Common Architecture Flaws

Problems in Identity, Authentication, & Authorization

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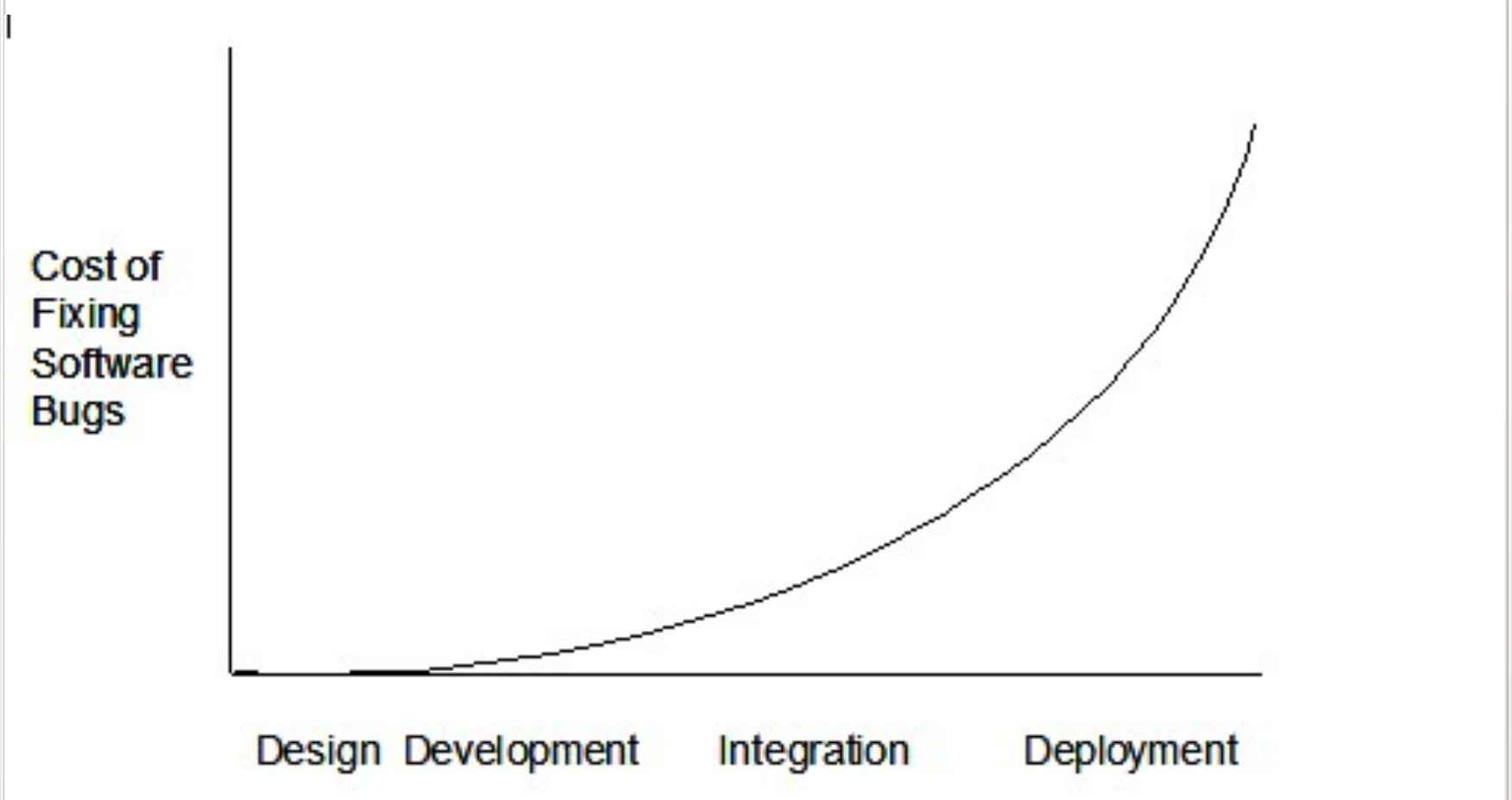
Why are Flaws Important?

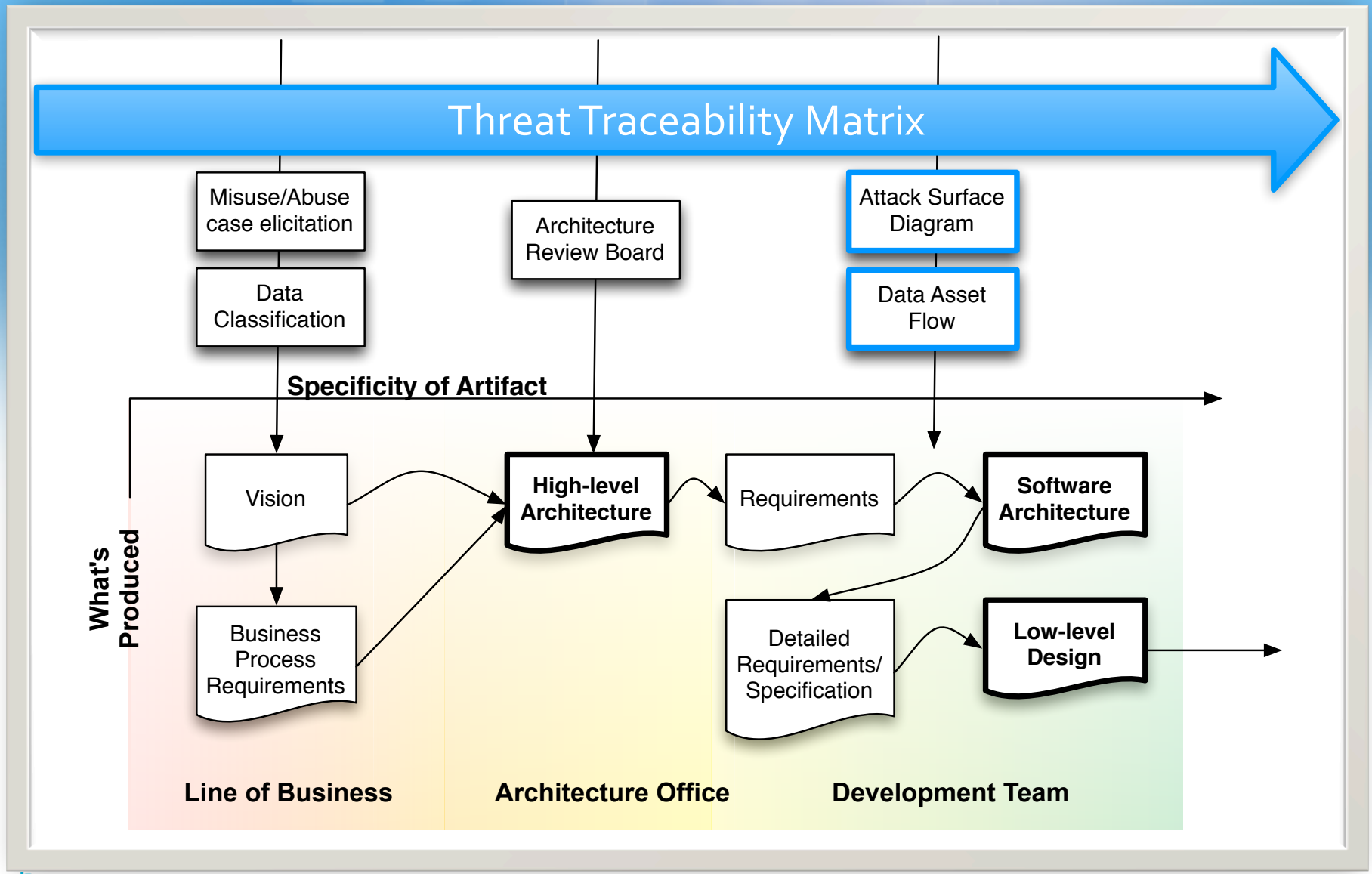
The "NASCAR EFFECT" -- It's Fun

- Study how systems fail
- Build for failure
- "Moving left"
  - Time
  - Money
  - Scale

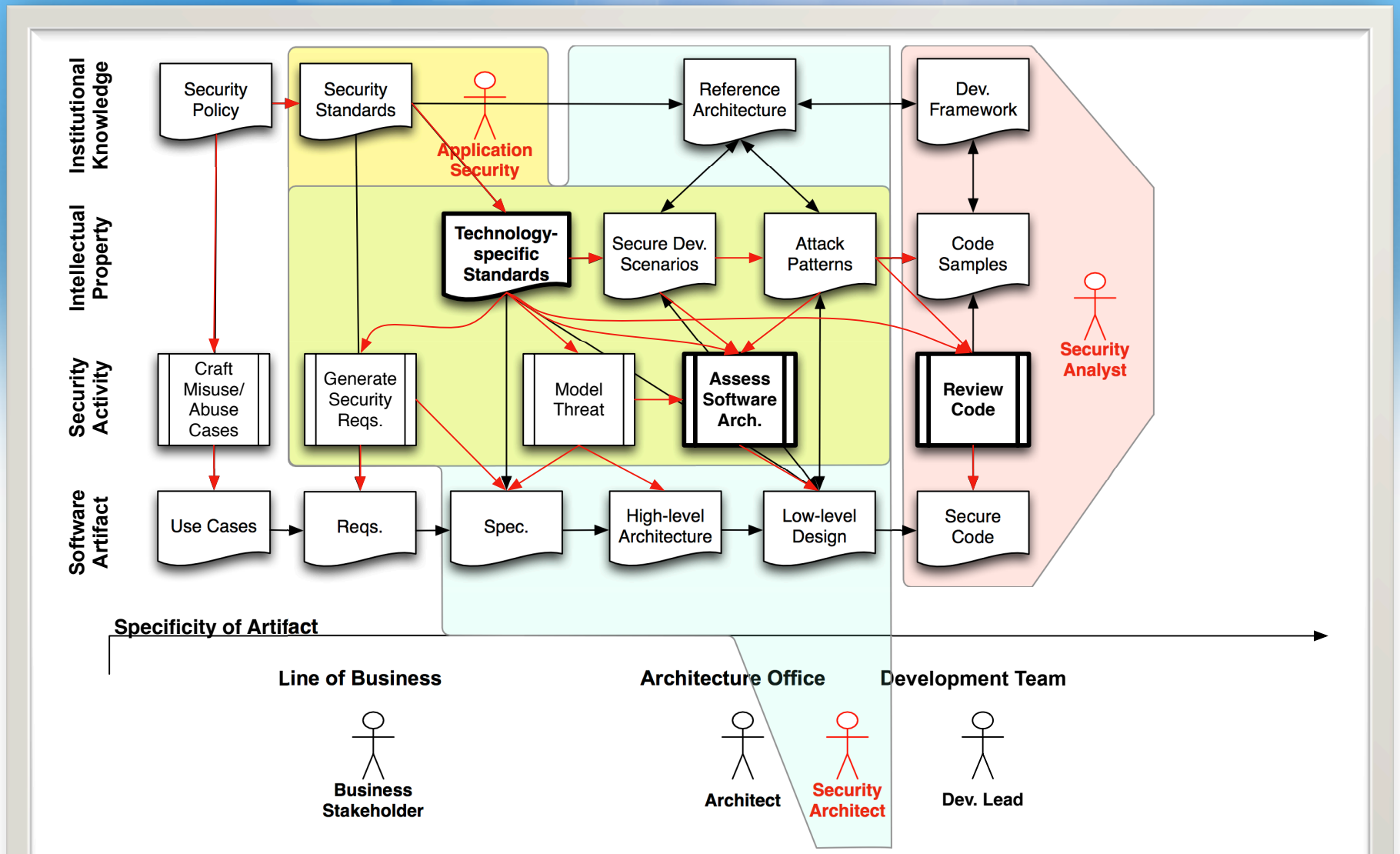
Cost to fix



Moving Left (Conceptually)

