

Gustavo Alonso • Fabio Casati Harumi Kuno • Vijay Machiraju

Web Services

Concepts, Architectures and Applications

With 143 Figures



Contents

Part I Conventional Middleware

Dis	tribut	ed Information Systems	3
1.1	Design of an Information System		
	1.1.1	Layers of an Information System.	4
	1.1.2	Top-down Design of an Information System	6
	1.1.3	Bottom-up Design of an Information System	. 7
1.2	Archi	tecture of an Information System	9
	1.2.1	One-tier Architectures	10
	1.2.2	Two-tier Architectures	12
	1.2.3	Three-tier Architectures	. 16
	1.2.4	N-tier Architectures	19
	1.2.5	Distributing Layers and Tiers	21
1.3	Com	nunication in an Information System	. 22
	1.3.1	Blocking and Non Blocking Interactions.	
	1.3.2	Synchronous or Blocking Calls	23
	1.3.3	Asynchronous or Non Blocking Calls	
1.4	Sumn	nary	
Mid		ıre	
2.1	Understanding Middleware.		
	2.1.1	Middleware as a Programming Abstraction	
	2.1.2	Middleware as Infrastructure	
	2.1.3	Types of Middleware	
	2.1.4	Middleware Convergence	
2.2	RPC	and Related Middleware.	35
	2.2.1	Historical Background	35
	2.2.2	How RPC Works	
	2.2.3	Binding in RPC	39
	2.2.4	RPC and Heterogeneity	. 41
	2.2.5	Extensions to RPC	42

		2.2.6	RPC Middleware Infrastructure: DCE	. 43			
	2.3	TP M	onitors	45			
		2.3.1	Historical Background	. 45			
		2.3.2	Transactional RPC and TP Monitors				
		2.3.3	Functionality of a TP Monitor	50			
		2.3.4	Architecture of a TP Monitor	51			
	2.4	Objec	t Brokers	53			
		2.4.1	Historical Background				
		2.4.2	CORBA: System Architecture				
		2.4.3	How CORBA Works.				
		2.4.4	CORBA: Dynamic Service Sclcction and Invocation				
		2.4.5	CORBA: Encapsulation				
		2.4.6	TP Moiiitors+Object Brokers = Object Monitors.				
	2.5		age-Oricnted Middleware.				
		2.5.1	Historical Background.				
		2.5.2	Mcssage-Based Interoperability				
		2.5.3	Message Queues.				
		2.5.4	Interacting with a Message Queuing System				
		2.5.5	Transactional Queues				
	2.6	Summ	1ary				
3	Enterprise Application Integration						
3	3.1		Middleware to Application Integration				
	5.1	3.1.1	From a Mainframe to a Set of Servers.				
		3.1.2	From a Set of Servers to a Multitude of Services.				
		3.1.2	An Example of Application Integration				
	3.2		Aiddleware: Message Brokers.				
	5.2	3.2.1	Historical Background				
		3.2.2	The Need for Message Brokers				
		3.2.3	Extending Basic MOM				
		3.2.4	The Publish/Subscribe Interaction Model				
		3.2.5	Distributed Administration of a Message Broker				
		3.2.6	EAI with a Message Broker.				
		3.2.7	A Critical View of Message Brokers as EAI Platforms .				
	3.3		flow Management Systems.				
		3.3.1	Historical Background				
		3.3.2	Workflow Definition				
		3.3.3	Workflow Execution				
		3.3.4	Workflows as Programming in the Large.				
		3.3.5	Integration of WfMSs with Other Middleware				
			Technologies	89			
		3.3.6	Benefits and Limitations of WfMS				
	3.4		nary				

4	We	b Technologies
	4.1	Exchanging Information over the Internet
		4.1.1 Before the Web
		4.1.2 The Web
		4.1.3 Limitations of HTTP
	4.2	Web Technologies for Supporting Remote Clients
		4.2.1 Need for Supporting Remote Clients
		4.2.2 Applets
		4.2.3 Common Gateway Interface
		4.2.4 Servlets102
	4.3	Application Servers
		4.3.1 Middleware for Web Applications
		4.3.2 J2EE as the Gore of an Application Server
		4.3.3 Application Server Support for the Application Layer 105
		4.3.4 Application Server Support for the Presentation Layer . 108
	4.4	Web Technologies for Application Integration
		4.4.1 Architectures for Wide Area Integration
		4.4.2 Middleware Extensions
		4.4.3 Firewalls and Tunneling through HTTP
		4.4.4 Common Data Repräsentation: EDIFACT
		4.4.5 XML
	4.5	Summary

Part II Web Services

5	We	b Serv	rices	
	5.1	Web	Services and their Approach to Distributed Computing .	. 124
		5.1.1	Defining Web Services	. 124
		5.1.2	Motivating the Need for B2B Integration	125
		5.1.3	Limitations of Conventional Middleware in B2B	
			Integration	127
		5.1.4	B2B Integration before Web Services	130
		5.1.5	B2B Integration with Web Services	131
		5.1.6	Web Services and EAL	134
	5.2	Web a	Services Technologies	136
		5.2.1	Service Description	
		5.2.2	Service Discovery.	
		5.2.3	Service Interactions.	
		5.2.4	Combining Web Services: Composition	141
	5.3	Web	Services Architecture	. 141
		5.3.1	The Two Facets of Web Services Architectures	. 141
		5.3.2	Internal Architecture of a Web Service	143
		5.3.3	External Architecture of a Web Service	144
	5.4	Sumn	nary	148

