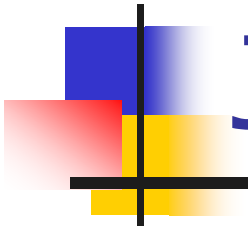

J2EE Security Model

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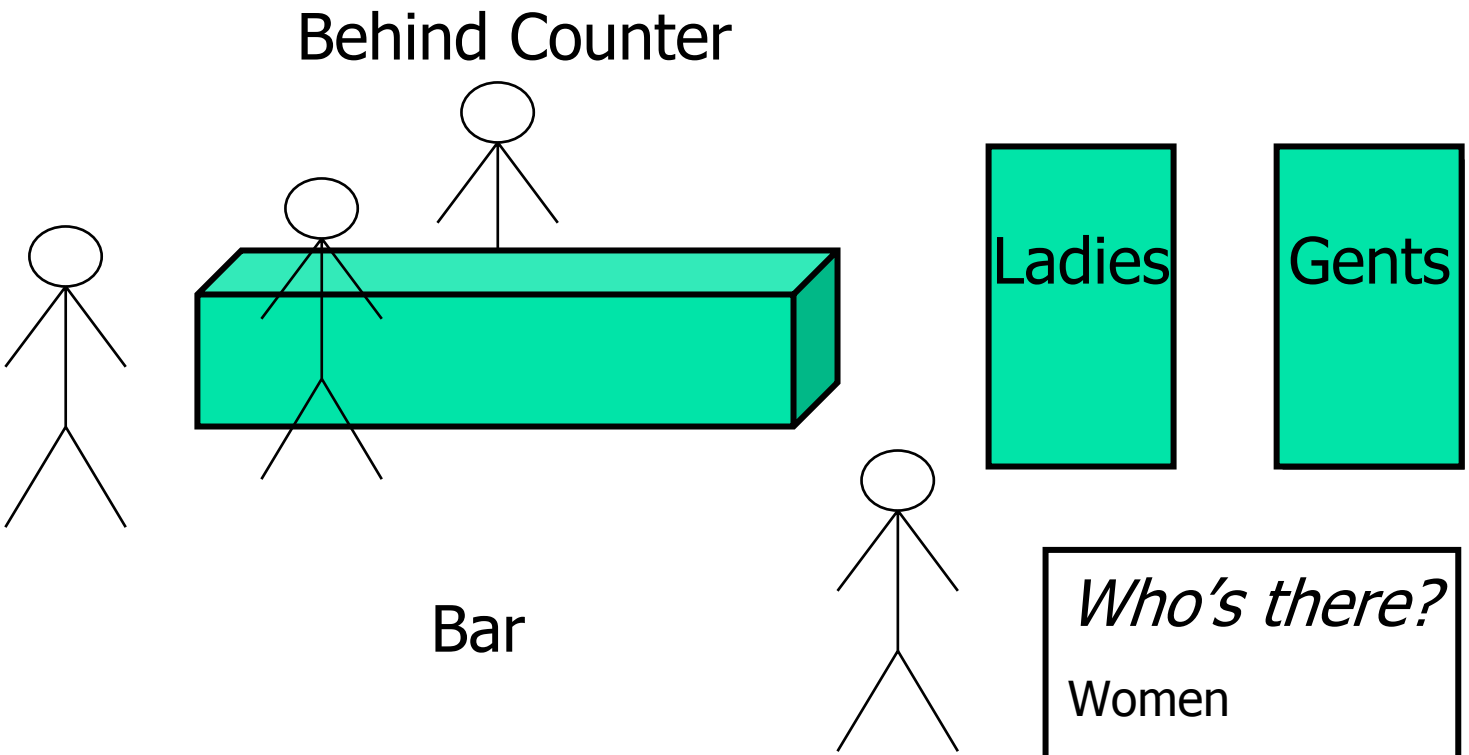
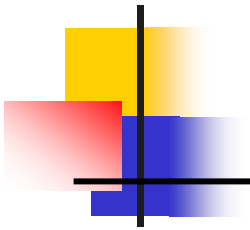
Silly Example - Bar





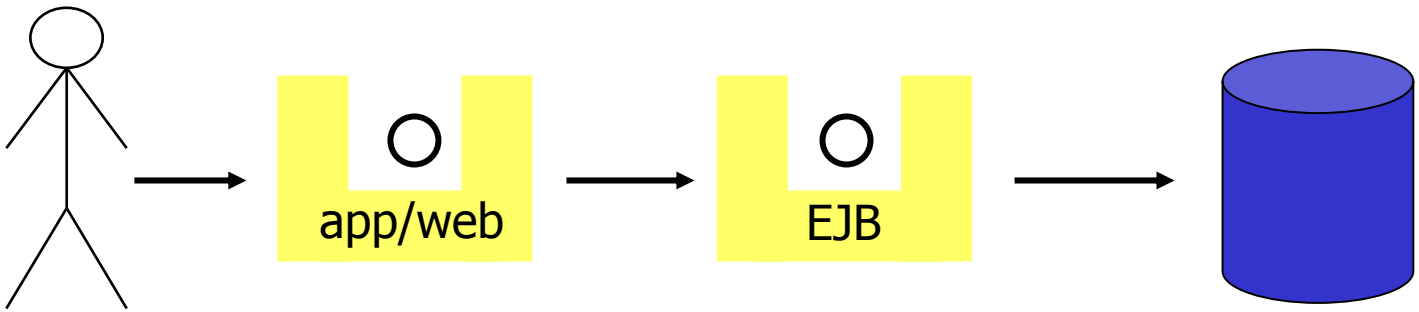
Bar Activities

- Move around
  - Bar area
  - Behind counter
  - Ladies
  - Gents
  - Home
- Buy Drinks
- Take money from cash register

Who may do what?

The Story

- Use of Enterprise System

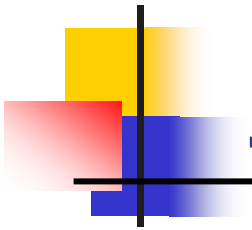


ejb-jar.xml

m RRR
m RRR
m RRR

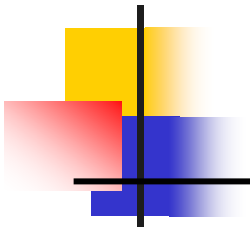
User DB

id cred	id RRR
id cred	id RRR
id cred	id RRR



J2EE

- Platform for enterprise systems
- Why do we need security model

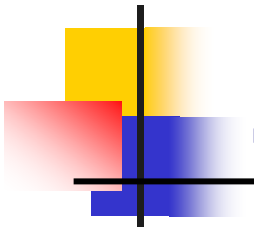


Enterprise Systems

- Information system
  - Information = data *about* something
  - Manage data
    - Oppose: games, FEM-calculations
  - Producers and consumers
  - Consistency of data
  - Enterprise Logic = rules on data
  - System is Model of Reality

Large Scale Distributed Enterprise Systems

- Large Scale
  - Lots of users
  - Lots of kinds of users
  - Lots of functionality
  - Lots of kinds of use per user
- Distributed
  - No control of clients

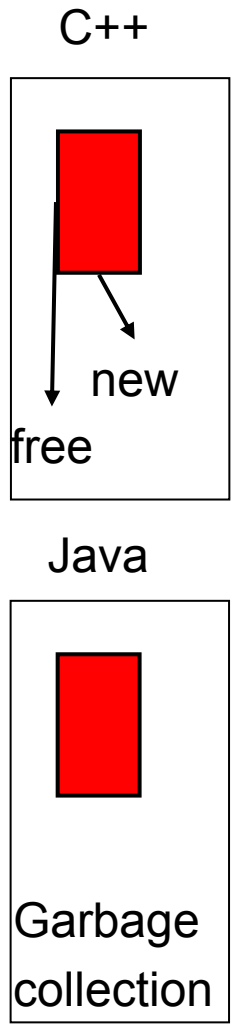


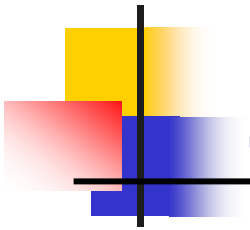
Security Challenges

- Different access to functionality
  - Event within same component
  - *e.g.* register sale - sale statistics
  - Need authorisation system
- Functional components exposed
  - Risk for malicious clients
  - Need authentication

What Is in a Platform?