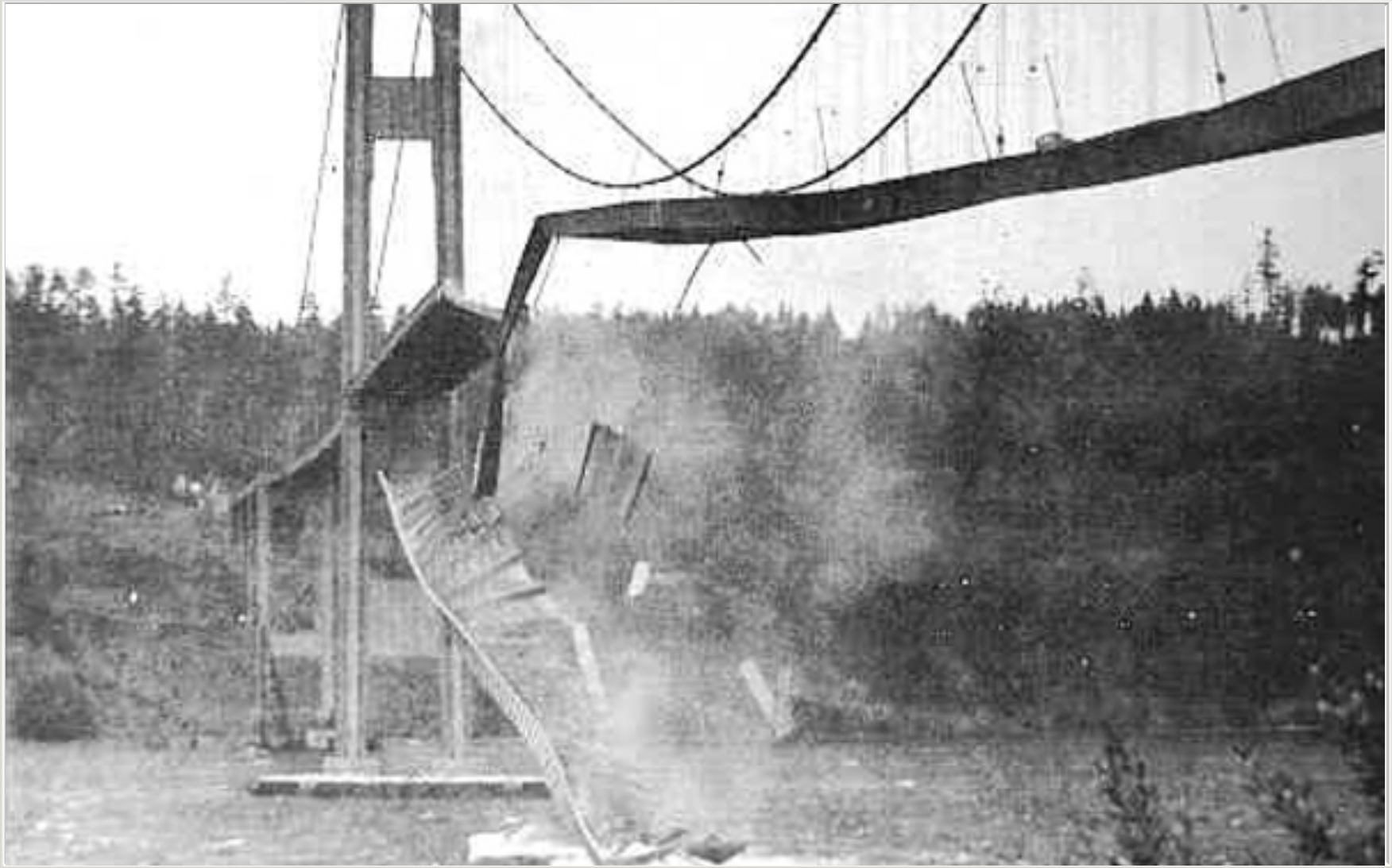


Moving Left (Large Org)

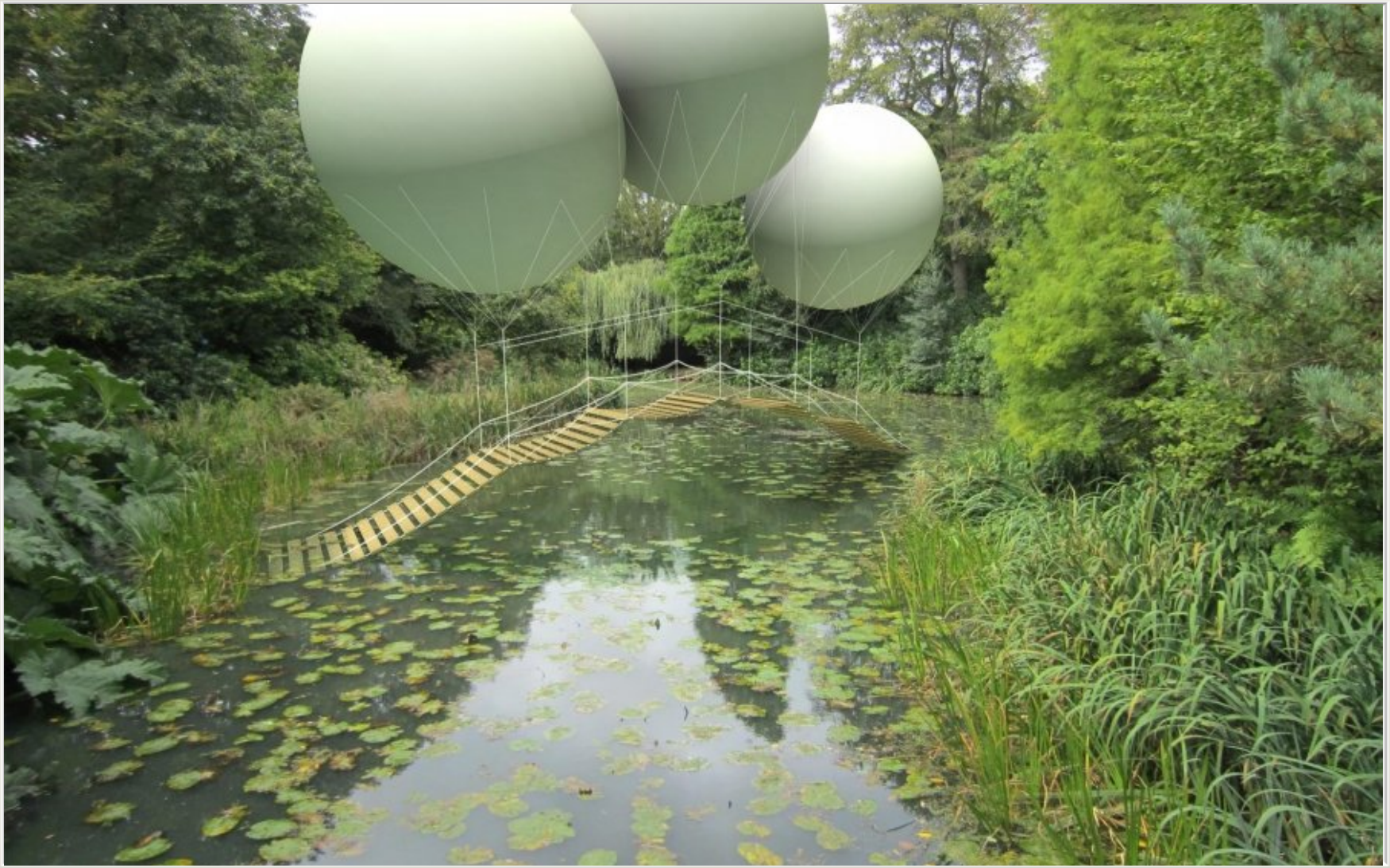


Bug

Flaw

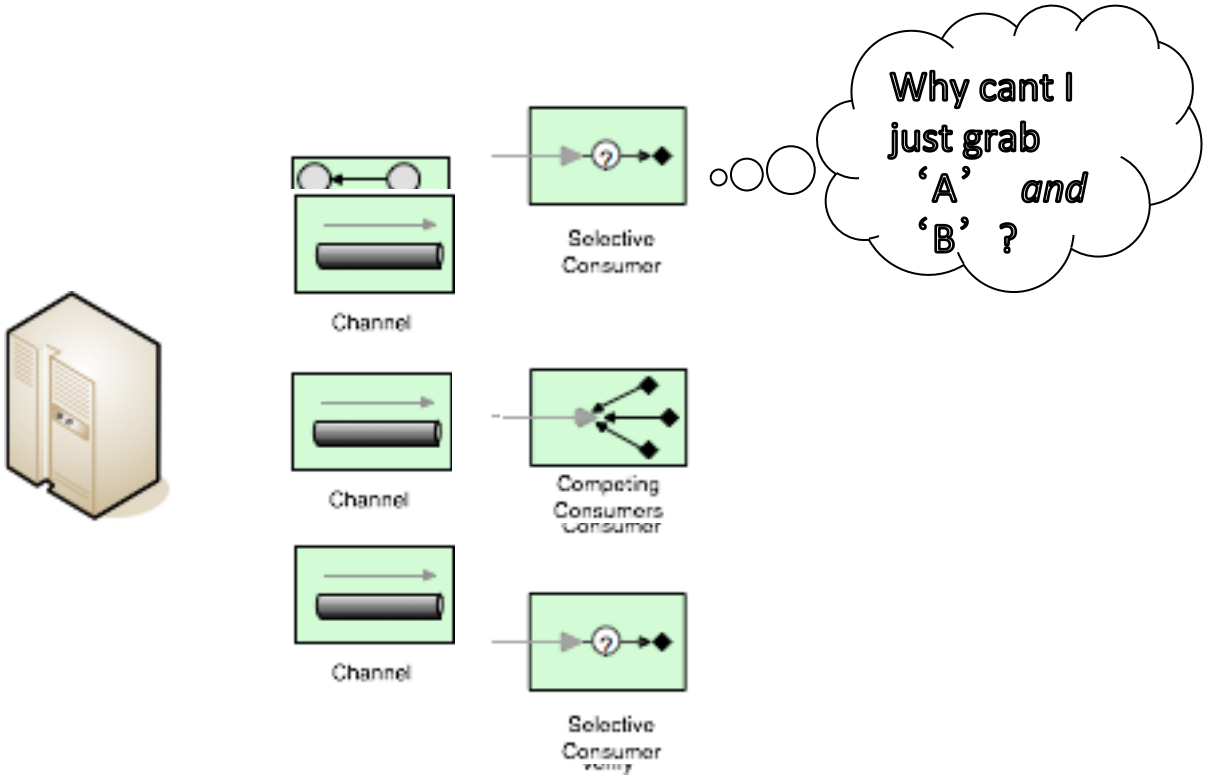


Flaw



Flawed?

