Università della Svizzera italiana

Facoltà di scienze informatiche

REST vs. SOAP: Making the Right Architectural Decision

Cesare Pautasso

Faculty of Informatics

University of Lugano (USI), Switzerland

http://www.pautasso.info

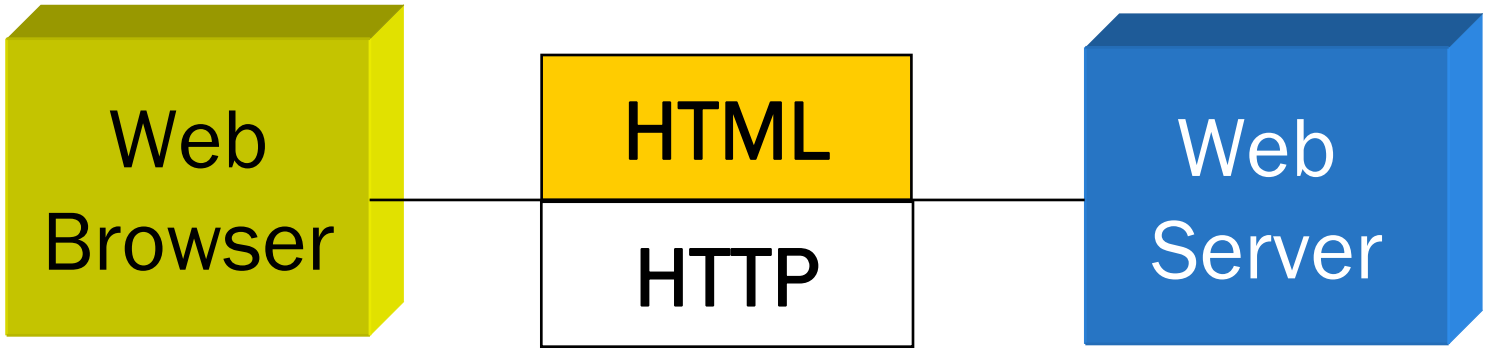
©2008 Cesare Pautasso

Agenda

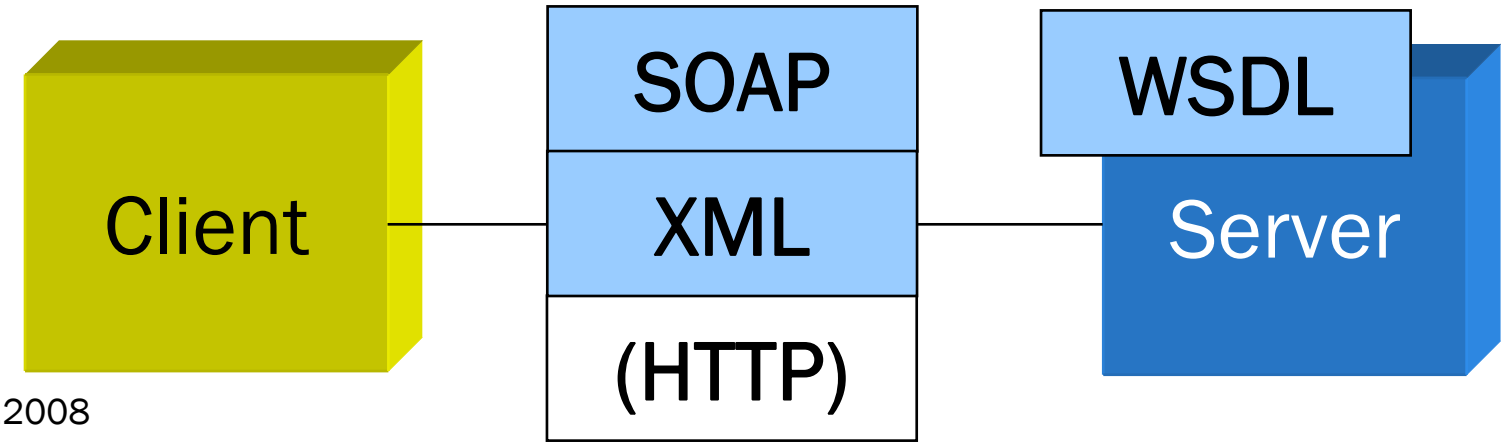
1. Motivation: A short history of Web Services
2. Comparing REST vs. SOAP/WS-*
3. Architectural Decision Modeling
4. Conceptual Comparison
5. Technology Comparison
6. How to measure the “complexity” of WS-* or the “simplicity” of REST?
7. Conclusion: Making the right Architectural Decision

©2008 Cesare Pautasso

Web Sites (1992)

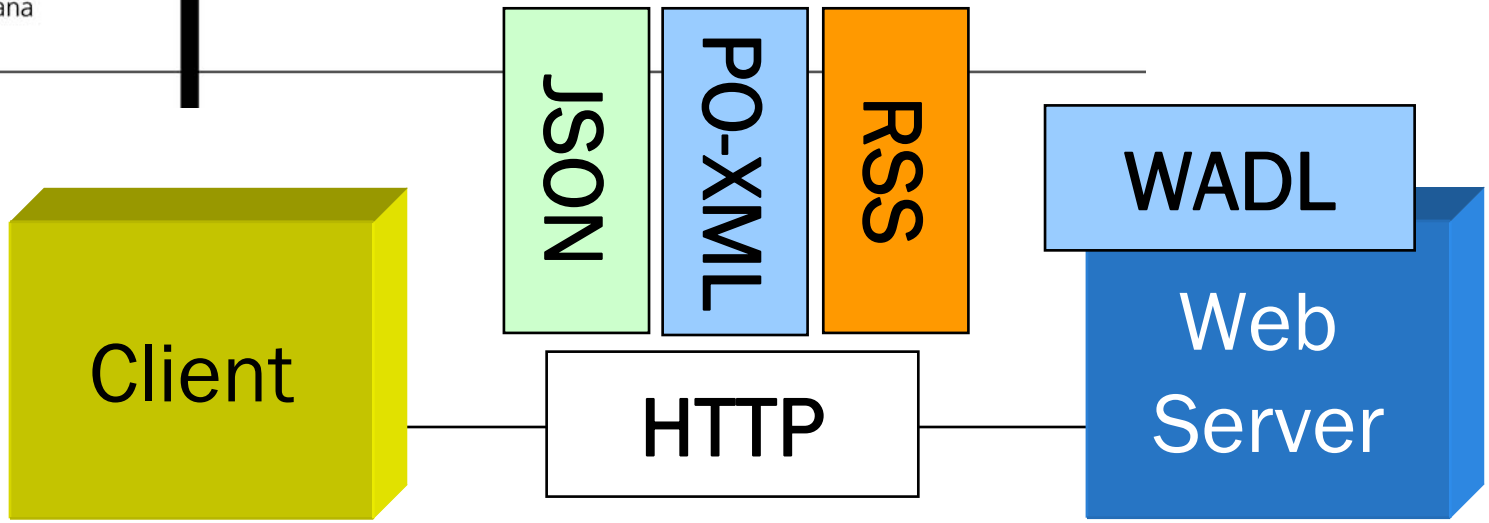


WS-* Web Services (2000)