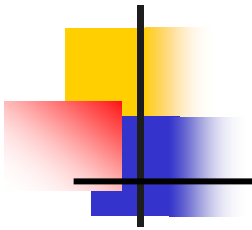
- Services provided by runtime environment
- *e.g.*: memory management
  - C++: keep track of your object lest memory will leak
    - Learn strategies (object ownership etc)
    - Repetitive coding
  - Java: Garbage Collect
- Like it or leave it





J2EE Platform Services (a few)

- Web tier: session tracking
  - HttpRequest.getSession()
- EJB tier: persistence service
  - EJB CMP
- Across all tiers
  - Standard Transaction Model
  - Standard Security Model
- All services: use or leave

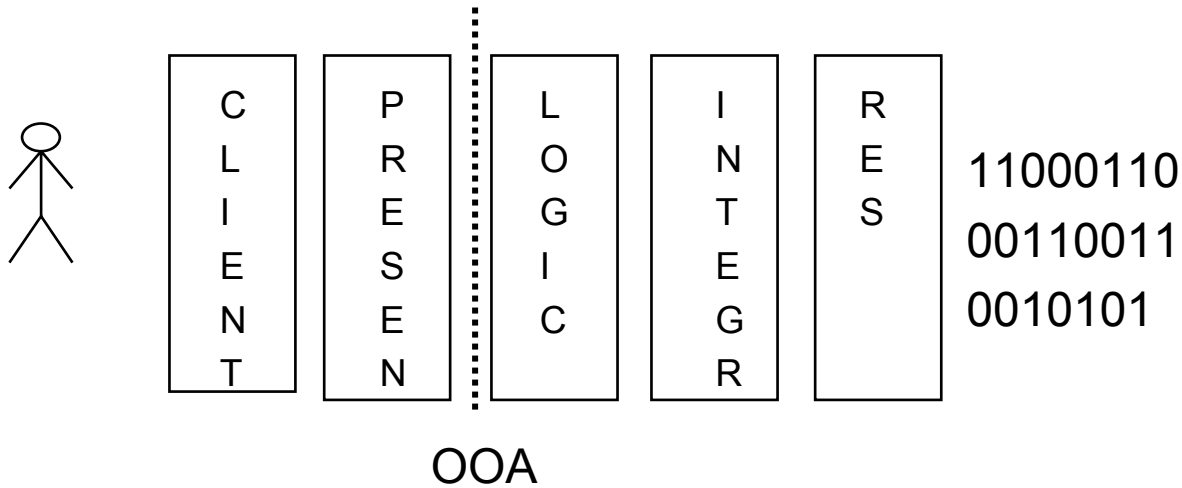


Sound Use of Services

- 1 - Use (Standard Model)
  - Configure
    - majority of cases
- 2 - Augment
  - Build code on top
    - some cases
- 3 - Discard
  - Build your own system
    - very unususal

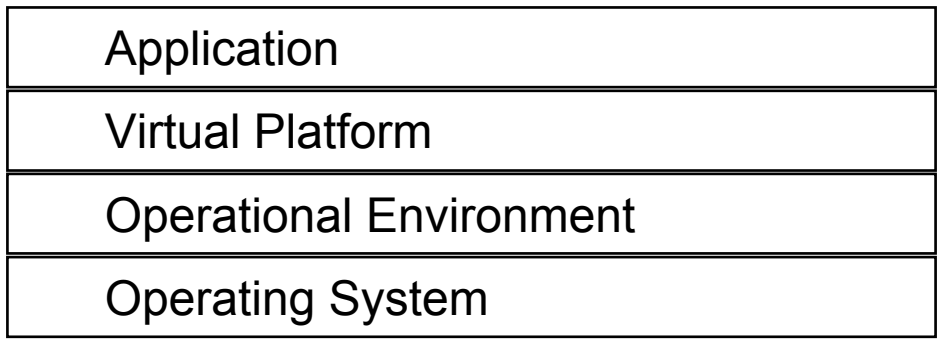
The Cube - Tiers

- Split system functionality
  - Client
  - Presentation
  - Enterprise/Business Logic
  - Integration
  - Resource



The Cube - Layers

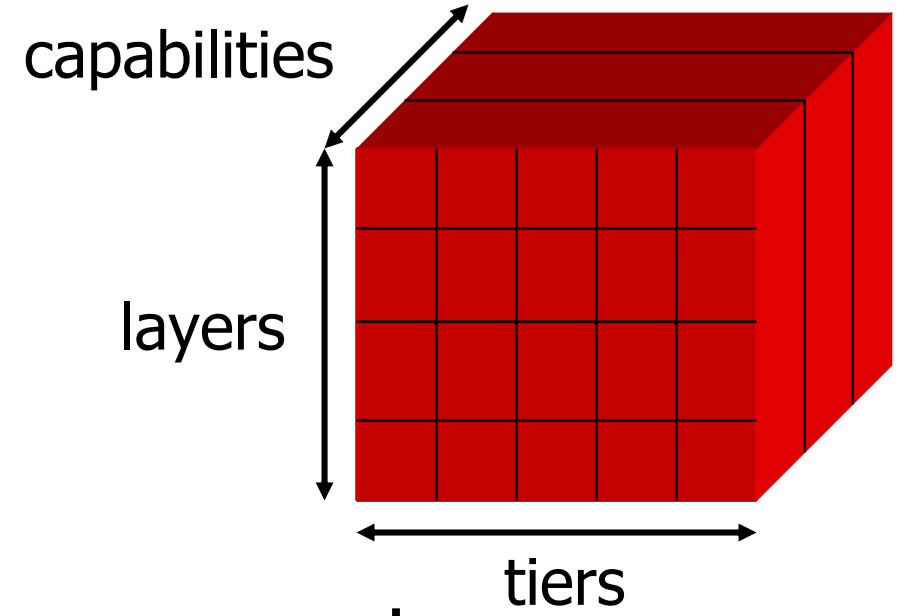
- Layers of abstraction

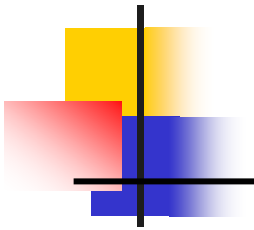


- Functionality
  - Buy - platform
  - Write - application

The Cube - Capabilities

- Emergent properties
  - Performance
  - Availability
  - Security
  - Extensibility
- Not located in single component
- Discussing architecture - must consider entire system

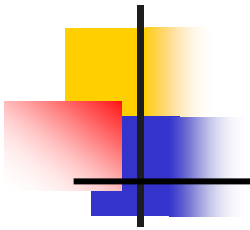




BarDweller - EJB Session

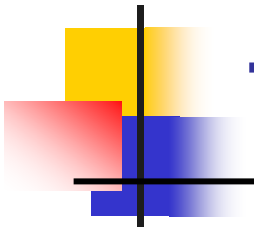
- Session EJBs encapsulate enterprise flow

```
public interface BarDweller extends EJBObject {
    public void buyDrink() throws RemoteException;
    public void takeMoney() throws RemoteException;
    public void goBar() throws RemoteException;
    public void goBehindCounter() throws RemoteException;
    public void goLadies() throws RemoteException;
    public void goGents() throws RemoteException;
    public void goHome() throws RemoteException;
}
```



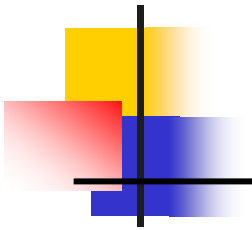
Security Threats (Examples)

- Crackers
- Denial of Service
- Burglary
- Blackmailing
- Inside jobs



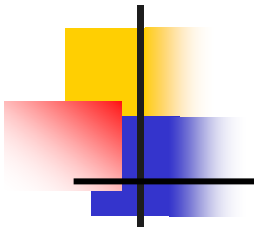
Two Sides of Security

- Negative Security
  - What people must not be able to do
  - Risk: crackers
- Positive Security
  - What people must be able to do
  - Risk: denial of service



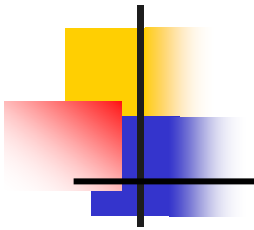
Security Policy

- Line between positive and negative
- Who is allowed to do what?
- Metric for measuring security
  - Can make automated tests
- Remember: System is Model of Reality



Bar Security Rules

- Only personnel/guards behind the counter
- Only women in the ladies (except guards)
  - Personnel in ladies must be women
- Only men in the gents (except guards)
  - Personnel in gents must be men
- Only personnel may handle money
- No drinking by personnel and guards



BarDweller - Security

- public void buyDrink()
  - all men and women, but neither guards nor personnel
- public void takeMoney()
  - personnel
- public void goBar()
  - everybody
- public void goBehindCounter()
  - personnel and guards
- public void goLadies()
  - women and guards
- public void goGents()
  - men and guards
- public void goHome()
  - everybody

