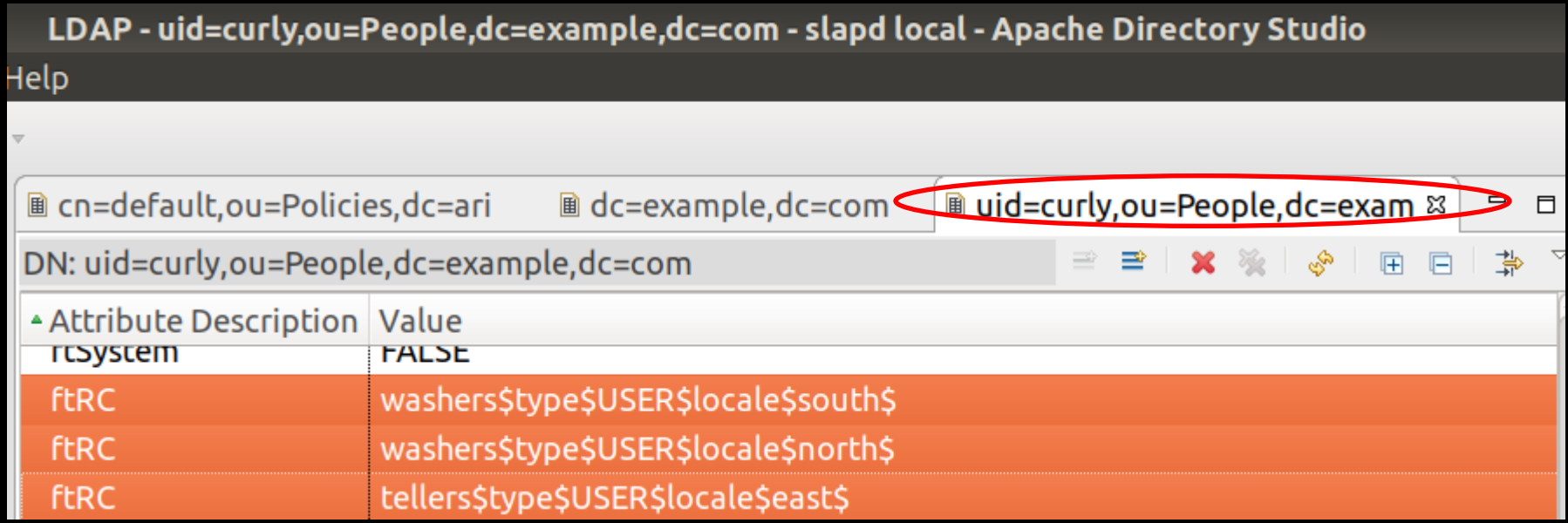
User-Role Constraints

```
userId="Curly"
 role="Teller"
 key="location" value="East"

userId="Curly"
 role="Coin Washer"
 key="location" value="North"

userId="Curly"
 role="Coin Washer"
 key="location" value="South"
```

Under the Hood

https://appdevcloudworkshop.github.io/images/introduction/image16.png

RBAC w/ ABAC


LDAP - uid=curly,ou=People,dc=example,dc=com - slapd local - Apache Directory Studio
Help
cn=default,ou=Policies,dc=ari
dc=example,dc=com
uid=curly,ou=People,dc=exam
DN: uid=curly,ou=People,dc=example,dc=com
Attribute Description
Value
ftSystem
FALSE
ftRC
washers$type$USER$locale$south$
ftRC
washers$type$USER$locale$north$
ftRC
tellers$type$USER$locale$east$

