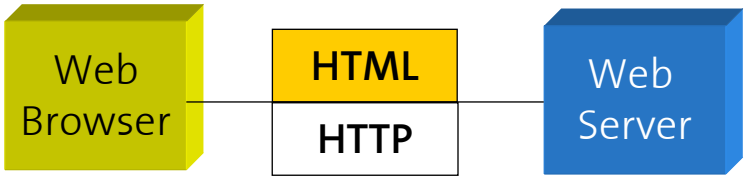
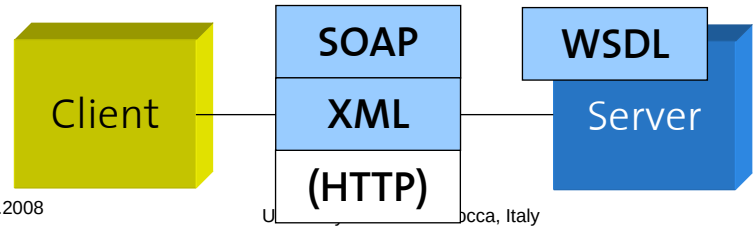
Web Services in 2008: *to REST or not to REST?*

Cesare Pautasso
Faculty of Informatics
University of Lugano, CH
http://www.pautasso.info

Web Sites (1992)



WS-* Web Services (2000)



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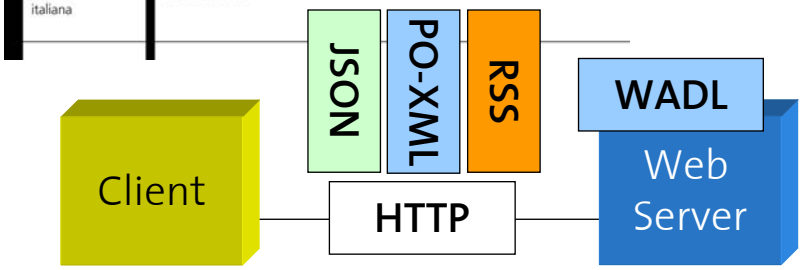
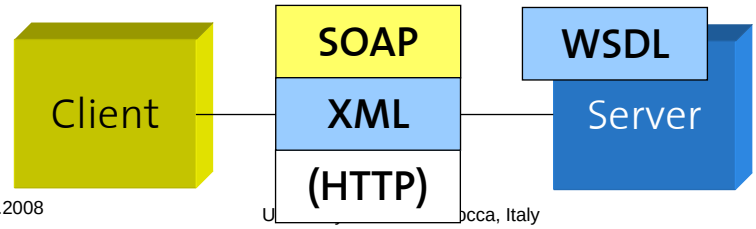
RESTful Web Services (2007)



WS-* Web Services (2000)



Web Services Standards

Web Services Standards

RESTful

RSS

XML JSON

MIME

URI HTTP

SSL

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Is REST being used?

Slide from Paul Downey, BT

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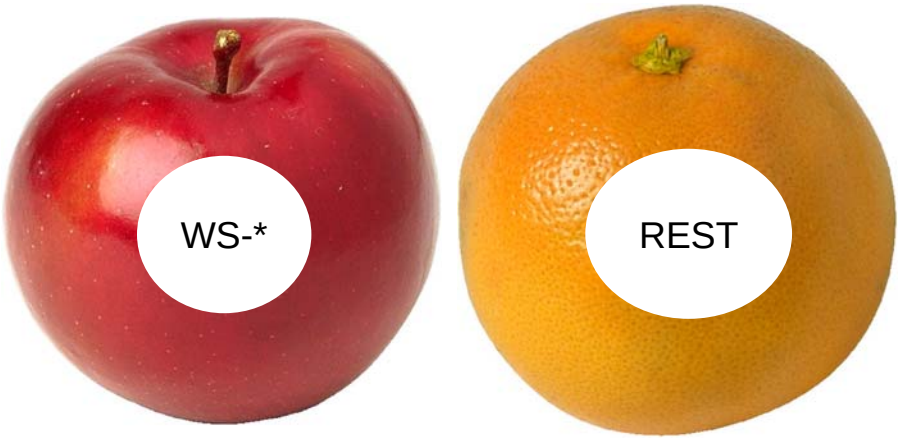
Can we really compare WS-* vs. REST?