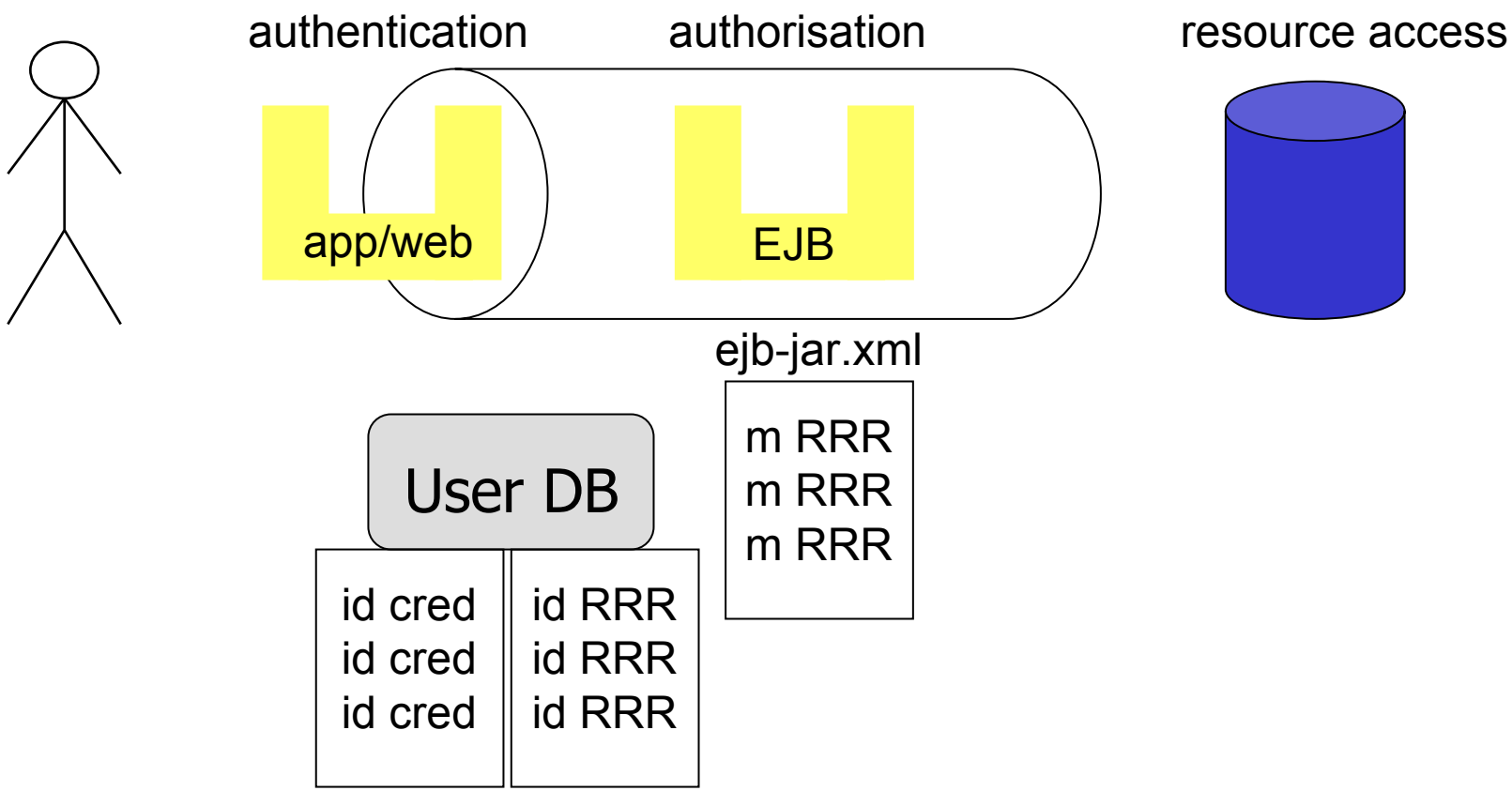
Standard Security Model - Ambition

- Ambition: nice general level
- Considerations
  - Transparent for components
  - Declarative configuration
  - Extensible - possible to augment
    - Programmatic support

Standard Security Model - Design Fundamentals

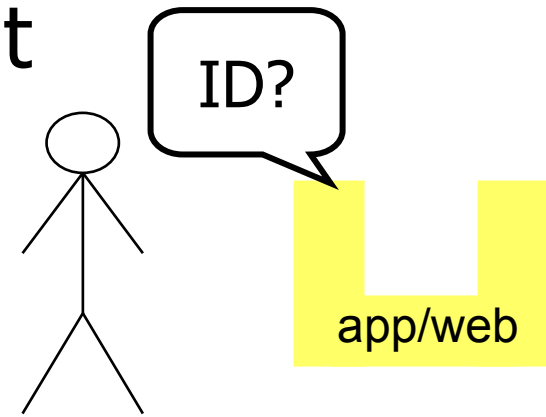
- Method based access control
  - J2EE recommends Service Oriented Architectures
    - functionality grouped by themes
  - SOA demands method granularity
    - Functionality for mixed clients in one component
    - Component based access control - would not work
- Role based
  - Suffice for lots of applications
  - Still simple

Pipe Metaphor



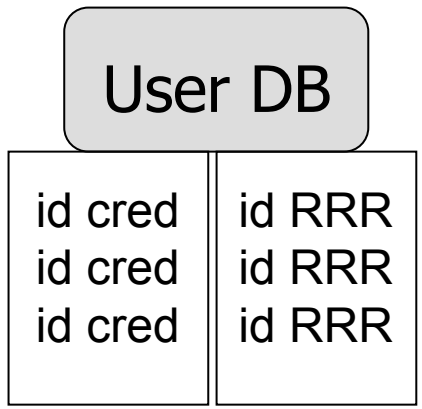
Authentication

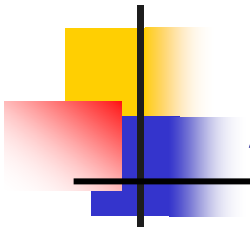
- Establish identity
- As close as possible to client
- Client container
  - Application container
  - Web container
- Transparent to code/web-app
- Client container holds identity
  - Pass in call to EJB-methods



User Database

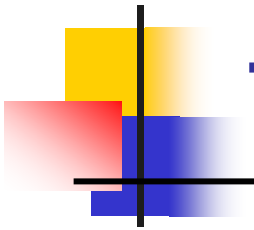
- Keeps the user information
  - principal / credentials
- Operating environment, not covered by spec
  - Rigged by deployer / sysadmin
- Used by client container to verify identity
- Technology
  - Relational Database
  - LDAP Directory (preferred)





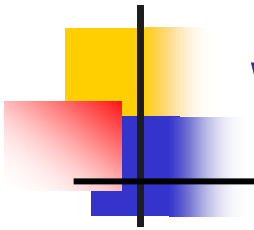
Application clients (J2EE [1.3] 9.2)

- Interact with user through JAAS
  - javax.security.auth.callback.CallbackHandler
- Configurable in deployment descriptor
- Flexible: Some possible authenticators
  - Pop-up window
  - Operating System
  - Biometric device
  - Smart Card



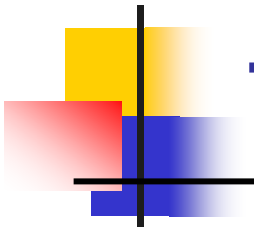
To Make It Work - GUI Client

- META-INF/application-client.xml
- <application-client>
  <callback-handler>
  bar.auth.RetinaScanCallbackHandler
  </callback-handler>
  </application-client>



Web Clients

- Web Container asks for proof of identity
  - BASIC, (DIGEST), FORM, CLIENT-CERT
- Identity stored in container (*e.g.* session)
- Identity passed to EJB on call
- Fixed identity: run-as (deploy setting)
  - Web container uses same ID
- Servlet [2.3] 12.5 (Security/Authentication)



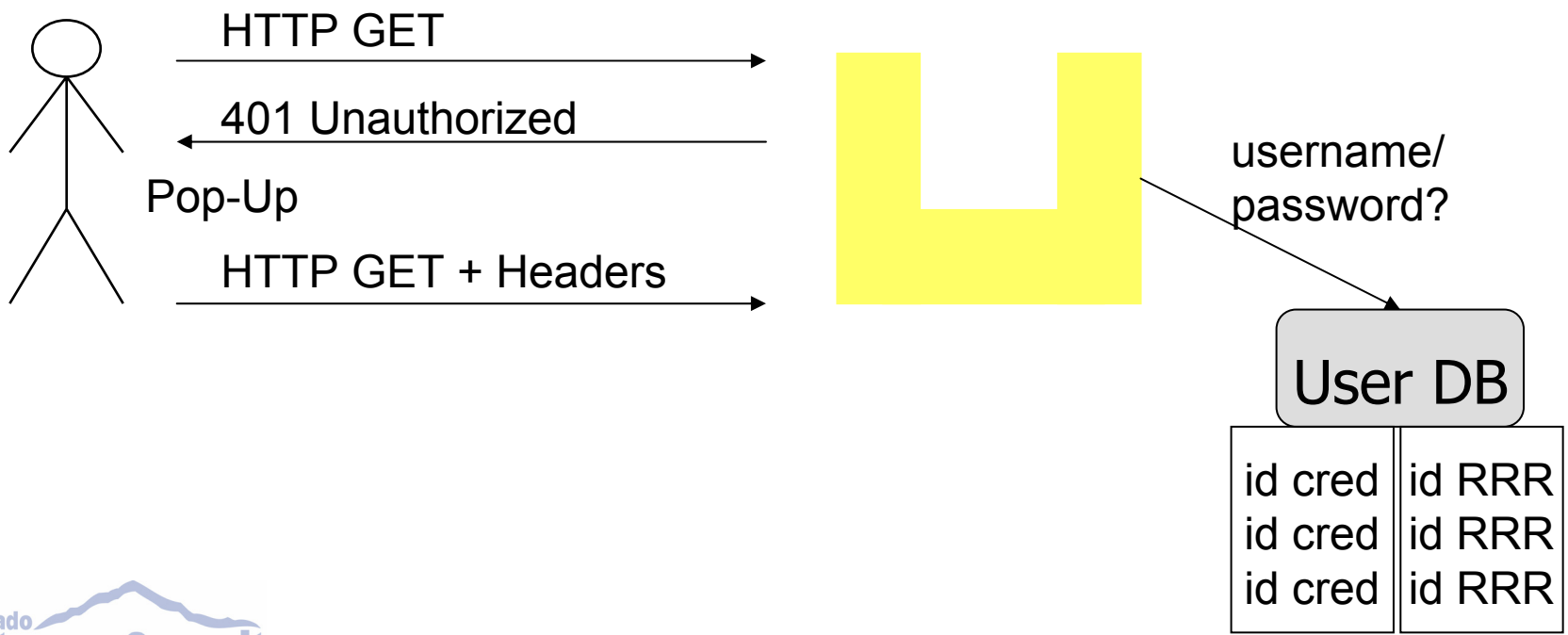
To Make It Work - Web Login

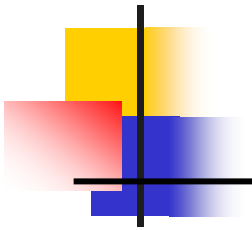
- web-inf/web.xml
- <web-app>

```
        <security-constraint>…</security-constraint>
        <login-config>
                <auth-method>BASIC</auth-method>
        </login-config>
</web-app>
```