Code Sample

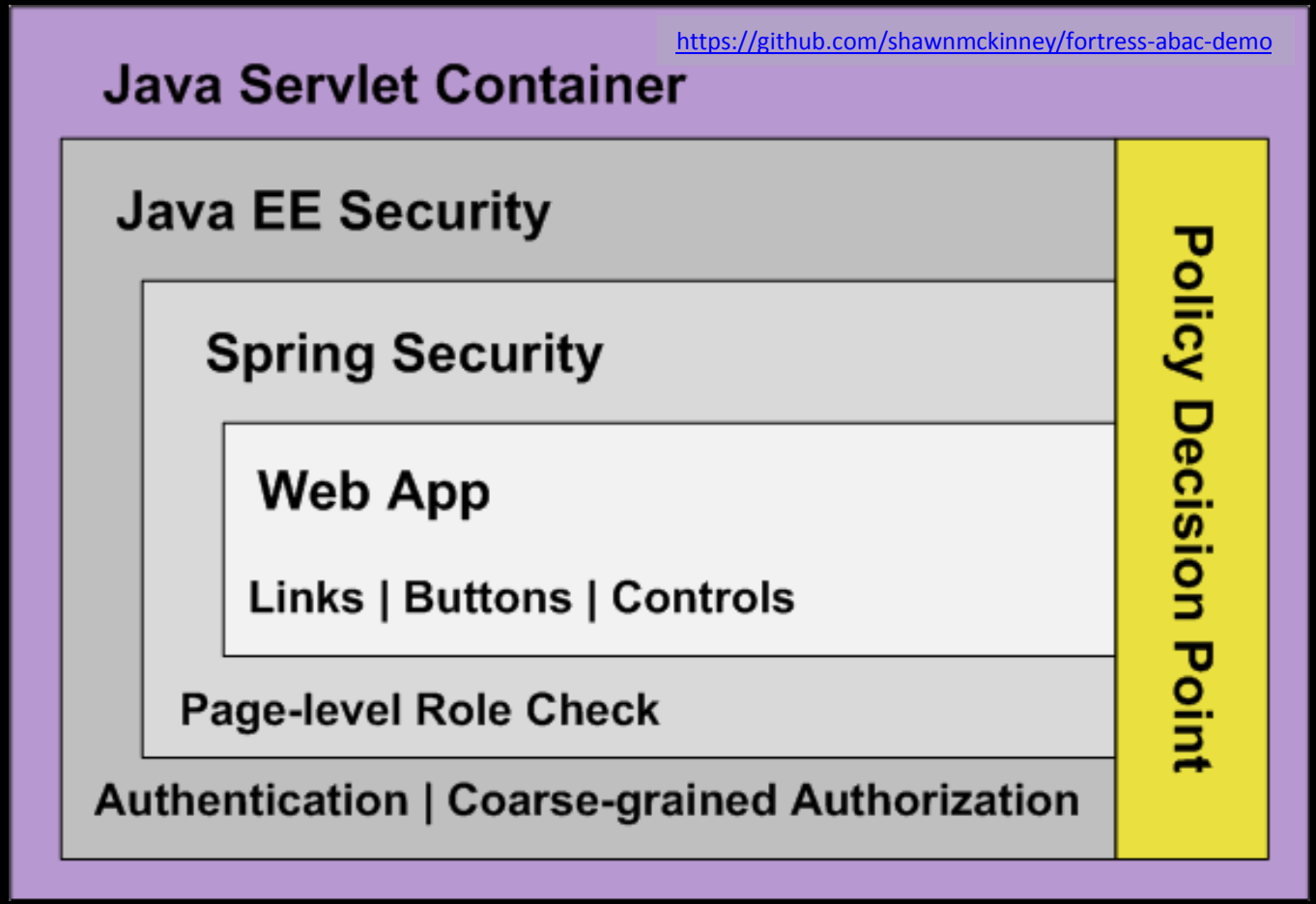
```
// Nothing new here:
User user = new User(“curly”);

// This is new:
RoleConstraint constraint = new RoleConstraint( );

// In practice we're not gonna pass hard-coded key-values in here:
constraint.setKey( “location" );
constraint.setValue( “north" );

// This is just boilerplate goop:
List<RoleConstraint> constraints = new ArrayList();
constraints.add( constraint );

try
{
   // Create the RBAC session with ABAC constraint -- location=north, asserted:
   Session session = accessMgr.createSession( user, constraints );
   ...
}
```

https://github.com/shawnmckinney/fortress-abac-demo/blob/master/src/main/java/com/mycompany/MyBasePage.java

ABAC Demo


his is the first time you've seen this Stop error screen,
art your computer. If this screen appears again, follow
e steps:
to make sure any new hardware or software is properly installed.
his is a new installation, ask your hardware or software manufacti
any Windows updates you might need.
roblems continue, disable or remove any newly lled hardware
oftware. Disable BIOS memory options such as g or shadowing.
ou need to use Safe Mode to remov disable nents, restart
computer, press F8 to select Ad Startup ns, d then
ct Safe Mode.
nical information:
STOP: 0x00000050 (0xFD3094C2,0x00000 000)
SPCMDCON.SYS - Address FBFE7617 base at F eStamp 3d6d

Example 2 Apache Fortress ABAC Demo



User456	Customer 123	Customer 456	Customer 789
Page1	False	True	False
Page2	False	True	False
Page3	False	True	False

User2	Customer 123	Customer 456	Customer 789
Page1	False	False	False
Page2	True	True	True
Page3	False	False	False

User2_123	Customer 123	Customer 456	Customer 789
Page1	False	True	False
Page2	False	False	False
Page3	False	False	False

Next Steps

1. Dynamic Constraints Role-Permission
2. Dynamic Policies

Apache Fortress User-Role Validators

```
temporal.validator.0=Date
temporal.validator.1=LockDate
temporal.validator.2=Timeout
temporal.validator.3=ClockTime
temporal.validator.4=Day
temporal.validator.5=UserRoleConstraint
```

Since v 2.0.1

Apache Fortress Role-Perm Validators

Not implemented yet

```
permission.validator.0=Limit
permission.validator.1=Clearance
permission.validator.2=Domain
```

Closing Thoughts

Standards-based RBAC allows attributes into the mix.

- *Fine-grained Authorization*

https://directory.apache.org/fortress

Examples

1. https://github.com/shawnmckinney/apache-fortress-demo
2. https://github.com/shawnmckinney/fortress-abac-demo
3. https://gitlab.symas.net/symas-public/ansible-apache-fortress

Contact

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https://iamfortress.net

https://directory.apache.org/fortress