Reference Architecture

"A Reference Architecture
for Web Servers"
by Hassan, Holt – SWAG UoW

Reference Architecture
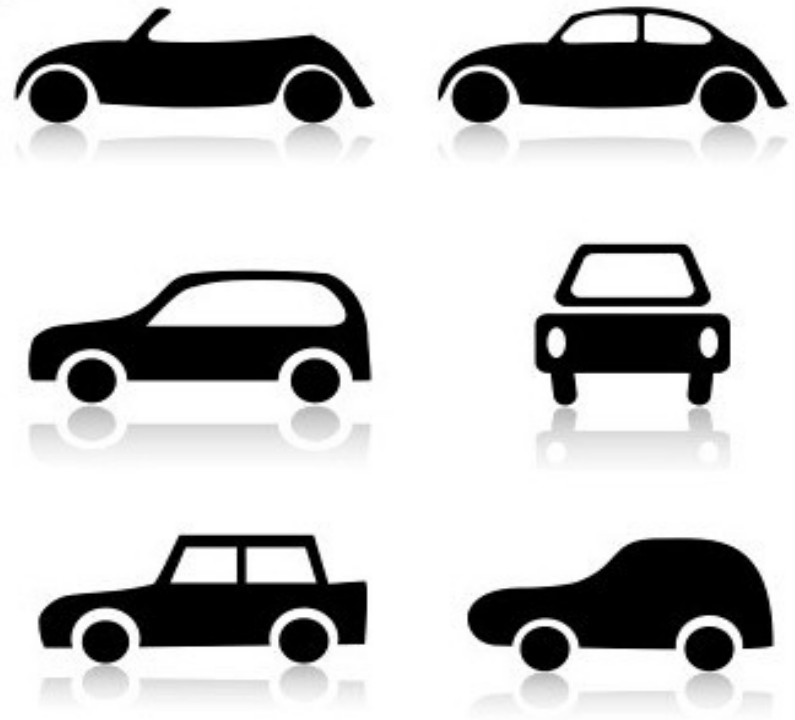
Definition

- *"A reference architecture for a <u>domain</u> defines the <u>fundamental components</u> of the <u>domain</u> and the <u>relations</u> between them"*

- *"A reference architecture for a <u>domain</u> is an architectural template for all the software systems in the <u>domain</u>"*

Example 1

Automobile

- attributes
  - transportation
  - wheels
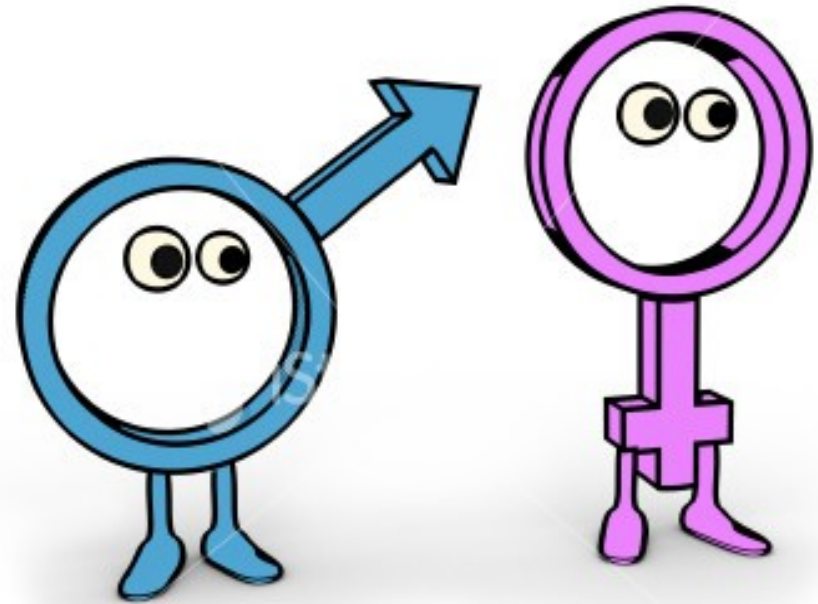 - steering
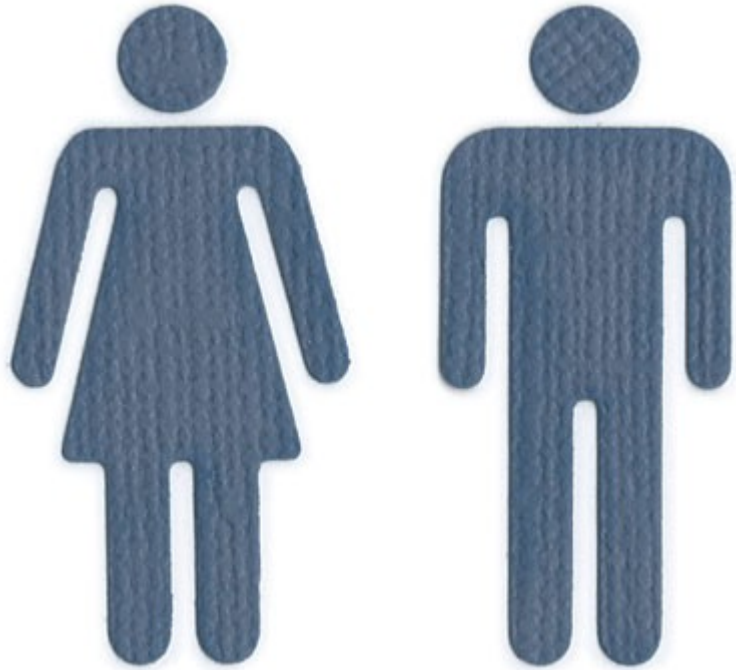 - speed / gears