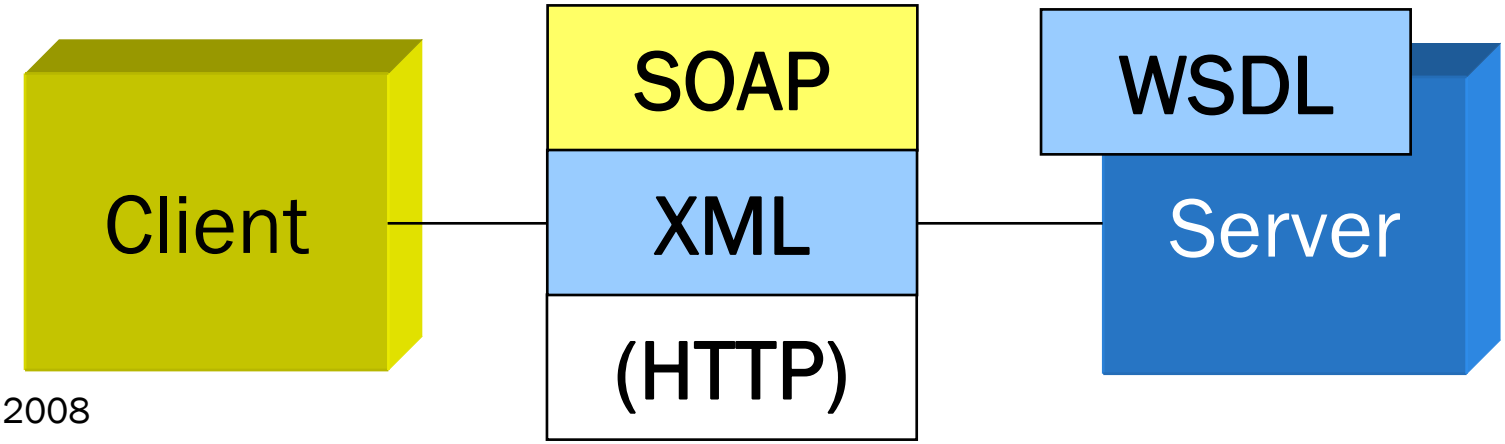


©2008 Cesare Pautasso

RESTful Web Services (2006)

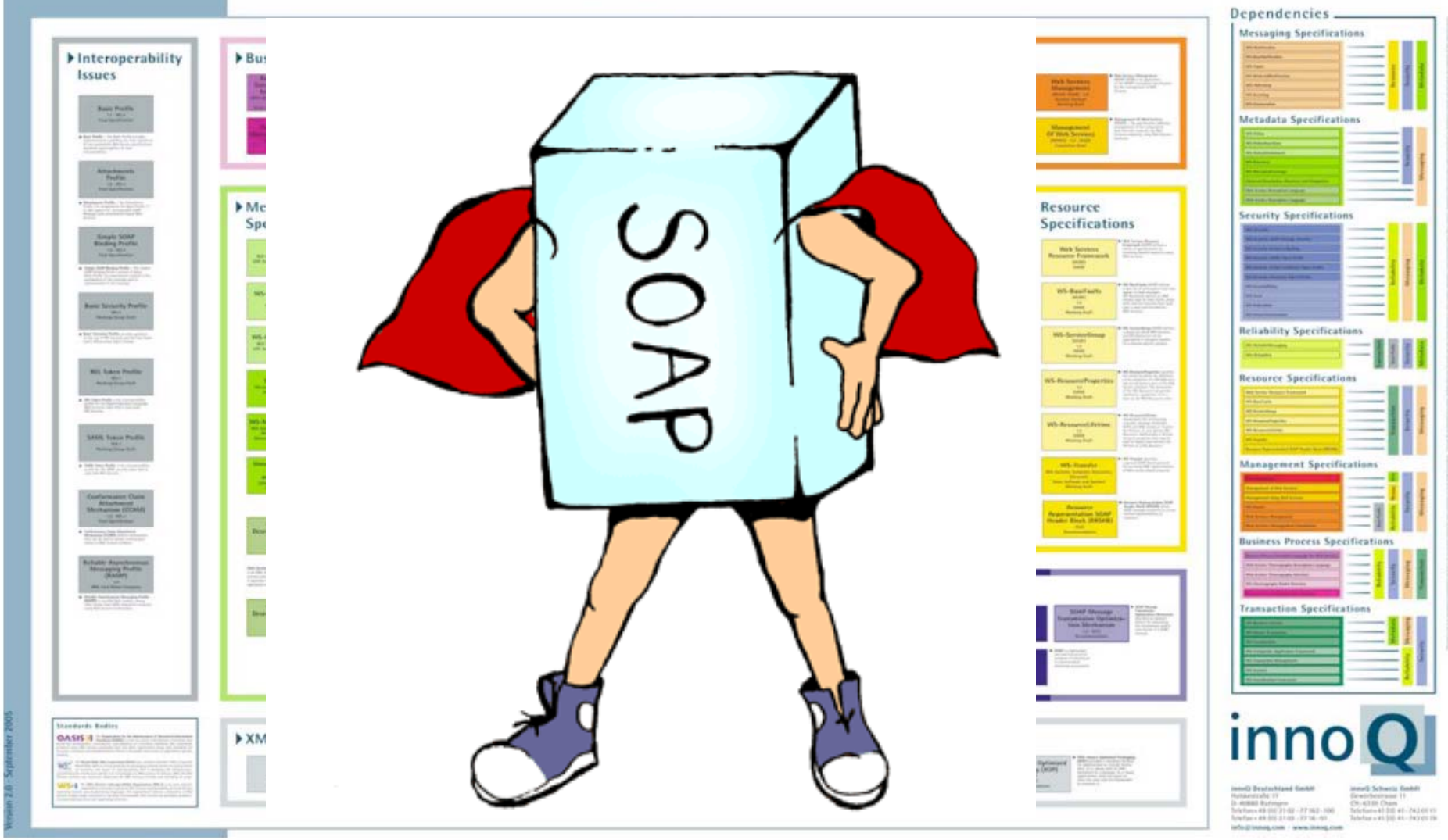


WS-* Web Services (2000)