BASIC Authentication

- HTTP Authentication (RFC 2617)
- Username / Password Headers



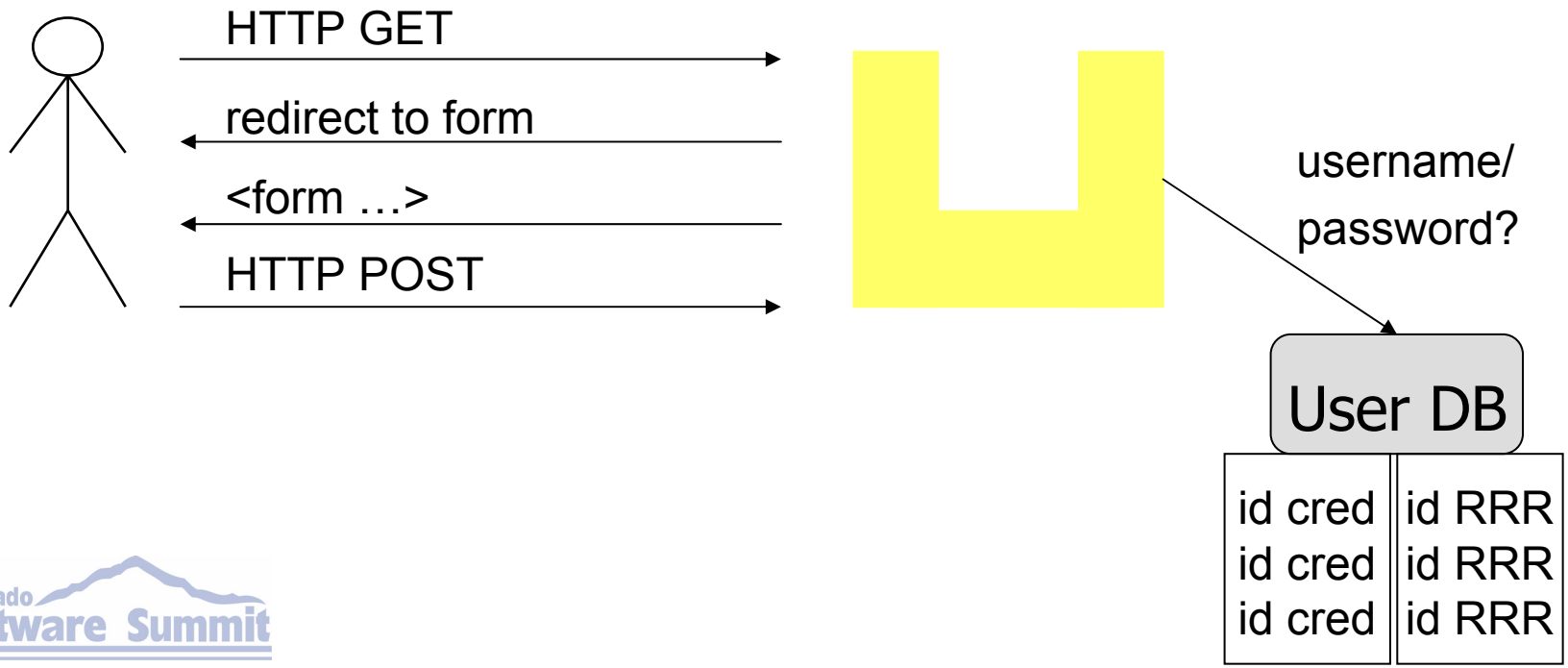


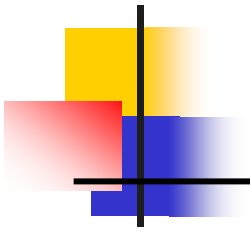
Evaluation of BASIC

- Advantages
  - Simple
- Drawbacks
  - Credentials in plain text
    - HTTPS - all pages
      - ✓ strain on web server
  - Art Director
    - That pop-up looks ugly!
  - Browser enforce security
    - Or so it seems to user
  - Browser keeps credentials
    - Bad for public terminals
    - No “clear credentials” button

FORM-based Authentication

- Challenge - Response
- Challenge = login form
  - j_username, j_password, j_security_check



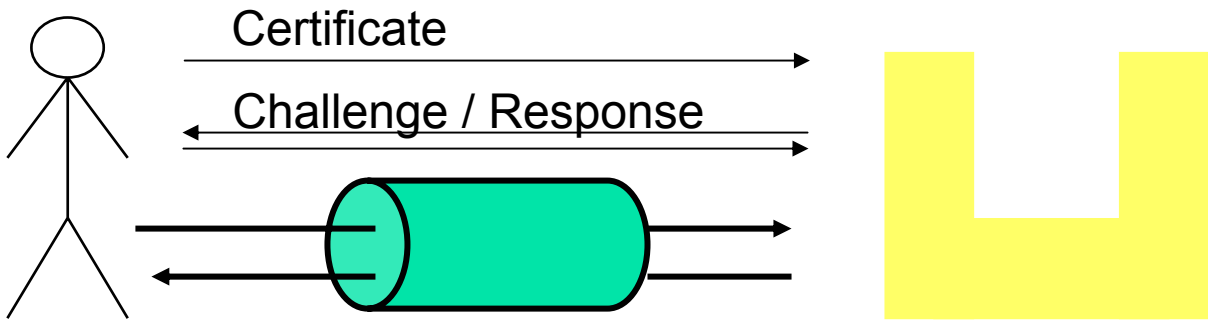


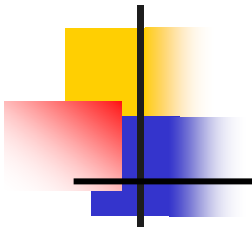
Evaluation of FORM

- Advantages
  - Control over Look-and-Feel of login form
  - Can secure just login
    - Redirect to HTTPS-URL
- Drawbacks
  - Hard to add extra info to login form
    - *e.g.* "login failed"
  - Credentials saved by some browsers

CLIENT-CERT Authentication

- Client present certificate w public key
- Server open SSL-tunnel
- Data encryption not really authentication
  - challenge-response auth during handshake

