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Modeling Web Services with UML

OMG Web Services Workshop 2002

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Agenda

- What are Web Services?
- What is SOAP?
- What is UDDI?
- What is WSDL?
- What does all of this have to do with each other?
- UML modeling for SOAP, WSDL, and UDDI

What is a Web Service?

- Represents a specific business function
- Exposed by a company
 - Usually through an Internet connection
- Provided to another company or software application to consume

"Web services are becoming the programmatic backbone for electronic commerce..."

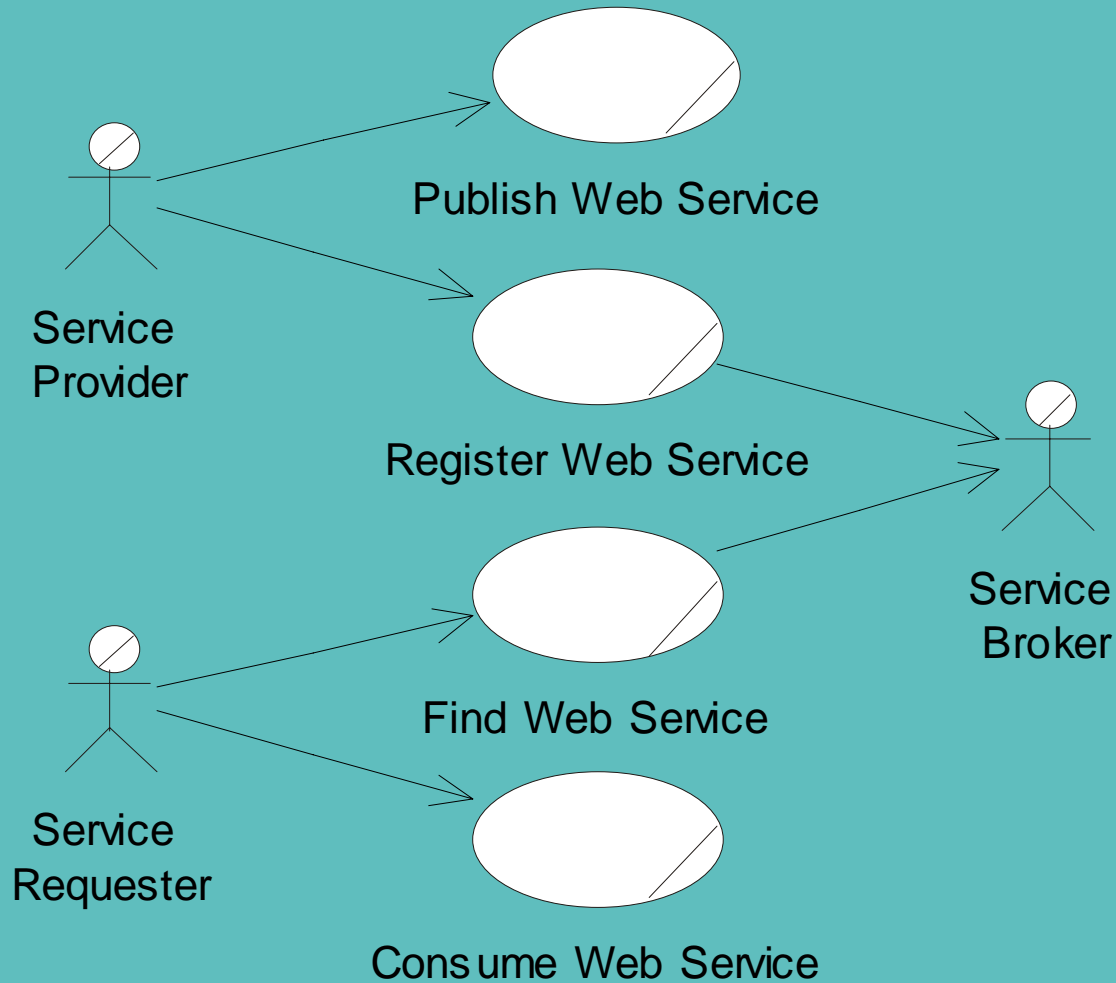
UDDI Technical White Paper

uddi.org

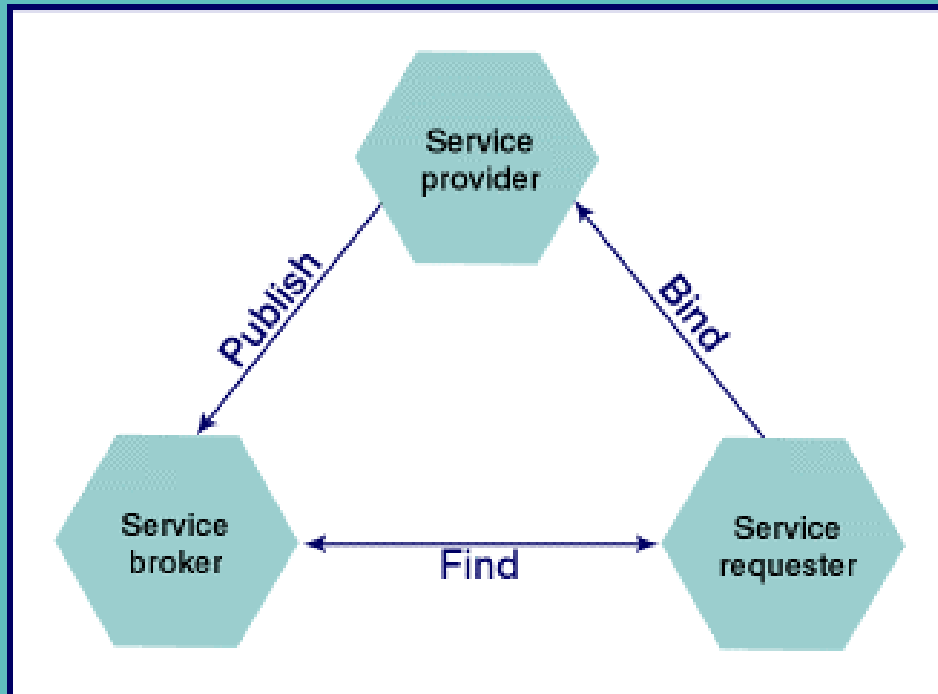
What are Web Service Applications?

- Hyper-applications that are
 - Designed
 - Assembled
 - Executeddynamically at run-time using web services
 - Especially in a B2B environment
- Use emerging industry standards
 - Extensible Markup Language (XML)
 - Simple Object Access Protocol (SOAP)
 - Web Services Description Language (WSDL)
 - Universal Description, Discovery, and Integration (UDDI)

