A little REST and Relaxation

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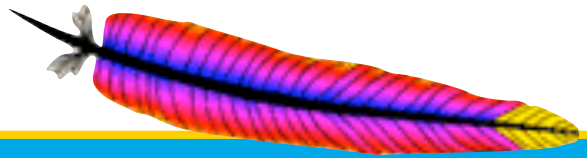
V.P., Apache HTTP Server

http://roy.gbiv.com/talks/200711_REST_ApacheCon.pdf

ApacheCon



Representational State Transfer

REST retrospective

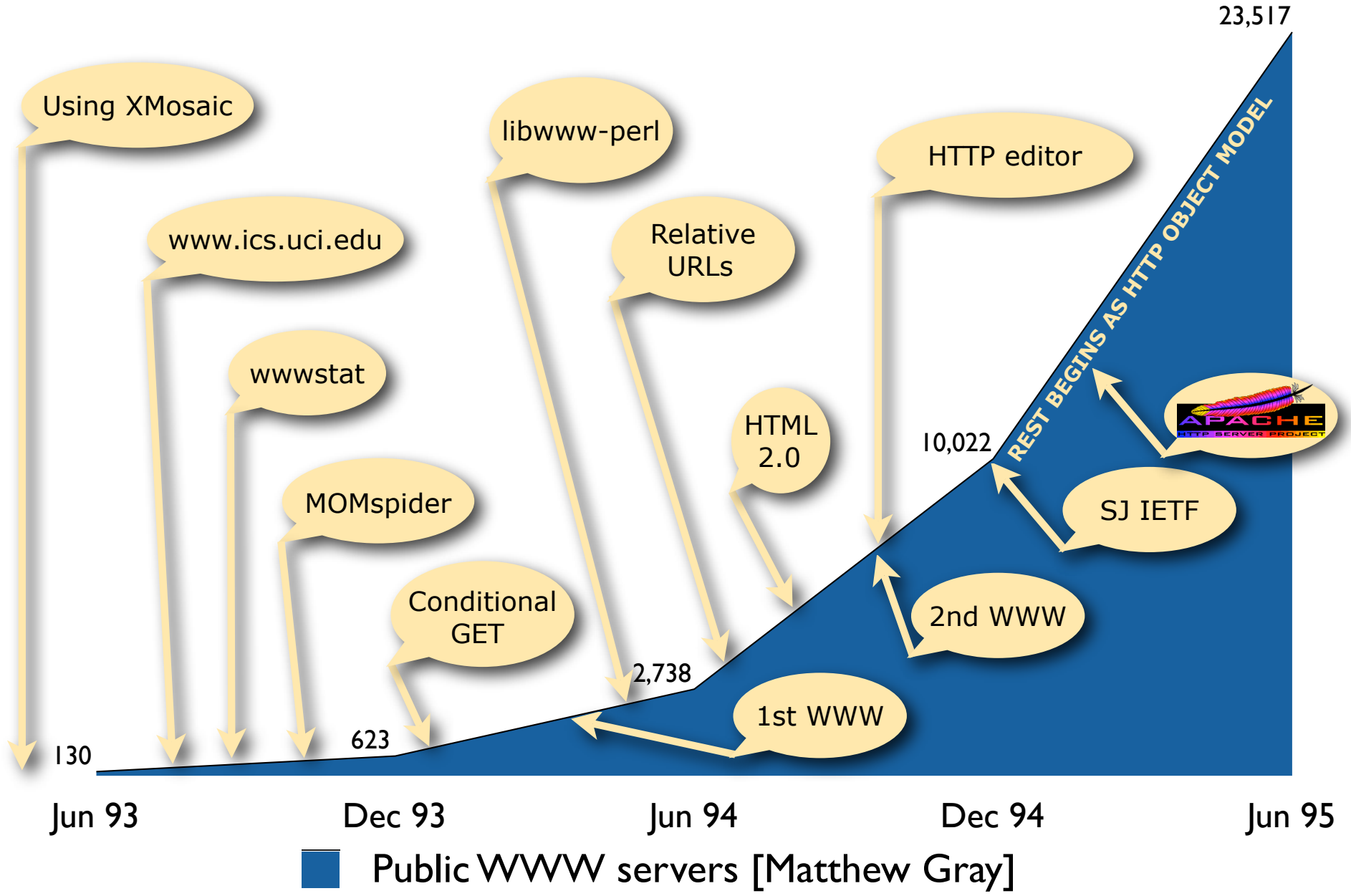
What is REST?

Why REST?

REST at Day

Q & A

Why me?


Oct 07 = 142,805,398 (6,072x)
23,517
Using XMosaic
www.ics.uci.edu
wwwstat
MOMspider
Conditional GET
libwww-perl
Relative URLs
HTML 2.0
HTTP editor
REST BEGINS AS HTTP OBJECT MODEL
APACHE HTTP SERVER PROJECT
SJ IETF
2nd WWW
1st WWW
10,022
2,738
623
130
Jun 93
Dec 93
Jun 94
Dec 94
Jun 95
Public WWW servers [Matthew Gray]

The Web Problem (circa 1994)

Early architecture based on solid principles

- URLs, separation of concerns, simplicity
  - lacked architectural description and rationale

Protocols assumed a direct server connection

- no awareness of caching, proxies, or spiders
- many independent extensions

Emerging awareness of the Web

- exponential growth threatened the Internet
  - commercialization meant new stakeholders with new (selfish) requirements

A modern Web architecture was needed

- but how do we avoid breaking the Web in the process?

Software Architecture

A software architecture is an **abstraction** of the run-time elements of a software system during some phase of its operation.

- A system may be composed of many levels of abstraction and many phases of operation, each with its own software architecture.
- A software architecture is defined by a configuration of architectural elements—components, connectors, and data—constrained in their relationships in order to achieve a desired set of architectural properties.
  - A configuration is the structure of architectural relationships among components, connectors, and data during a period of system run-time.

Architectural Styles

An architectural style is a **coordinated set of architectural constraints** that restricts the roles and features of architectural elements, and the allowed relationships among those elements, within any architecture that conforms to that style.

- A style can be applied to many architectures.
- An architecture can consist of many styles.