©2008 Cesare Pautasso

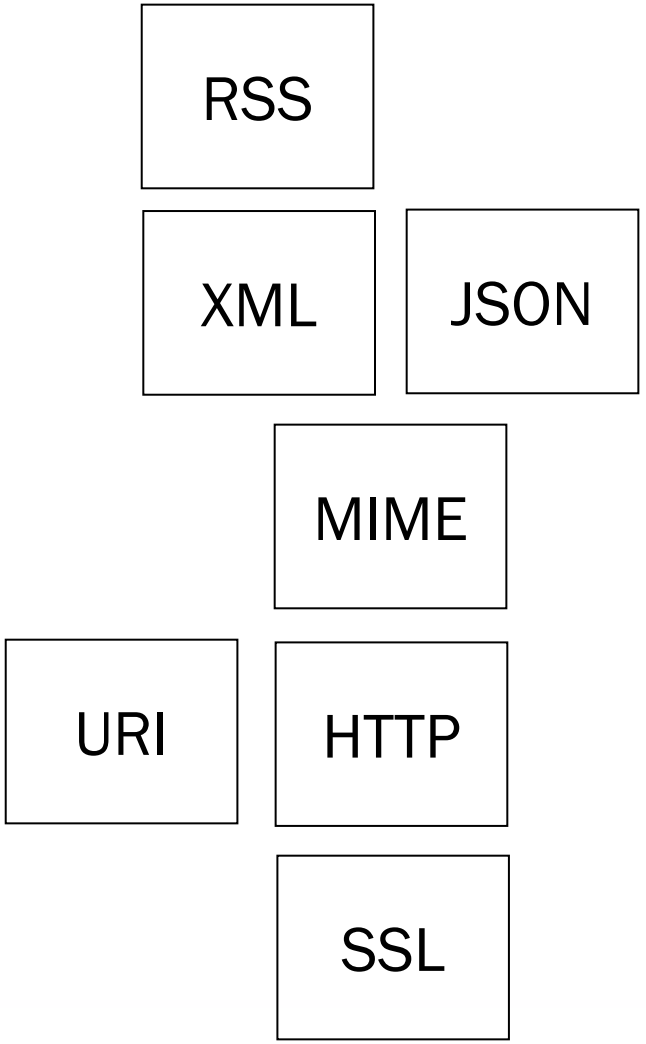
Web Services Standards



©2008 Cesare Pautasso

Web Services Standards

RESTful



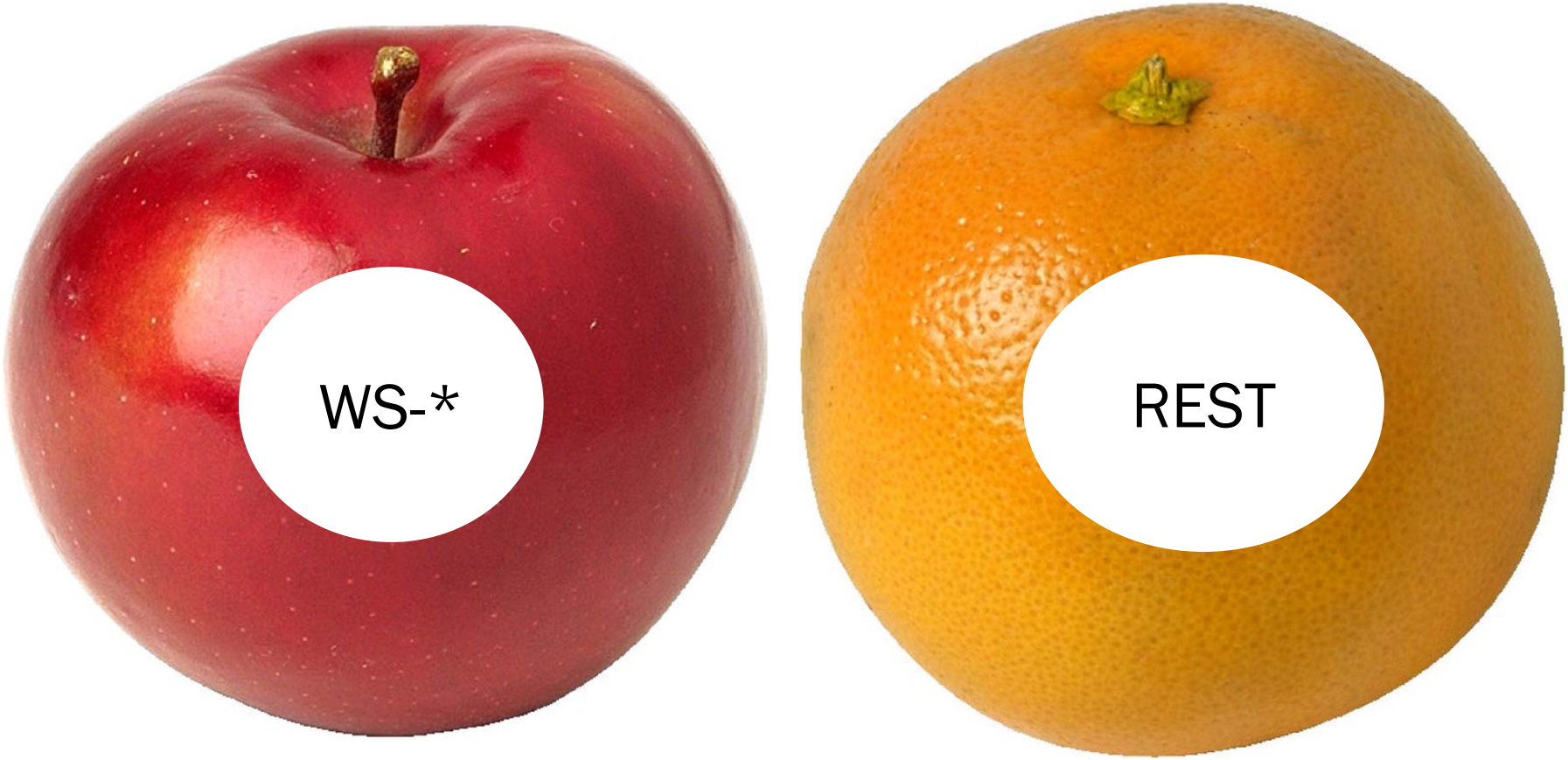
©2008 Cesare Pautasso

Is REST being used?

Slide from Paul Downey, BT

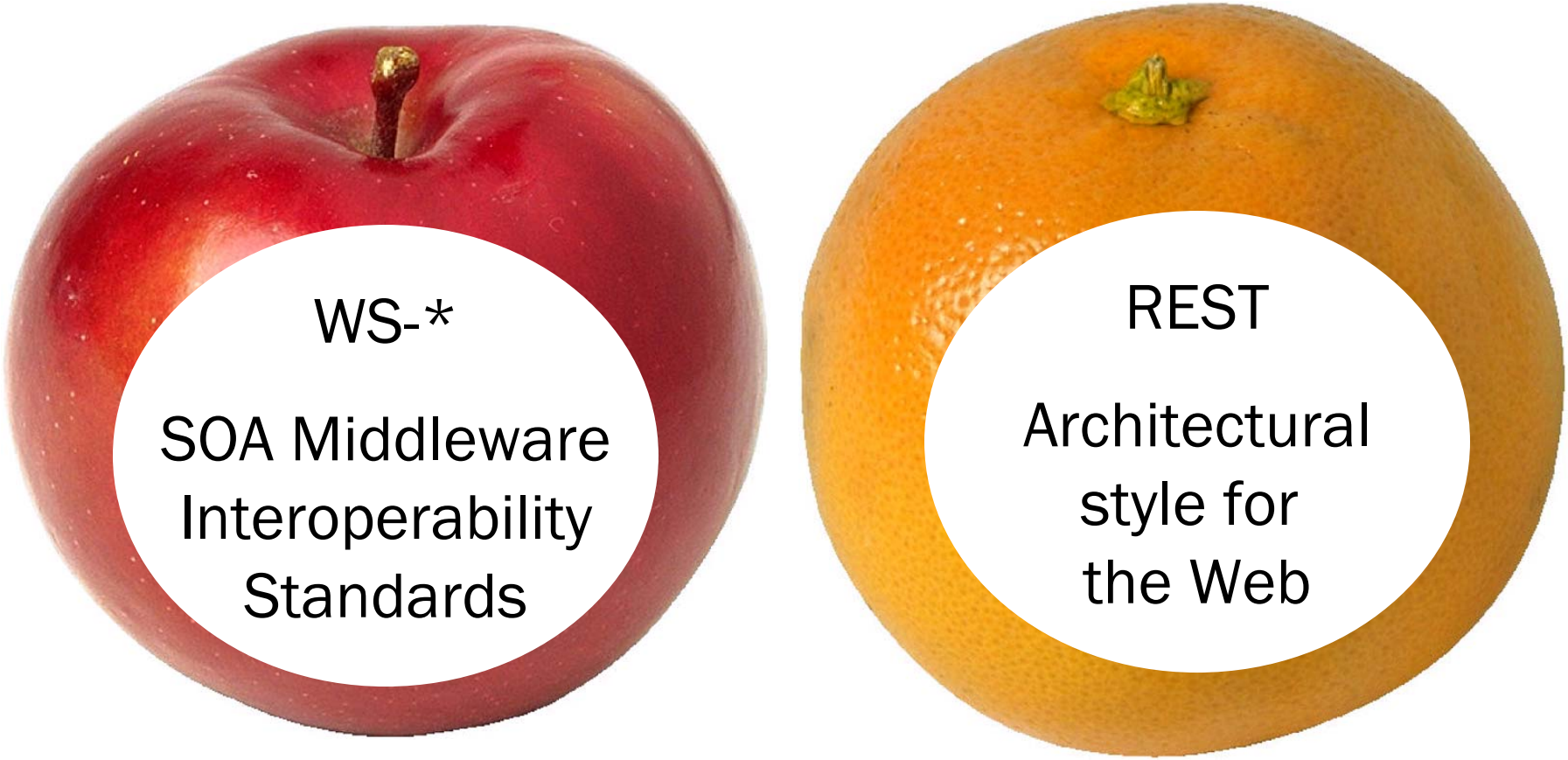
©2008 Cesare Pautasso

Can we really compare WS-* vs. REST?



©2008 Cesare Pautasso

Can we really compare WS-* vs. REST?