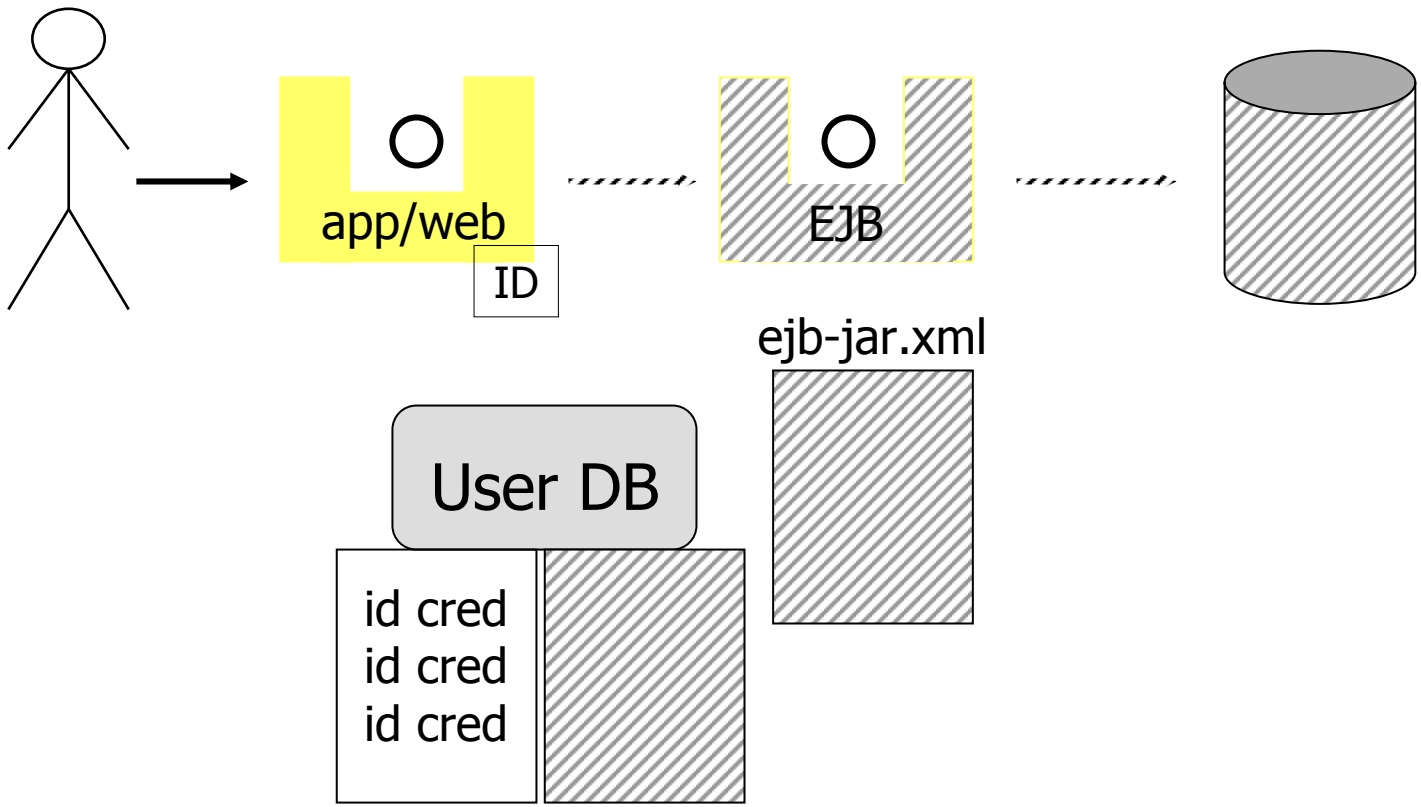




Evaluation of CLIENT-CERT

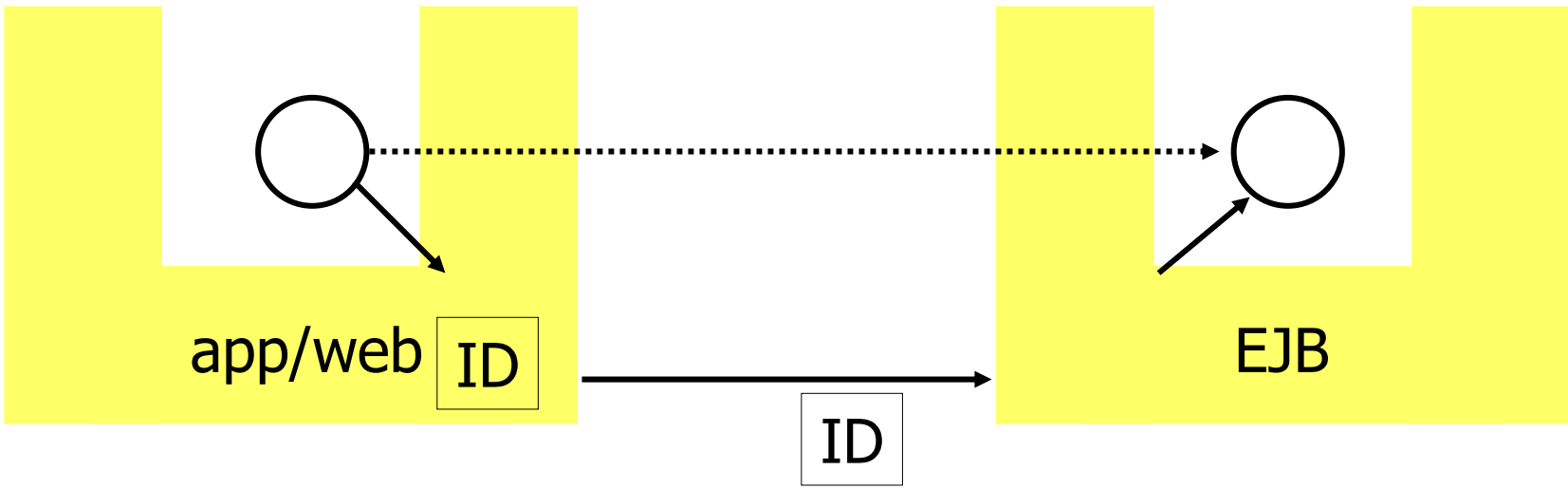
- Advantages
  - Very secure
- Drawbacks
  - Demands PKI
    - Cumbersome admin

The Story This Far



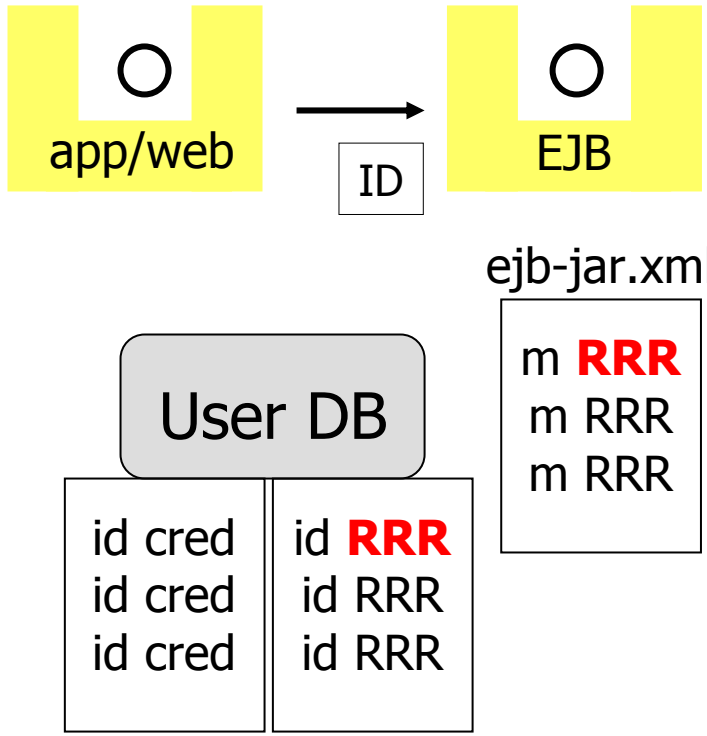
Call to EJB

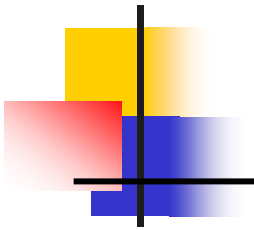
- Identity passed in call
  - Packed in network package
    - EJB [2.0] 19.8.2 Securing EJB invocations



Authorisation

- By EJB container
- Transparent
- Fetch ID from call
- Fetch roles from user database
- Fetch permitted roles from EJB DD
- Role resolution





Role Resolution

- Automatic by the platform
- Programmatic
  - EJBContext.isCallerInRole
  - EJBContext.getCallerPrincipal

To Make It Work - Roles

- Application
  - Define application roles
  - Assign access permissions
- ejb-jar.xml
- <assembly-descriptor>
  <security-role>…</security-role>
  <security-role>…</security-role>
  <method-permission>
  <role-name>…</role-name>
  <method>…</method>
  <method>…</method>
  </method-permission>
  </assembly-descriptor>
- Operating Environment
  - Map principals to application roles
- Managed through app-server tool

BarDweller - Security

- public void buyDrink()
  - all men and women, but neither guards nor personnel
- public void takeMoney()
  - personnel
- public void goBar()
  - everybody
- public void goBehindCounter()
  - personnel and guards
- public void goLadies()
  - women and guards
- public void goGents()
  - men and guards
- public void goHome()
  - everybody

Hmm, tricky
Let's ignore

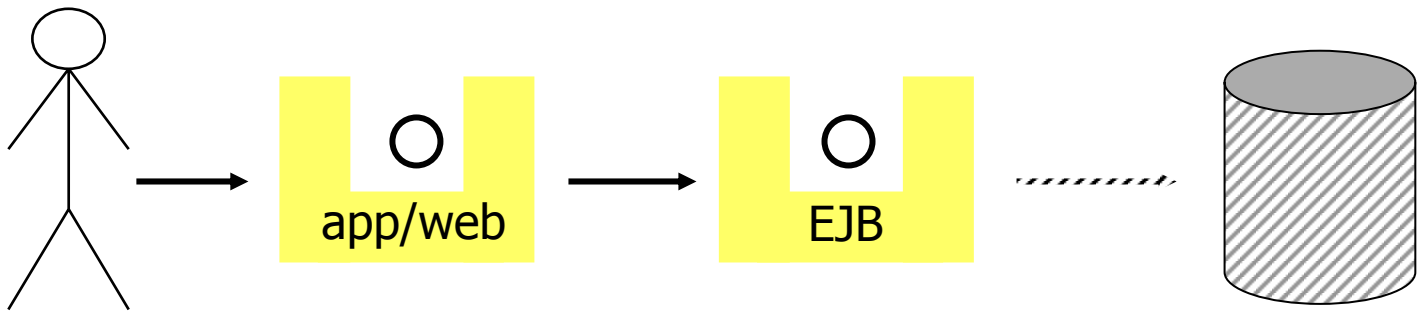
OK

To Make It Work - ejb-jar.xml

- Security Roles
- <security-role>
  <description>
  male or …
  </description>
  <role-name>man</role-name>
  </security-role>
  <security-role>
  <role-name>guard</role-name>
  </security-role>
  <security-role>
  <role-name>woman</role-name>
  </security-role>
  <security-role>
  <role-name>personnel</role-name>
  </security-role>

- Method permissions
- <method-permission>
  <role-name>
  woman
  </role-name>
  <method>
  <ejb-name>
  BarDwellerEJBean
  </ejb-name>
  <method-intf>Remote</method-intf>
  <method-name>
  buyDrink
  </method-name>
  <method-params />
  </method>
  <method>
  … goLadies
  </method>
  </method-permission>

The Story This Far

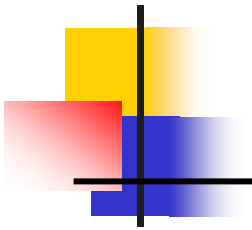


ejb-jar.xml

m RRR
m RRR
m RRR

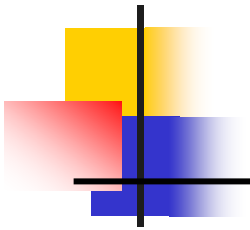
User DB

id cred	id RRR
id cred	id RRR
id cred	id RRR



Resource Control

- Containment
  - Limits access to resource
- Exposure
  - Gives controlled access to resource