System Flaw: Principal Mapping



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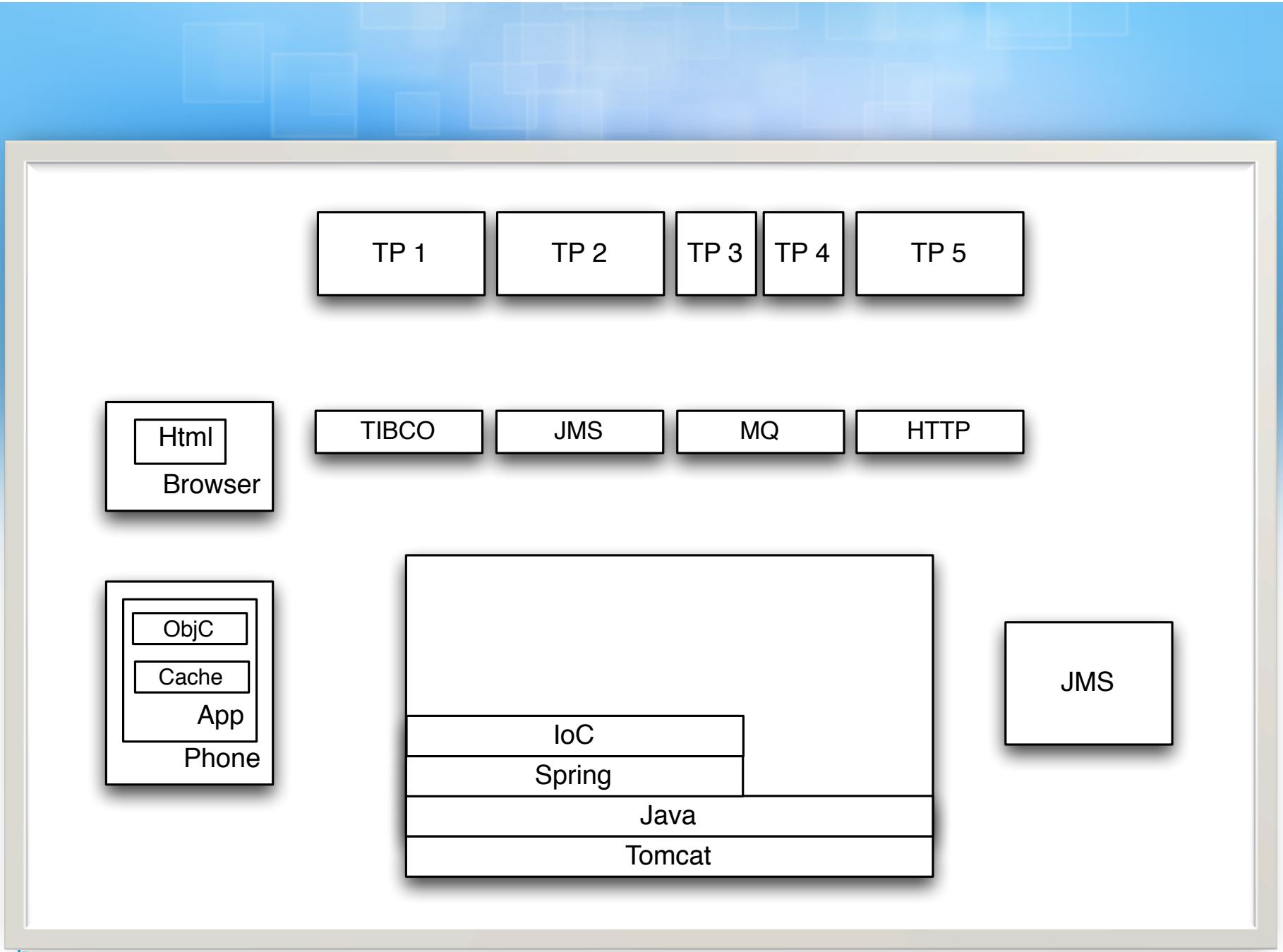
TP 1
TP 2
TP 3
TP 4
TP 5
Html
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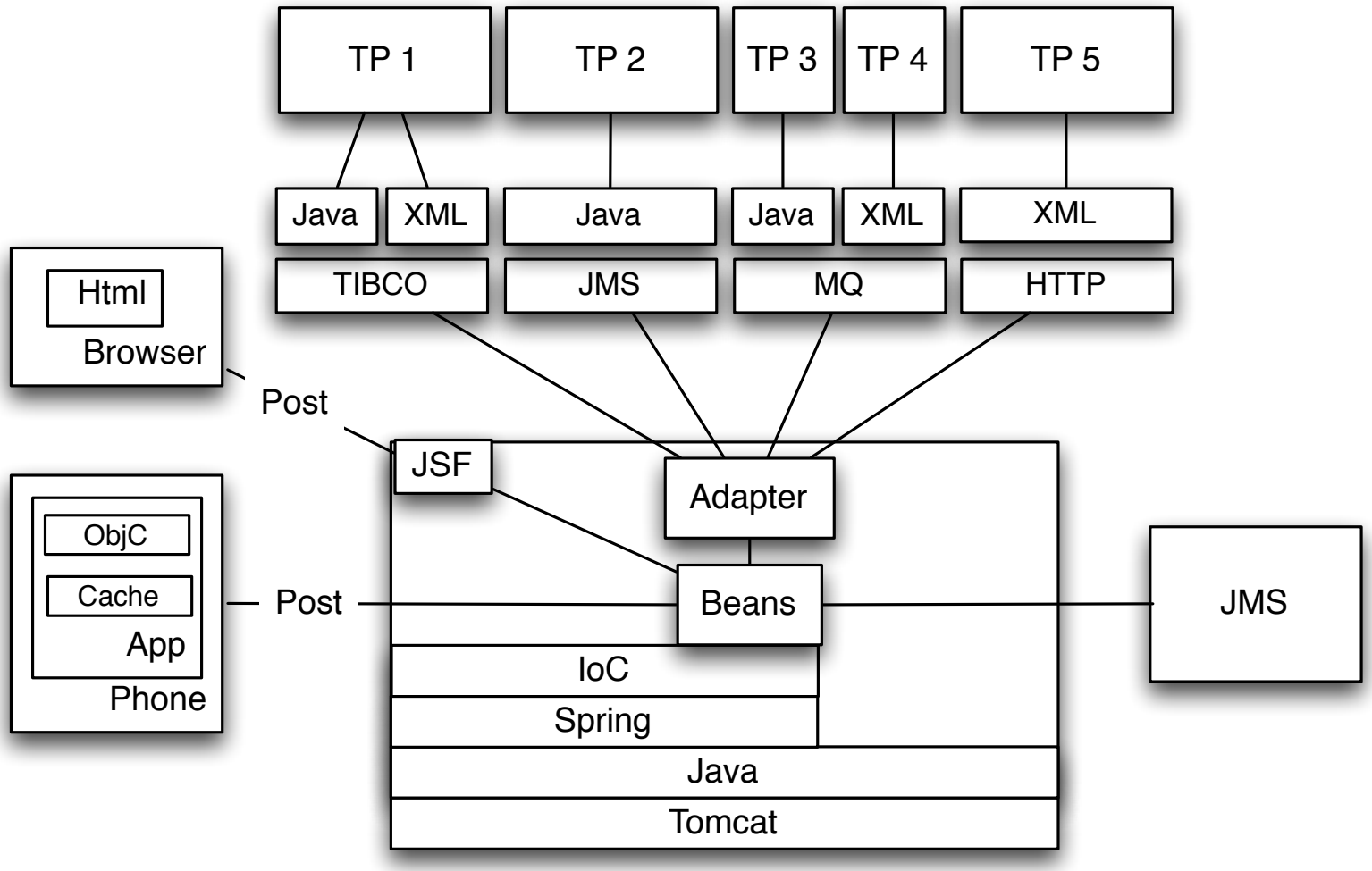
TIBCO
JMS
MQ
HTTP
ObjC
Cache
App
Phone
IoC
Spring
Java
Tomcat
JMS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JSF
Adapter
ObjC
Cache
App
Phone
Post
Beans
JMS
IoC
Spring
Java
Tomcat

Output Encoding Bugs

Contextually Aware Output Encoding

ESAPI

```
<%-- Must escape content (even in user names!) --%>
Hello <%= ESAPI.encoder().encodeForHTML(user.getName()) %>!

<%-- Must escape 3 different contexts correctly --%>
<img src="/profile-photo?user=<%= ESAPI.encoder().encodeForURL(user.getId()) %>"
   alt="<%= "Photo of "+ESAPI.encoder().encodeForHTMLAttribute(user.getId()) %>"
   onclick="<%= "openProfile('"+ESAPI.encoder().encodeForHTMLAttribute(
            ESAPI.encoder().encodeForJavaScript(user.getId())) + "')" %>" />

<%-- Outputting unescape, is however, easy: --%>
<%= user.getProfileHtml() %>
```

JXT

```
<!-- Automatically escaped content -->
Hello ${user.getName()}!

<!-- Example tag with 3 different contextual encoding requirements -->
<img src="/profile-photo?user=${user.getId()}"
   alt="Photo of ${user.getName()}"
   onclick="openProfile('${user.getId()}')" />

<!-- Override the default escape, rare, but occasionally needed: -->
<jxt:out value="${user.getProfileHtml()}" escape="none"/>
```

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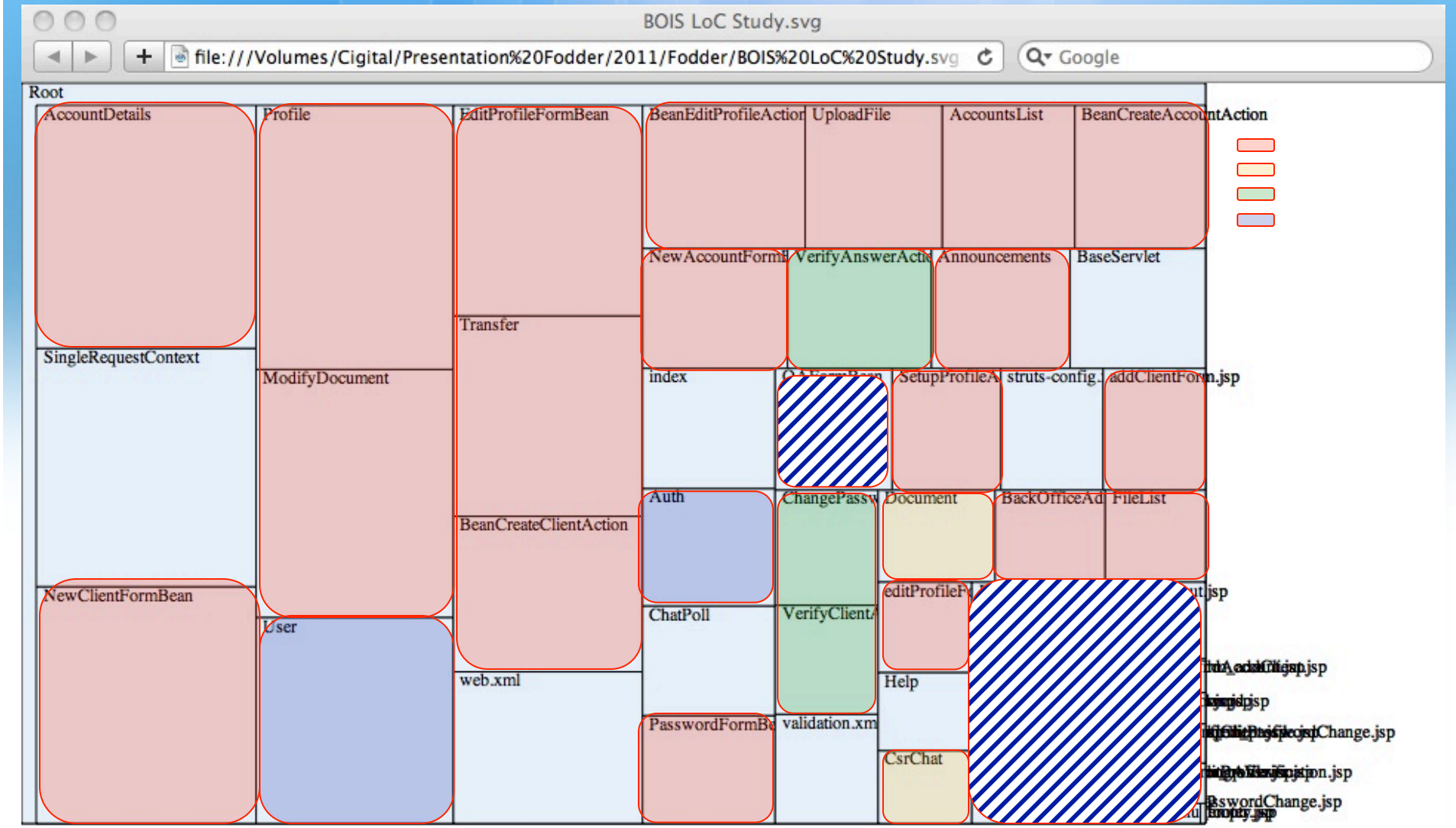
Fixing Output Encoding with OWASP ESAPI