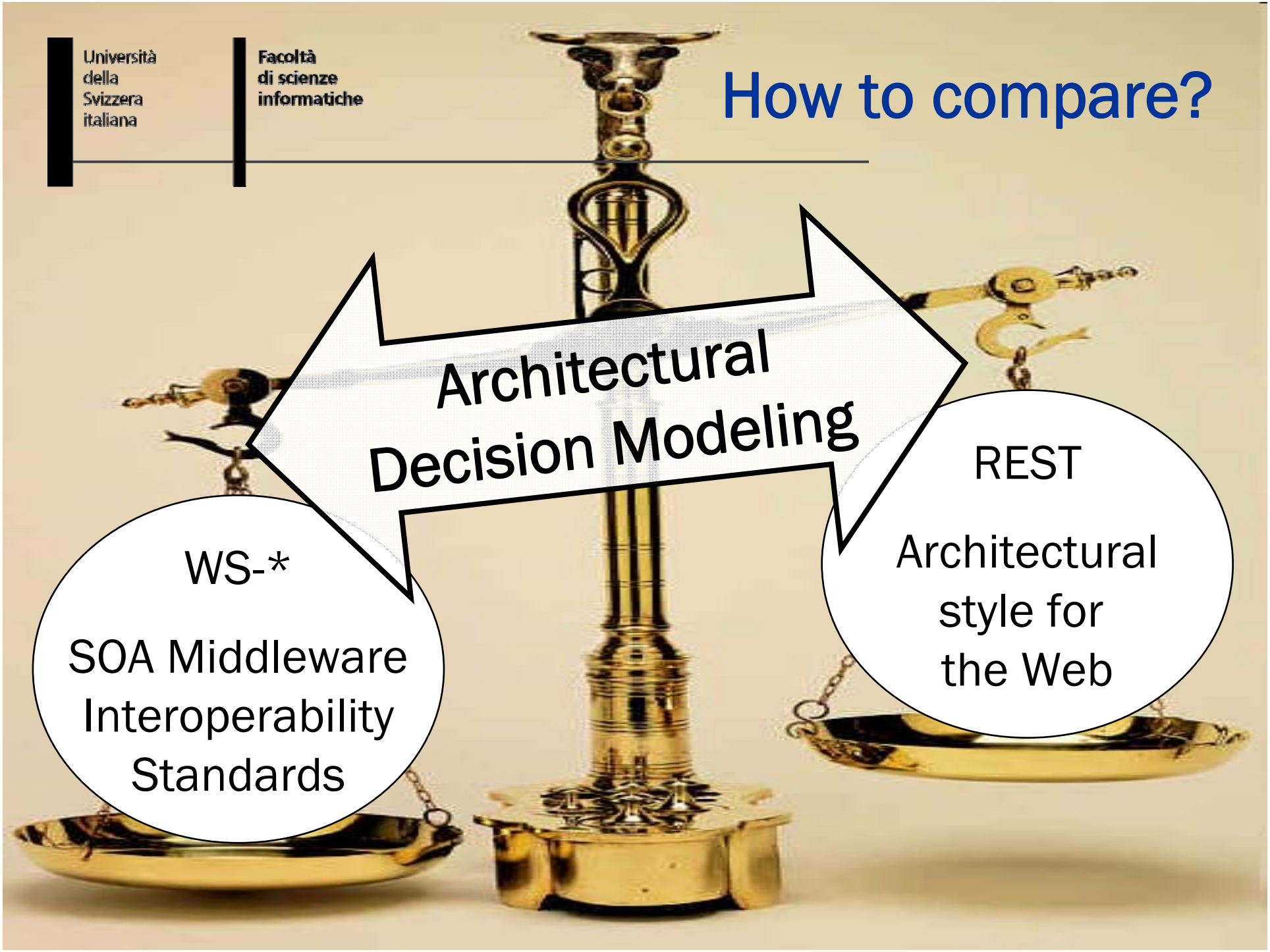


©2008 Cesare Pautasso

Università della Svizzera italiana

Facoltà di scienze informatiche

How to compare?



Architectural Decisions

- Architectural decisions capture the main design issues and the rationale behind a chosen technical solution
- The choice between REST vs. WS-* is an important architectural decision for integration projects
- Architectural decisions affect one another

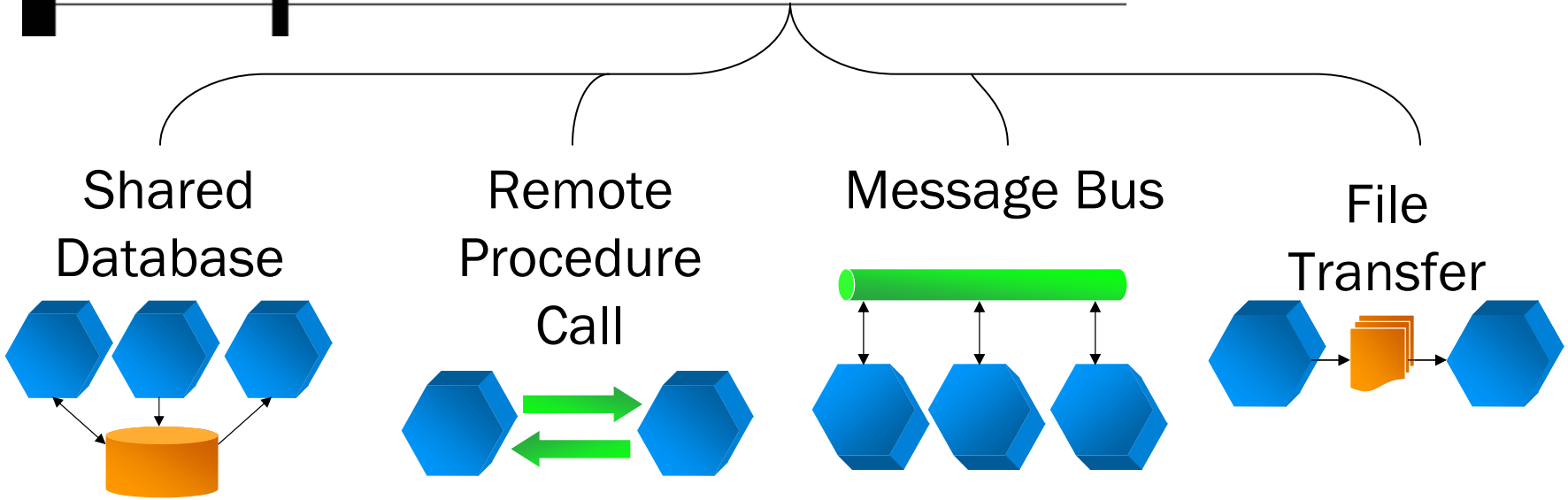
Architectural Decision:
Communication Protocol

Architecture Alternatives:
1. TCP
2. SMTP
3. HTTP
4. MQ
5. BEEP
6. CORBA IIOP
7. …