Is This an Automobile?

But this meets the attribute list

Example 2

Properties

Domain

- what is a domain?
- reference architecture covers a whole domain

Fundamental components

- universal abstractions
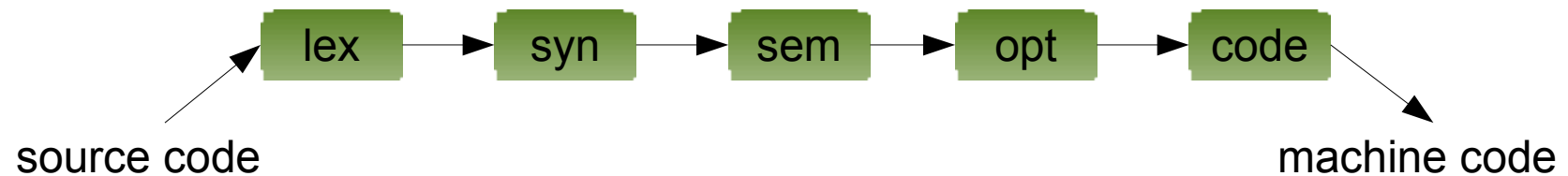 - applicable across the domain
- interaction of these abstractions

Template

- a product architecture is an instantiation of the reference architecture

Properties

Availability

- well known for mature domain
    - compilers, operating systems

source code → lex → syn → sem → opt → code → machine code

- absent for new domains
    - web servers

Benefits

Documentation

- captures the main ideas and components across domain
- provides a higher level abstraction for architecture itself
    - we don't have to reinvent the wheel or the architecture

Communication

- provides a common vocabulary
    - the *wheel* is too big
    - *braking* distance of the car is reasonable
    - 0 to 60 in 10 seconds

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Benefits

Evaluation

- aids in the comparison of the different product architectures in the <u>same domain</u>
    - electric vs. hybrid
    - sedan vs. coupe

The Study

"Web Server Reference Architecture"

- Domain:
  - web servers, application servers
- Web servers
  - Apache
  - AOL Server
  - Jigsaw