Styles of Architectural Design

Design at the right level of abstraction

- Styles help architects communicate architecture
- Architecture determines potential system properties
- Implementation determines actual system properties

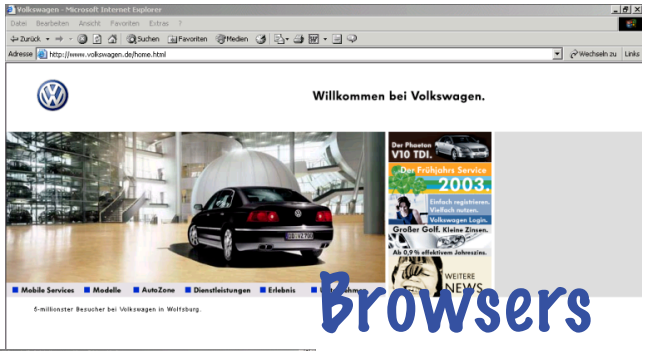
Sometimes known by other names

- Architectural patterns are styles with common recipes

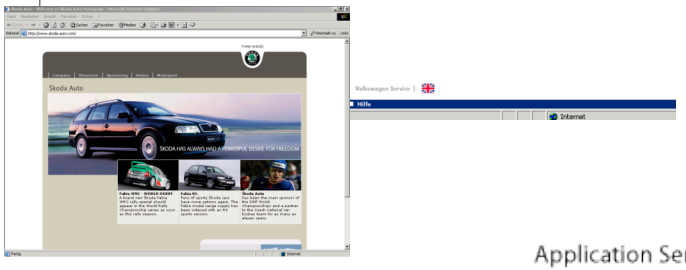
Just because it's called architecture ...

Where CIOs become CUSTOMERS

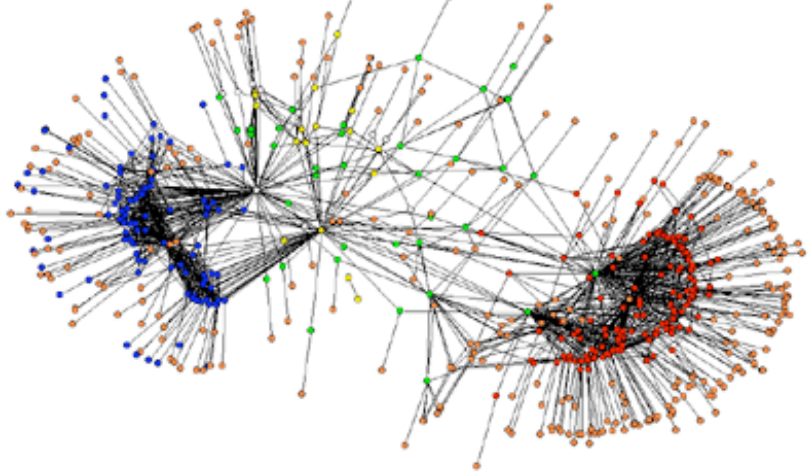
What is the Web, really?