Web Services Business Model

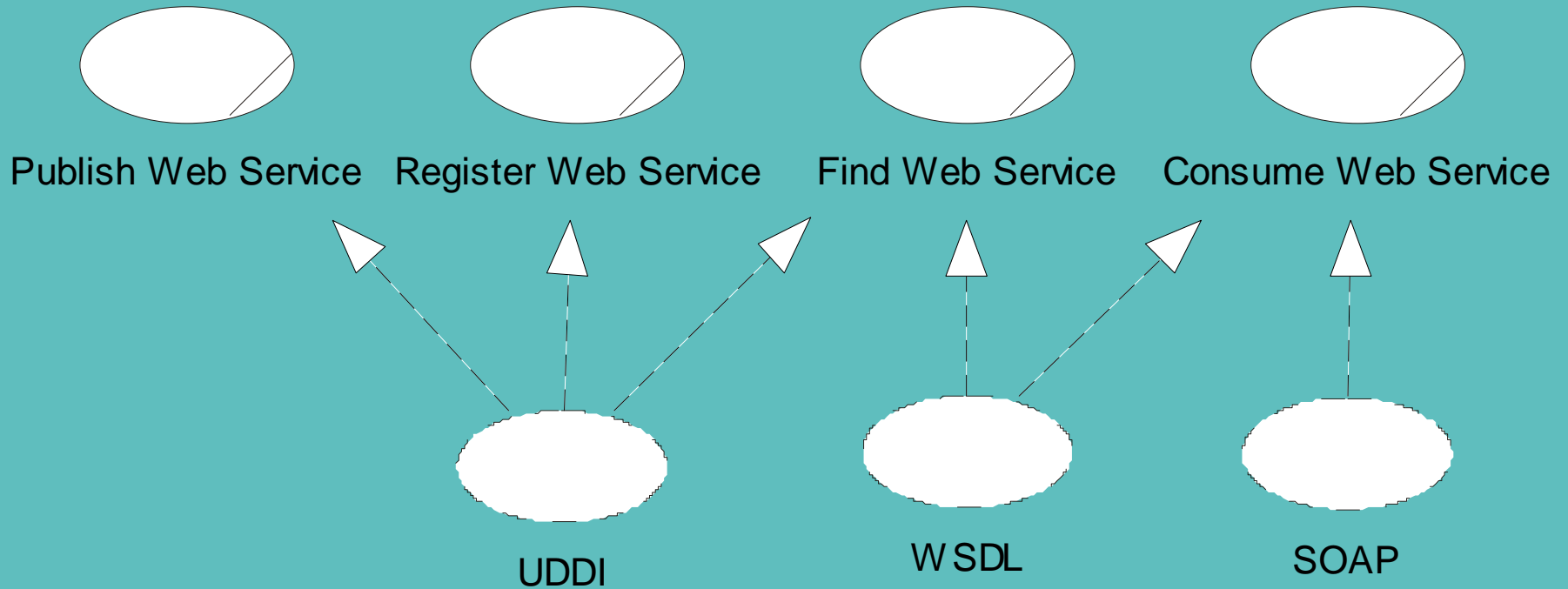


Fundamental Web Service Concepts



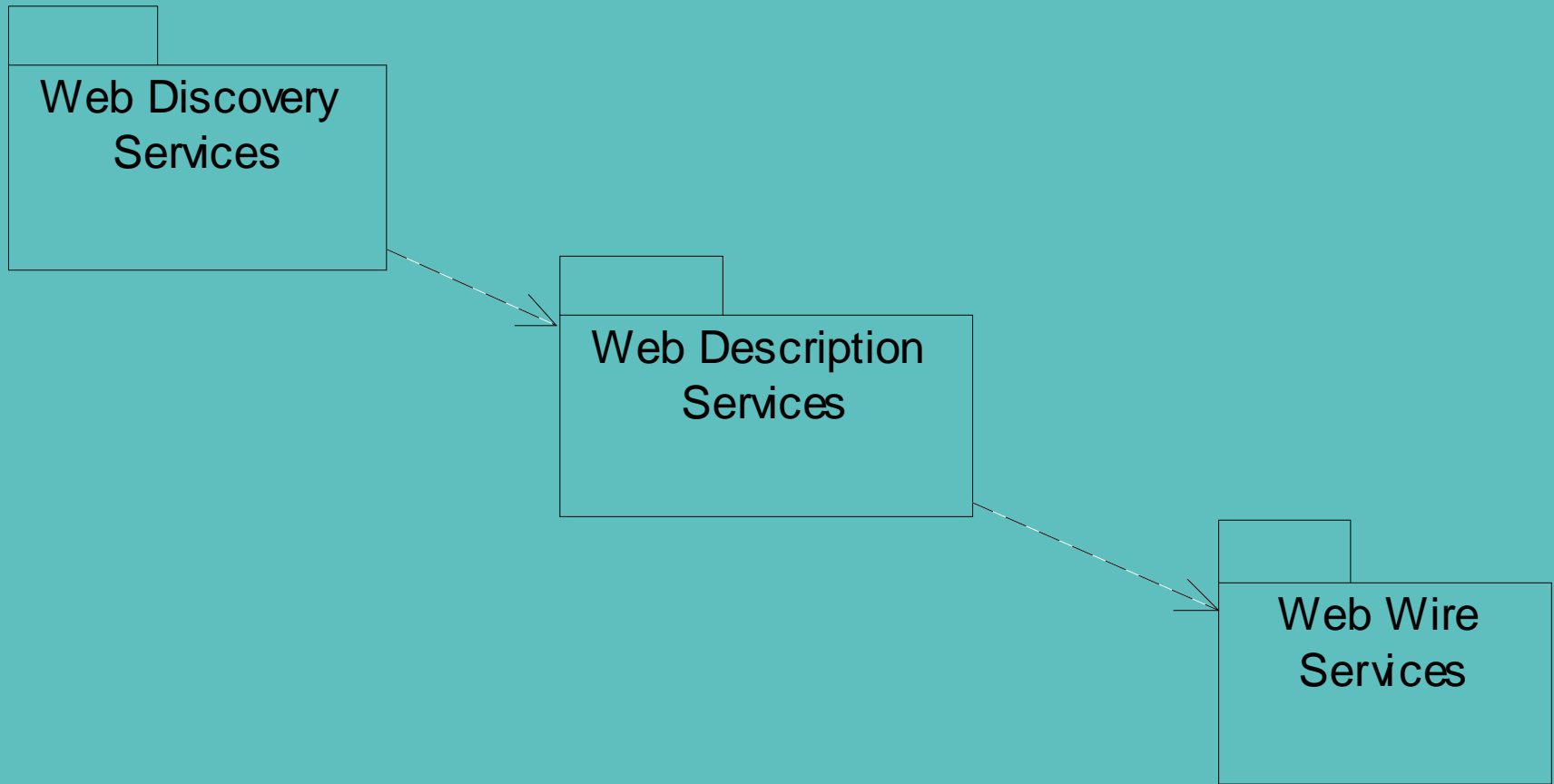
Service	Standard
Publish	UDDI
Find	UDDI, WSDL, DISCO
Bind	WSDL, SOAP

Realization of Web Services Business Model



This is not complete – only shows relationships to industry standards

Web Services Architectural Mechanisms



Web Wire Services

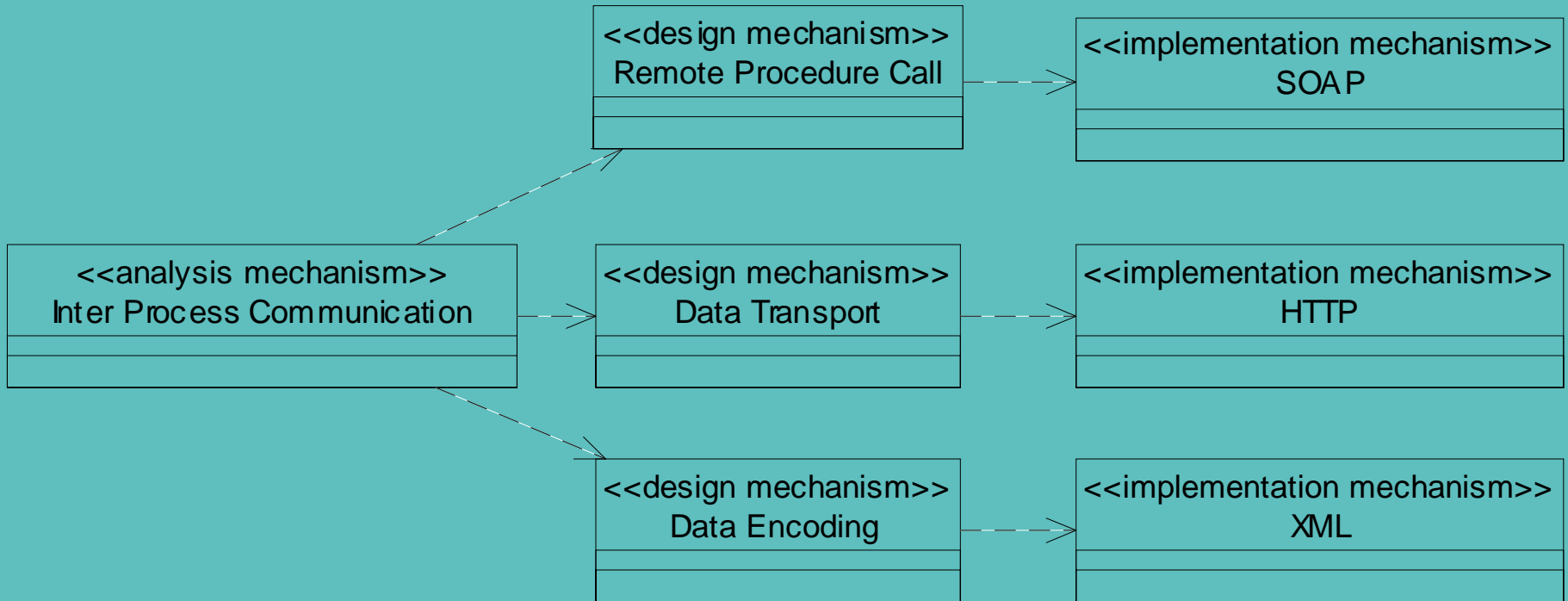
<<analysis mechanism>>
Inter Process Communication