Browser

Network

WEB SERVER

Operating System

Resouces

Programs servlet/ CGI

Files
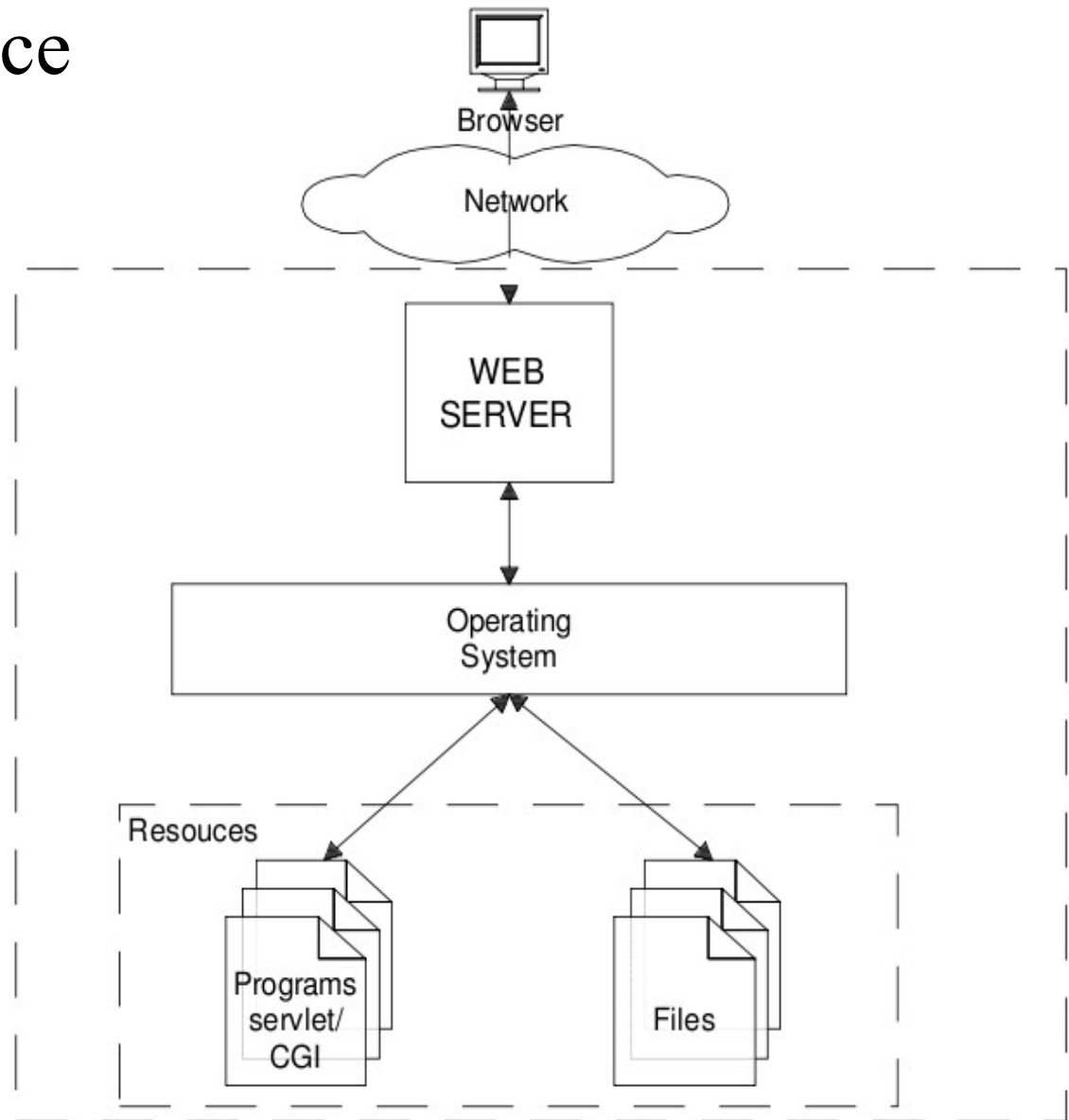
Summary of Web Servers

Web Server	Dev Type	1st Release	Code Size (KLOC)	Impl	Arch stable for (years)
Apache	Open source	April 1995	80	C	5
AOL Server	Commercial	May 1995	164	C & TCL	-
Jigsaw	Educational	May 1996	106	Java	2.5