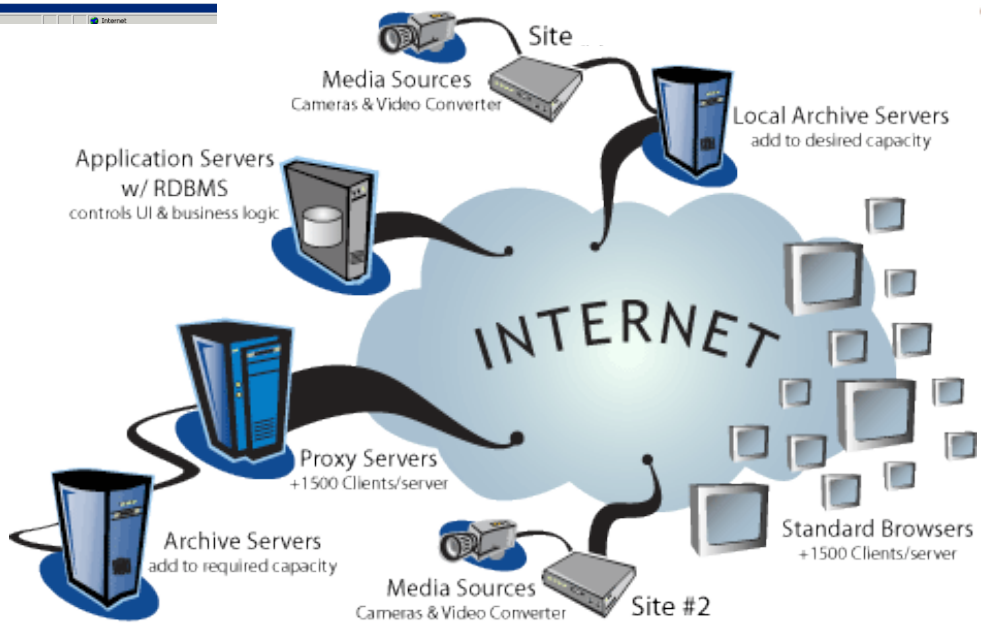


Browsers



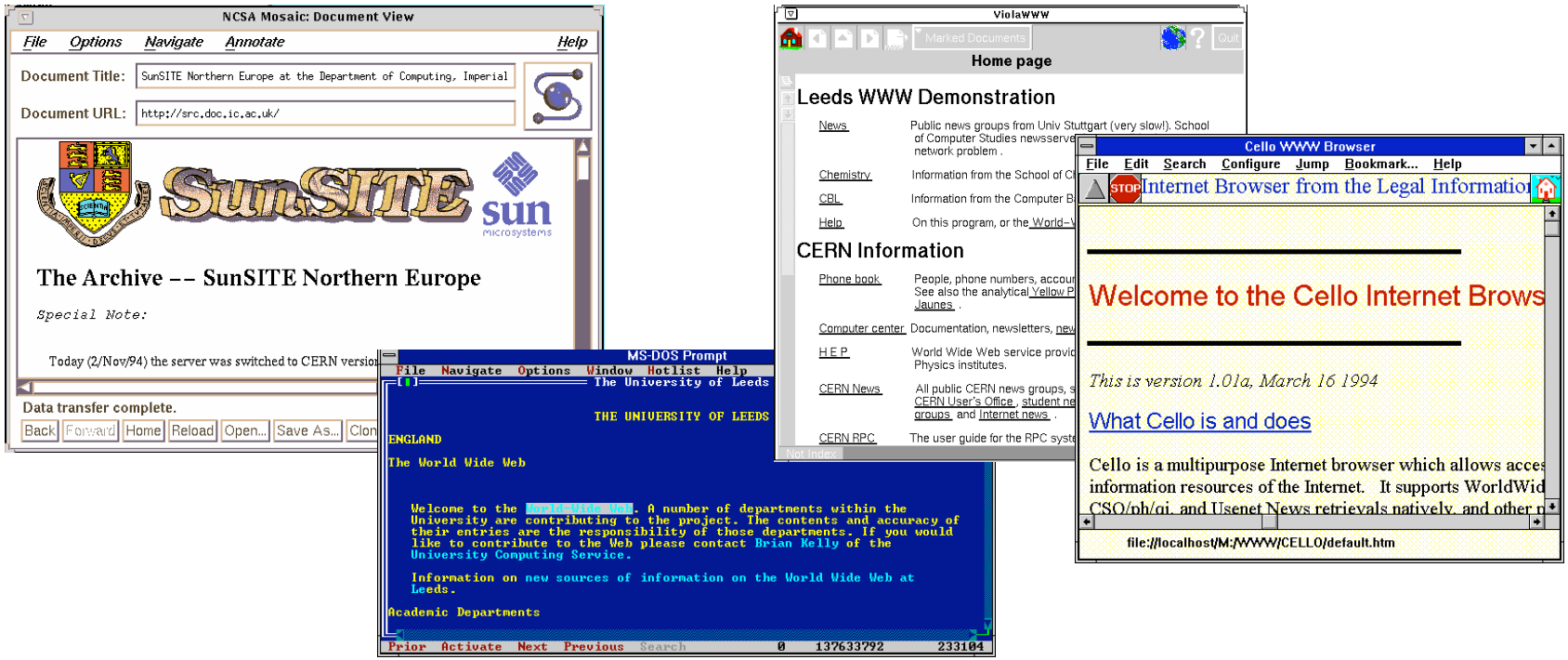
Information





Protocols

Web Implementation



Web Architecture

One abstraction above the implementation

Components

- User agents, Intermediaries, Servers
- Browsers, Spiders, Proxies, Gateways, Origin Servers

Connectors

- HTTP: a standard transfer protocol to prefer over many

Data

- URI: one identifier standard for all resources
- HTML, XML, RDF, ...: common representation formats to describe and bind resources

Web Architectural Style

One abstraction level above Architecture

- two abstraction levels above implementation
- that's one too many for most folks

An architectural style is a set of constraints

- unfortunately, constraints are hard to visualize
  - kind of like gravity or electromagnetism
  - observed only by their effect on others

Constraints induce architectural properties

- both desirable and undesirable properties
  - a.k.a., software qualities
  - a.k.a., design trade-offs

Web Requirements

Low entry barrier

- Hypermedia User Interface
- Simple protocols for authoring and data transfer

▸ a.k.a., must be **Simple**, **Reusable**, and **Extensible**

Distributed Hypermedia System

- Large data transfers
- Sensitive to user-perceived latency

▸ a.k.a., must be **Data-driven**, **Streamable**, and **Cacheable**

Multiple organizational boundaries

- Anarchic scalability
- Gradual and fragmented change (deployment)

▸ a.k.a, must be **Scalable**, **Evolvable**, **Visible**, **Reliable**, ...

Agenda

REST retrospective

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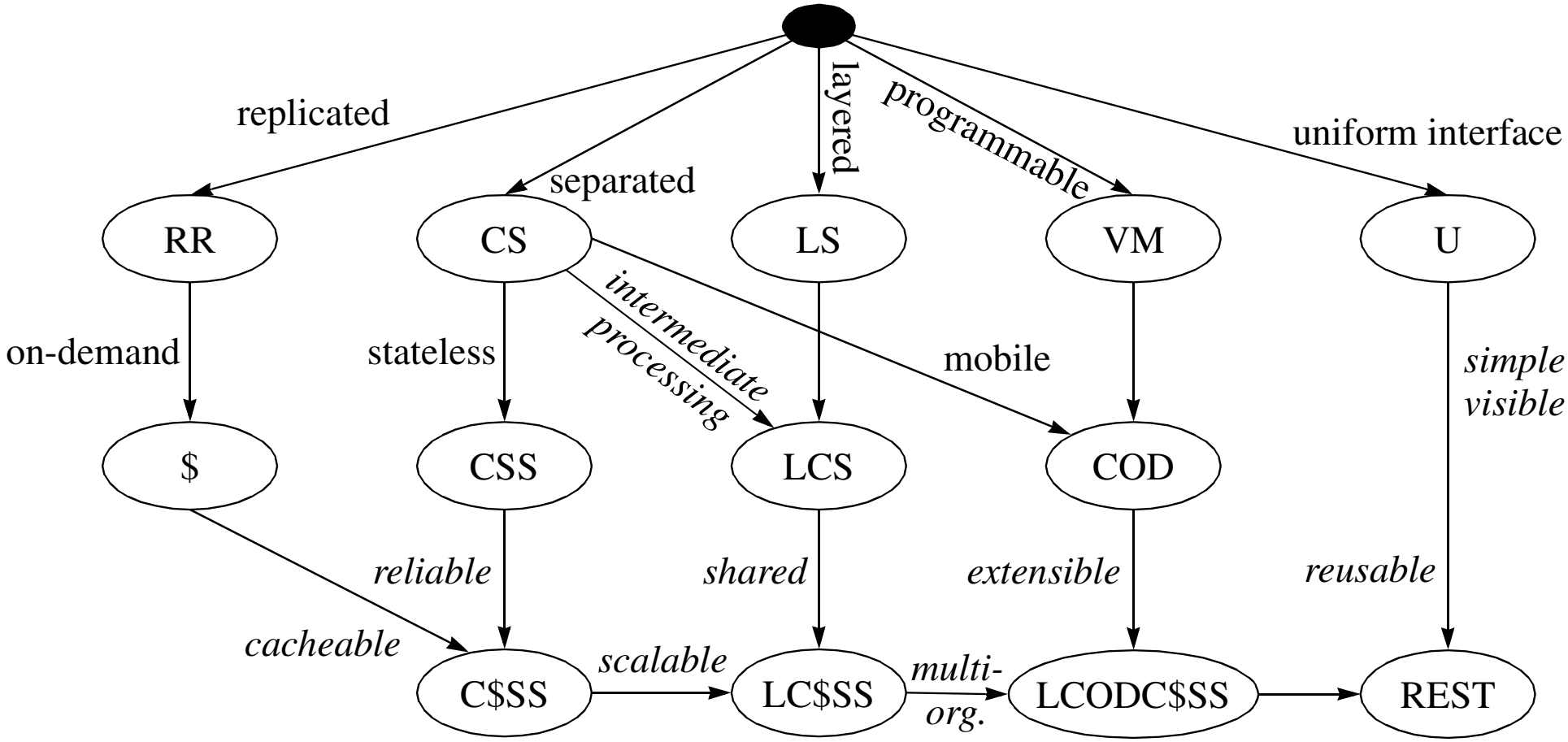
REST on a slide

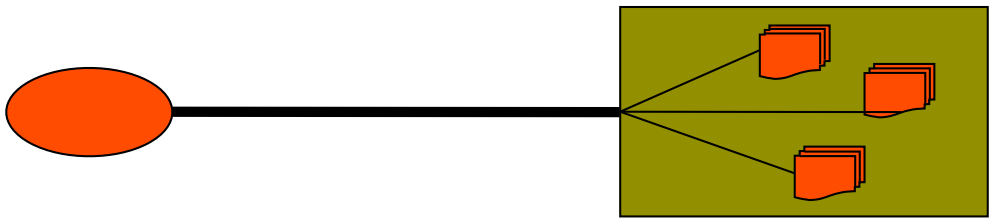


Style = nil

Starting from a condition of no constraints...