<<analysis mechanism>>
Reliability

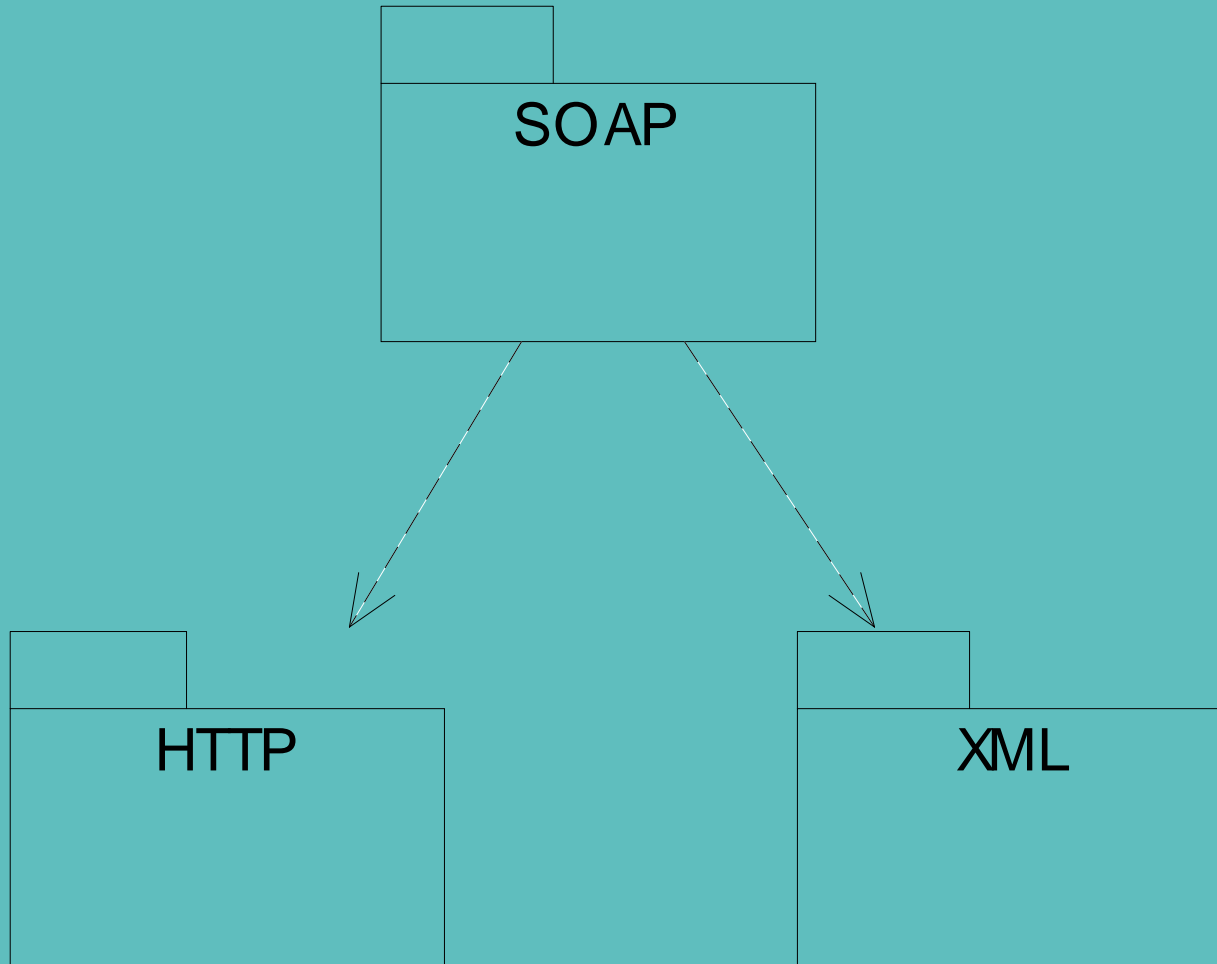
<<analysis mechanism>>
Security

<<analysis mechanism>>
Routing

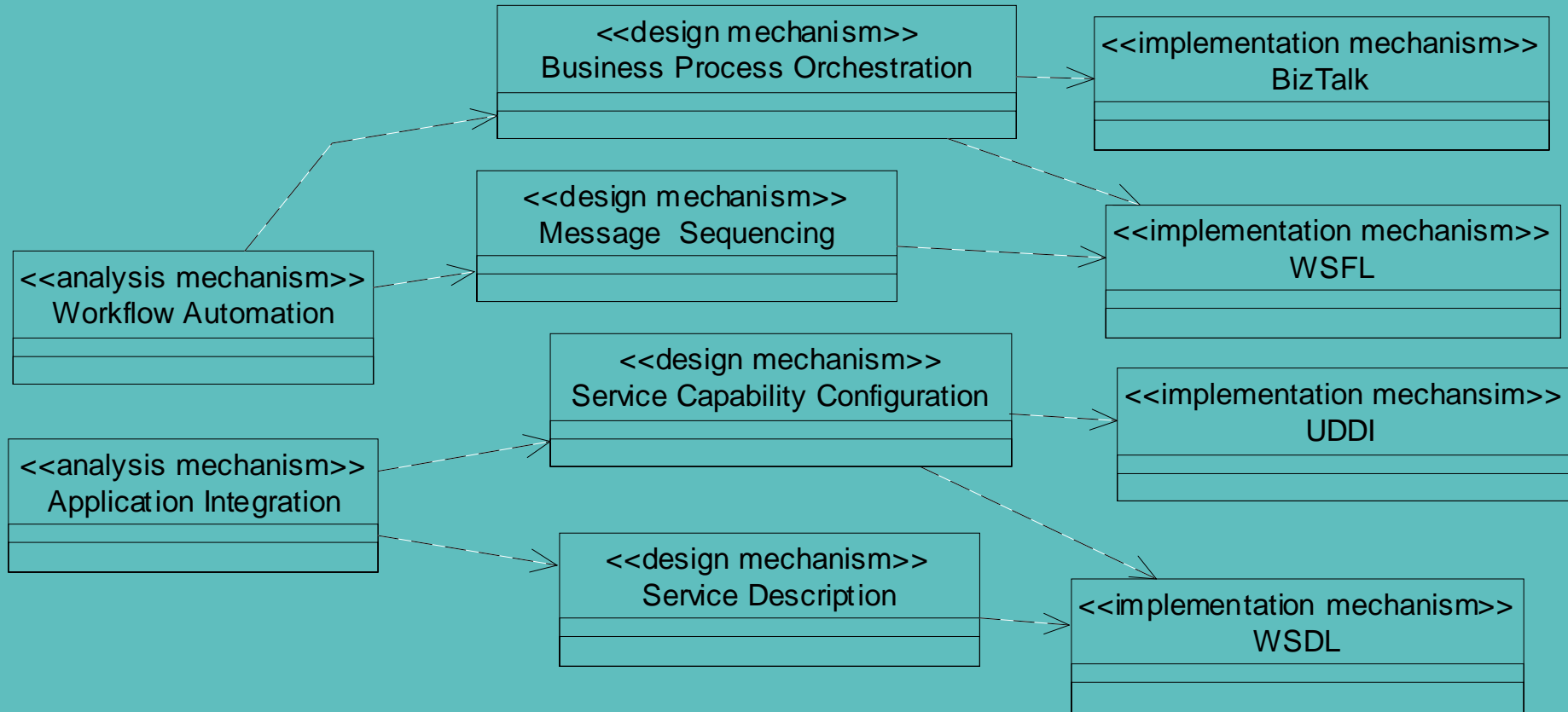
IPC Wire Services



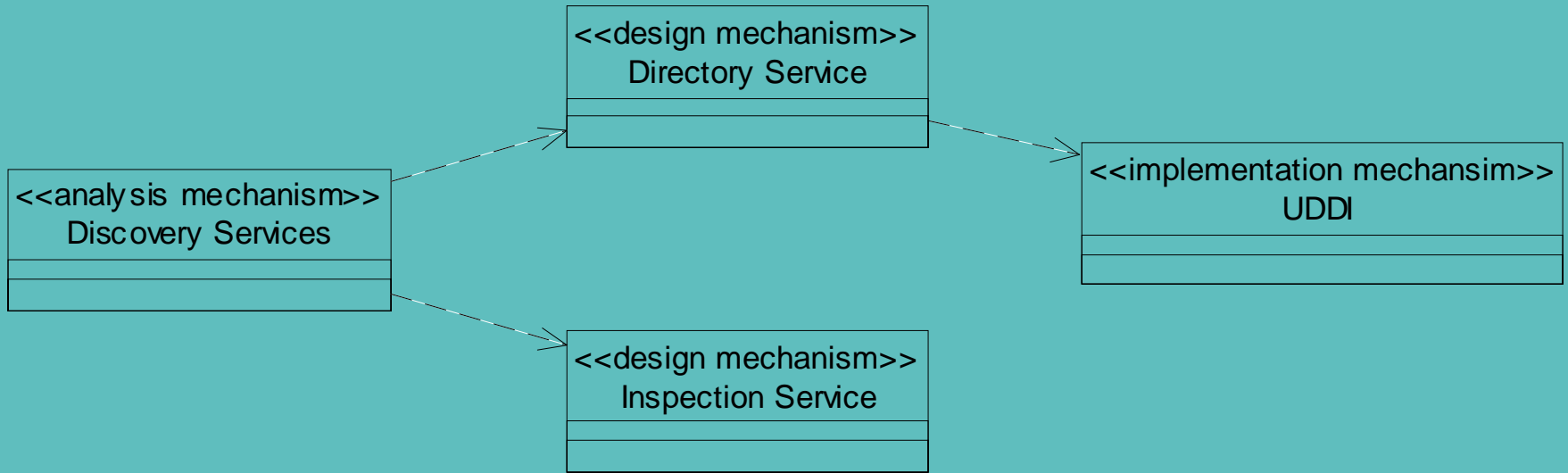
SOAP Wire Services



Web Description Services



Web Discovery Services



What is SOAP?

- Simple Object Access Protocol (SOAP)
 - Standard for invoking services across the web
 - Uses HTTP for transport
 - Uses XML for data encoding
 - Extensible

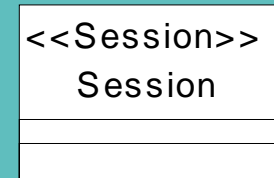
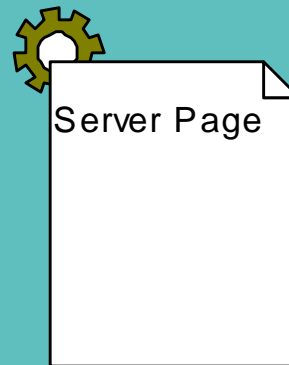
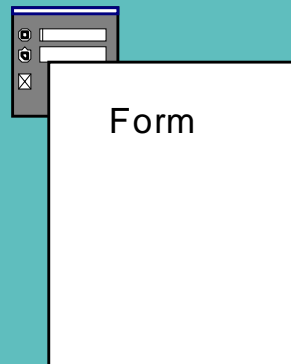