("Blast Radius" – Struts1)



Change 70% of files, representing 78% of KLOC

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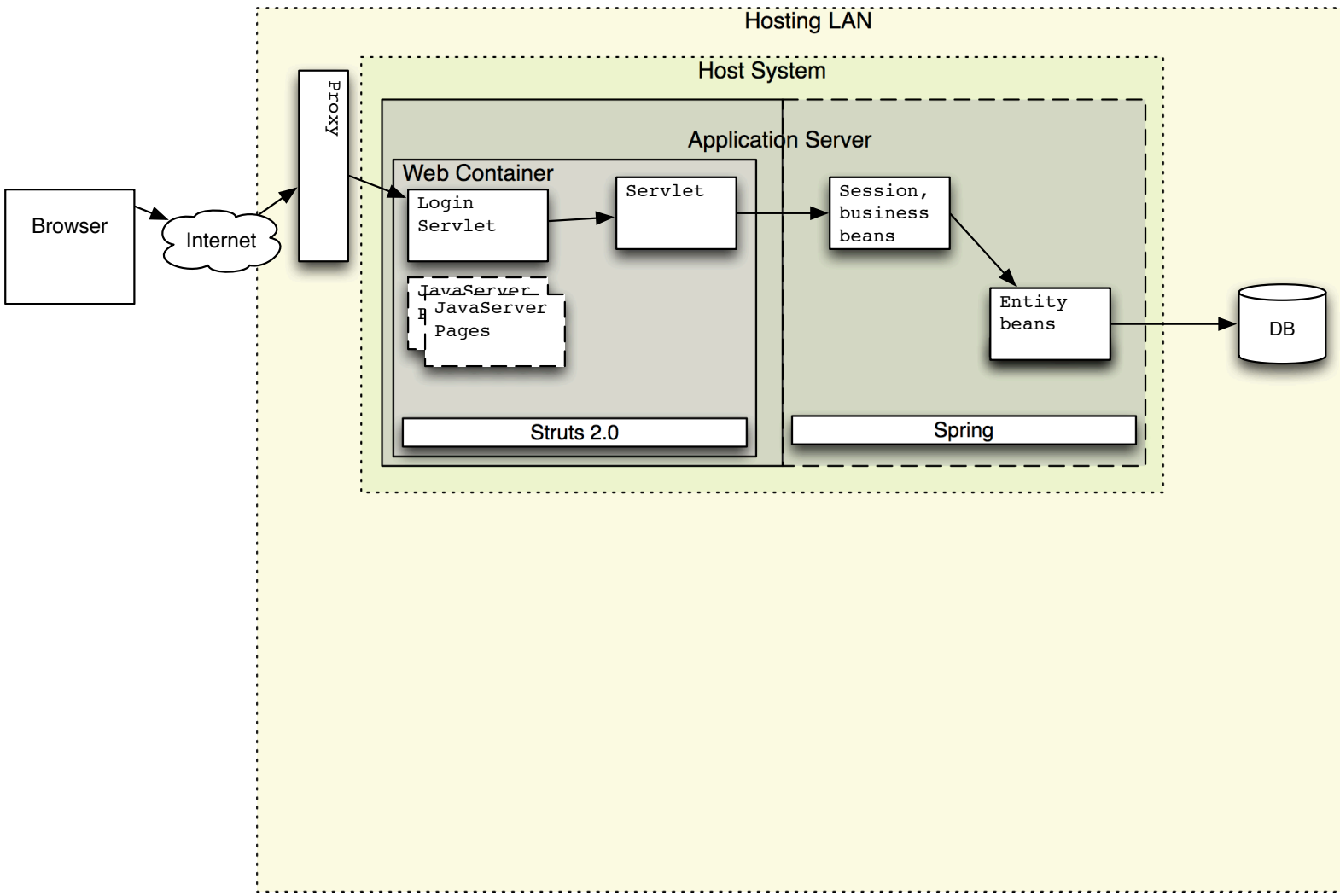
Bugs vs. Flaws

- Names are not important
- What is important is the:
  - Stakeholders engaged in the fix
  - Techniques used to fix the problem
  - Scope/scale at which the fix is applied
- If fixing a bug entails improving *how* something is implemented, fixing a flaw improves *what* it is.
  - …opening a new set of implementation bug opportunities;-)

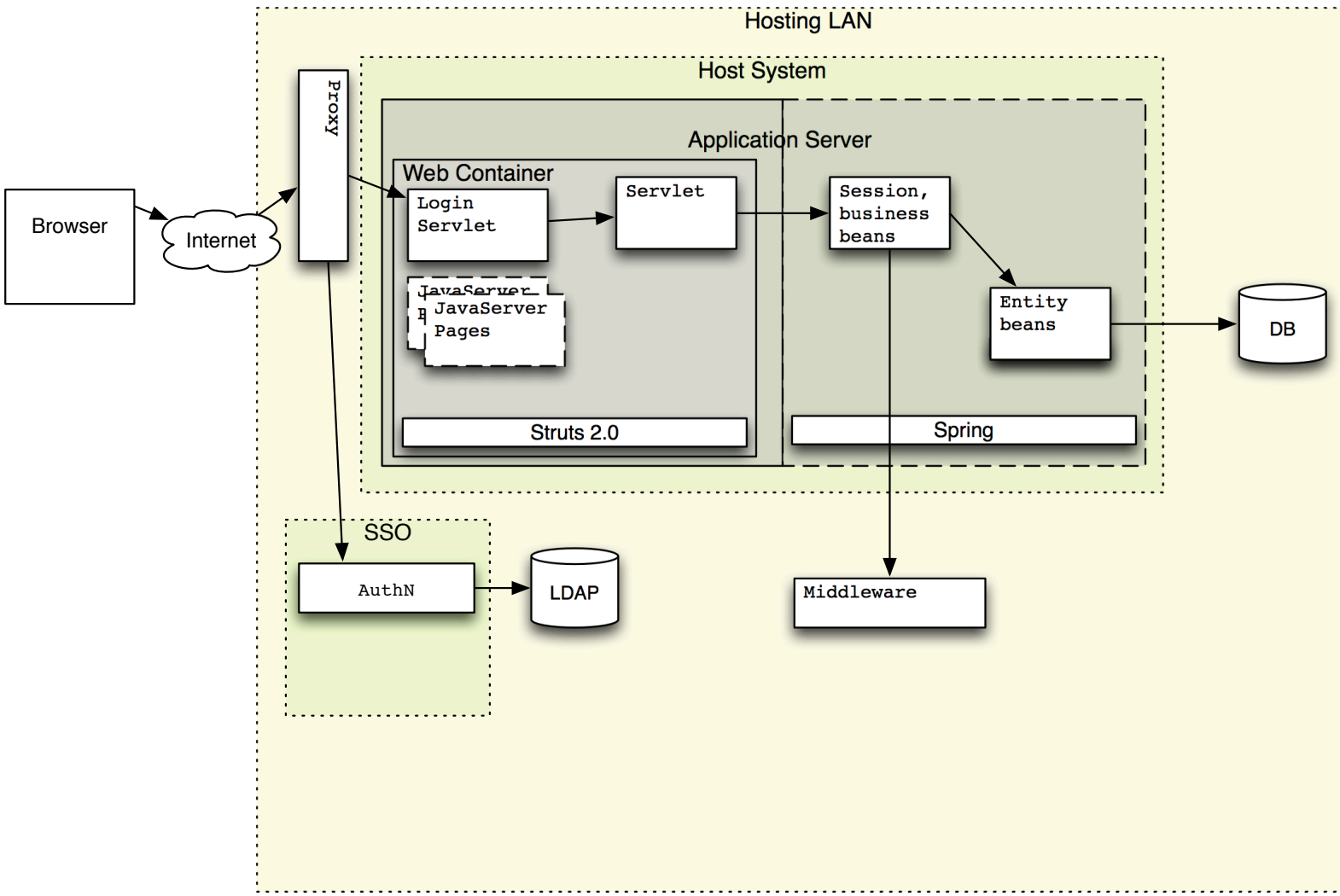
Common IAM/Auth[N|Z] Flaws

Principal Identity

Propagating Principal: Most Basic Form



Federated Systems



Federated Systems

Browser → AuthN

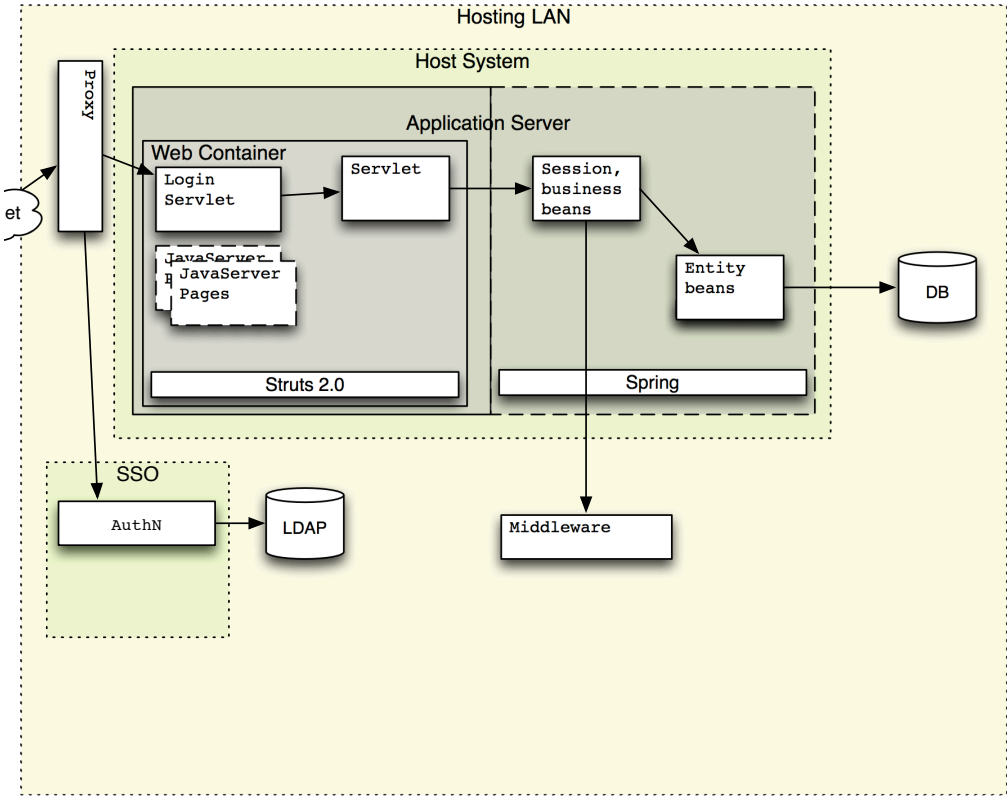
- User-level: UN/PW
- Creds → UID + Session