Style += Client/Server

Apply separation of concerns: Client-Server



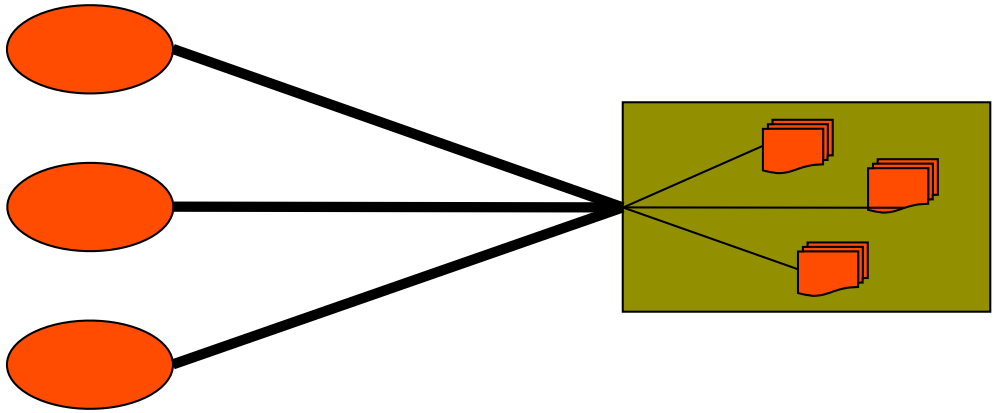
improves UI portability

simplifies server

enables multiple organizational domains

Style += Stateless

Constrain interaction to be stateless...