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Deriving a Reference Architecture
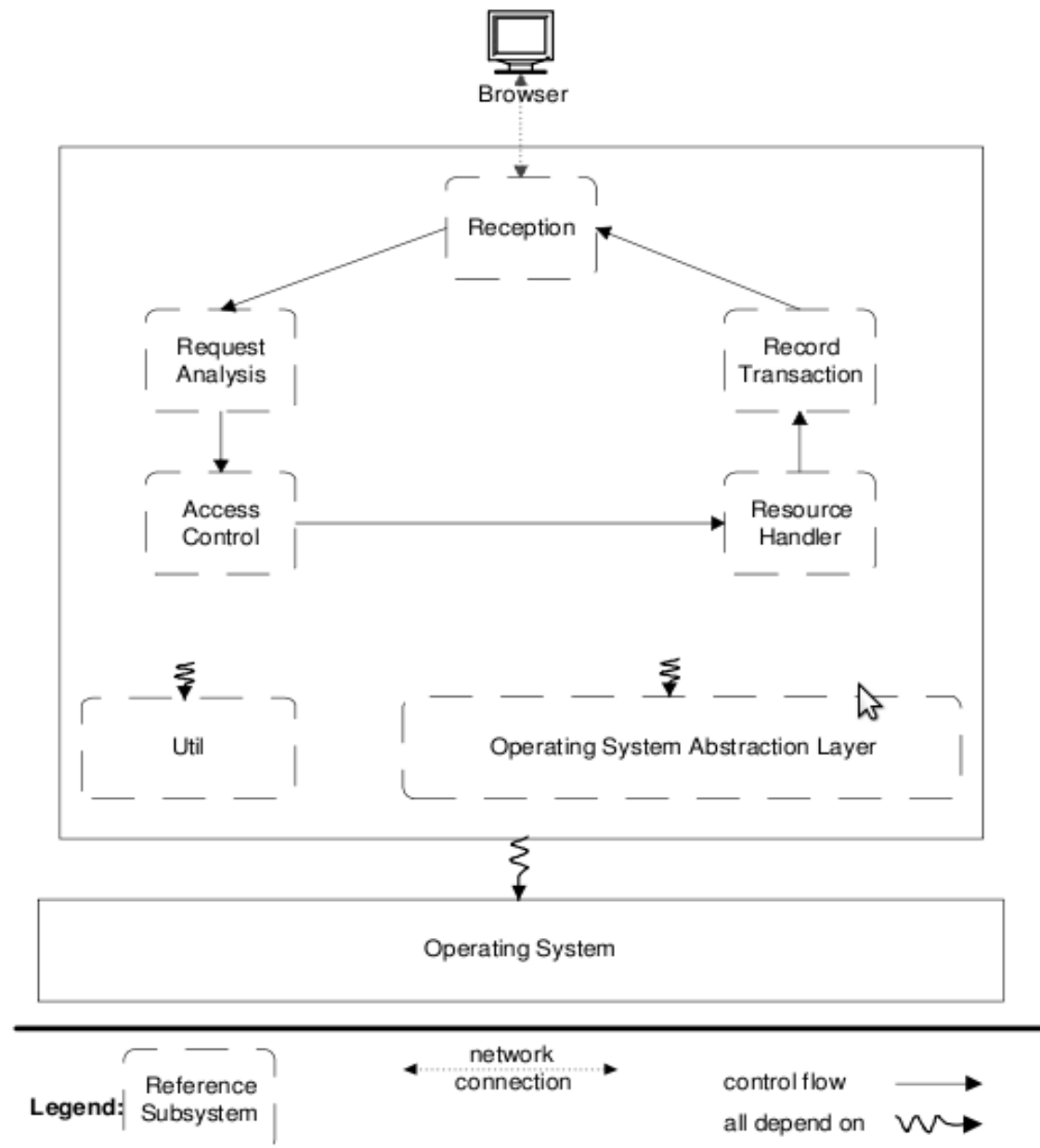
Process

- step1: derive a conceptual architecture for each
  - **propose** a conceptual architecture
    - using <u>domain knowledge</u> and available <u>documentation</u>
  - **refine** the conceptual architecture
    - using the <u>concrete</u> architecture
  - QUESTION: did we not say that a reference architecture should be an input artifact to a conceptual architecture?

Deriving a Reference Architecture

Process

- step2: derive a reference architecture from step 1
  - **propose** a reference architecture based on
    - domain knowledge
    - common structure between the conceptual architecture
  - **refine** the reference architecture
    - using the conceptual architecture (from step 1)

Web Server Reference Architecture

Browser

Reception

Request Analysis

Record Transaction

Access Control

Resource Handler

Util

Operating System Abstraction Layer

Operating System

Legend: Reference Subsystem | network connection | control flow | all depend on

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Web Server Reference Architecture