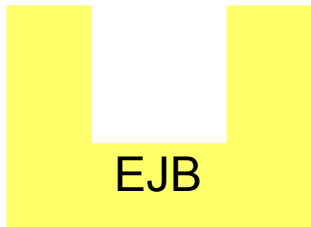


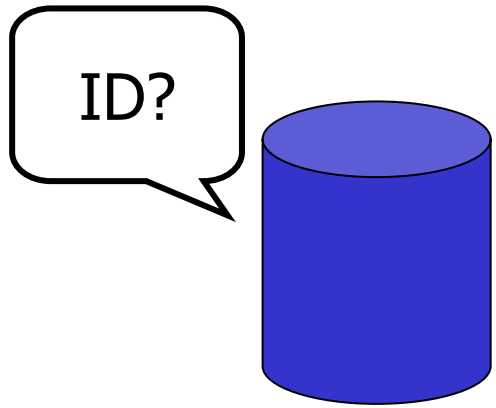
Example: Log Database

- Problem
  - Database w/ complex table relations
  - Do not want access code throughout system
- Solution
  - Database hidden behind EJB
  - EJB configured with credentials
  - Database inaccessible “from side”

Resource Authentication Requirements (J2EE 1.3 spec)

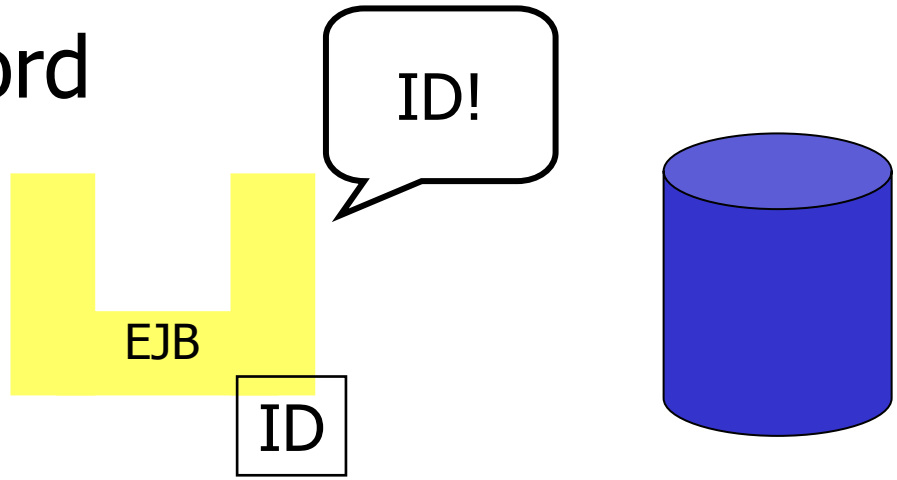
- Required
  - Configured Identity
  - Programmatic Authentication
- Recommended
  - Caller Impersonation
  - Principal Mapping
  - Credential Mapping





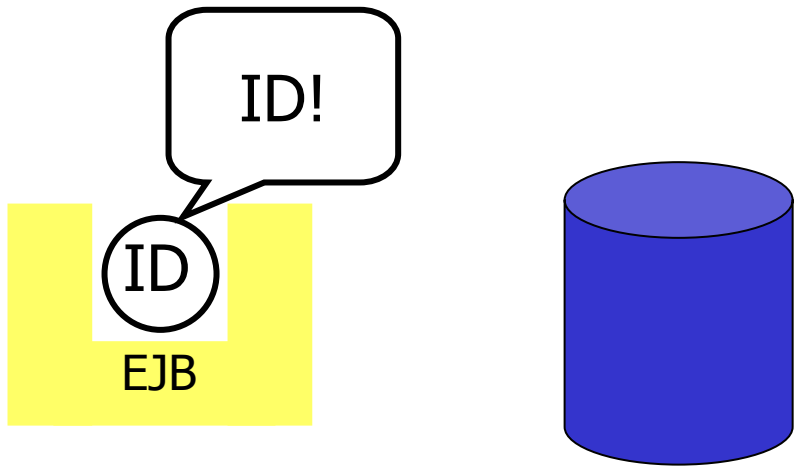
Configured Identity

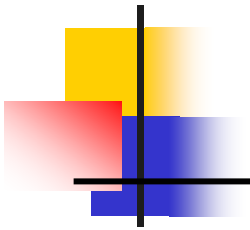
- Standard model
- Username / password
  - Held by EJB
  - Set by deployer
  - Static
- Code:
  - datasource.getConnection()



Programmatic Authentication

- If standard model not good enough
- Code it in component (app layer)
- Code:
  - datasource.getConnection(user, passwd)
- Completely general



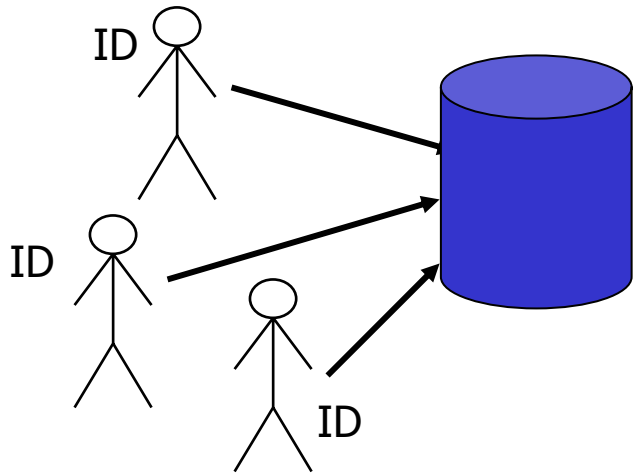


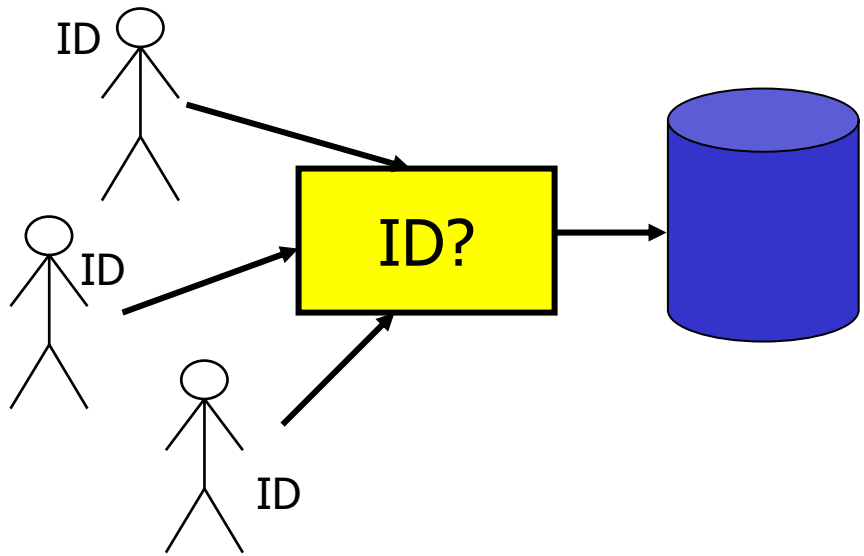
Recommended Features

- Caller Impersonation
- Principal/credentials mapping
- Why are they recommended?
  - Handy in some usual cases

Example

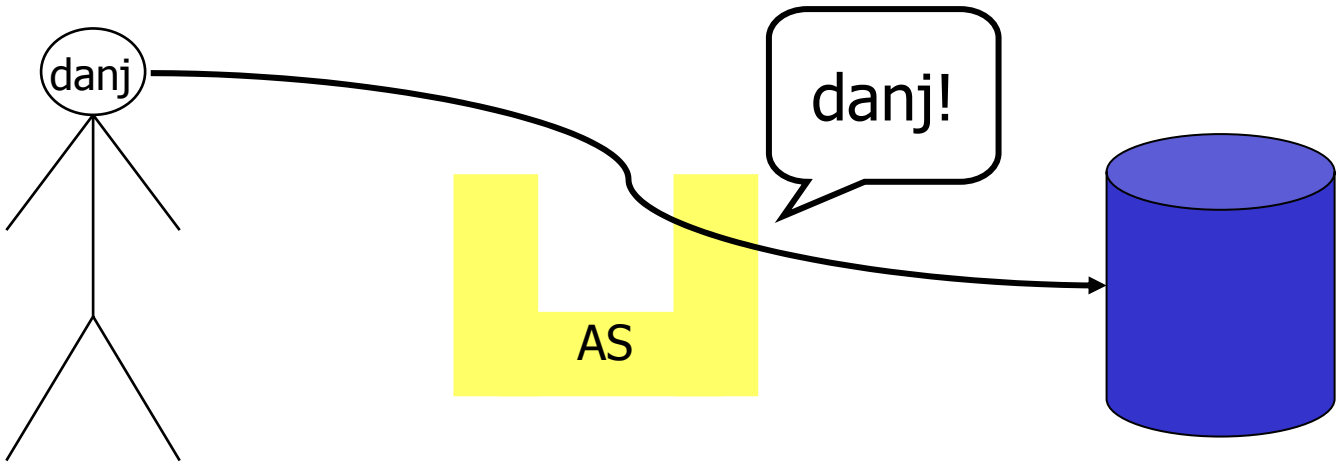
- Legacy system
  - Database
  - GUI clients
  - Users in database
- Webbify it!
  - What ID should Web system use?
  - Need to user client's ID