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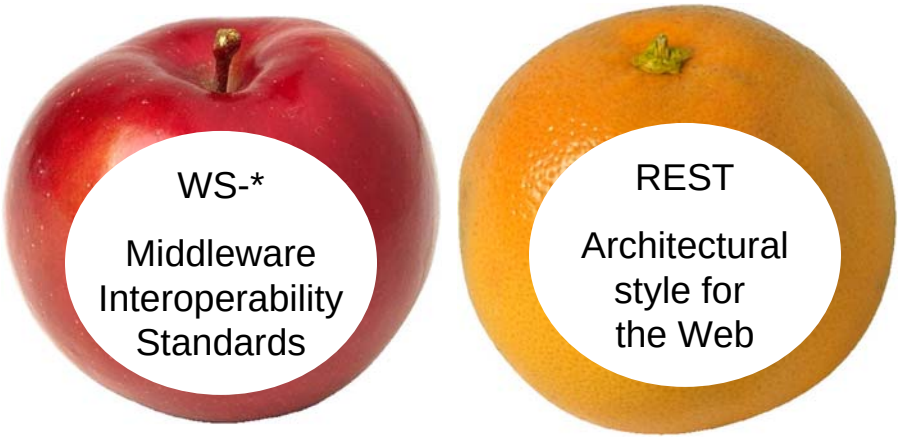
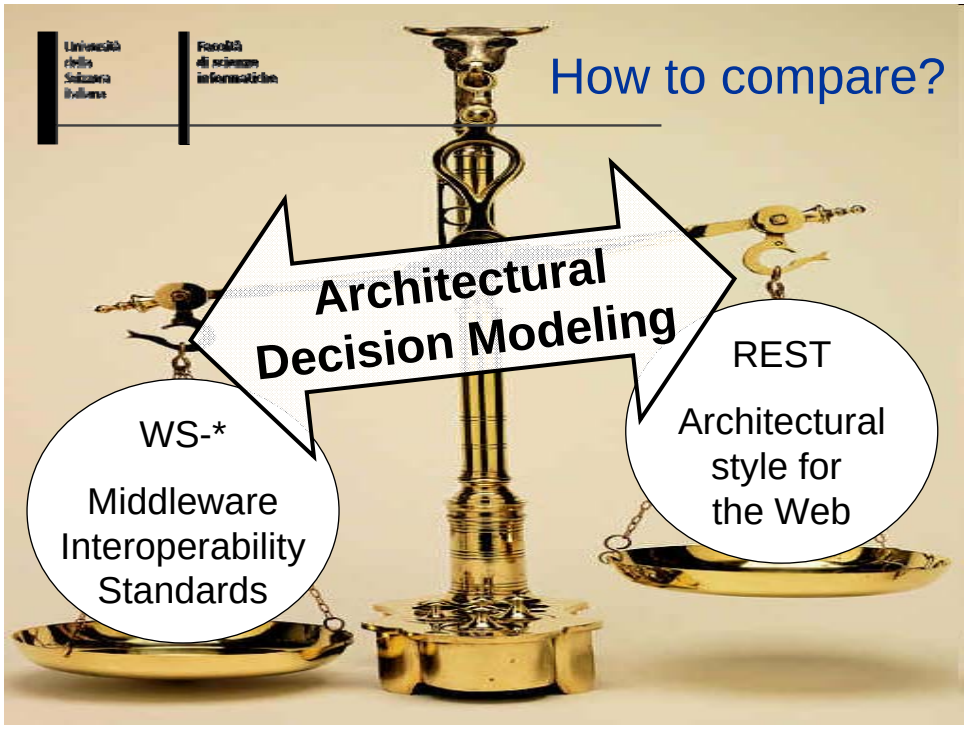
Can we really compare WS-* vs. REST?