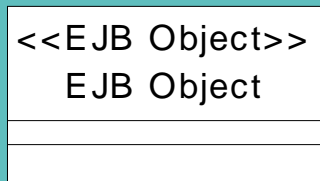
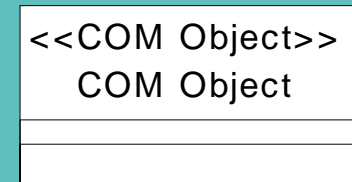
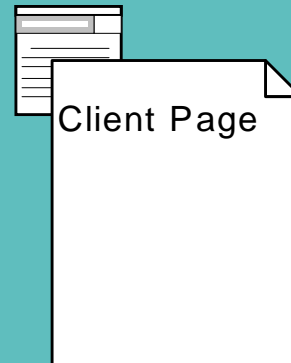
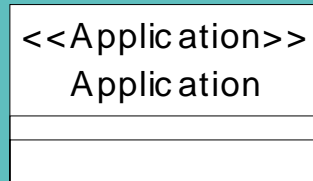
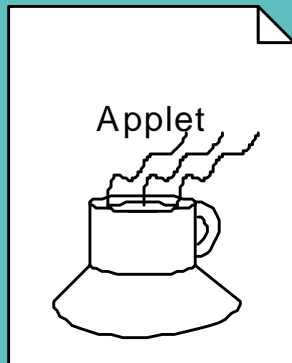
Benefits of SOAP

- Can invoke components residing in many architectures
 - DCOM
 - CORBA
 - EJB
 - Perl
- ⇒ Heterogeneous “glue”
- Cross-platform, cross-architecture integration

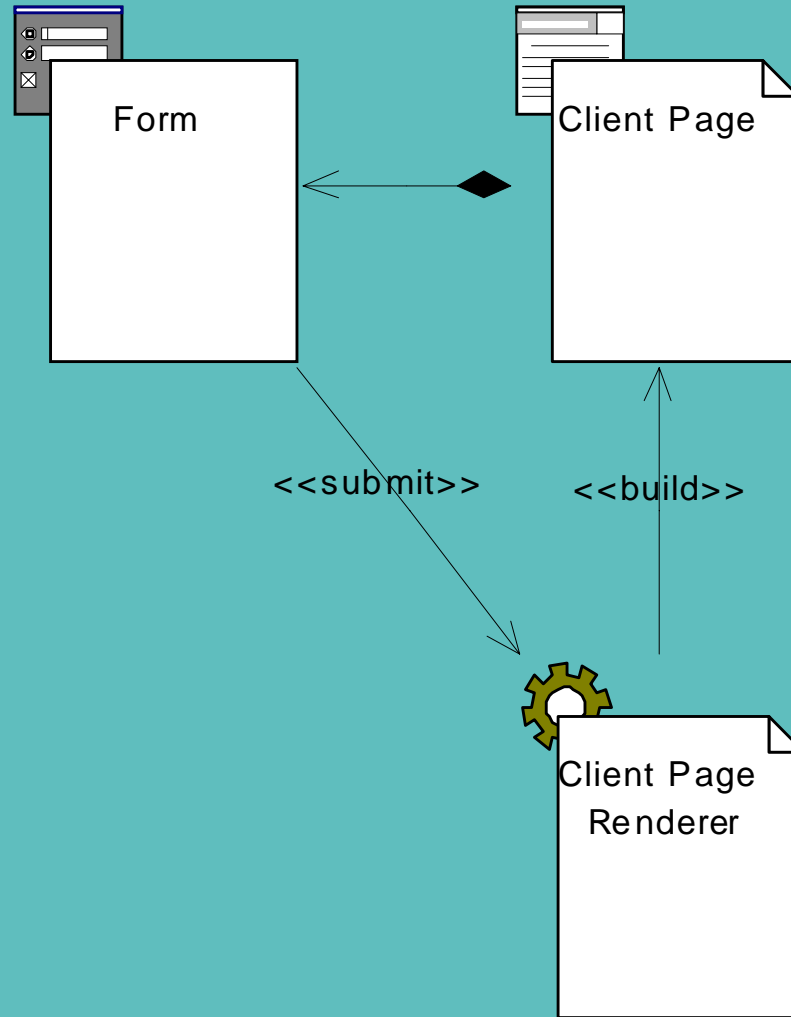
Benefits of SOAP

- Uses industry standards
 - HTTP
 - Works through firewalls!
 - XML
- Platform-independent
 - Can be invoked from any platform
 - Browser
 - Desktop application
 - Server component