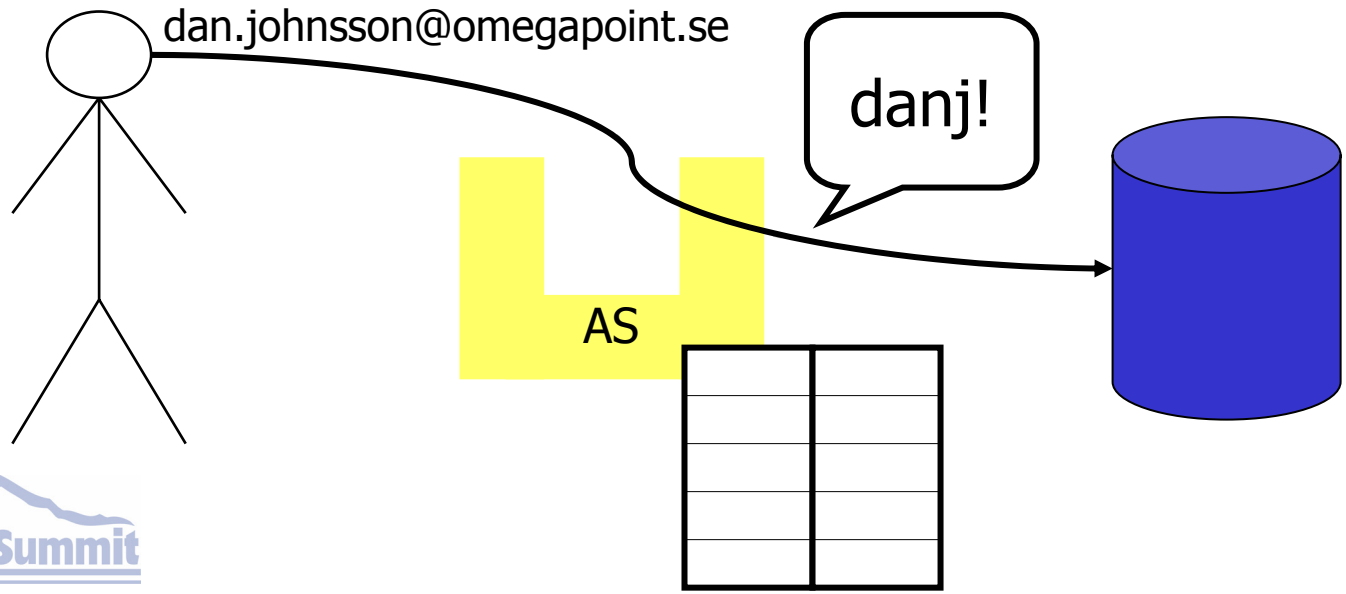
Caller Impersonation

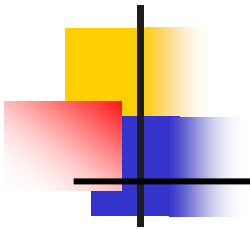
- User caller ID to contact resource



Principal Mapping

- Principal is not always same
- Principal 'danj' to database
- Principal 'dan.johnsson@omegapoint.se' to Web system

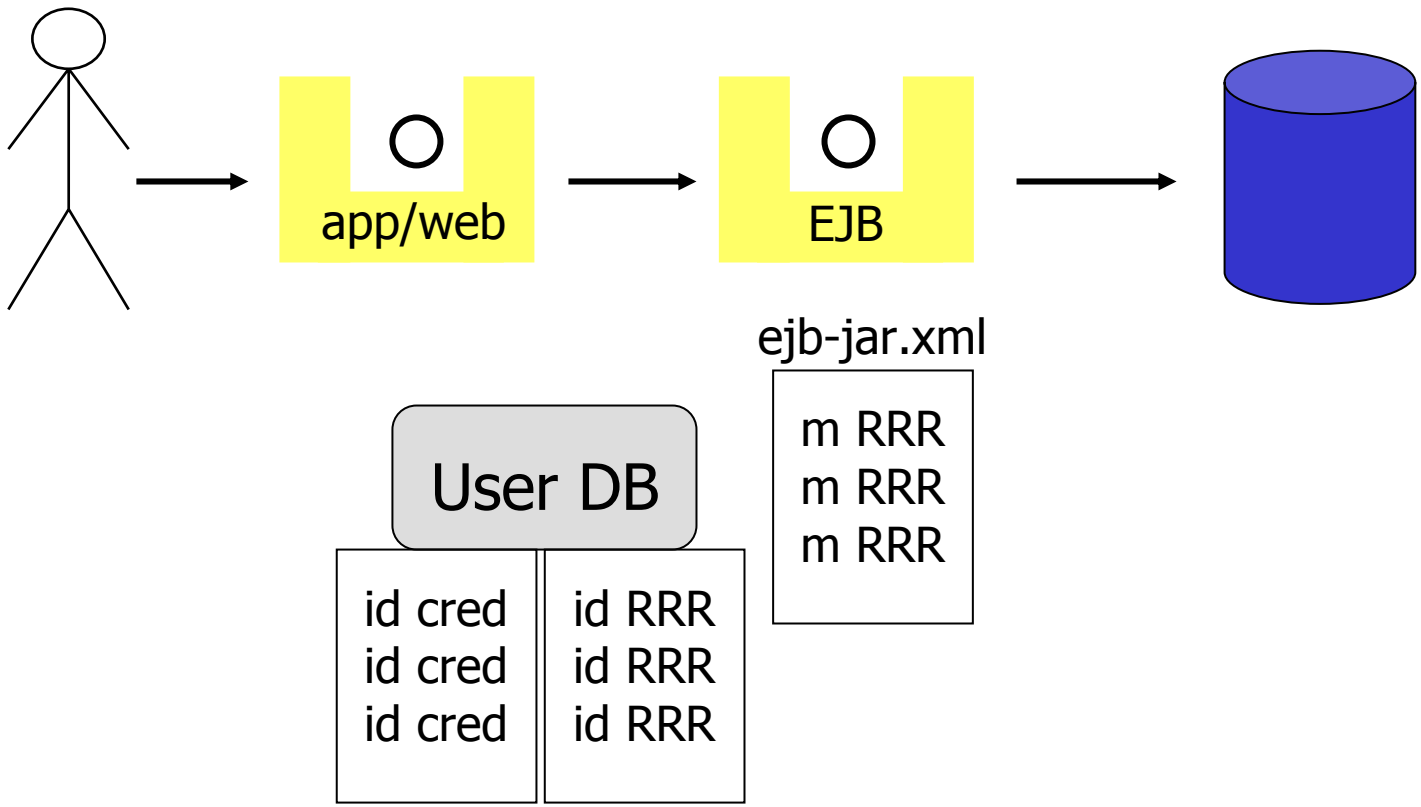


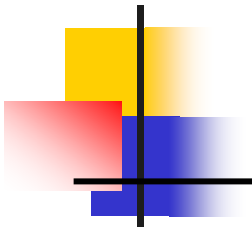


Credential Mapping

- Not only different principals
- Different passwords
- Different ways of authentication
  - Certificate to web tier
  - Username/password to database
- Credential mapping translates

The Story This Far



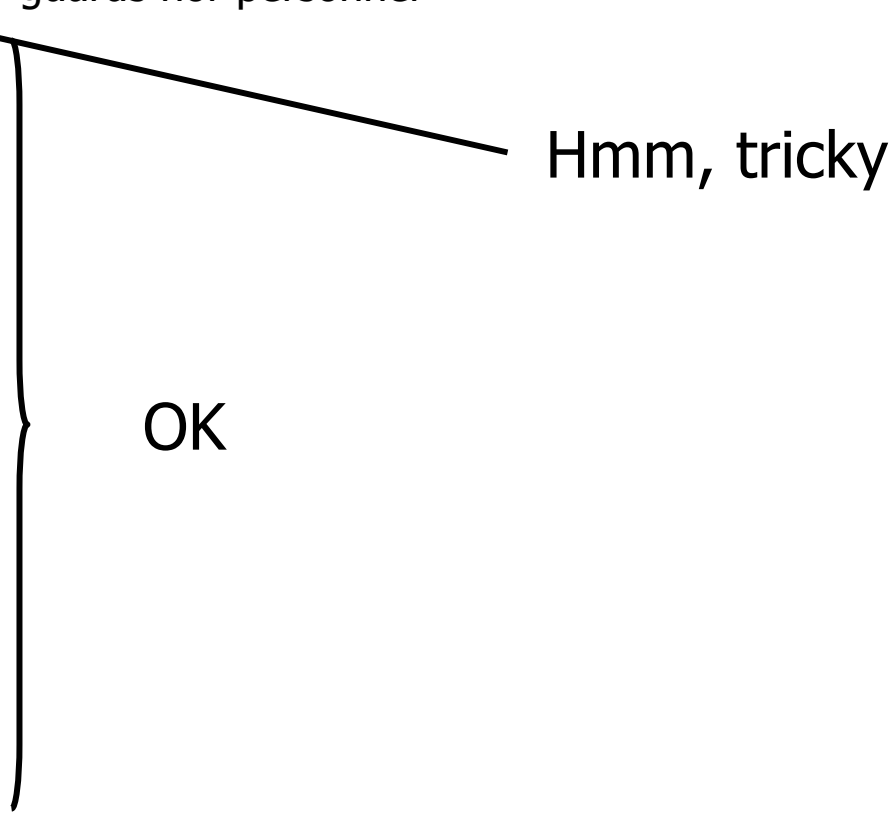


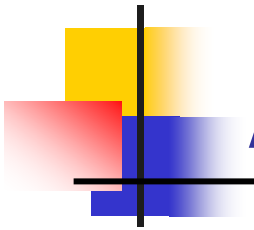
Limitations of Model

- Complicated role systems
  - negative permissions
- Data-oriented security
  - Balance of bank account
    - Not for all "Web-user"s - just for me

BarDweller - Security

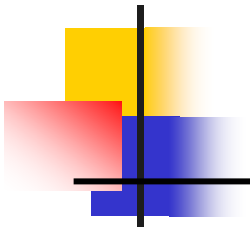
- public void buyDrink()
  - all men and women, but neither guards nor personnel
- public void takeMoney()
  - personnel
- public void goBar()
  - everybody
- public void goBehindCounter()
  - personnel and guards
- public void goLadies()
  - women and guards
- public void goGents()
  - men and guards
- public void goHome()
  - everybody





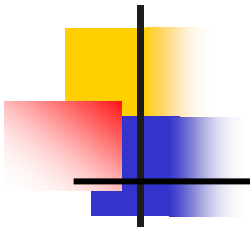
Augmenting the Model

- Do not throw out model
  - baby / bath water
- Code on top of model
- public void buyDrink() {
  if(sessionctx.isCallerInRole("personnel")
  || sessionctx.isCallerInRole("guard"))
  throw new SecurityException("Not permitted to drink");
  …
  }
- Note: Seemingly hardcoded ”personnel” and ”guard” are mapped to application roles.