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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

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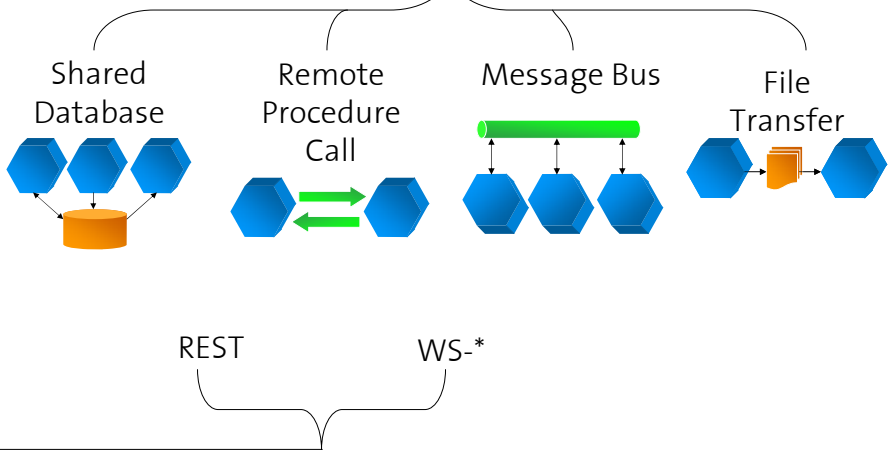
Application Integration Styles



Integration Technology Platform

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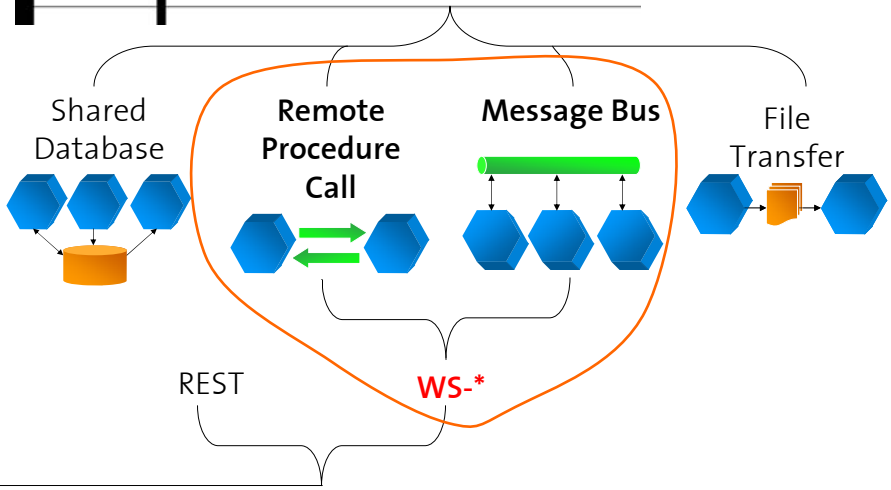
Related Decisions (WS-*)



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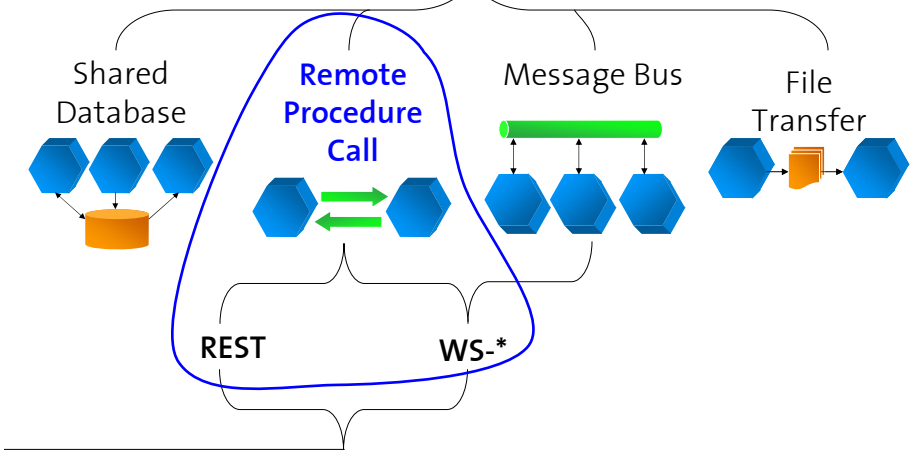
Related Decisions (RPC)