Browser → Container

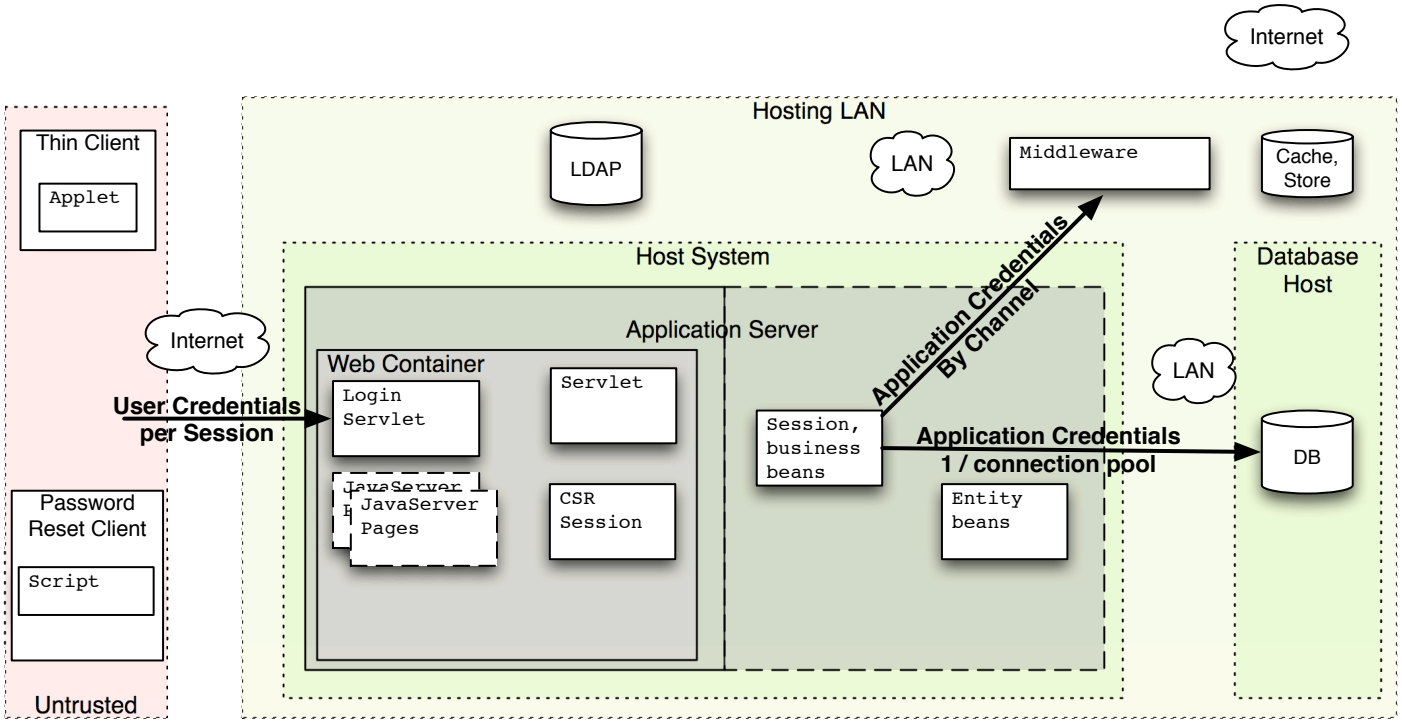
- Binary AuthN: session
- Optional RBAC

Container → DB

- Host-level AuthN
- Optional RBAC



Principal Resolution Changes...



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Consequences: AuthZ Foiled

1. Authenticated requests can access anything
    1. Forced browsing
    2. Parameter tampering, pollution, and so forth
    3. Replay attacks

2. Containers lack info required for AuthZ
    - Role is too coarse to mitigate account access
    - UID lacks user context
    - Access control list lies in directory or DB
    - Requests carry no claims-based info

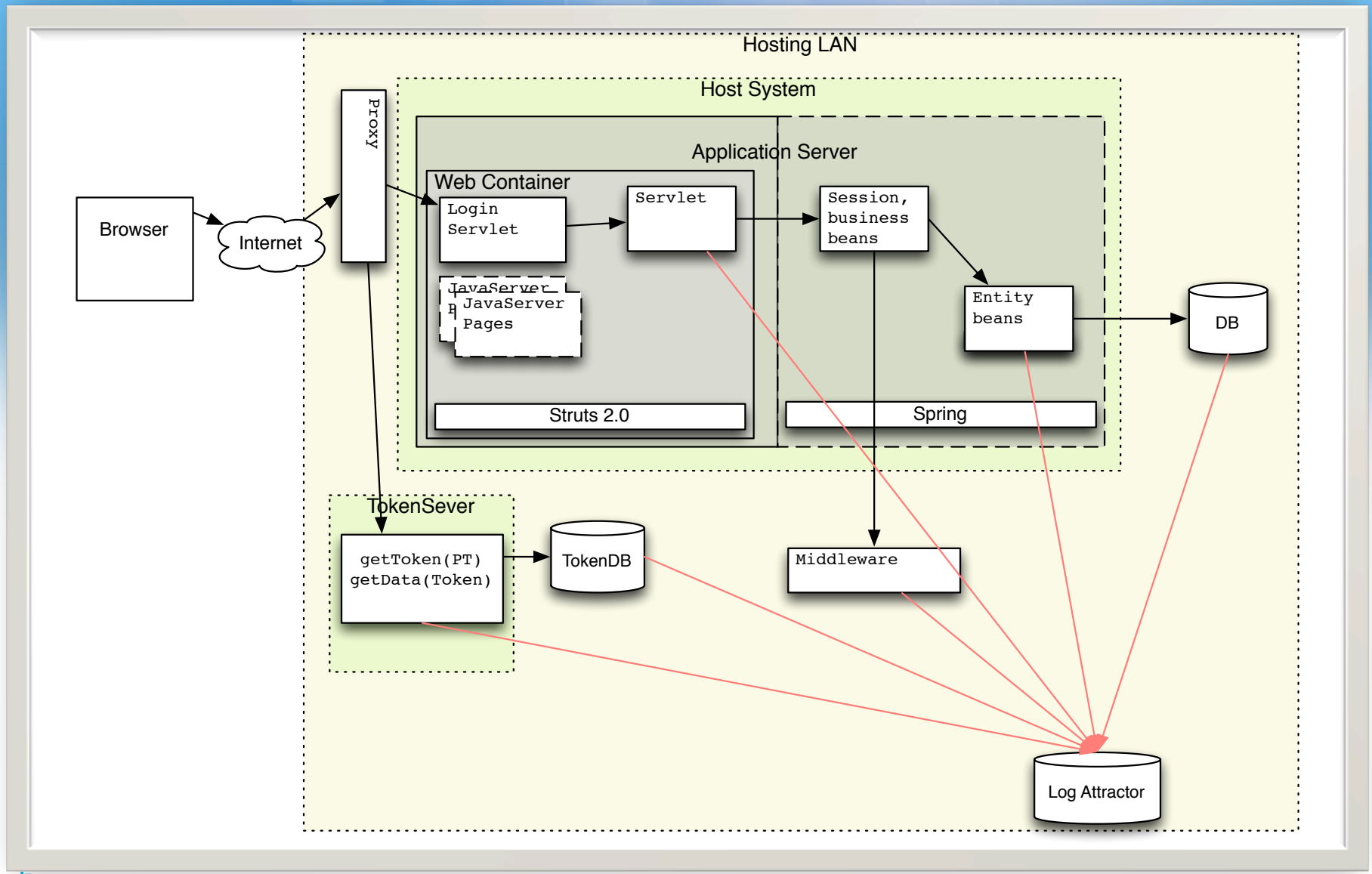
Principal Resolution counter Privilege

Asset access & privilege increase moving 'right'

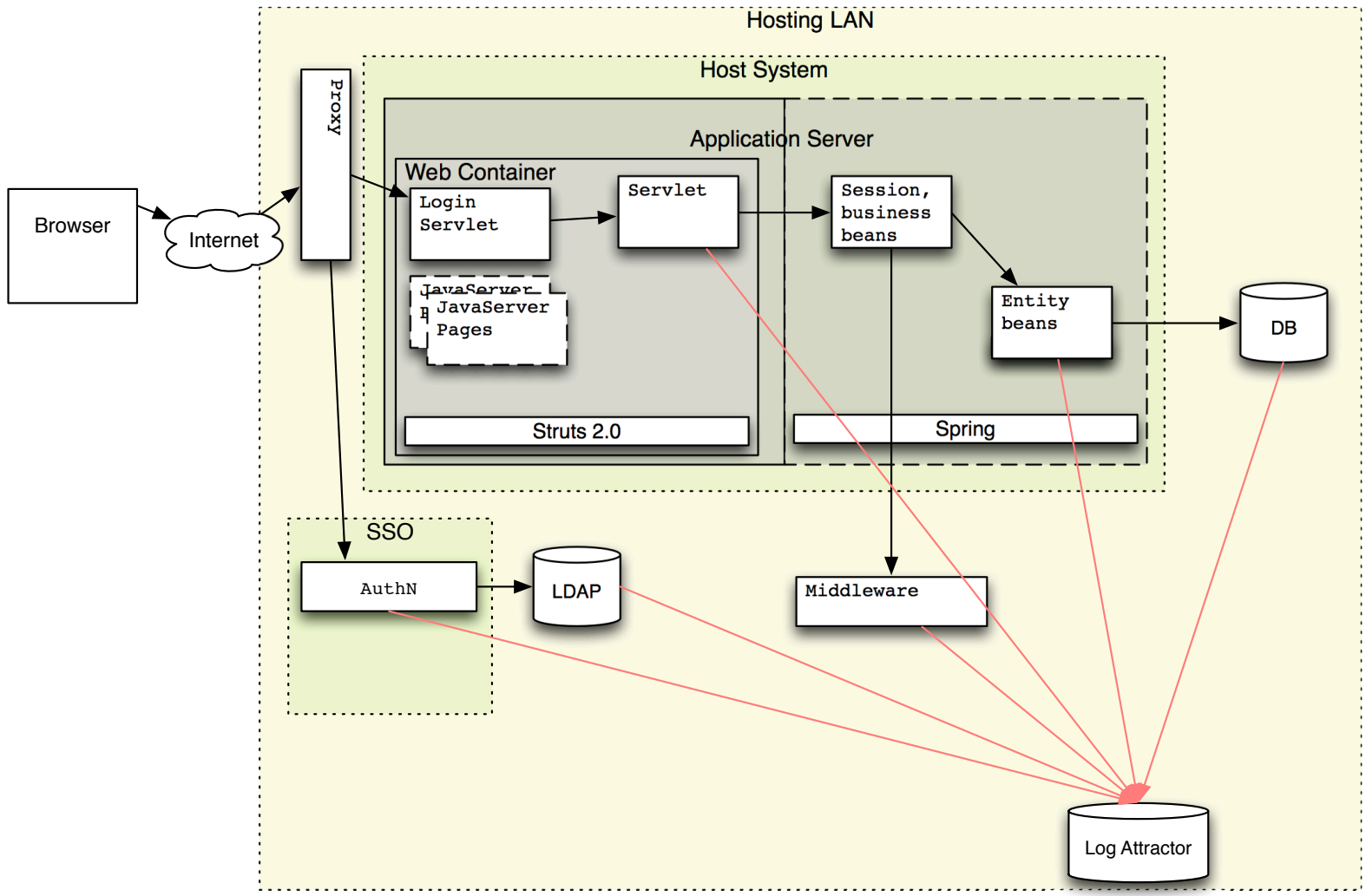
Information available to assert privilege decreases

…this, BTW, drove CC# as ID years ago.