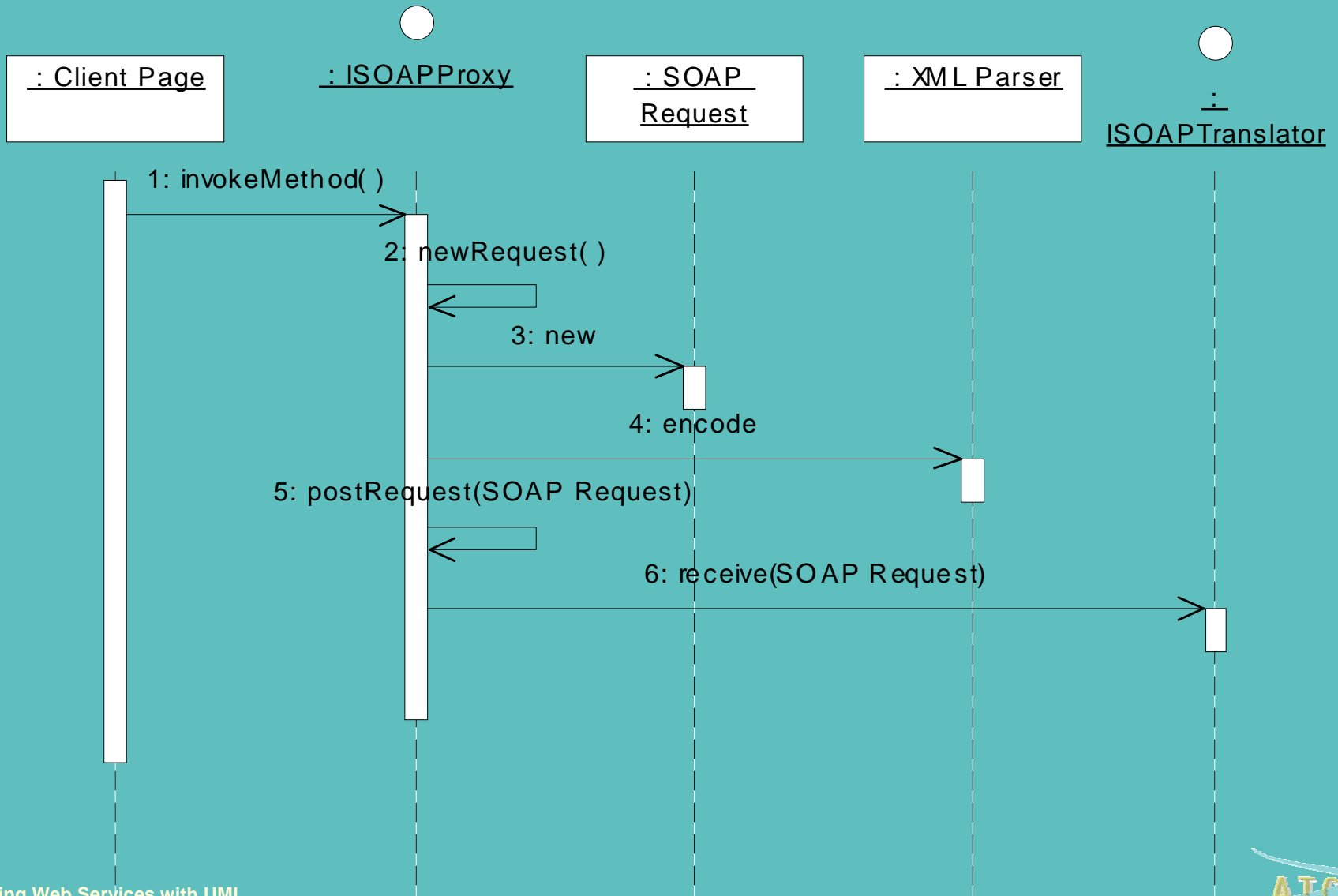
Web Application Extensions (WAE) for UML