simplifies server

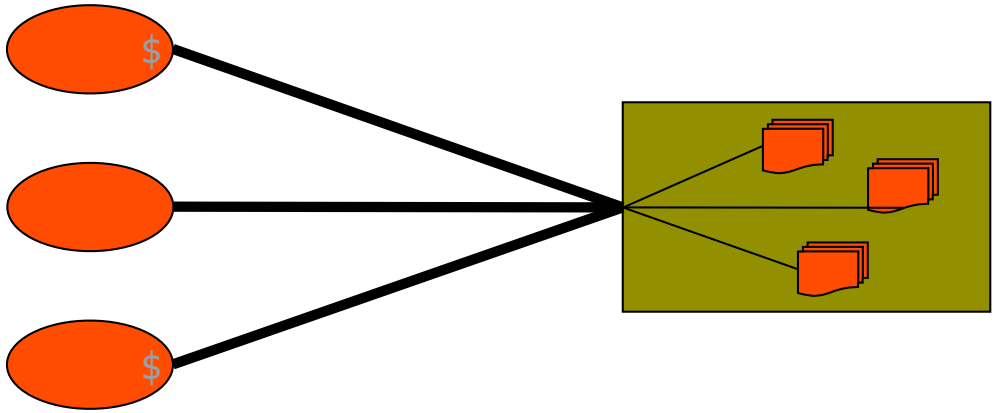
degrades efficiency

improves scalability

improves reliability

Style += Caching

Add optional non-shared caching



reduces average latency

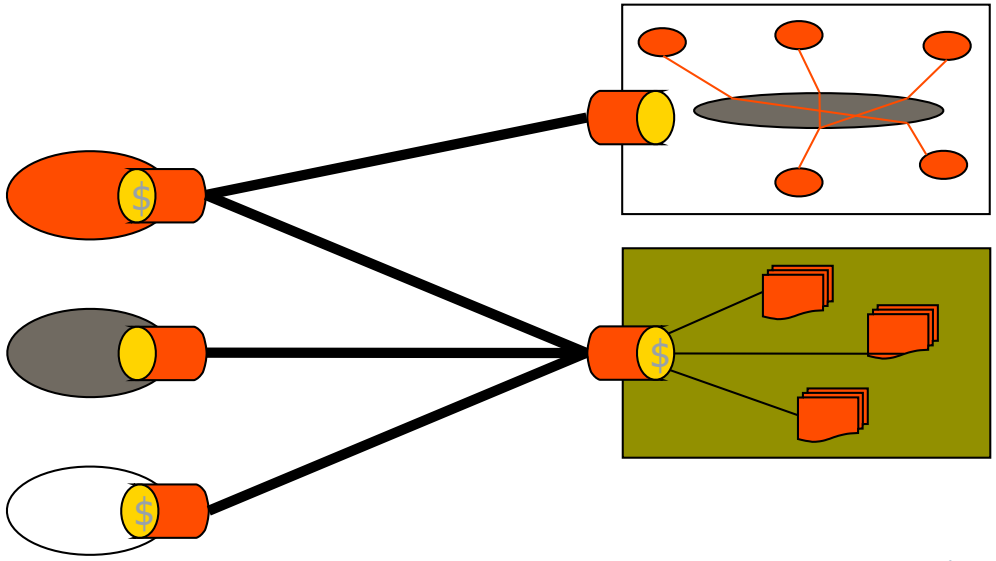
degrades reliability

improves efficiency

improves scalability

Style += Uniform Interface

Apply generality: uniform interface constraint



improves visibility

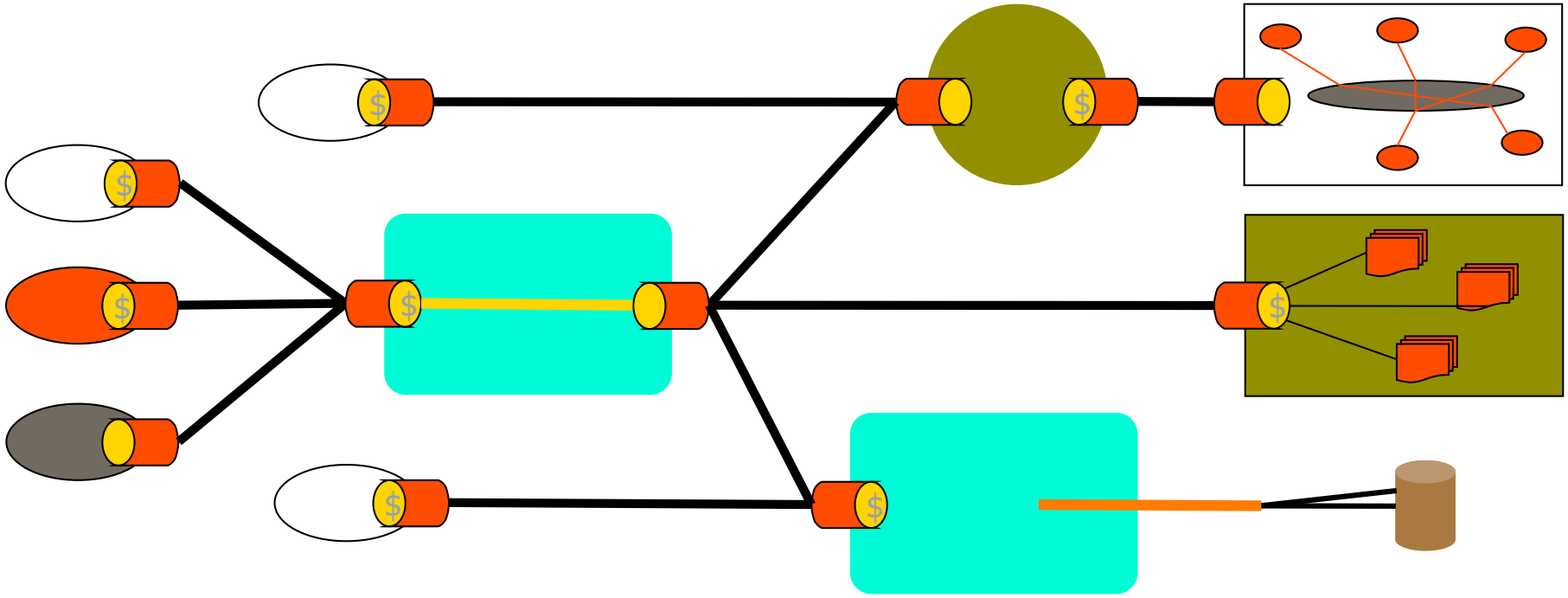
degrades efficiency

independent evolvability

decouples implementation

Style += Layered System

Apply info hiding: layered system constraints



adds latency

shared caching

legacy encapsulation

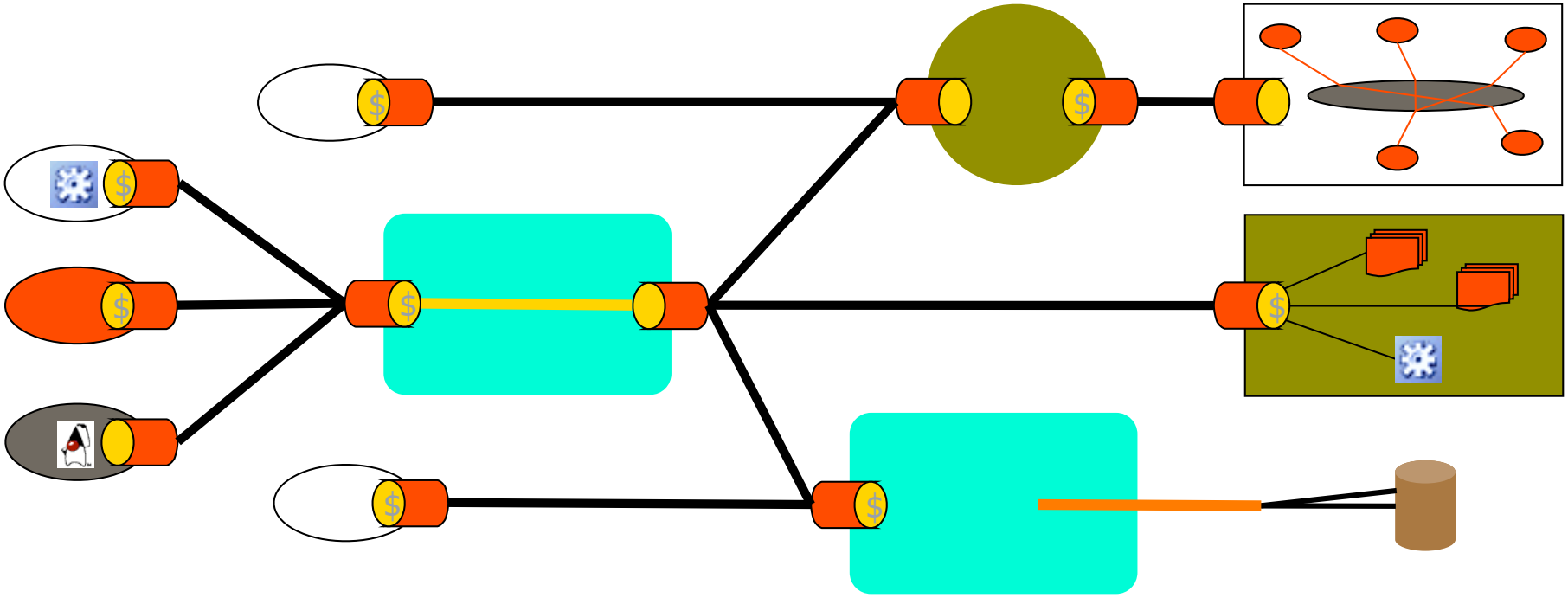
simplifies clients

improves scalability

load balancing

REST Style

Finally, allow code-on-demand (applets/js)



simplifies clients

improves extensibility

reduces visibility

REST Uniform Interface

All important resources are identified by one (uniform) resource identifier mechanism

- simple, visible, reusable, stateless communication

Access methods (actions) mean the same for all resources (universal semantics)

- layered system, cacheable, and shared caches

Resources are manipulated through the exchange of representations

- simple, visible, reusable, cacheable, and stateless communication

Exchanged as self-descriptive messages

- layered system, cacheable, and shared caches

REST Uniform Interface

Hypertext as the engine of application state

- A successful response indicates (or contains) a current **representation** of the state of the identified resource; the **resource remains hidden** behind the interface.
- Some **representations contain links** to potential next application states, including direction on how to transition to those states when a transition is selected.
- Each steady-state (Web page) embodies the current **application state**
  - simple, visible, scalable, reliable, reusable, and cacheable
- All application state (not resource state) is kept on client
- All shared state (not session state) is kept on origin server

Hypertext Clarification

Hypertext has many (old) definitions

- "By 'hypertext,' I mean non-sequential writing — text that branches and allows choices to the reader, best read at an interactive screen. As popularly conceived, this is a series of text chunks connected by links which offer the reader different pathways" [Theodor H. Nelson]
- “Hypertext is a computer-supported medium for information in which many interlinked documents are displayed with their links on a high-resolution computer screen.” [Jeffrey Conklin]

When I say Hypertext, I mean ...