6	Bas	ic We	b Services Technology	. 151		
	6.1	A Mi	nimalist Infrastructure for Web Services	.152		
	6.2	SOAF	P: Simple Object Access Protocol	155		
		6.2.1	Goals of SOAP	155		
		6.2.2	Structure and Contents of a SOAP Message	157		
		6.2.3	Processing a SOAP Message	. 160		
		6.2.4	Binding SOAP to a Transport Protocol	. 161		
		6.2.5	A Simple Implementation of SOAP			
		6.2.6	Asynchronous SOAP			
		6.2.7				
	6.3		L: Web Services Description Language			
		6.3.1	Goals of WSDL			
		6.3.2	Structure of a WSDL Interface			
		6.3.3	Implications of the WSDL Model.			
		6.3.4	üsing WSDL			
		6.3.5	WSDL and Other Standards.			
	6.4		I: Universal Description Discovery and Integration			
		6.4.1	Goals of UDDI			
		6.4.2	Information in a UDDI Registry.			
		6.4.3	UDDI Data Structures			
		6.4.4	Understanding tModels.			
		6.4.5	UDDI Registry API			
		6.4.6	Searching the UDDI Registry.			
		6.4.7	Storing WSDL Interfaces in a UDDI Registry.			
		6.4.8	Public and Private R.cgistries.			
	6.5					
	6.6		ctions Between the Specifications	. 18/		
		6.6.1		18/		
		6.6.2	Advanced SOAP: Effects on Service Description and	100		
			Discovery.			
		6.6.3	UDDI and Dynamic Binding.			
	6.7		ed Standards.			
		6.7.1	0			
		6.7.2	6			
		6.7.3	<i>.</i>			
		6.7.4				
	6.8	6.7.5	Web Services Invocation Framework (WSIF)			
	0.8	Summ	nary	193		
7	Ser	vice c	oordination protocols	. 197		
	7.1	An Iı	ntroduction to Coordination Protocols	. 198		
		7.1.1	The Need for Coordination	. 198		
		7.1.2	Modeling Conversations between a Client and a Web			
			Service	199		
		7.1.3	Modeling Conversations among Multiple Web Services	. 200		

	7.1.4	Service Interfaces and Coordination Protocols	205
	7.1.5	Classifying Web Services Protocols	207
7.2	Infras	tructure for Coordination Protocols	. 209
	7.2.1	Conversation Controllers	. 209
	7.2.2	Gencric Protocol Handlers	212
	7.2.3	Standardization Requirements for Coordination	
		Protocols	
7.3		pordination	
	7.3.1	Goals of WS-Coordination	
	7.3.2	Components of WS-Coordination	
	7.3.3	Central Coordination	
	7.3.4	Distributed Coordination	
	7.3.5	Summary of WS-Coordination	
7.4		ransaction	
	7.4.1	Transactions in Web Services	
	7.4.2	Relationship with WS-Coordination	
	7.4.3	Atomic Transactions.	
	7.4.4	Business Activities.	
7.5		taNet	
	7.5.1	Goals and Scope of RosettaNet.	
	7.5.2		
	7.5.3	RosettaNet Implementation Framework (RNIF)	
7.6		Standards Related to Coordination Protocols	
		XML Common Business Library (xCBL)	. 239
	7.6.2	Electronic Business Using cXtensible Markup	240
		Language (ebXML)	
	7.6.3	Web Service Choreography Interface (WSCI)	
7.7	Summ	nary	. 243
Ser	vice C	omposition	245
8.1		s of Service Composition.	
0.1	8.1.1	Composition as a Way to Master Complexity.	
	8.1.2	The Need for Service Composition Middleware.	
	8.1.3	Main Elements of Web Services Composition Middlewa	
	8.1.4	Composition Versus Coordination Middleware	
8.2		w Chance of Success for Composition?	
0	8.2.1	Limitations of Conventional Composition Middleware .	
	8.2.2	Opportunities for Web Service Composition Middlewar	
8.3		e Composition Models.	
0.0	8.3.1	Dimensions of a Web Service Composition Model	
	8.3.2	Component Model.	
	8.3.3	Orchestration Model	
	8.3.4	Data and Data Transfer Model	
	8.3.5	Service Selection	
	8.3.6	Transactions	

		8.3.7 Exception Handling.	.273
	8.4	Dependencies between Coordination and Composition	.276
		8.4.1 Coordination Protocols and Composition Schemas	276
		8.4.2 Conversation Controllers and Composition Engines	282
	8.5	BPEL: Business Process Exccution Language for Web Services	283
		8.5.1 Overview	.284
		8.5.2 Component Model	.285
		8.5.3 Orchestration Model	
		8.5.4 Data Types and Data Transfer	
		8.5.5 Service Selection	289
		8.5.6 Exceptions and Transactions.	.290
		8.5.7 Instance Routing	
	8.6	Summary	293
9	Out	look	295
-	9.1	State of the Art in Web Services	
		9.1.1 Available Technology	
		9.1.2 Current Architecture of Web Services.	
		9.1.3 EAI as a Natural Fit for Today's Web Services.	
		9.1.4 Emerging Trends	
	9.2	Applicability of Web Services	
		9.2.1 The Holy Grail	
		9.2.2 The Complexity of B2B Interactions	
		9.2.3 Bypassing Complexity in Closed Communities.	
		9.2.4 Toward Open Communities	
		9.2.5 The Semantic Web	.306
		9.2.6 How Far Are Wc from the Holy Grail?	.308
	9.3	Web Services as a Problem and a Solution: an Example	.308
		9.3.1 Management in Conventional Middleware	
		9.3.2 Management in Web Services.	.309
		9.3.3 Cross-Enterprise Management	.312
		9.3.4 Management through Web Services	
		9.3.5 Web Services Management Standards	.317
	9.4	Summary	.320
Bił	bliogi	raphy.	.321
Inc	dex.		.333