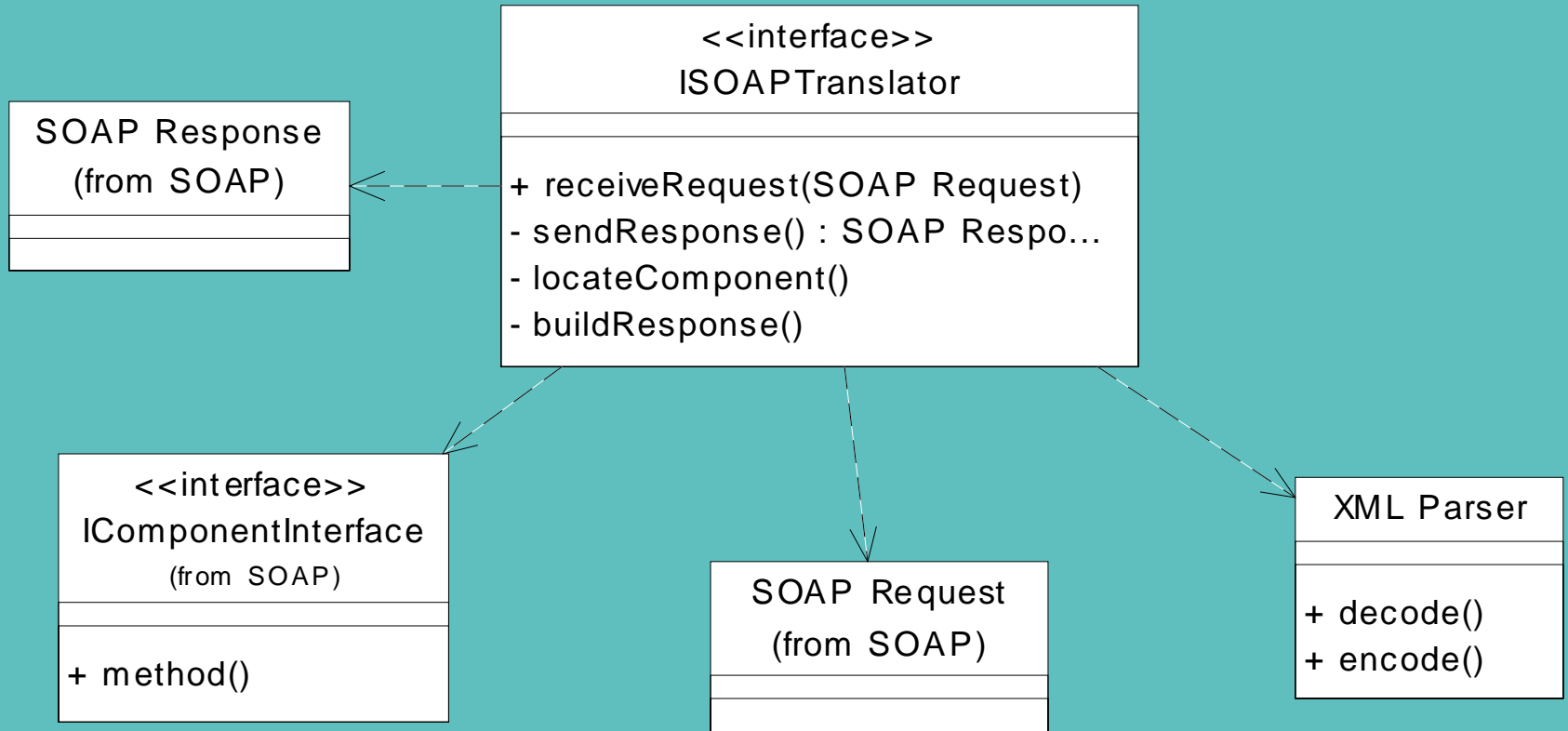
Standard HTTP Form POST



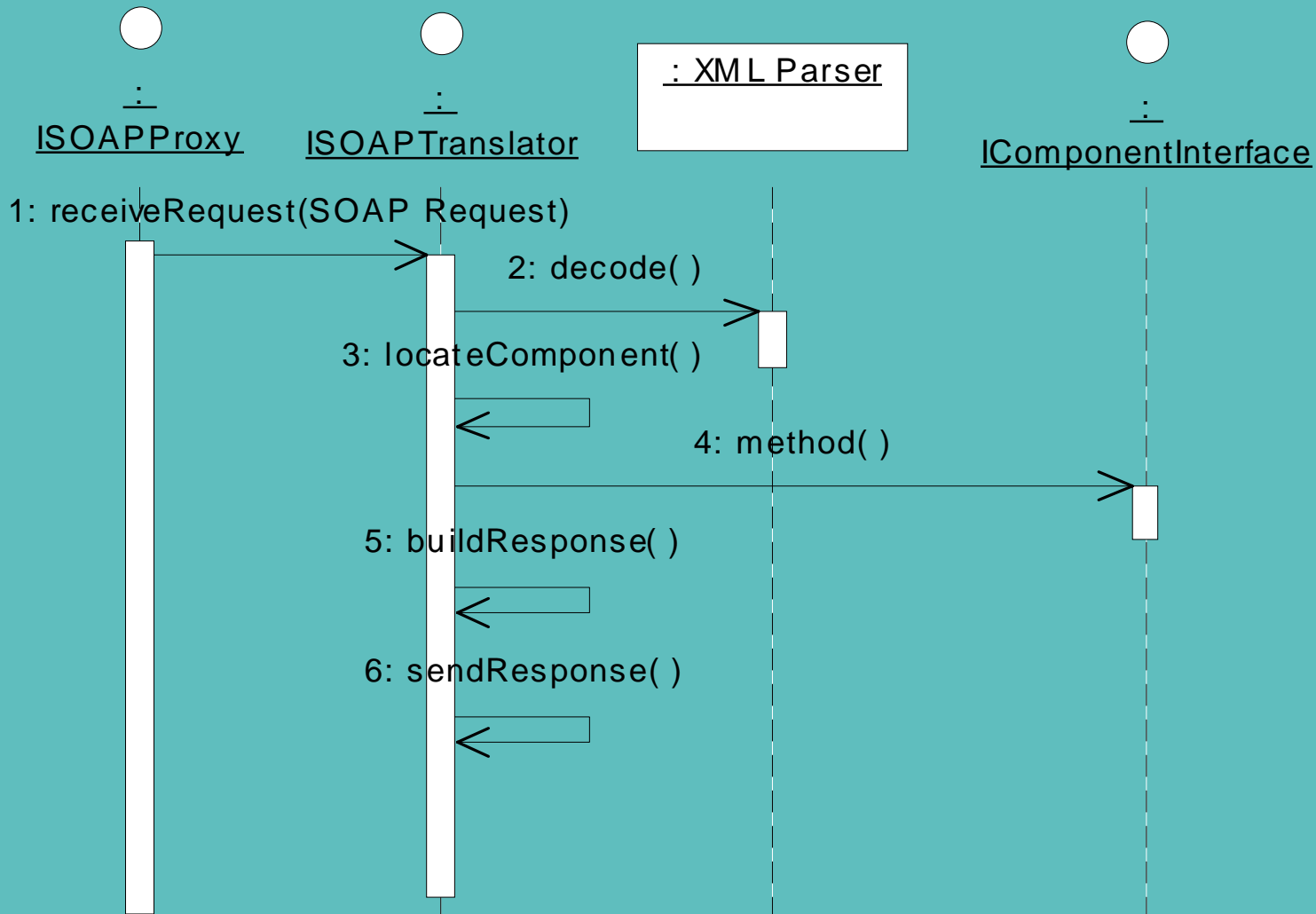
SOAP Request from Browser - Behavior



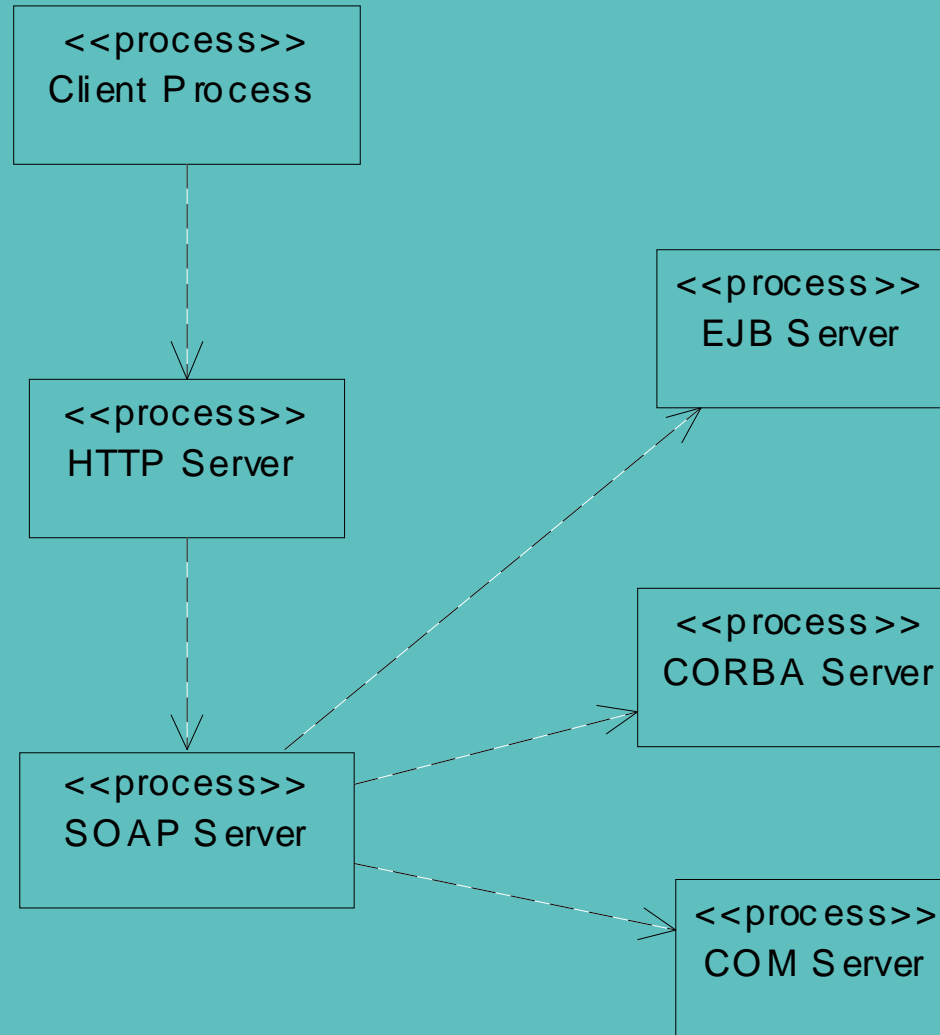
SOAP Request on Server - Structure



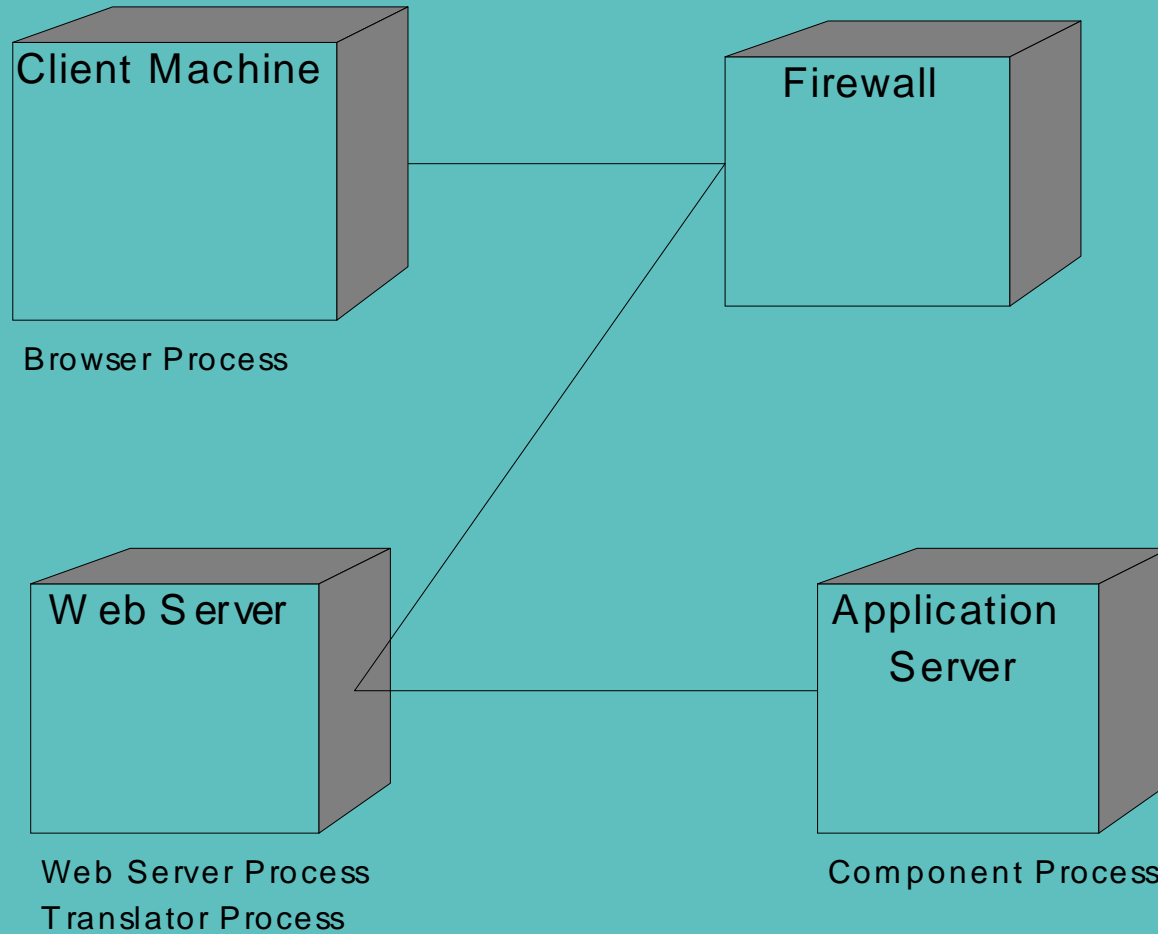
SOAP Request on Server - Behavior



SOAP Process View



SOAP Deployment View



What is WSDL?