Tokenization



Tracking Users



Solution: DMV?!

Centralize identity provision

- Force requests to carry ID
- Multiple verifiable elements

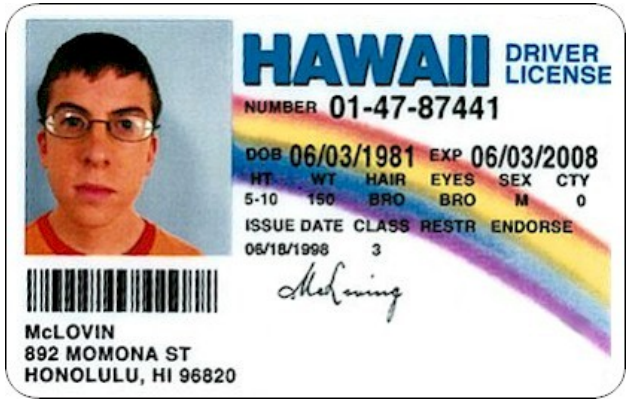
- Accepted everywhere w/in federation
- Accepted at foreign crossings as well

Verify

- Principal and ID match
- Principal is expected (e.g. guest list)

Quick verify

Costly creation/provision



May carry (optional) endorsements as necessary / appropriate

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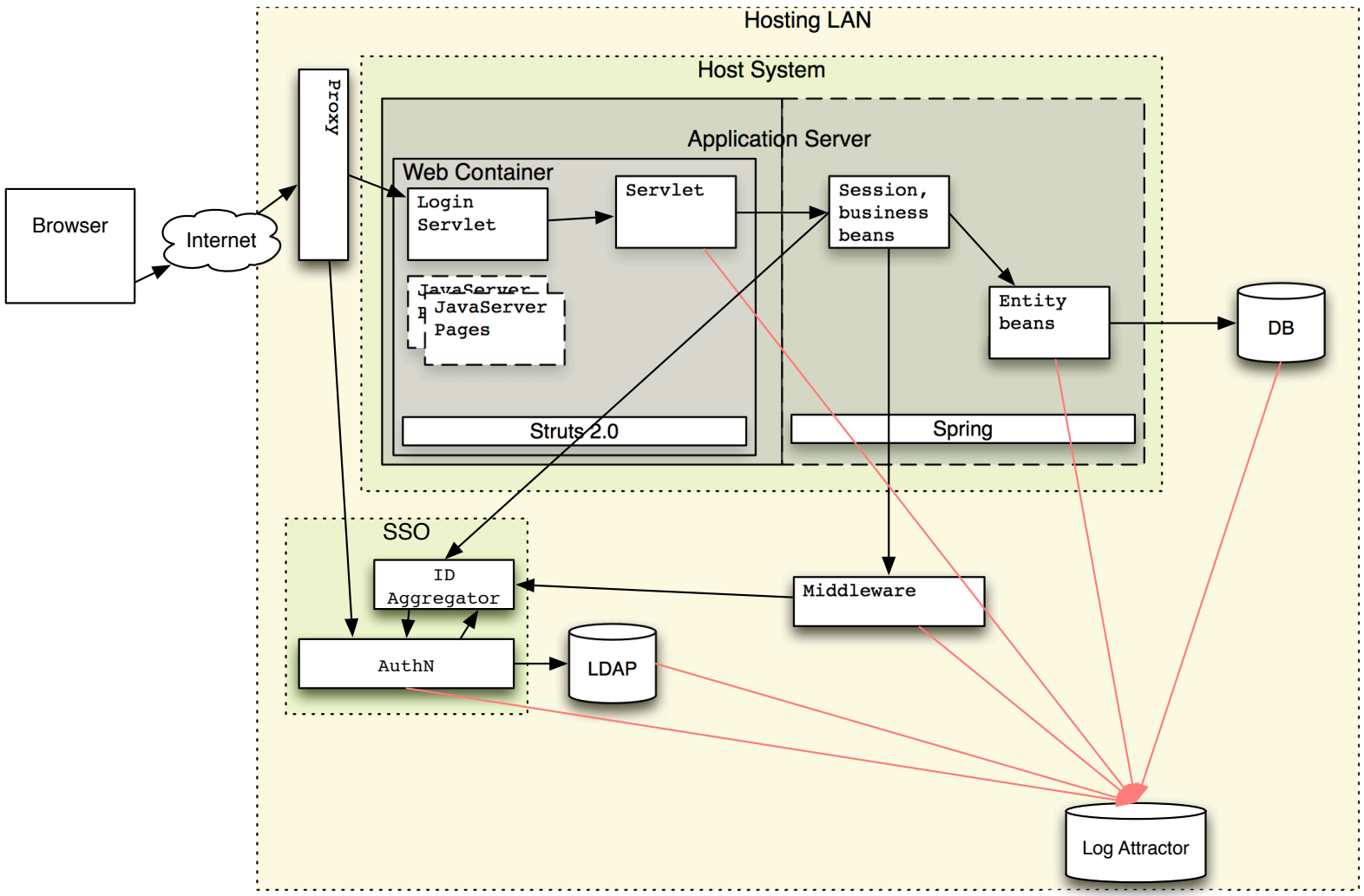
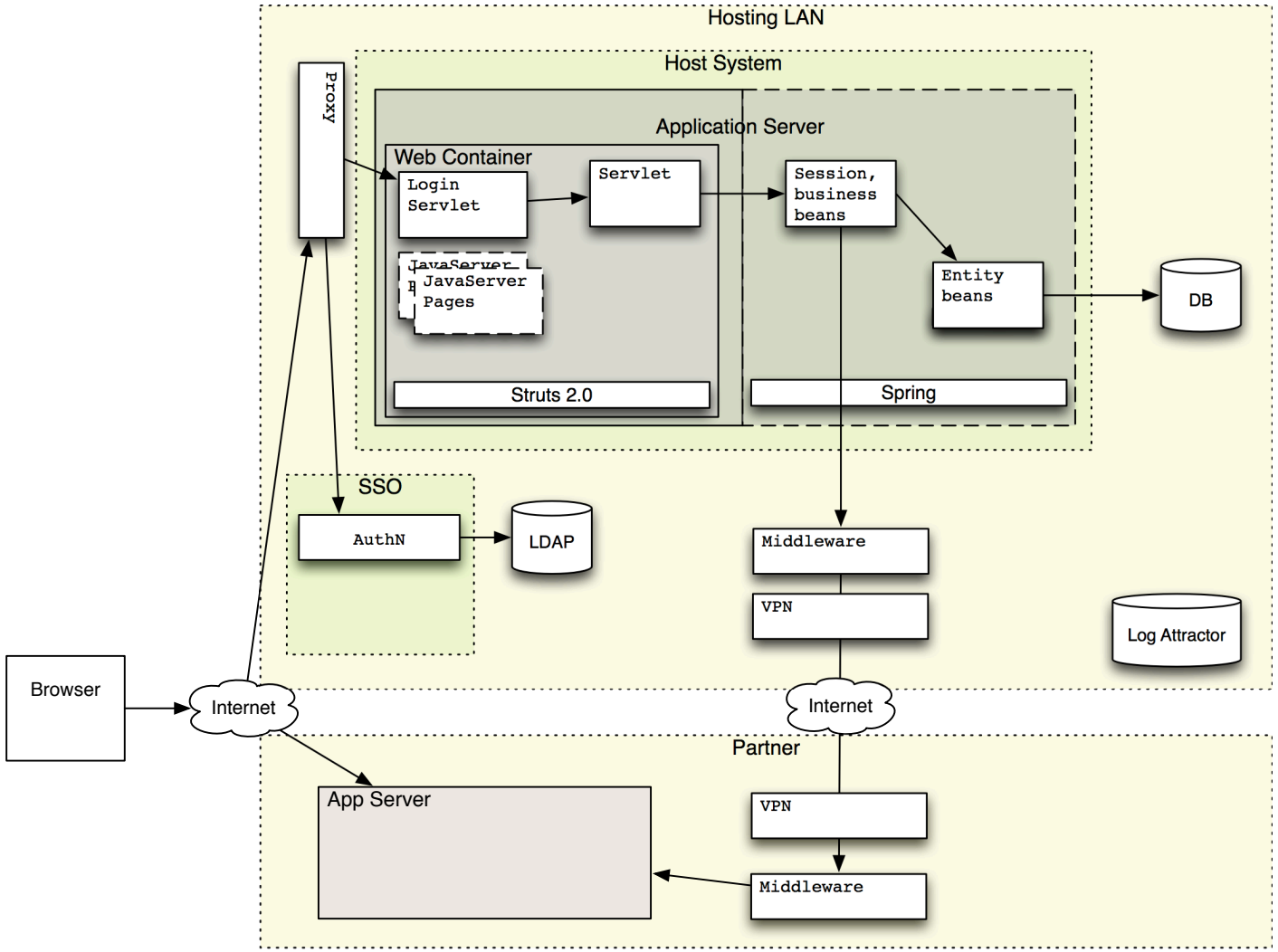
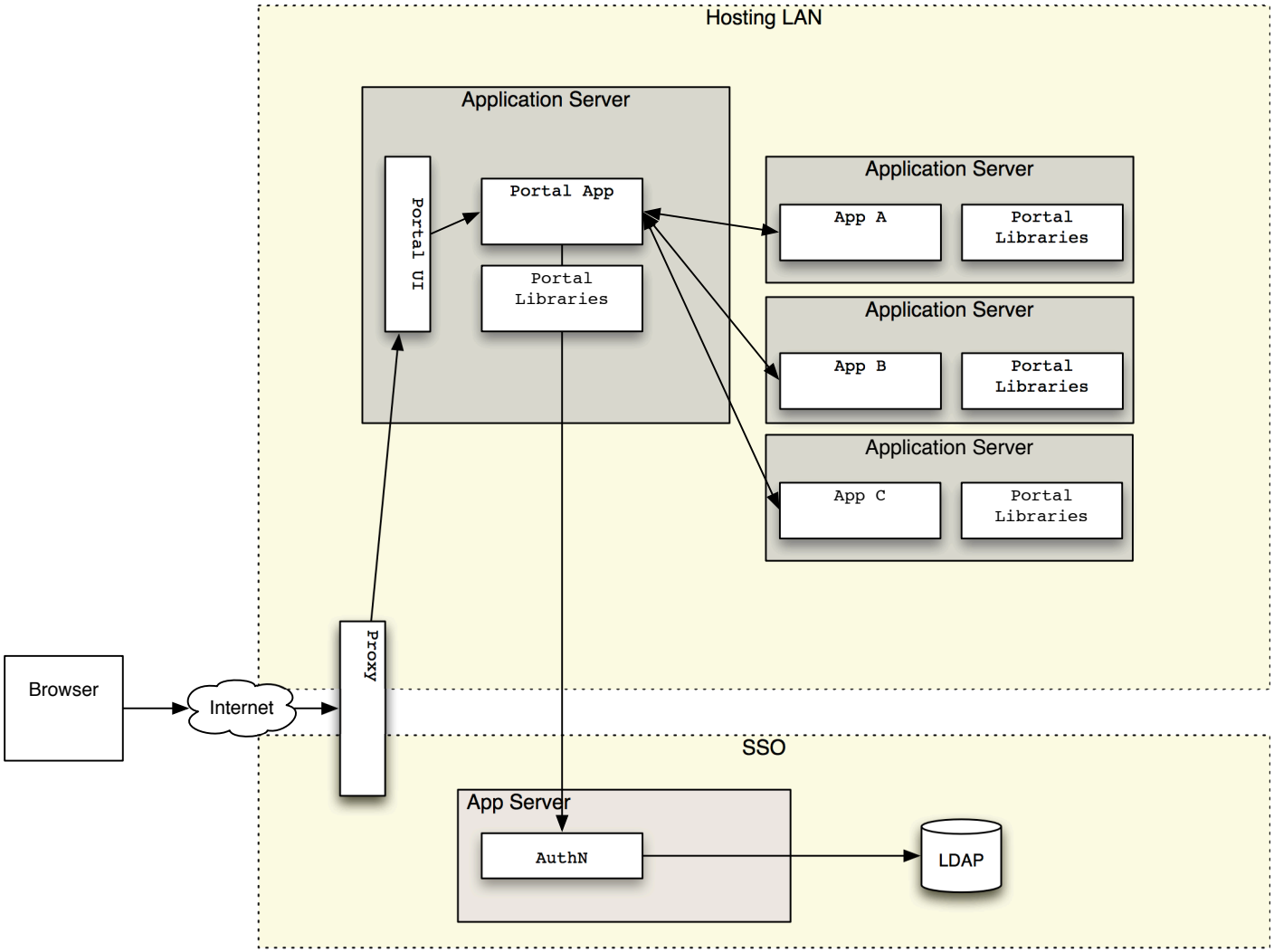