- The simultaneous presentation of information and controls such that the information becomes the affordance through which the user obtains choices and selects actions.
- Hypertext does not need to be HTML on a browser
  - machines can follow links when they understand the data format and relationship types

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Hypertext = non-linear documents

Hypertext = selectable GUI controls

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- The simultaneous presentation of information and controls such that the information becomes the affordance through which the user obtains choices and selects actions.
- Hypertext does not need to be HTML on a browser
  - machines can follow links when they understand the data format and relationship types

Hypertext = data-guided controls

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Benefits of REST-based Architecture

Maximizes reuse

- uniform resources having identifiers = Bigger WWW
- visibility results in serendipity

Minimizes coupling to enable evolution

- uniform interface hides all implementation details
- hypertext allows late-binding of application control-flow
- gradual and fragmented change across organizations

Eliminates partial failure conditions

- server failure does not befuddle client state
- shared state is recoverable as a resource

Scales without bound

- services can be layered, clustered, and cached

Benefits of REST-based Architecture

Simplifies

- hypertext is standardized (fewer UIs)

Simplifies

- identification is standardized (less communication)

Simplifies

- exchange protocols are standardized (fewer integrations)

Simplifies

- interactions are standardized (fewer semantics)

Simplifies

- data formats are standardized (fewer translations)

What if: Non-Uniform Interface

If the interface would be resource-specific...

- URI is no longer sufficient for resource identification
  - lose benefit of URI exchange (assumed GET)
  - require resource description language
- Information becomes segregated by resource type
  - walled into gardens (loss of power laws / pagerank)
  - important information must be replicated
- Intermediaries cannot encapsulate services
  - unable to anticipate resource behavior
  - too complex to cache based on method semantics
- No more serendipity
  - mashups must be defined per interface
  - services become tightly coupled

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But would anyone seriously suggest such an obviously dumb idea?

Industry Practice

Meanwhile, in a parallel universe ...

- http://www.youtube.com/watch?v=-RxhkWLJH4Y
  - Microsoft was selling COM+/DCOM
  - IBM and friends were selling CORBA
  - Sun was selling RMI
  - W3C was developing XML
- Then SOAP was dropped on the shower floor as an Internet Draft
  - and quickly laughed out of the IETF
  - only to be picked up by IBM and renamed "Web Services"
- and REST became the only counter-argument to multi-billions in advertising

Industry Reaction?

Not very constructive

- proponents labeled as RESTafarians
- arguments derided as a “religion”
- excused as “too simple for real services”

Service-Oriented Architecture (SOA)

- a direct response to REST
- attempt at an architectural style for WS
  - without any constraints
- What is SOA?
  - Wardrobe, Musical Notes, or Legos?
  - http://www.youtube.com/profile_videos?user=richneckyogi

Industry Acceptance

Something has changed ...

- People started to talk about the value of URIs (reusable resources)
- Google maps decided to encourage reuse (Mashups)
- O'Reilly began talking about Web 2.0
- Rails reminded people that frameworks can be simple

and REST(ful) became an industry buzzword

Yikes!