- Web Services Description Language (WSDL)
- Way to describe web services
 - Where do they reside locally
 - What are they called
 - How are external operations bound to internal operations
 - How data is encoded
 - How operation is invoked
- WSDL is similar to an interface in a component architecture, but also includes information on
 - Protocol bindings
 - Deployment

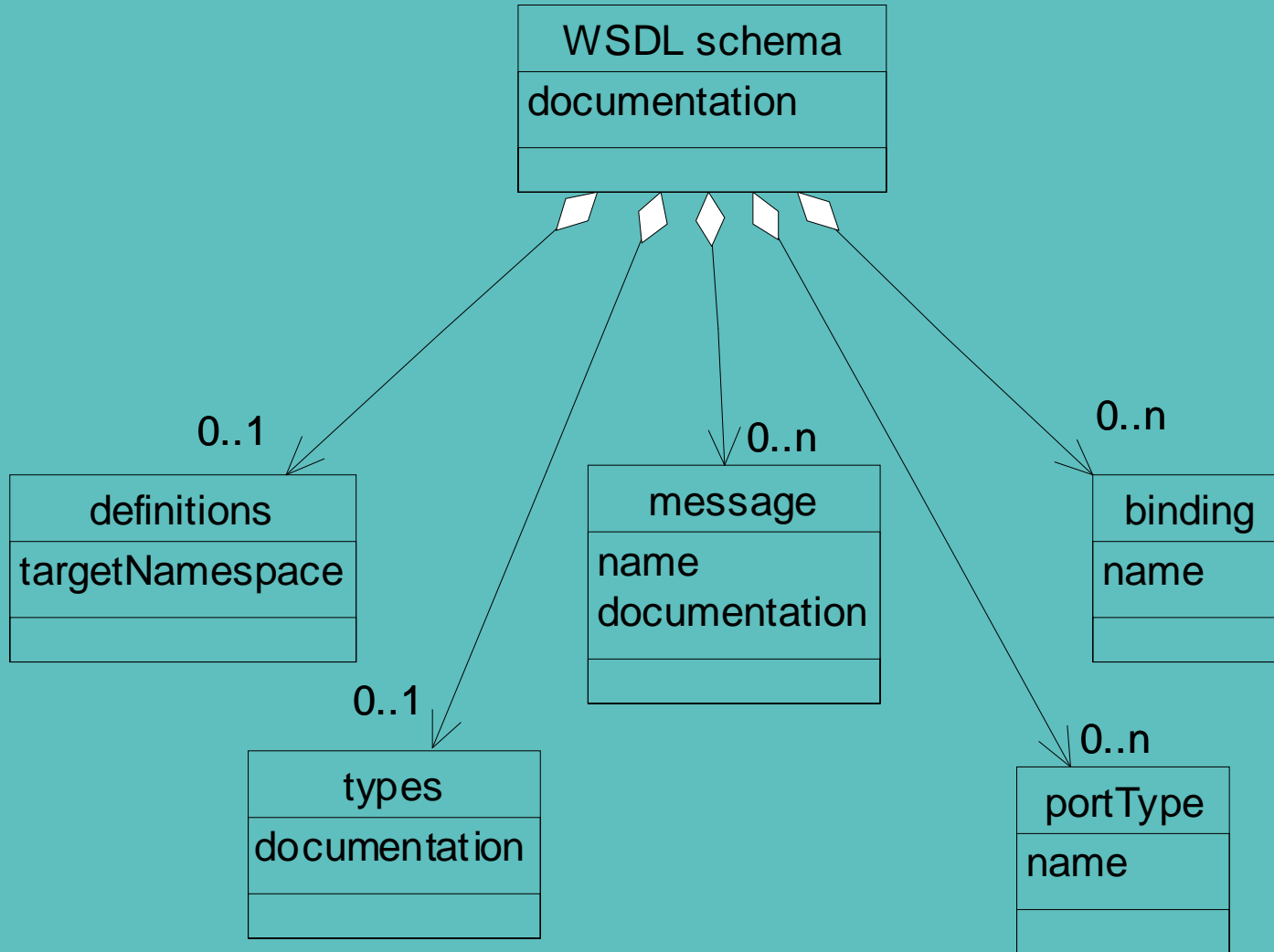
What is WSDL?

- History
 - Started as Service Description Language (SDL)
 - Part of early SOAP efforts
 - Turned into Service Contract Language (SCL)
 - Currently called Web Services Description Language (WSDL)
- In Apache SOAP, use XML Deployment Descriptors
 - Register with ServiceManagerClient in org.apache.soap.server package
- WSDL extensions defined
 - HTTP GET
 - HTTP POST
 - SOAP

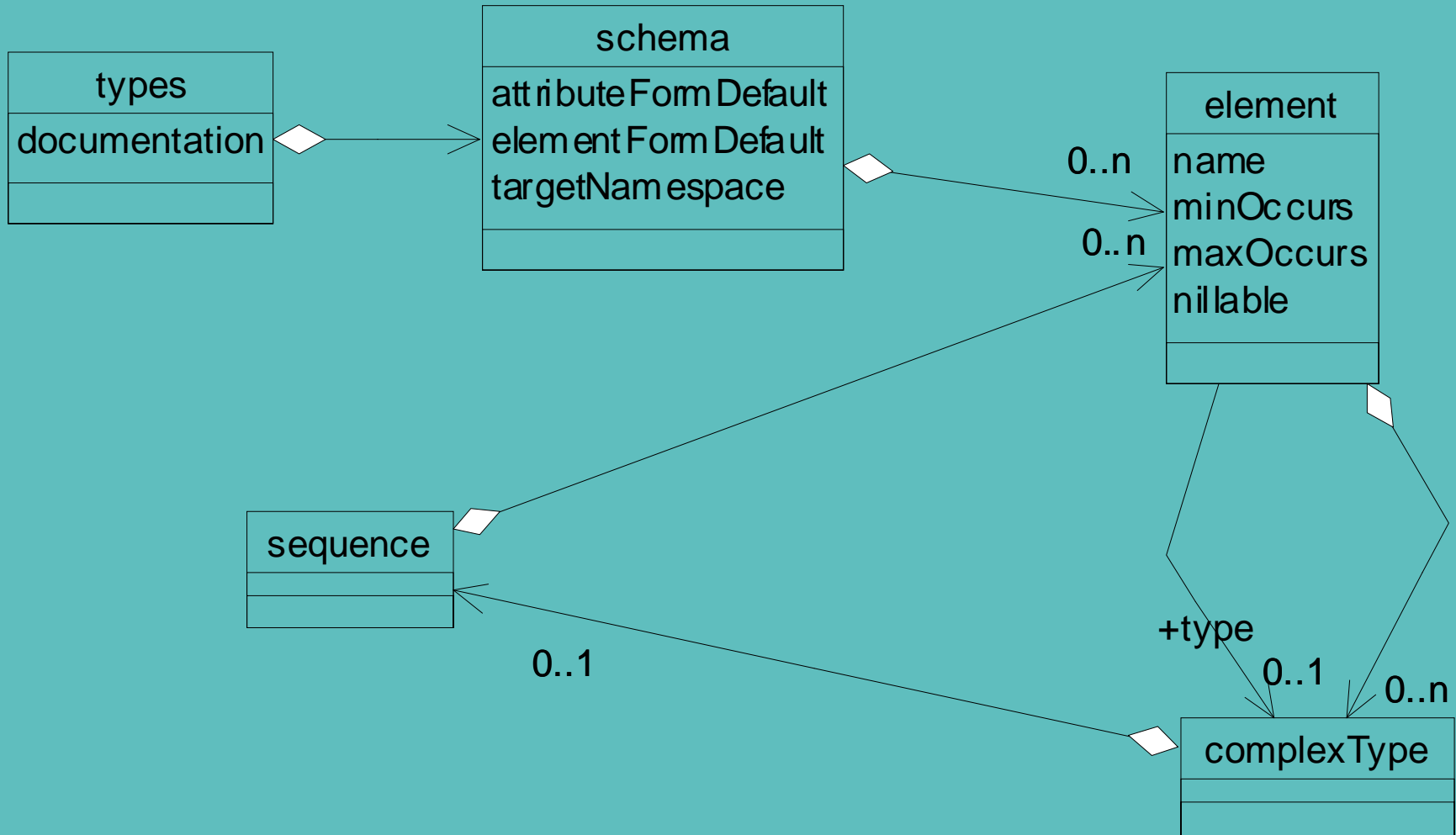
WSDL Generation

- Development tool vendors provide WSDL generation tools
 - Microsoft VisualStudio 6.0
 - Uses Web Services Meta Language (WSML) for COM binding on server side
 - Microsoft VisualStudio.NET
 - IBM Web Services Tool Kit (WSTK)
- Also provide tools to generate client-side proxies