Architectural Style

- follows pipes & filter architectural style
    - hmmm.... does it really?
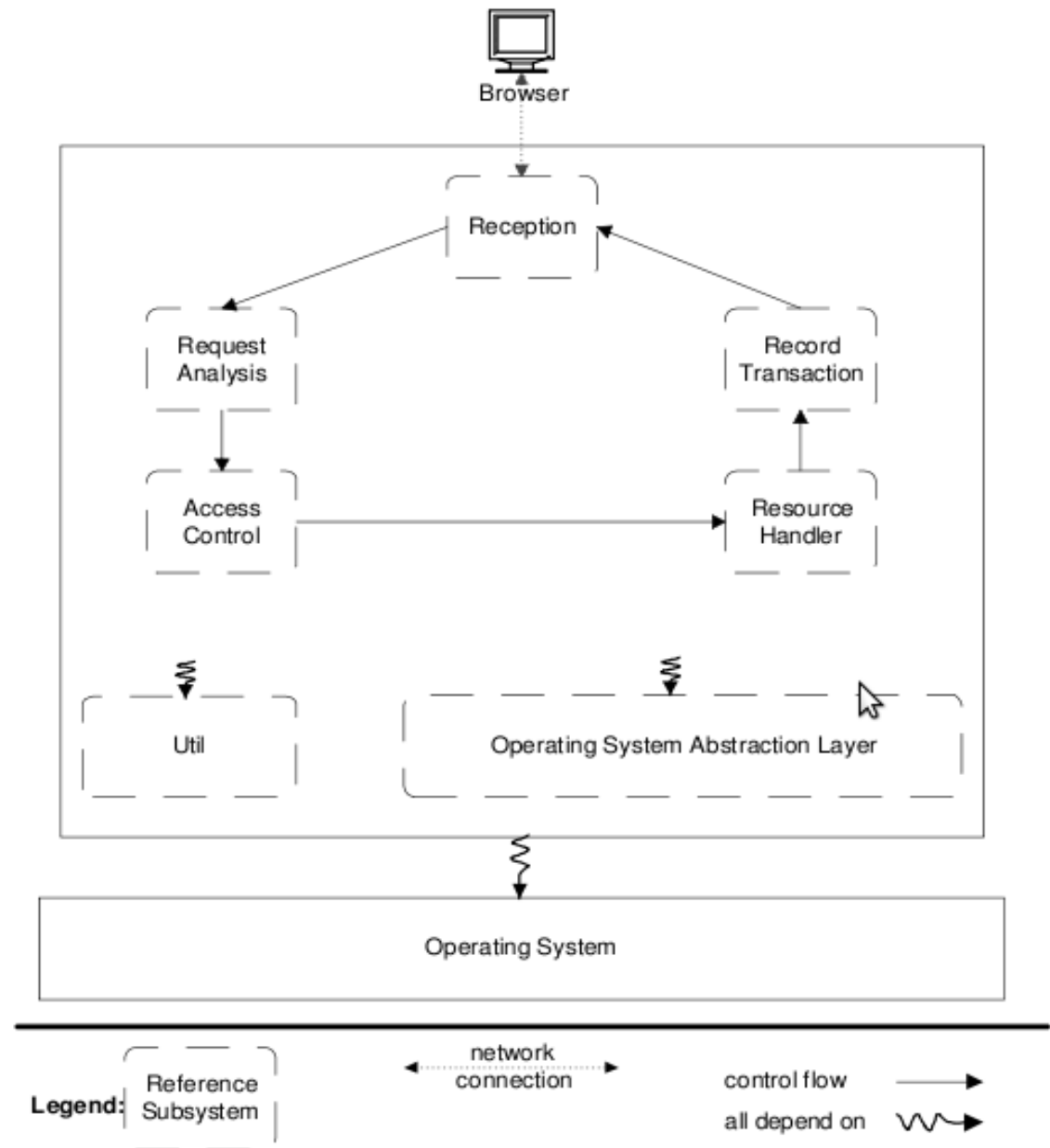   - what other architectural styles better define web servers?

Reference Architecture

Main subsystems

- reception

- request analyzer

- access control

- resource handler

- transaction log

Support subsystem

- utility

- operating system abstraction (OSAL)

Subsystems

Reception

- process the request from client
- transforms the HTTP request into internal system representation
- virtual extension of the browser/user
    - browser capabilities, preferences etc
- concurrency & load balancing
    - should be able to handle multiple concurrent requests

Subsystems

Request Analyzer

- operates on the internal representation of the HTTP user request

- maps a logical resource to a physical resource
  - www.test.com/test.html ► /public_html/testing/test.html
  - www.test.com/test.cgi ► /public_html/testing/scripts/test.pl

- can provide additional features
  - correction of typing errors
  - case insensitivity