Identity extends beyond org. boundaries

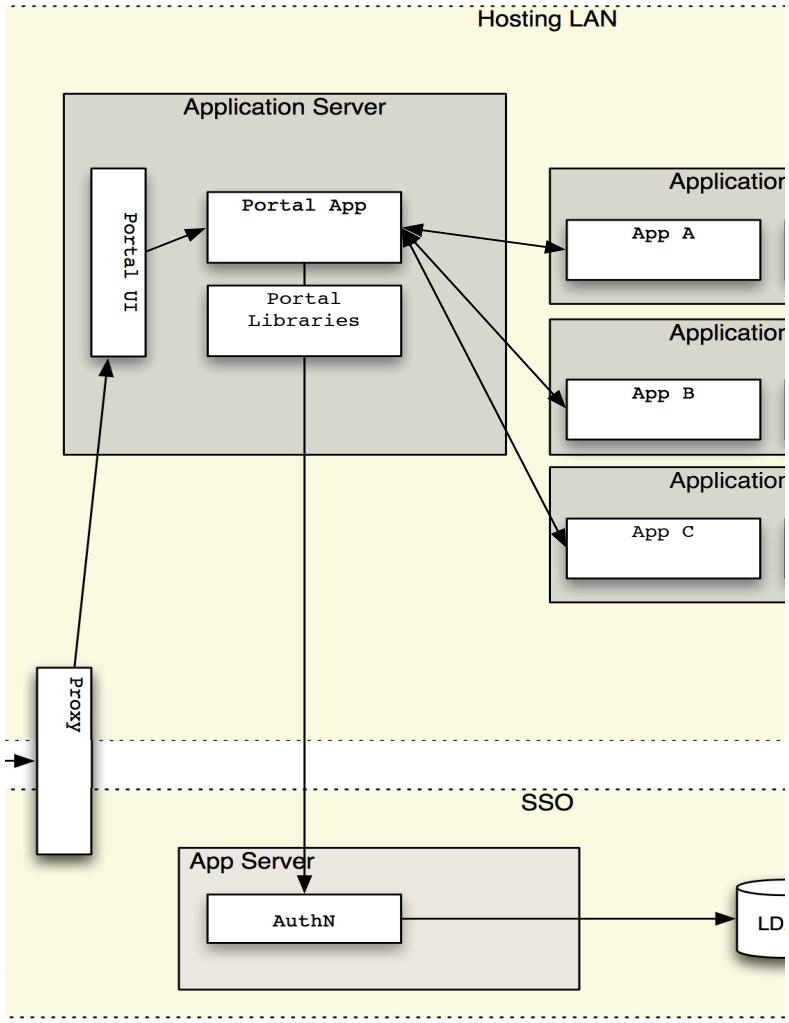


Scope & Termination

Context: Common Portals & Mash-up Sites



Context: Common Portals & Mash-up Sites



AuthN & Portal UI collaborate

- Conduct login workflow
- Associate session w/ UID

User navigates to App X

- Portal calls AuthN
  - Check session validity
- Checks UN valid for realm
- Hands control to App X

App X

- Checks UN valid for App

Consequences

- Decoupling Session Management Log-in/out means
  - Application doesn't know about:
    - Timeout
    - Logout (sometimes)
    - User Termination/Deletion events
  - App can't participate in work flows

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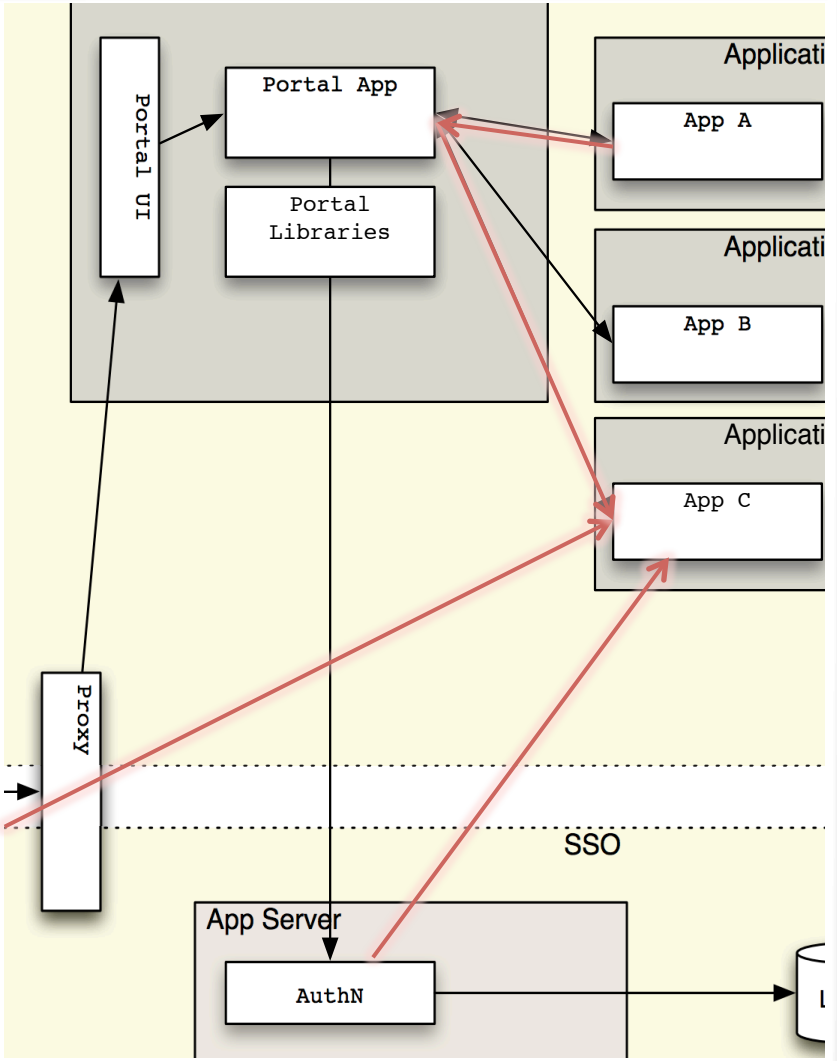
Visually…

AuthN can't talk to AppC

AppC must replicate behavior

- AuthN (Session)
- Portal (User maps, workflow)

Portal Can't talk to AppC w/o valid request



Generate Single Scope Handles

AuthN system generates:

- Application-specific sessions, in concert with
- Portal-specific identity

AuthN system formats specific sessions

- <session ID> ':' <app ID>

Unfortunately, existing products don't support this out of the box

Solution: Callbacks w/ UUID

AuthN system communicates with App

- (Pull) Application polls AuthN for session properties
- (Push) AuthN makes requests 'pushing' session events

The application can:

- (pull) Query AuthN for session tuple get back answer
  - Centralizes ACLs, PDP
- (push) AuthN annotates request
  - Annotation sufficient to make decisions
  - UUID → APP_SESSION_UUID
  - XACML, JSON, etc.

Coopt the User for Fraud Detection

Context

AuthN workflows have become complex

- Discern computer/human
- Implement Multi-"factor" authentication
- Apply 'risk-based' workflow based on client
  - *** Known clients get 'easier path'

Fraud systems interact with the login workflow

- Systems involve users in workflow
- Systems support notifications

Problem

Complexity breeds errors

- Workflow state machines often broken
- Confusing end-point registration systems proves easy
- Multi-factors are redundant

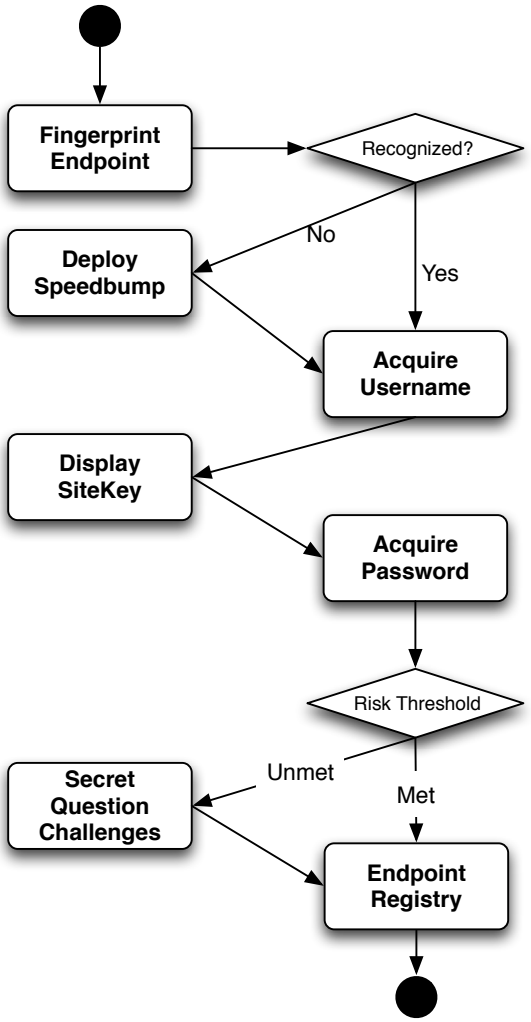
Attackers always pick "shortest path"

- Attack a registered end-point
- Spoof a common end-point (IOS)

Privilege / Trust are sticky

- How long is trust appropriate?
- Is there a way to revoke it?