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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	(✓)[c]	✓
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

[c]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

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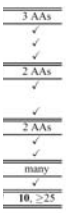
Outline

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-*



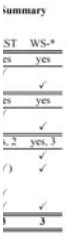


Table 2: Conceptual Comparison Summary

Table 1: Principles Comparison Summary

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Architectural Principles

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

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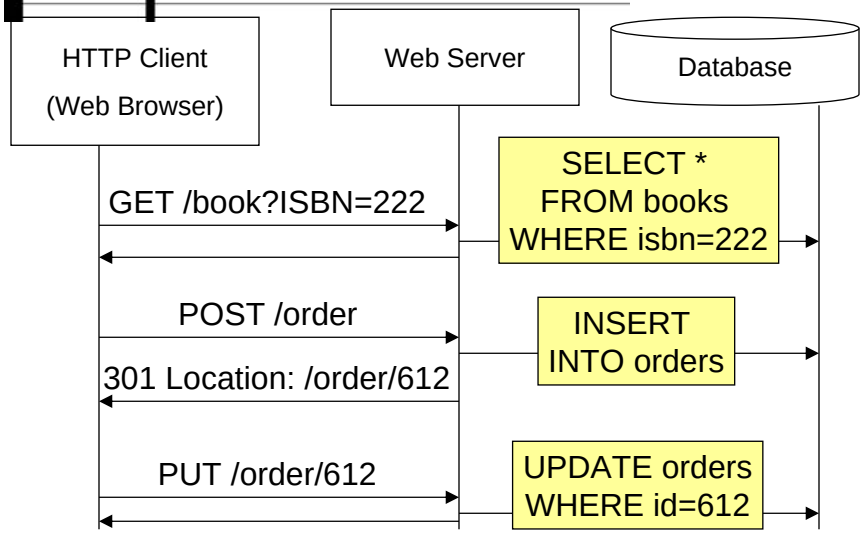
RESTful Web Service Example



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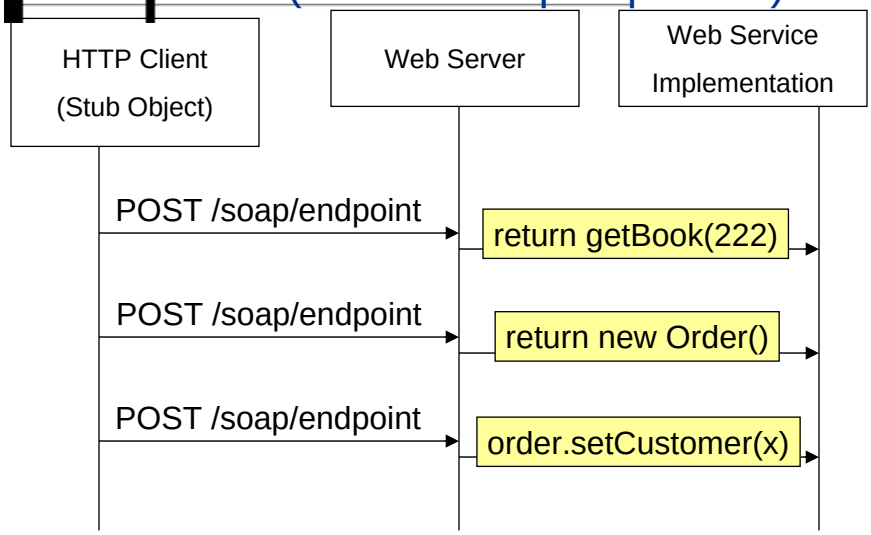
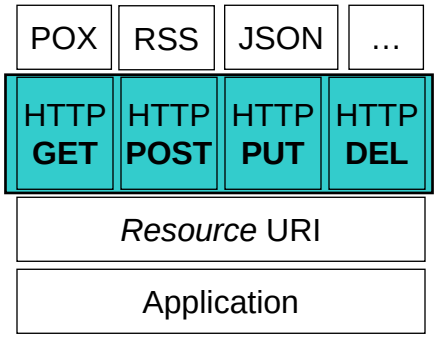
Big Web Service Example (from REST perspective)