Rationale

©2008 Cesare Pautasso

Application Integration Styles

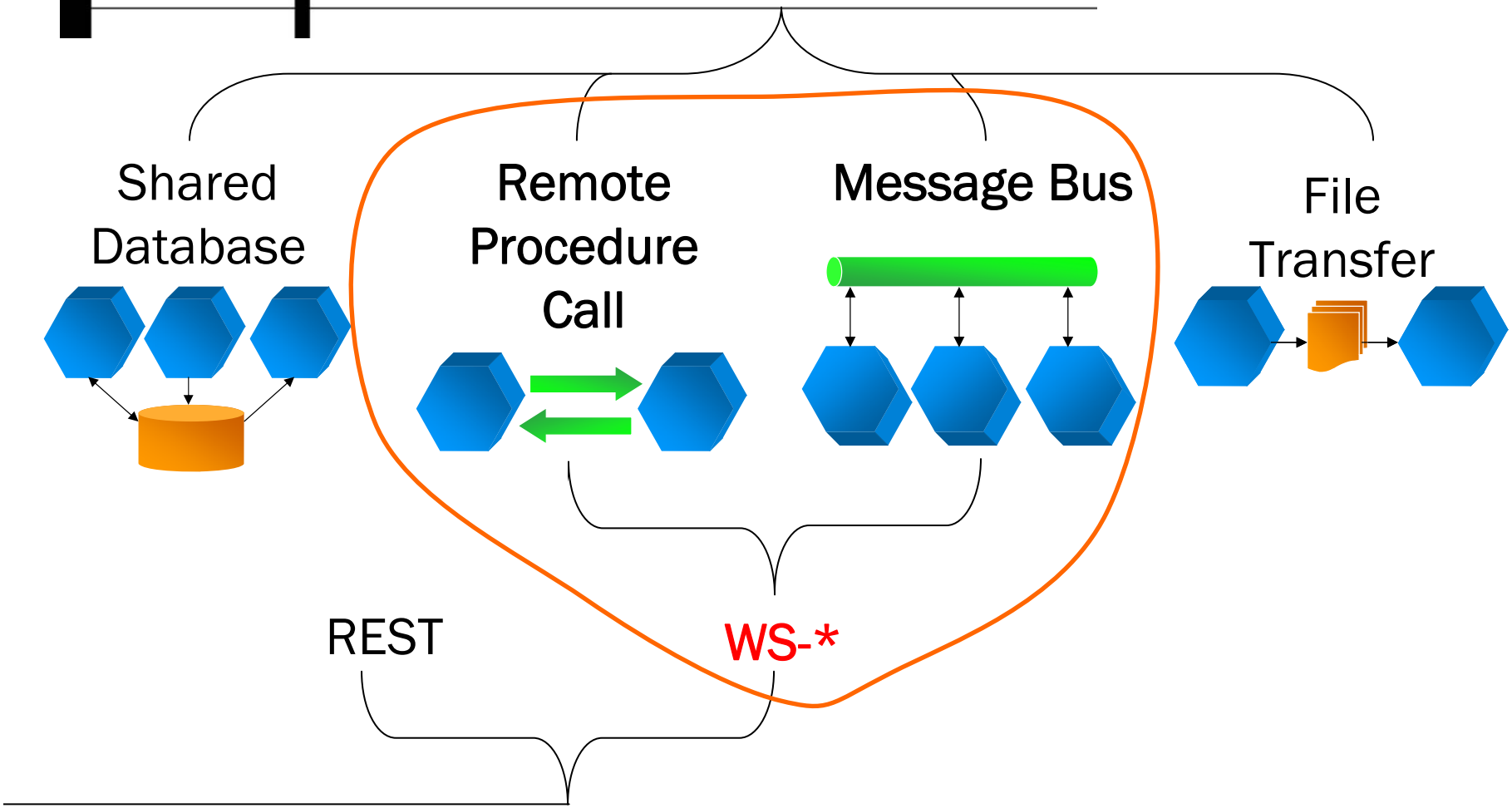


REST WS-*

Integration Technology Platform

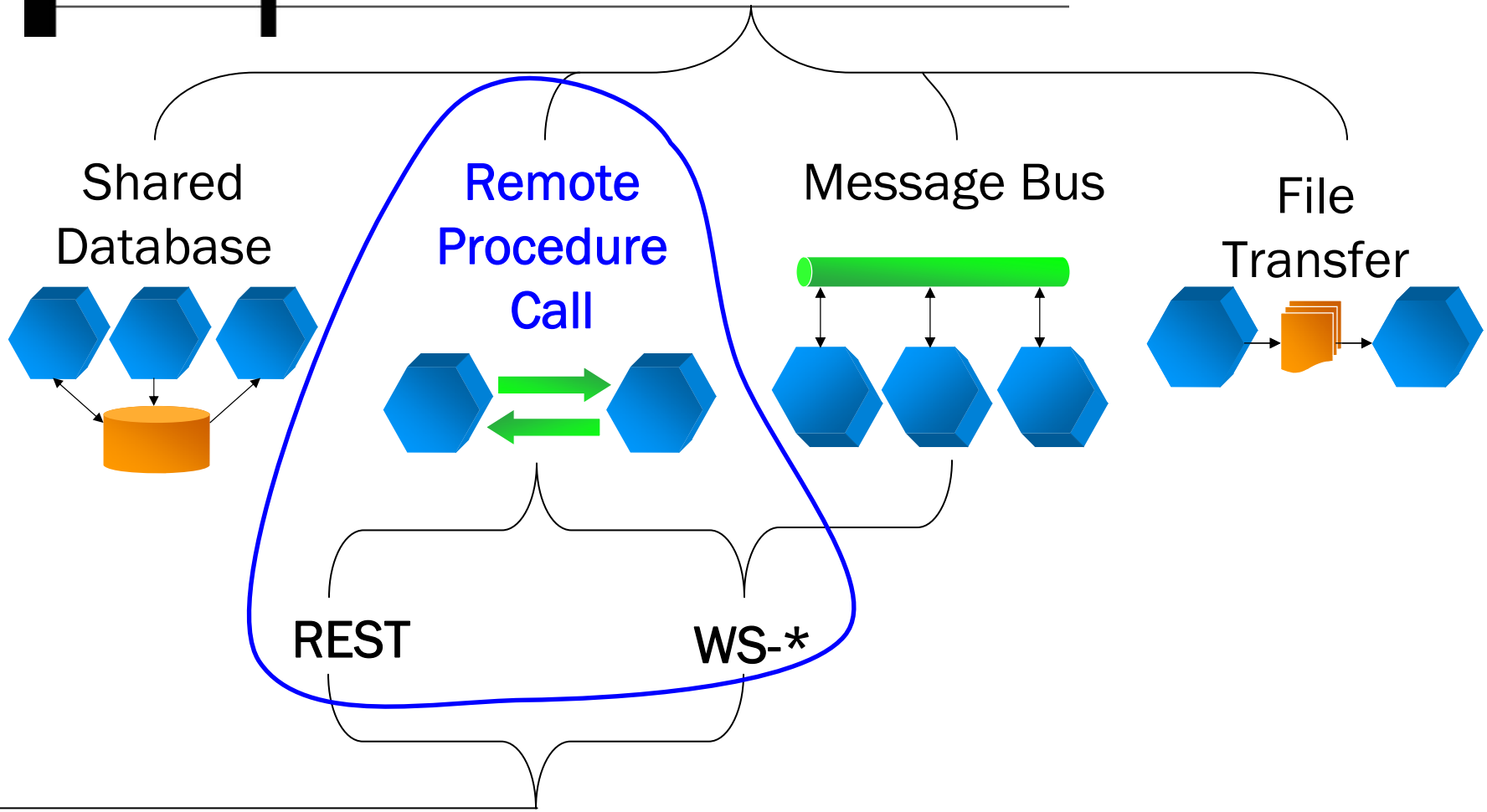
©2008 Cesare Pautasso

Related Decisions (WS-*)



©2008 Cesare Pautasso

Related Decisions (RPC)



©2008 Cesare Pautasso

Università della Svizzera italiana

Facoltà di scienze informatiche

Decision Space Overview

Architectural Decision and AAs	REST	WS-*
Integration Style	1 AA	2 AAs
Shared Database		
File Transfer		
Remote Procedure Call	✓	✓
Messaging		✓
Contract Design	1 AA	2 AAs
Contract-first		✓
Contract-last		✓
Contract-less	✓	
Resource Identification	1 AA	n/a
Do-it-yourself	✓	
URI Design	2 AA	n/a
"Nice" URI scheme	✓	
No URI scheme	✓	
Resource Interaction Semantics	2 AAs	n/a
Lo-REST (`POST`, `GET` only)	✓	
Hi-REST (4 verbs)	✓	
Resource Relationships	1 AA	n/a
Do-it-yourself	✓	
Data Representation/Modeling	1 AA	1 AA
XML Schema	(✓)[a]	✓
Do-it-yourself	✓	
Message Exchange Patterns	1 AA	2 AAs
Request-Response	✓	✓
One-Way		✓
Service Operations Enumeration	n/a	≥3 AAs
By functional domain		✓
By non-functional properties and QoS		✓
By organizational criterion (versioning)		✓
Total Number of Decisions, AAs	**8**, 10	**5**, ≥10

[a] Optional

Table 2: Conceptual Comparison Summary

Architectural Decision and AAs	REST	WS-*
Transport Protocol	1 AA	≥7 AAs
HTTP	✓	✓[a]
waka [13]	(✓)[b]	
TCP		✓
SMTP		✓
JMS		✓
MQ		✓
BEEP		✓
IIOP		✓
Payload Format	≥6 AAs	1 AA
XML (SOAP)	✓	✓
XML (POX)	✓	
XML (RSS)	✓	
JSON [10]	✓	
YAML	✓	
MIME	✓	
Service Identification	1 AA	2 AA
URI	✓	✓
WS-Addressing		✓
Service Description	3 AAs	2 AAs
Textual Documentation	✓	
XML Schema	(✓)[c]	✓
WSDL	✓[d]	✓
WADL [18]	✓	
Reliability	1 AA	4 AAs
HTTPR [38][e]	(✓)	(✓)
WS-Reliability		✓
WS-ReliableMessaging		✓
Native		✓
Do-it-yourself	✓	✓
Security	1 AA	2 AAs
HTTPS	✓	✓
WS-Security		✓