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Vision

1 Everything is Content

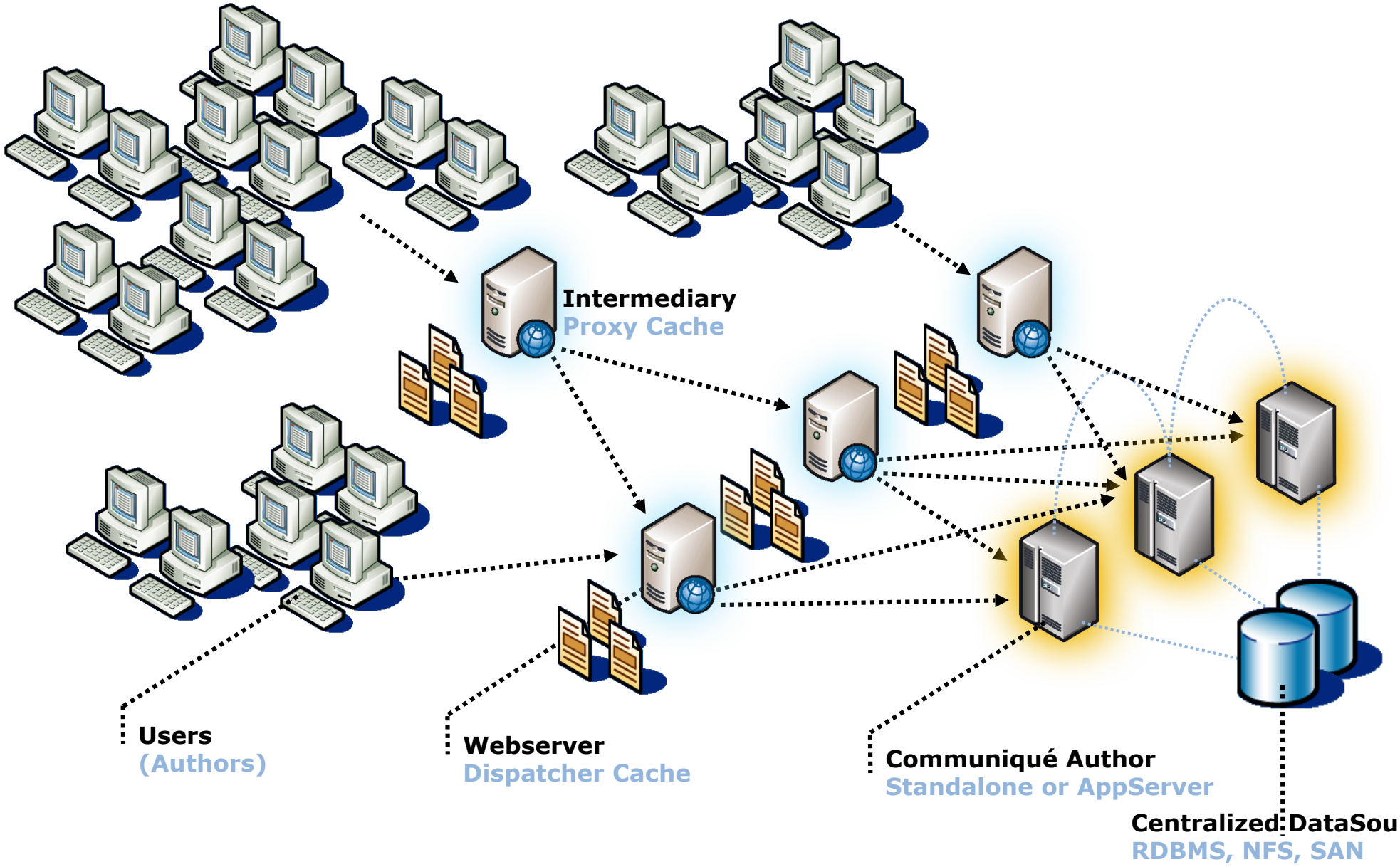
Vision

REST

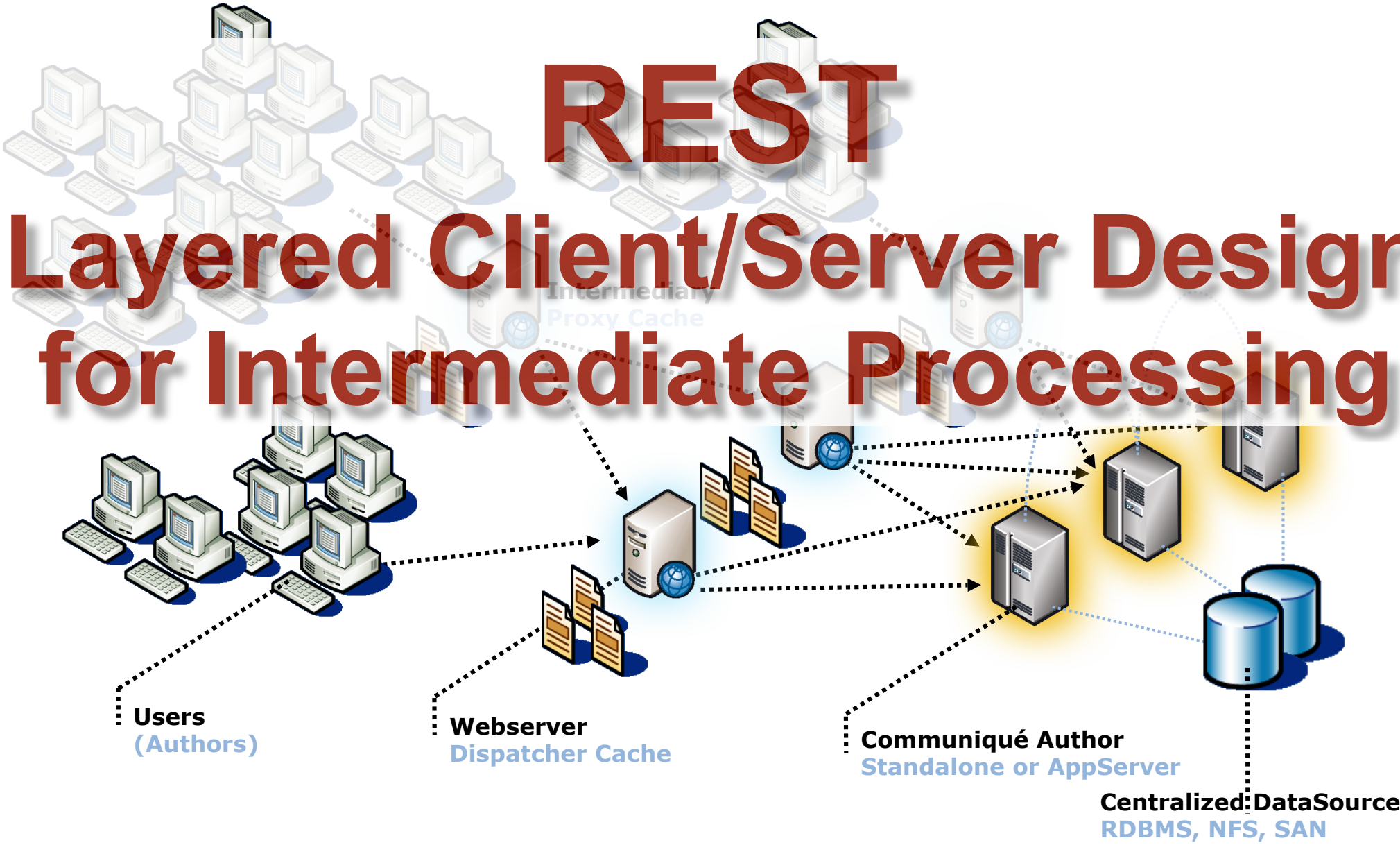
All important resources have uniform identifiers