Common Practice



Intended Purpose

- Identify client endpoint
- Prevent brute force attack
- Identify user
- Validate server (anti-phishing)
- Validate user
- Evaluate risk
- Validate user (further)
- Ease login process

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Solutions → Problems: Fingerprint

Fingerprint efficacy based on device

- IOS is low entropy (almost always matches)
- Firefox, Opera are so unique they give you away

Browser fingerprint is a biometric misnomer

- Something you have vs. something you are
- Control becomes liability w/ mobile device
  - Specially w/ Safari

Solutions → Problems: Speedbumps

Remove these for a mobile device?

- Keyboard & Autocorrect too annoying…

Remove for registered fingerprints?

- Server has seen this device, associates it w/ user…

Differentiate human vs. script

- Control becomes liability w/ mobile device theft
- Many schemes vulnerable to mining attacks

SiteKey: designed to assure user speaking to server directly

- Again: mining attacks

Solutions → Problems: Secret Questions

Another multi-factor conflation

- Duplicate "something you know"

Conflates

- Additional assertions about the user vs. endpoint

Key Scheme Improvements

Improve Fingerprinting

- Focus around only device, not user
  - This can't replace computer/human detection or theft
- Use access patterns
  - Telemetry, location (change is as useful as value)
  - Time, speed, etc.

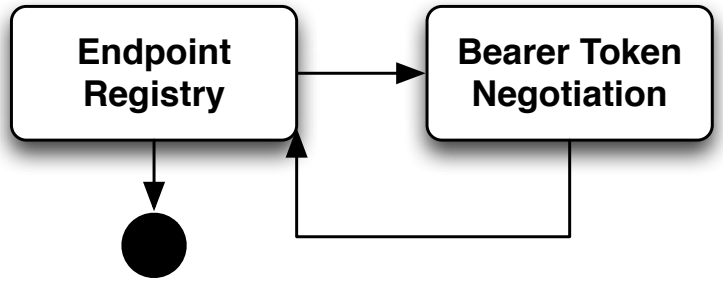
Trust once…

Many systems are add only

- No audit list
- No removal

This is bad for fingerprints

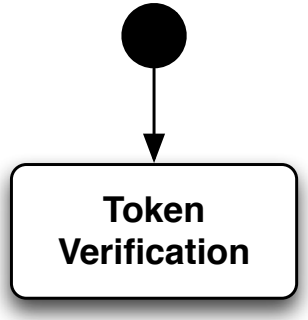
This is fatal for bearer tokens



"Trust" should not be binary

…and not for multiple purposes

- Fingerprinted mobile device != OOB Channel



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Key Scheme Improvements (2) - Involve User

Provide the user the ability to label endpoint

Provide a list of end-points, enable user disposition

- Do not think of as a sliding bar (black, grey, white)
- Actions may include:
  - Do not allow
  - Notify
  - Request addl. verification
  - Reduce access
  - Omit some verifications

Provide OOB notification, include:

- Fingerprint data
- Time
- Actions taken

Binary vs. Rings of Trust
The "Jelly Donut Architecture"

Castles, like me, are misunderstood

http://www.flickr.com/photos/sugarmonster/

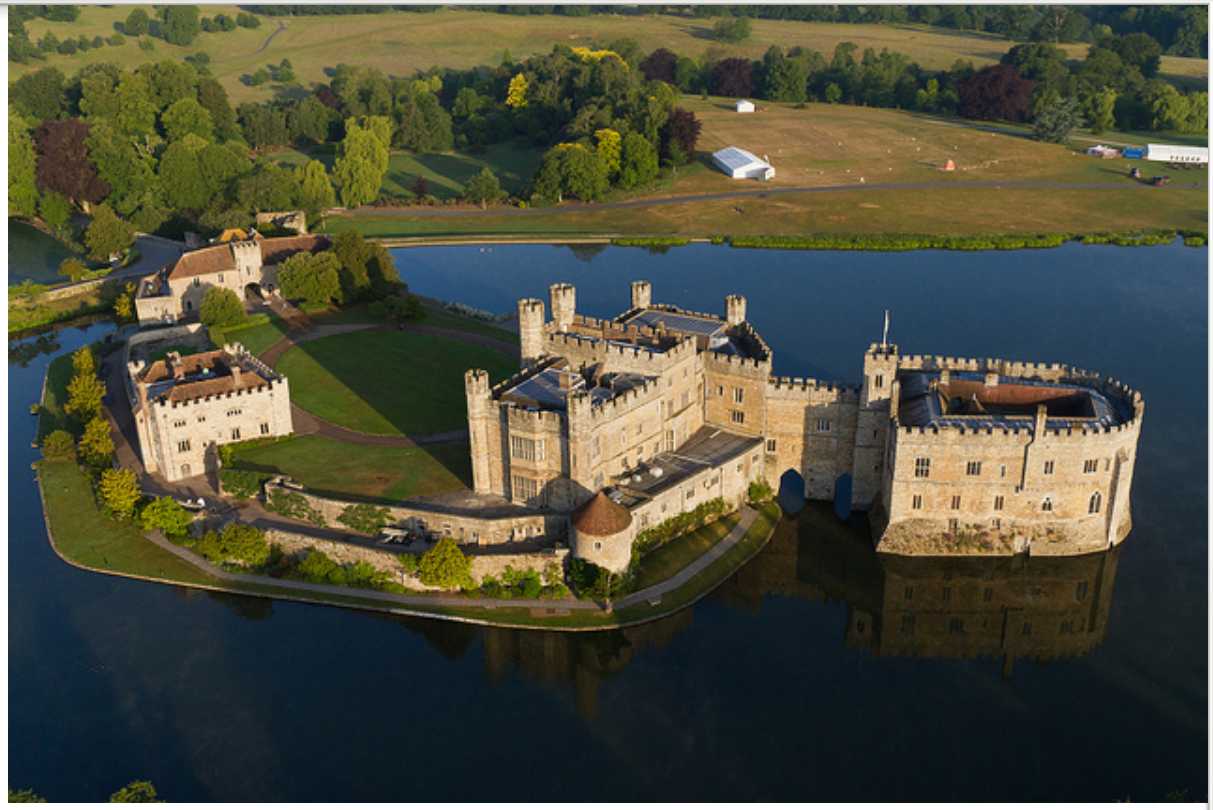
Barbican

Town

Bailey

Building

Keep



Consider a small bank's "castle"

Consider as alternative: Amazon.com

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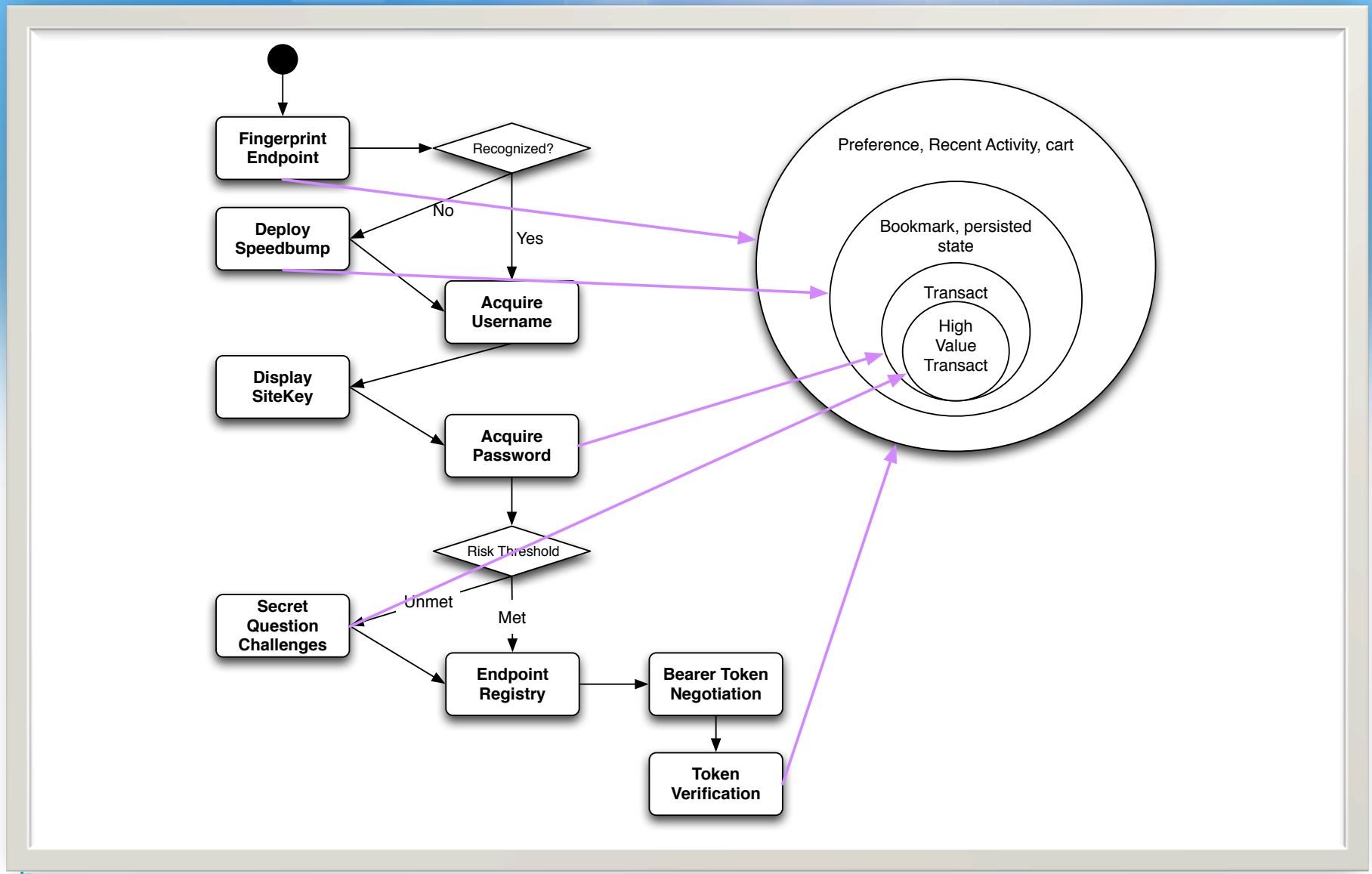
Castles, Entitlements, and so forth



Thank you for your attention