Transactions	1 AA	3 AAs
WS-AT, WS-BA		✓
WS-CAF		✓
Do-it-yourself	✓	✓
Service Composition	2 AAs	2 AAs
WS-BPEL		✓
Mashups	✓	
Do-it-yourself	✓	✓
Service Discovery	1 AAs	2 AAs
UDDI		✓
Do-it-yourself	✓	✓
Implementation Technology	many	many
...	✓	✓
Total Number of Decisions, AAs	**10**, ≥17	**10**, ≥25

[a] Limited to only the verb `POST`
[b] Still under development
[c] Optional
[d] WSDL 2.0
[e] Not standard

Table 3: Technology Comparison Summary

Architectural Principle and Aspects	REST	WS-*
Protocol Layering	yes	yes
HTTP as application-level protocol	✓	
HTTP as transport-level protocol		✓
Dealing with Heterogeneity	yes	yes
Browser Wars	✓	
Enterprise Computing Middleware		✓
Loose Coupling, aspects covered	yes, 2	yes, 3
Time/Availability		✓
Location (Dynamic Late Binding)	(✓)	✓
Service Evolution:		
Uniform Interface	✓	
XML Extensibility	✓	✓
Total Principles Supported	**3**	**3**

Table 1: Principles Comparison Summary

©2008 Cesare Pautasso

Università della Svizzera italiana

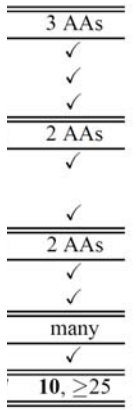
Facoltà di scienze informatiche

Decision Space Summary

21 Decisions and 64 alternatives

Classified by level of abstraction:

- 3 Architectural **Principles**
- 9 **Conceptual** Decisions
- 9 **Technology**-level Decisions



Decisions help us to **measure the complexity** implied by the choice of REST or WS-*

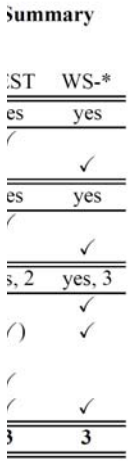


Table 2: Conceptual Comparison Summary

Table 1: Principles Comparison Summary

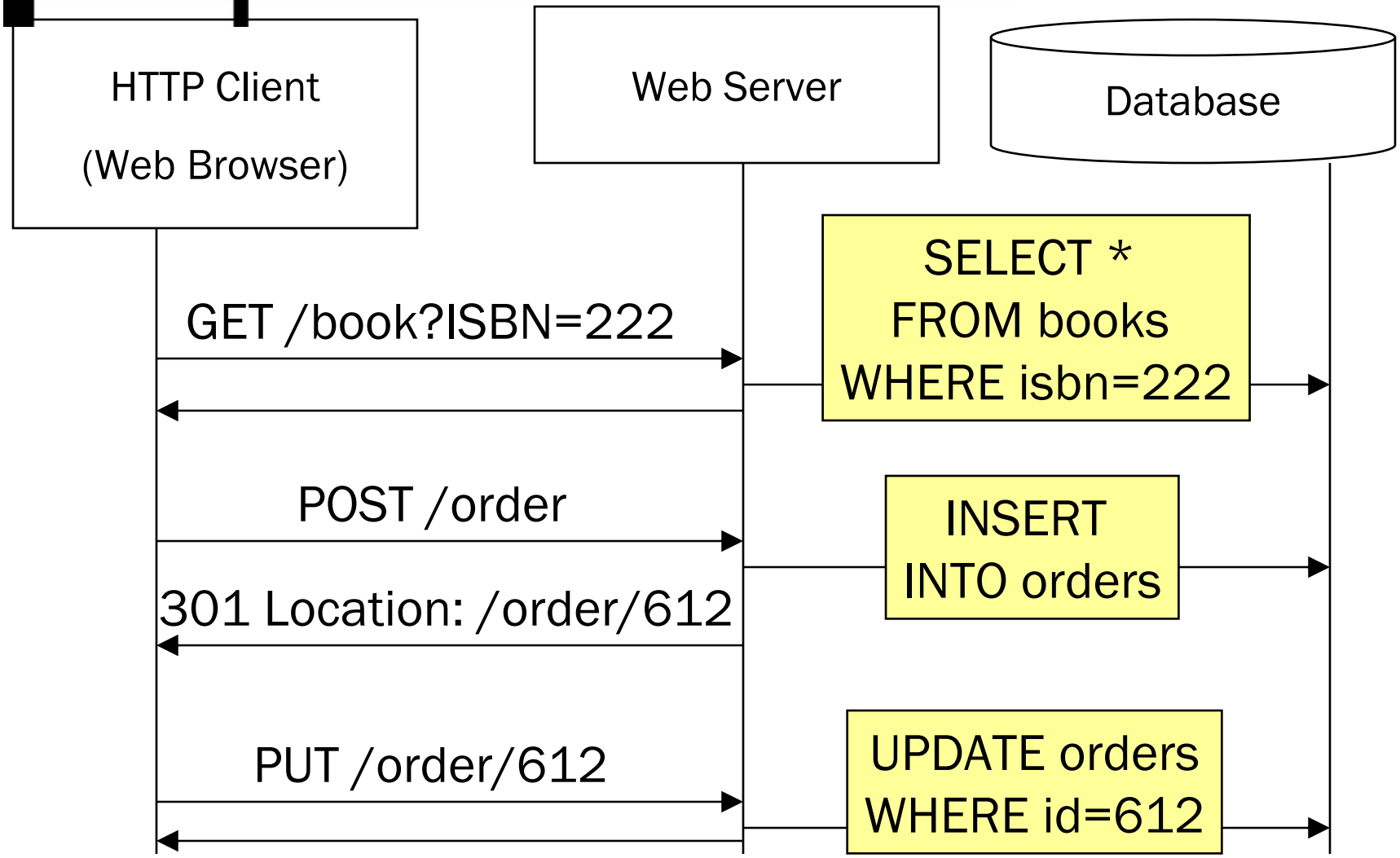
©2008 Cesare Pautasso

Architectural Principles

1. Protocol Layering
   - HTTP = Application-level Protocol (REST)
   - HTTP = Transport-level Protocol (WS-*)
2. Dealing with Heterogeneity
3. Loose Coupling