1. Everything is Content

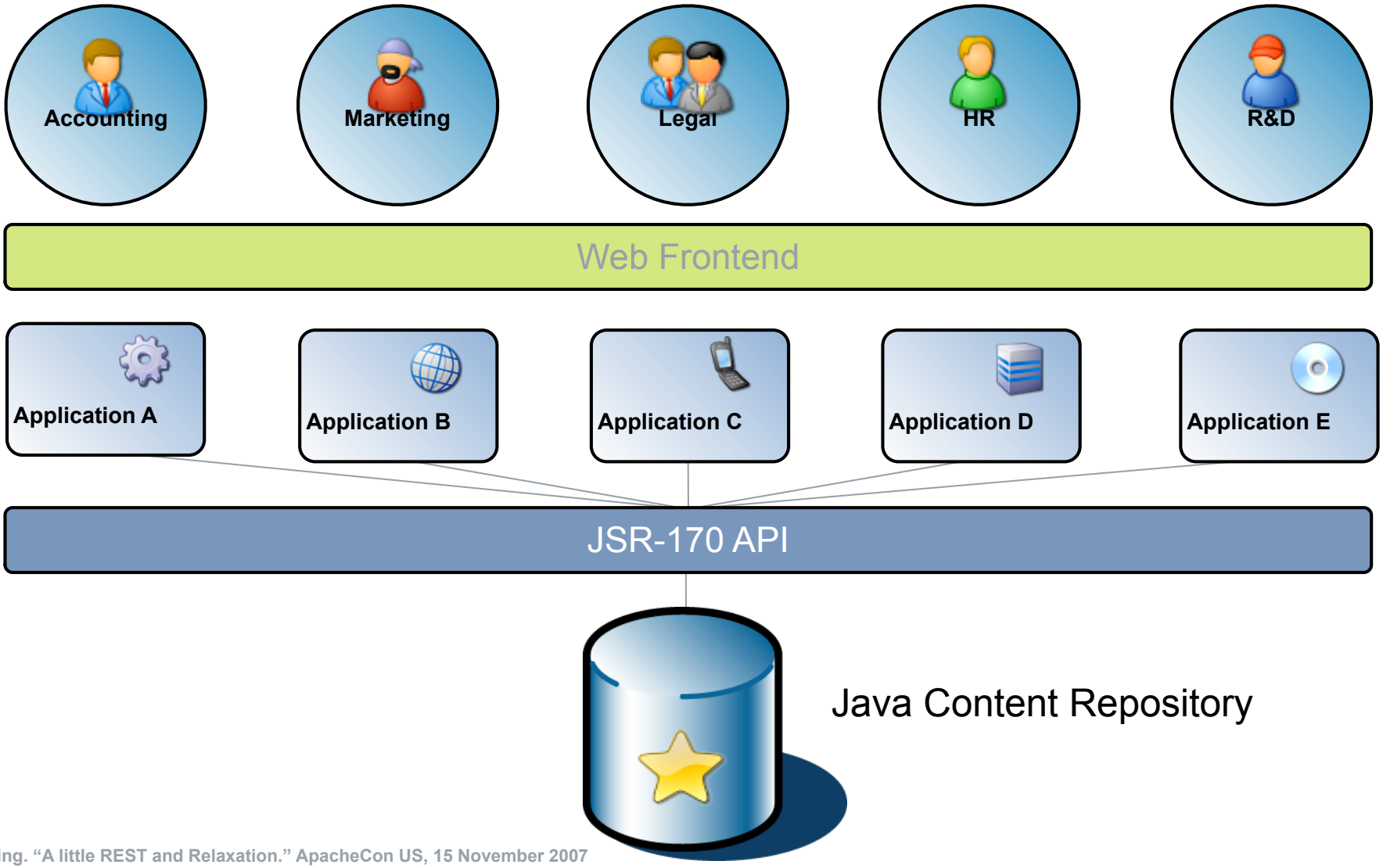
Intermediary and Cache Friendly



Intermediary and Cache Friendly



Standards


Accounting
Marketing
Legal
HR
R&D
Web Frontend
Application A
Application B
Application C
Application D
Application E
JSR-170 API
Java Content Repository

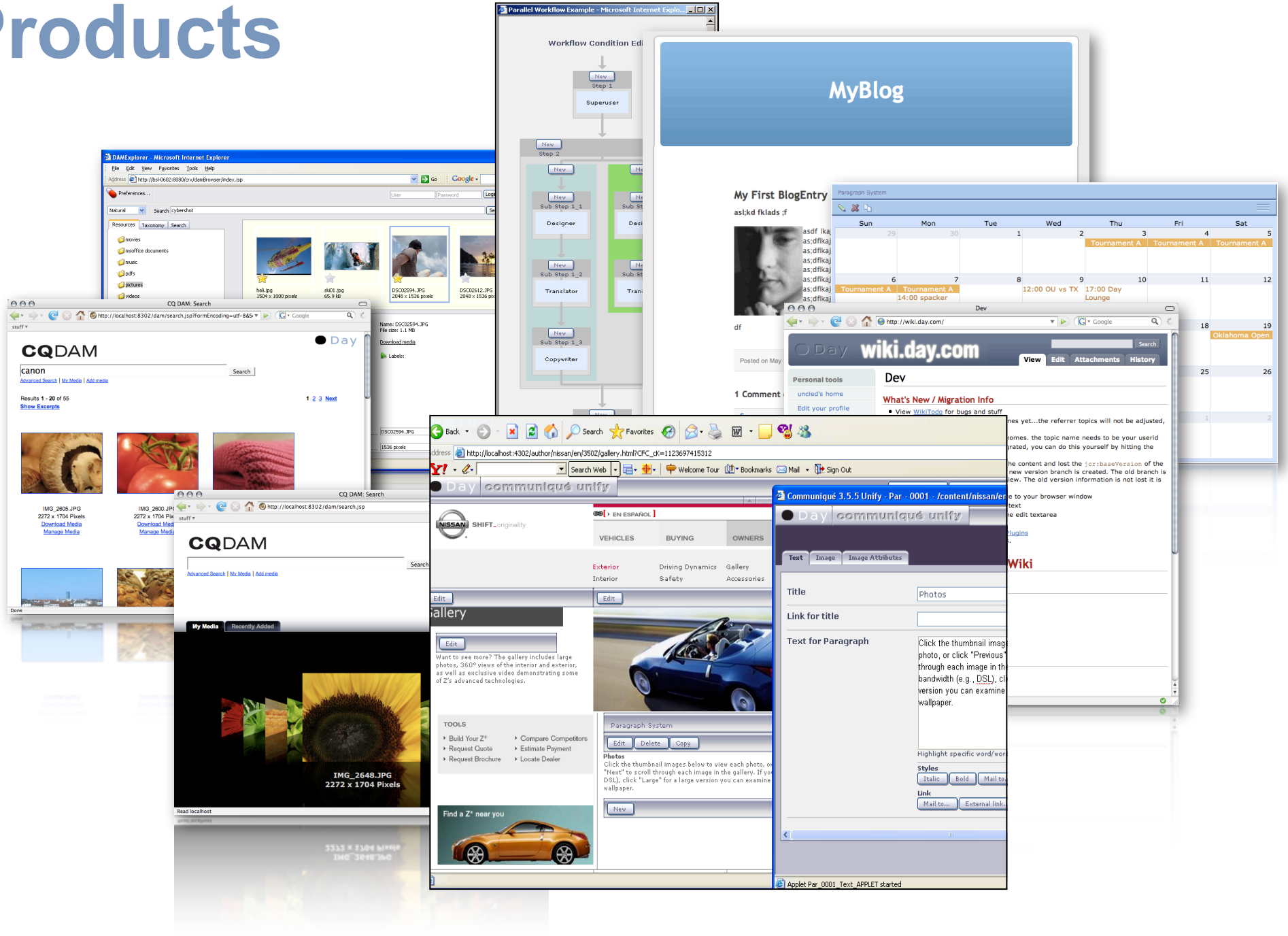
Standards

REST

All resources

have uniform interface

Products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Products

REST

Hypertext is the Engine of Application State

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