Subsystem

Access control

- authentication: *who are you?*

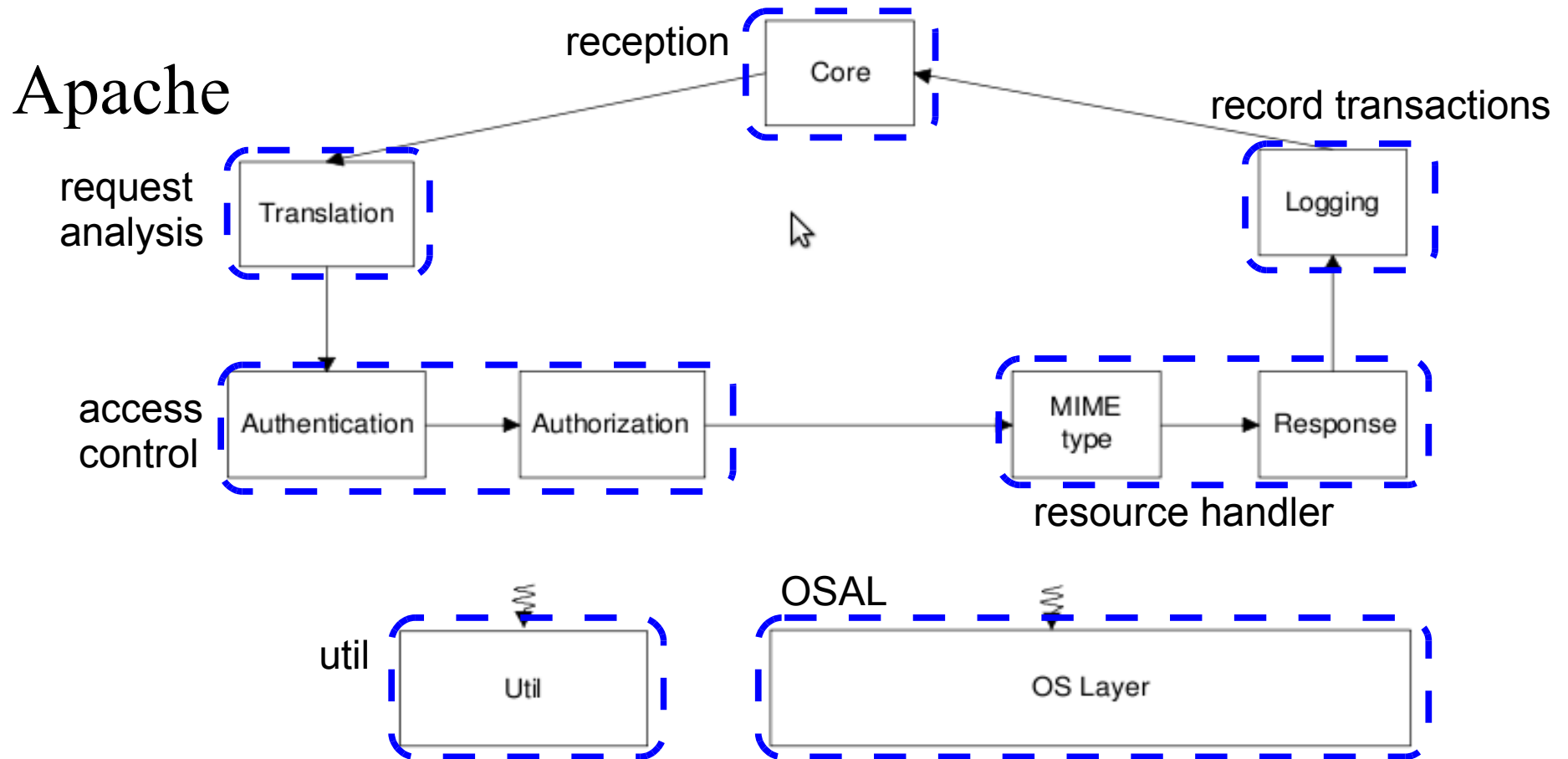- authorization: *are you allowed?*

Resource handler

- process a request

  – retrieves a file or executes a script

- generate a response

  – usually an HTML document

Flexibility of Reference Architecture
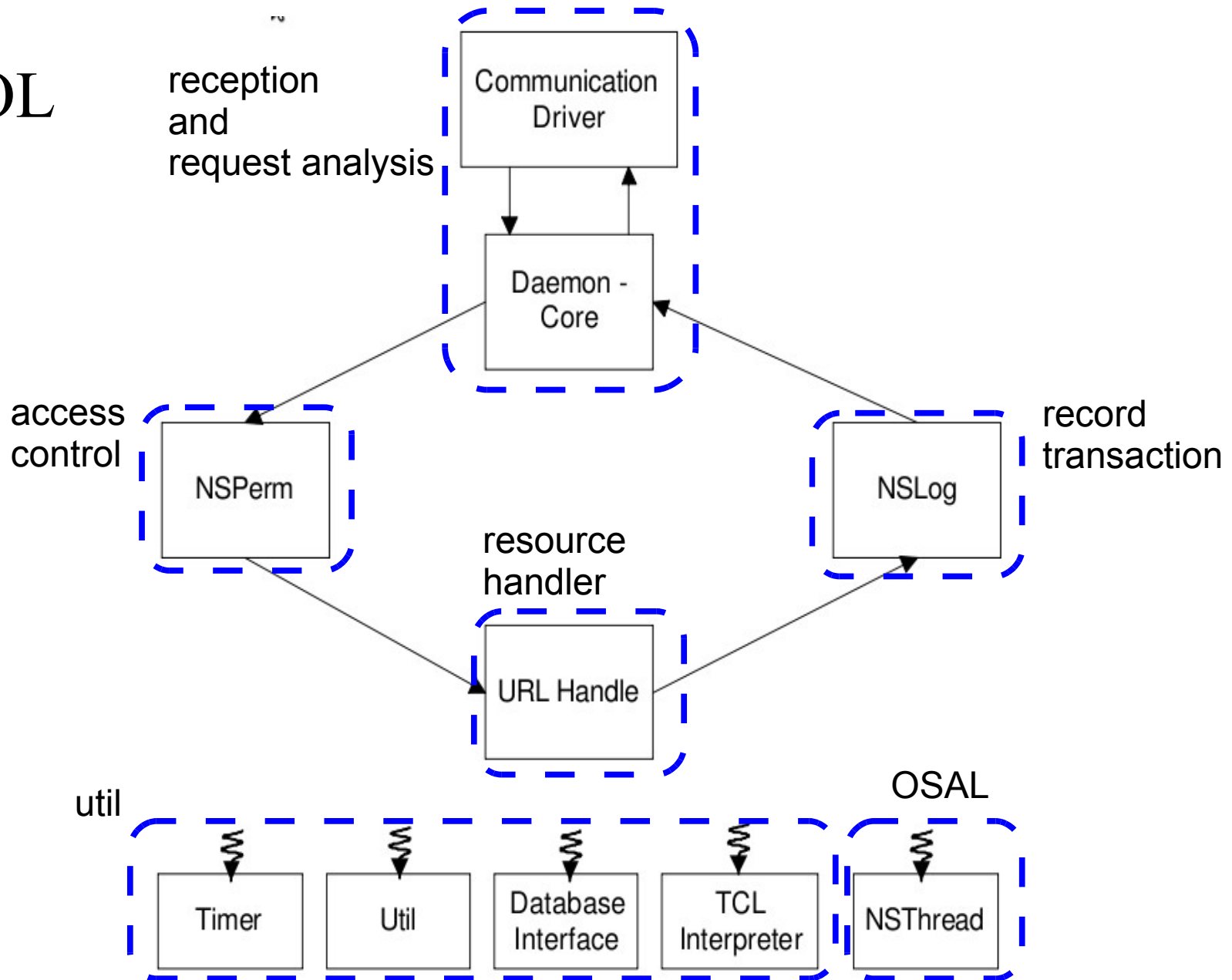
Intent

- *"To be useful a reference architecture must be <u>flexible</u> enough to <u>encompass many</u> product architectures"*

- what does flexibility mean?
- security flexibility
- concurrency flexibility

Reference & Conceptual Mapped

Apache

reception

Core

record transactions

request analysis — Translation

Logging

access control — Authentication → Authorization — MIME type → Response

resource handler

util — Util

OSAL — OS Layer

Legend: Subsystem

control flow →
all depend on ∿→

Reference & Conceptual Mapped

AOL

reception
and
request analysis

access
control

record
transaction

resource
handler

util

OSAL

Summary

Mapping

- mapping of three conceptual architectures to a reference architecture

- subsystem organization is the main difference and not the subsystem responsibility

- reference architecture is abstract

  - does not depend on

    - development methodology
    - platform
    - implementation concerns

Conclusion

Reference architecture

- provides a global template across a domain
- helps better understand and communicate the architecture
- enables a comparison of different architectures in the same domain