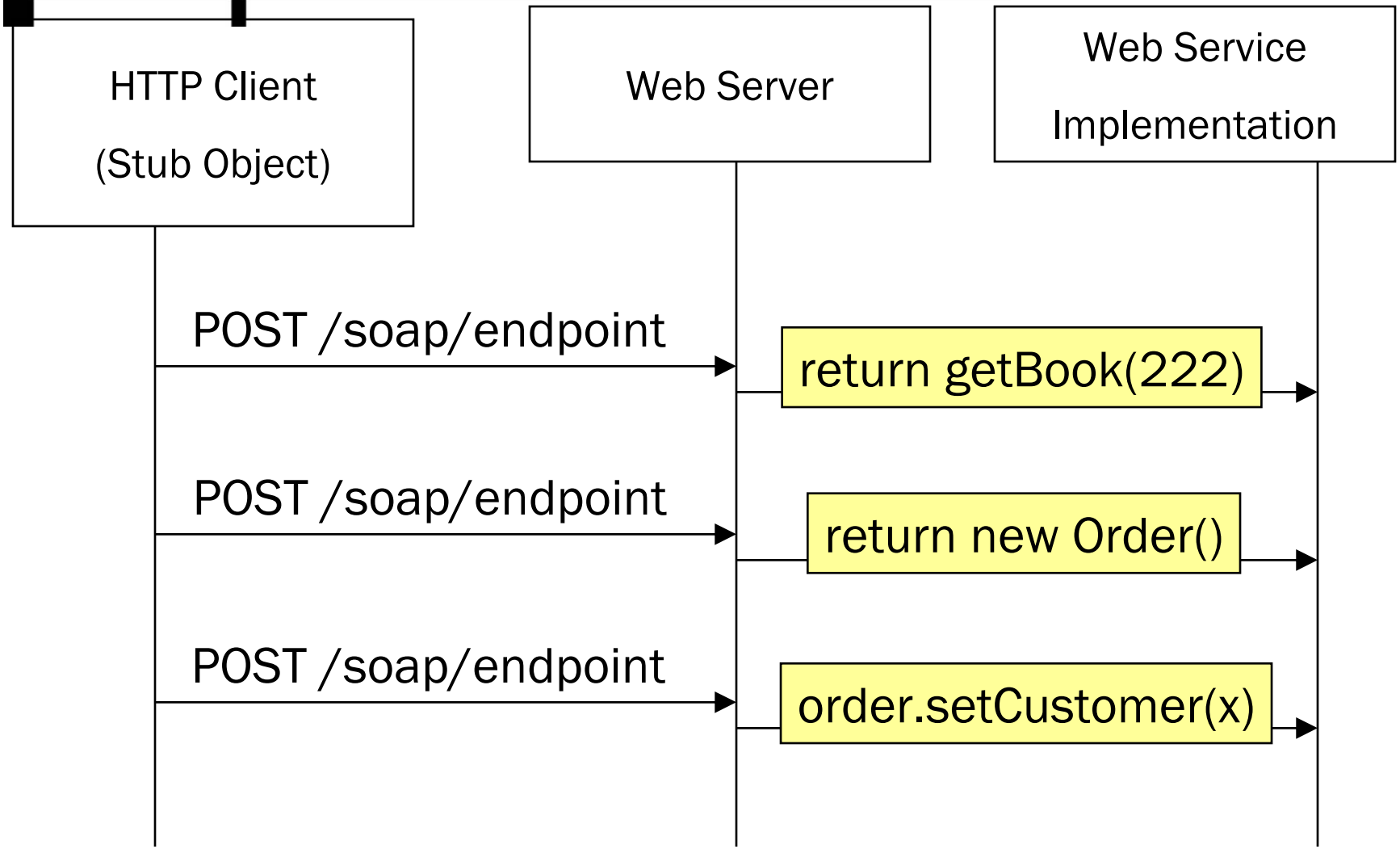
©2008 Cesare Pautasso

RESTful Web Service Example



©2008 Cesare Pautasso

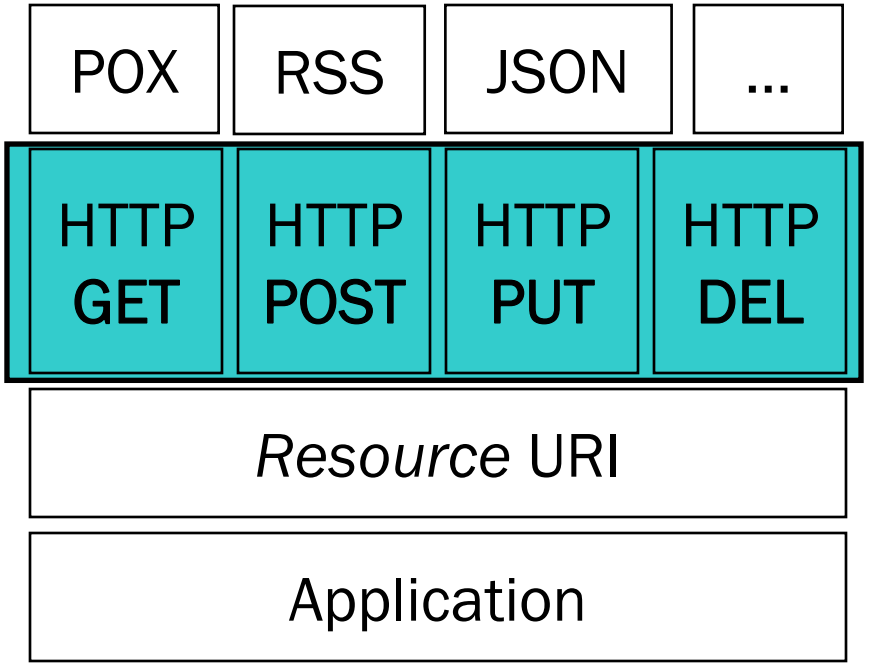
Big Web Service Example (from REST perspective)



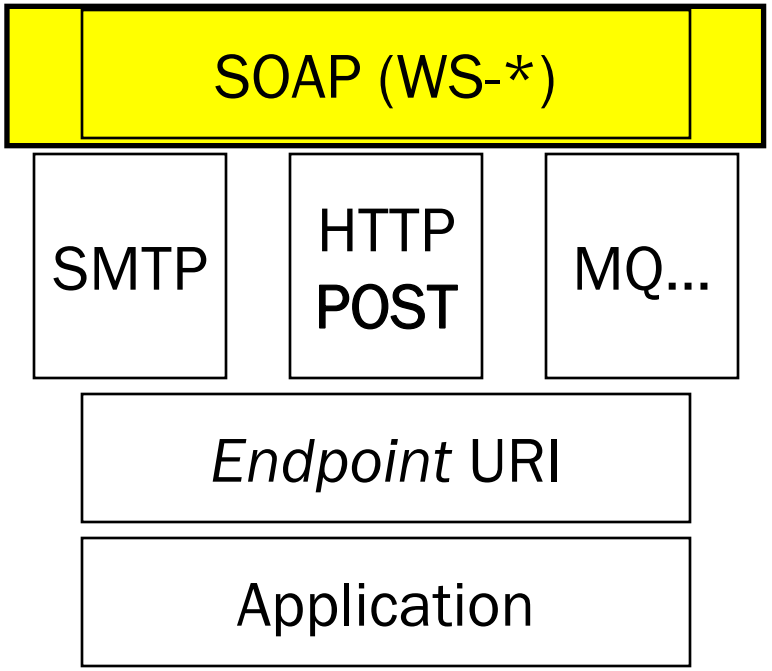
©2008 Cesare Pautasso

Protocol Layering

- "The Web is the universe of globally accessible information" (Tim Berners Lee)
  - Applications should publish their data on the Web (through URI)



- "The Web is the universal (tunneling) transport for messages"
  - Applications get a chance to interact but they remain "outside of the Web"

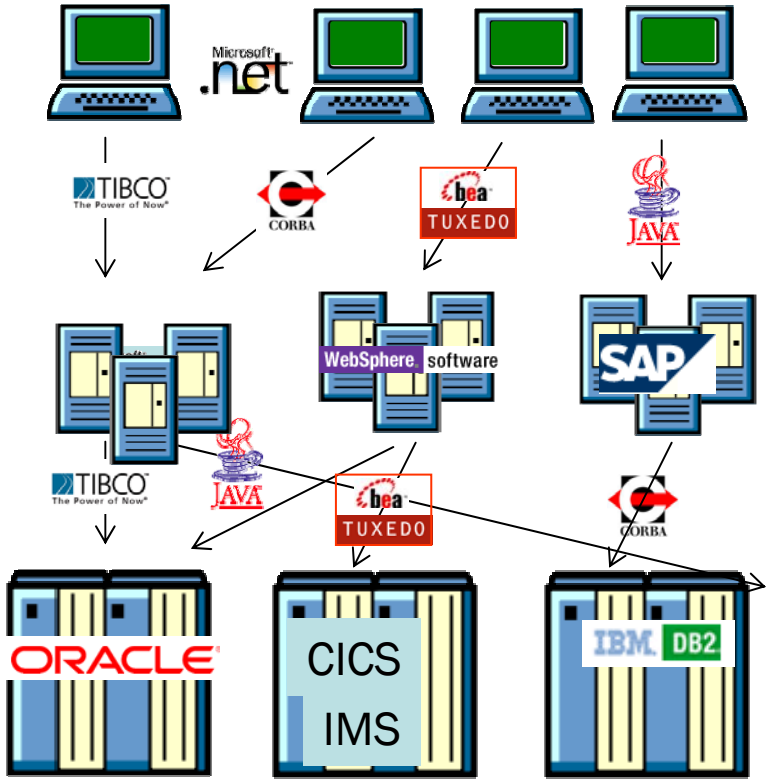


©2008 Cesare Pautasso

Dealing with Heterogeneity

- Web Applications

- Enterprise Computing



Picture from Eric Newcomer, IONA

©2008 Cesare Pautasso

Conceptual Comparison

Architectural Decision and AAs	REST	WS-*
Integration Style	1 AA	2 AAs
Shared Database		
File Transfer		
Remote Procedure Call	✓	✓
Messaging		✓
Contract Design	1 AA	2 AAs
Contract-first		✓
Contract-last		✓
Contract-less		
Resource Identification	AA	n/a
Do-it-yourself	✓	
URI Design	2 AA	n/a