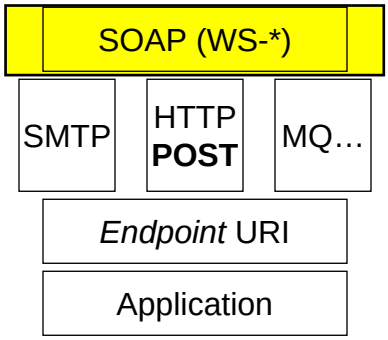


Protocol Layering

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



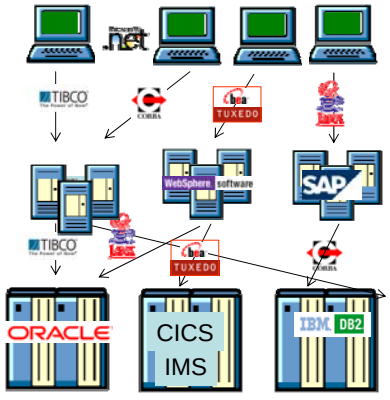
- "The Web is the universe (tunneling) transport for messages"
  - Applications get a chance to interact but they remain "outside of the Web"



Dealing with Heterogeneity

- Web Applications

- Enterprise Computing



Picture from Eric Newcomer, IONA

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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	1 AA	n/a
Do-it-yourself	✓	
URI Design	2 AA	n/a

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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)	✓	

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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

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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

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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

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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

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Measuring Complexity

- Payload Format
- Data Representation Modeling

	REST	WS-*
Decisions	12	2

Decisions with *only 1* alternative option

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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

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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

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Freedom of Choice
Freedom from Choice

Architectural Decision and AAs	REST	WS-*
Integration Style	1 AA	2 AAs
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File Transfer		
Remote Procedure Call	✓	✓
Messaging		✓
Contract Design	1 AA	2 AAs
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Resource Identification	1 AA	n/a
Do-it-yourself	✓	
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Hi-REST (4 verbs)	✓	
Resource Relationships	1 AA	n/a
Do-it-yourself	✓	
Data Representation/Modeling	1 AA	1 AA
XML Schema	(✓)[a]	✓
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[a] Optional

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MQ		✓
BEEP		✓
IIOP		✓
Payload Format	≥6 AAs	1 AA
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XML (POX)	✓	
XML (RSS)	✓	
JSON [10]	✓	
YAML	✓	
MIME	✓	
Service Identification	1 AA	2 AAs
URI	✓	✓
WS-Addressing		✓
Service Description	3 AAs	2 AAs
Textual Documentation	✓	
XML Schema	(✓)[a]	✓
WSDL	✓	✓
WADL [18]	✓	
Reliability	1 AA	4 AAs
HTTPR [38][c]	(✓)[a]	(✓)
WS-Reliability		✓
WS-ReliableMessaging		✓
Native		✓
Do-it-yourself	✓	
Security	1 AA	2 AAs
HTTPS	✓	✓
WS-Security		✓

	REST	WS-*
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WS-AT, WS-BA		✓
WS-CAF		✓
Do-it-yourself	✓	✓
Service Composition	2 AAs	2 AAs
WS-BPEL		✓
Mashups	✓	
Do-it-yourself	✓	✓
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Do-it-yourself	✓	✓
Implementation Technology	many	many
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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

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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)

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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.

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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.