Data-oriented Security

- Example: Internet bank w/ account
- Role based security not enough
- Augment model: code on top
- public void getBalance() {
  if(! areSame(getName(), ctx.getCallerPrincipal()))
  throw new SecurityException(”Not your account");
  …
  }

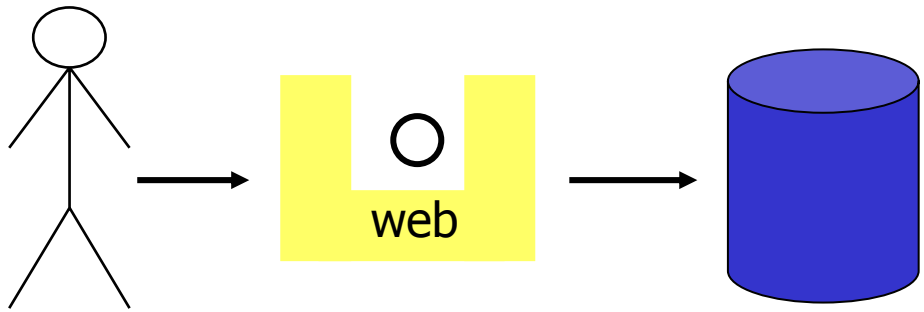


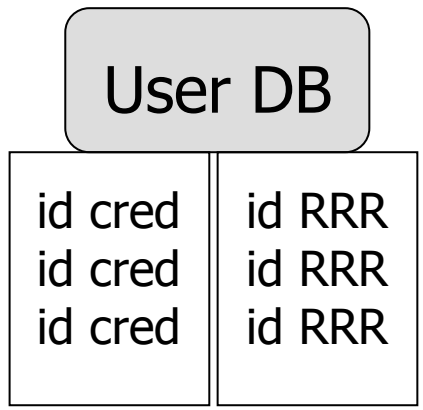
Recap of Full Scale Model

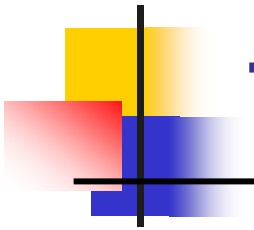
- Authentication by client containers
- ID transport on call - transparently
- Authorization by EJB container
- Protected resources
- todo: What triggers authentication?
- todo: User Administration

Web System

- Degenerated case
- No EJB tier
  - Who will authorise?
- Web container have to - no other around
  - Protected views
- Will trigger authentication!



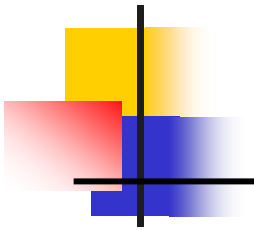




To Make It Work

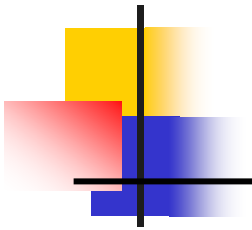
- Example web.xml (SRV[2.3] 13.4.2)

```
<security-constraint>
        <web-resource-collection>
                <web-resource-name>SalesInfo</web-resource-name>
                <url-pattern>/salesinfo/*</url-pattern>
                <http-method>GET</http-method>
        </web-resource-collection>
        <auth-constraint>
                <role-name>manager</role-name>
        </auth-constraint>
        <user-data-constraint>
                <transport-guarantee>CONFIDENTIAL</transport-guarantee>
        </user-data-constraint>
</security-constraint>
```



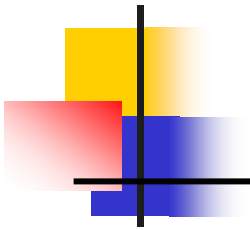
User Administration

- Large system ⇒ dynamic user base
- Black Sheep - no standard
- ”This scenario was widely discussed /…/ [JSR-53 EG] but we were unable to achieve consensus on the appropriate solution. We had to abandon this work for J2EE 1.3 ….”



Drawbacks in User Admin

- No User Admin API
- Cannot add users
- Cannot change password
- Cannot change roles
- Workarounds Exist!

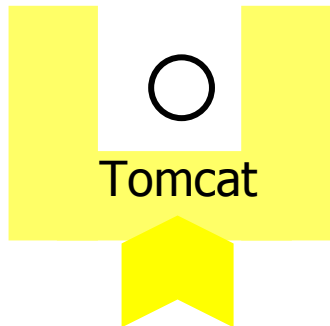


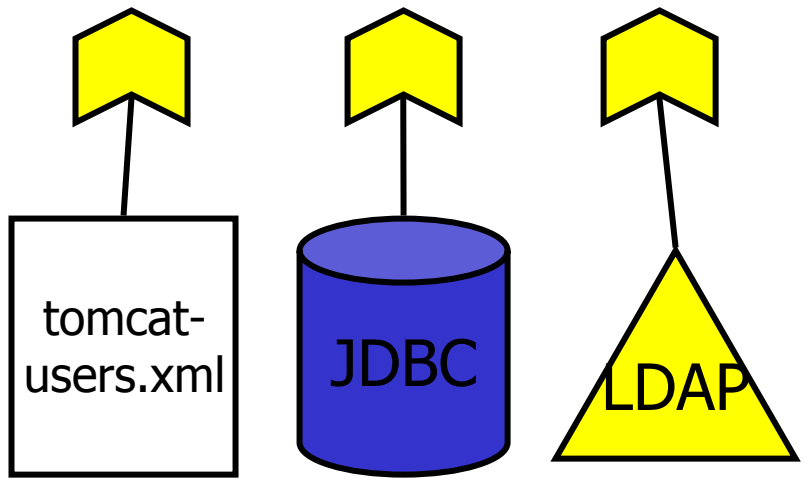
User Databases

- Not standardised
- Usual
  - Flat file
  - Relational database
  - LDAP system
- Most app-servers
  - Proprietary interface
  - Adapters

User DB Example - Tomcat

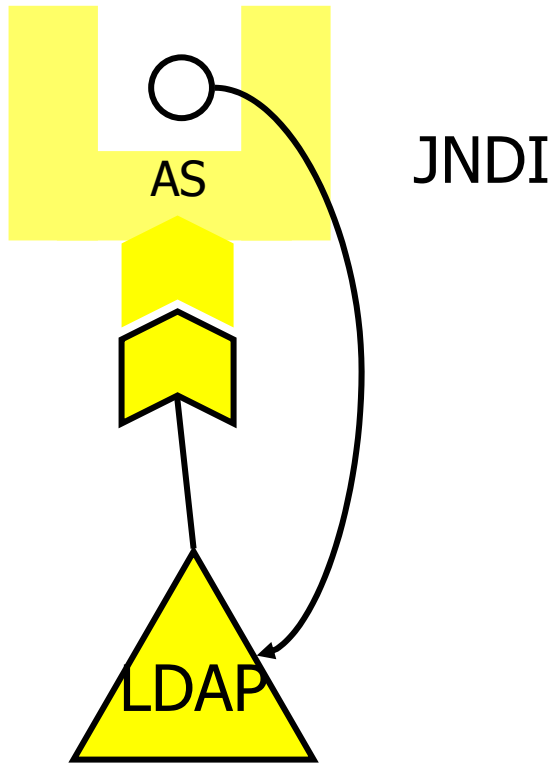
- Interface
- Adapters
  - MemoryRealm
  - JDBCRealm
  - JNDIRealm
- Config i server.xml

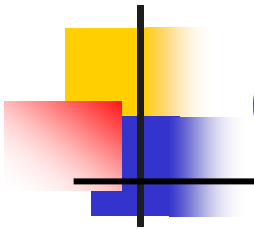




Workaround for User Admin

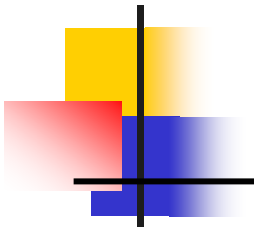
- Use your LDAP system
  - good industry support
- Update through JNDI
- No portability guarantee





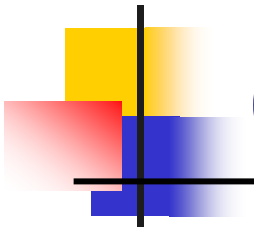
Crystal Ball

- User admin API
- Connectors to auth systems



Future JSRs

- Java Authentication Service Provider Interface for Containers (196)
- Java Authorization Contract for Containers (115)



Conclusions

- Standard model in platform
- Usable in most cases
- Declarative - transparent to code
- Can be augmented programmatically
- User admin is black sheep