Note: this table will scroll up during the talk

Technology Comparison

Architectural Decision and AAs	REST	WS-*
Transport Protocol	1 AA	≥7 AAs
HTTP	✓	✓[a]
waka [13]	(✓)[b]	
TCP		✓
SMTP		✓
JMS		✓
MQ		✓
BEEP		✓
IIOP		✓
Payload Format	≥6 AAs	1 AA
XML (SOAP)	✓	✓
XML (POX)	✓	
XML (RSS)	✓	

Note: this table will scroll up during the talk

Measuring Complexity

- Architectural Decisions give a **quantitative measure** of the complexity of an architectural design space:
  - Total number of decisions
  - For each decision, number of alternative options
  - For each alternative option, estimate the effort

	REST	WS-*
Decisions	17	14
Alternatives	27	35

Decisions with *1 or more* alternative options

©2008 Cesare Pautasso

Measuring Complexity

	REST	WS-*
Decisions	5	12
Alternatives	16	32

Decisions with *more than 1* alternative options

	REST	WS-*
Decisions	17	14
Alternatives	27	35

Decisions with *1 or more* alternative options

©2008 Cesare Pautasso

Measuring Complexity

	REST	WS-*
Decisions	5	12
Alternatives	16	32

Decisions with *more than 1* alternative options

- URI Design
- Resource Interaction Semantics
- Payload Format
- Service Description
- Service Composition

©2008 Cesare Pautasso

Measuring Complexity

	REST	WS-*
Decisions	5	12
Alternatives	16	32

Decisions with *more than 1* alternative options

	REST	WS-*
Decisions	12	2

Decisions with *only 1* alternative option

©2008 Cesare Pautasso

Measuring Complexity

- Payload Format
- Data Representation Modeling

	REST	WS-*
Decisions	12	2

Decisions with *only 1* alternative option

©2008 Cesare Pautasso

Measuring Effort

	REST	WS-*
Do-it-yourself Alternatives	5	0

Decisions with **only** *do-it-yourself* alternatives

	REST	WS-*
Decisions	12	2

Decisions with *only 1* alternative option

©2008 Cesare Pautasso

Measuring Effort

	REST	WS-*
Do-it-yourself Alternatives	5	0

Decisions with **only** *do-it-yourself* alternatives

- Resource Identification
- Resource Relationship

- Reliability
- Transactions
- Service Discovery

©2008 Cesare Pautasso

Università della Svizzera italiana

Facoltà di scienze informatiche

Freedom of Choice
Freedom from Choice

October 7-8, 2008
1st International SOA SYMPOSIUM

Architectural Decision and AAs	REST	WS-*
Integration Style	1 AA	2 AAs
Shared Database		
File Transfer		
Remote Procedure Call	✓	✓
Messaging		✓
Contract Design	1 AA	2 AAs
Contract-first		✓
Contract-last		✓
Contract-less	✓	
Resource Identification	1 AA	n/a
Do-it-yourself	✓	
URI Design	2 AA	n/a
"Nice" URI scheme	✓	
No URI scheme	✓	
Resource Interaction Semantics	2 AAs	n/a
Lo-REST (`POST`, `GET` only)	✓	
Hi-REST (4 verbs)	✓	
Resource Relationships	1 AA	n/a
Do-it-yourself	✓	
Data Representation/Modeling	1 AA	1 AA
XML Schema	(✓)[a]	✓
Do-it-yourself	✓	
Message Exchange Patterns	1 AA	2 AAs
Request-Response	✓	✓
One-Way		✓
Service Operations Enumeration	n/a	≥3 AAs
By functional domain		✓
By non-functional properties and QoS		✓
By organizational criterion (versioning)		✓
Total Number of Decisions, AAs	**8**, 10	**5**, ≥10

[a] Optional

Table 2: Conceptual Comparison Summary

Architectural Decision and AAs	REST	WS-*
Transport Protocol	1 AA	≥7 AAs
HTTP	✓	✓[a]
waka [13]	(✓)[b]	
TCP		✓
SMTP		✓
JMS		✓
MQ		✓
BEEP		✓
IIOP		✓
Payload Format	≥6 AAs	1 AA
XML (SOAP)	✓	✓
XML (POX)	✓	
XML (RSS)	✓	
JSON [10]	✓	
YAML	✓	
MIME	✓	
Service Identification	1 AA	2 AA
URI	✓	✓
WS-Addressing		✓
Service Description	3 AAs	2 AAs
Textual Documentation	✓	
XML Schema	(✓)[c]	✓
WSDL	✓[d]	✓
WADL [18]	✓	
Reliability	1 AA	4 AAs
HTTPR [38][e]	(✓)	(✓)
WS-Reliability		✓
WS-ReliableMessaging		✓
Native		✓
Do-it-yourself	✓	✓
Security	1 AA	2 AAs
HTTPS	✓	✓
WS-Security		✓

Transactions	1 AA	3 AAs
WS-AT, WS-BA		✓
WS-CAF		✓
Do-it-yourself	✓	✓
Service Composition	2 AAs	2 AAs
WS-BPEL		✓
Mashups	✓	
Do-it-yourself	✓	✓
Service Discovery	1 AAs	2 AAs
UDDI		✓
Do-it-yourself	✓	✓
Implementation Technology	many	many
…	✓	✓
Total Number of Decisions, AAs	**10**, ≥17	**10**, ≥25

[a] Limited to only the verb `POST`
[b] Still under development
[c] Optional
[d] WSDL 2.0
[e] Not standard

Table 3: Technology Comparison Summary

Architectural Principle and Aspects	REST	WS-*
Protocol Layering	yes	yes
HTTP as application-level protocol	✓	
HTTP as transport-level protocol		✓
Dealing with Heterogeneity	yes	yes
Browser Wars	✓	
Enterprise Computing Middleware		✓
Loose Coupling, aspects covered	yes, 2	yes, 3
Time/Availability		✓
Location (Dynamic Late Binding)	(✓)	✓
Service Evolution:		
Uniform Interface	✓	
XML Extensibility	✓	✓
Total Principles Supported	**3**	**3**

Table 1: Principles Comparison Summary

©2008 Cesare Pautasso

Comparison Summary

- Architectural Decisions measure complexity implied by alternative technologies

- **REST simplicity** = freedom from choice
  - 5 decisions require to choose among 16 alternatives
  - 12 decisions are already taken (but 5 are *do-it-yourself*)

- **WS-* complexity** = freedom of choice
  - 12 decisions require to choose among 32 alternatives
  - 2 decisions are already taken (SOAP, WSDL+XSD)

©2008 Cesare Pautasso

Conclusion

- You should focus on whatever solution gets the job done and try to **avoid being religious** about any specific architectures or technologies.
- WS-* has strengths and weaknesses and will be highly suitable to some applications and positively terrible for others. Likewise with REST.
- The decision of which to use depends entirely on the application requirements and constraints.
- We hope this comparison will help you make the right choice.

©2008 Cesare Pautasso

References

- Cesare Pautasso, Olaf Zimmermann, Frank Leymann, RESTful Web Services vs. Big Web Services: Making the Right Architectural Decision, Proc. of the 17th International World Wide Web Conference (WWW2008), Bejing, China, April 2008.

- Cesare Pautasso, BPEL for REST, Proc. of the 6th International Conference on Business Process Management (BPM 2008), Milan, Italy, September 2008.

- Cesare Pautasso, Gustavo Alonso: **From Web Service Composition to Megaprogramming** In: Proceedings of the 5th VLDB Workshop on Technologies for E-Services (TES-04), Toronto, Canada, August 29-30, 2004.

©2008 Cesare Pautasso

Università della Svizzera italiana

Facoltà di scienze informatiche

REST vs. SOAP: Making the Right Architectural Decision

Cesare Pautasso

Faculty of Informatics

University of Lugano (USI), Switzerland

http://www.pautasso.info

©2008 Cesare Pautasso