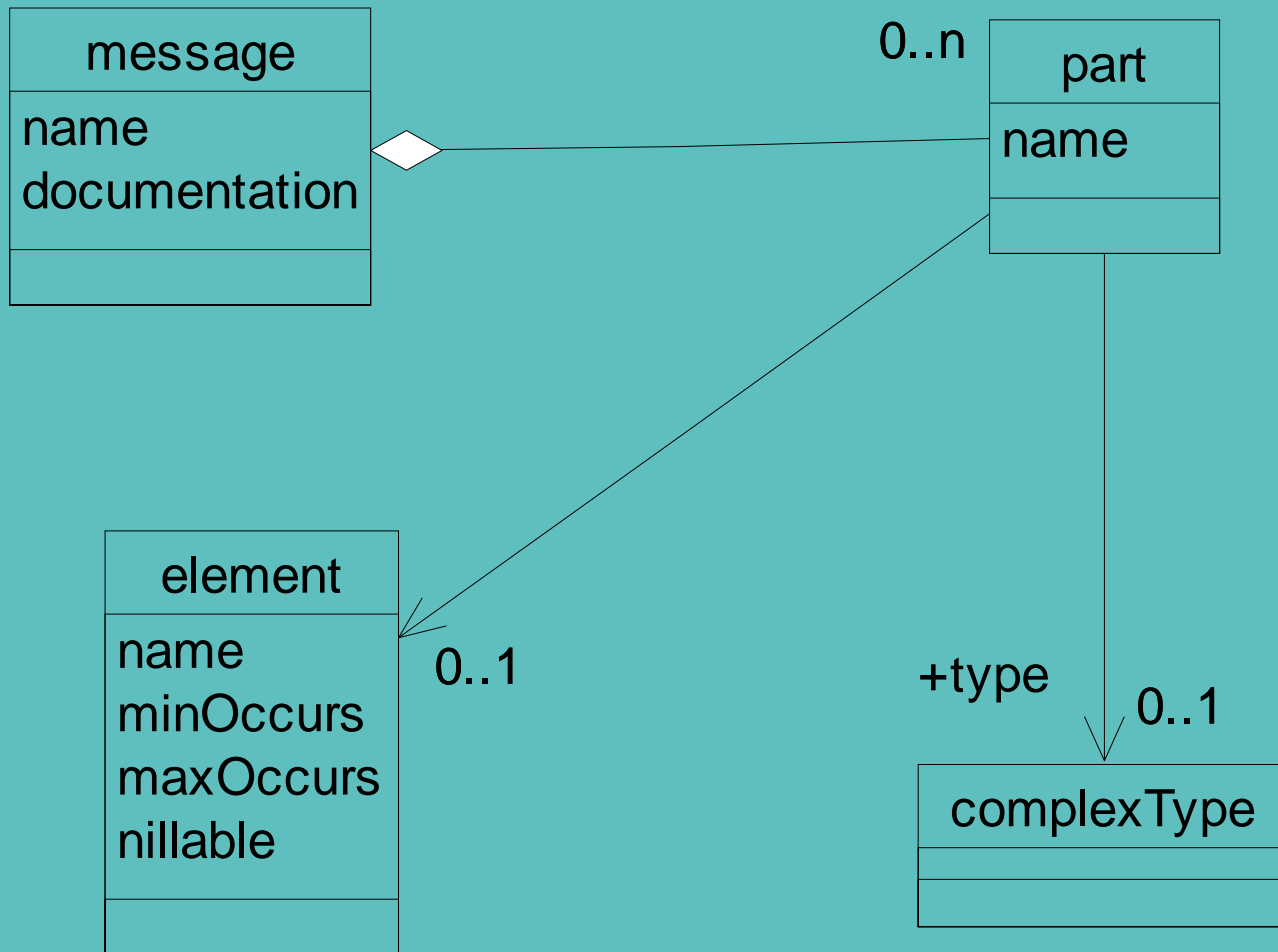
WSDL Schema – High-Level



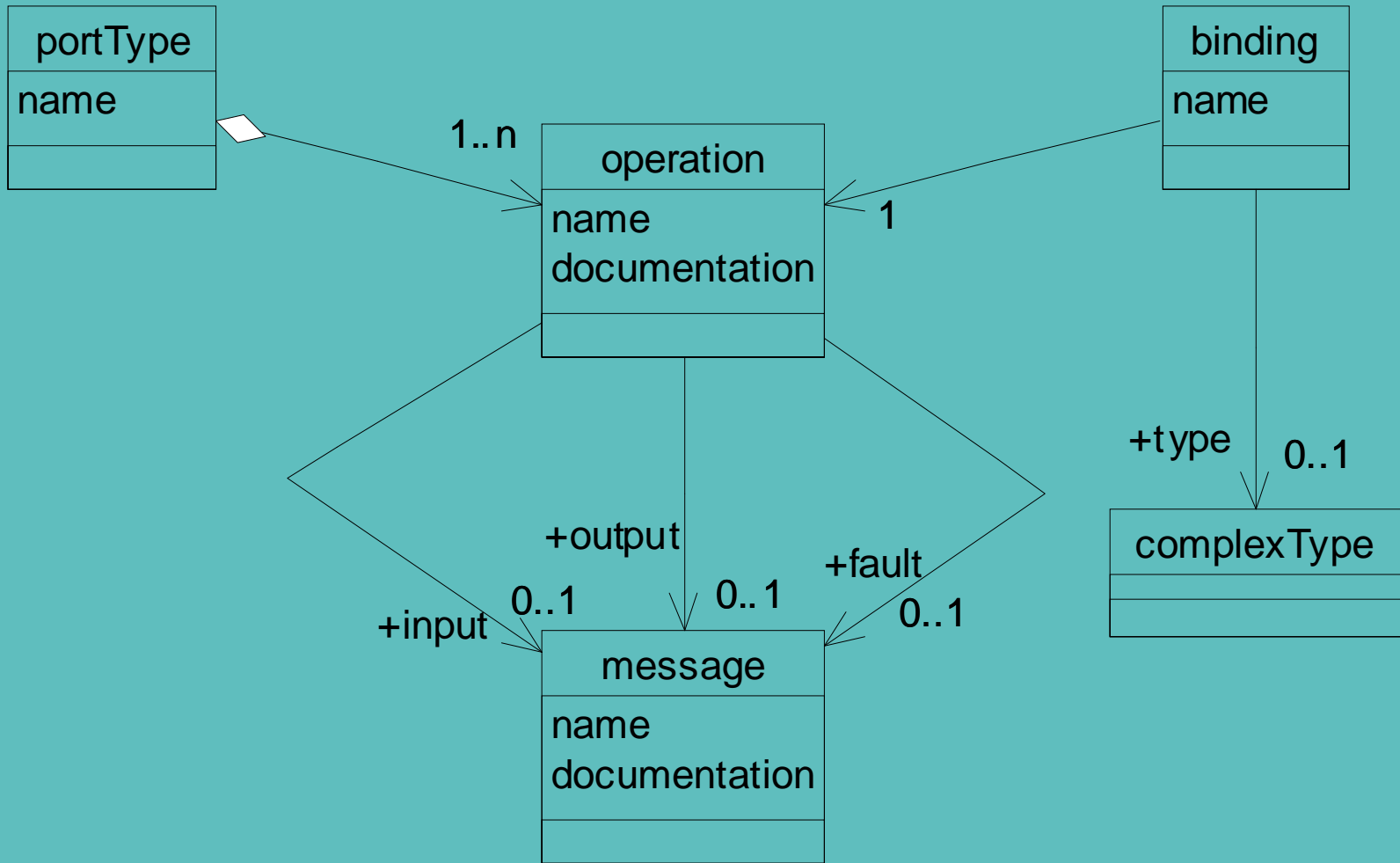
WSDL Schema – Types



WSDL Schema – Messages



WSDL Schema – Port Types and Bindings



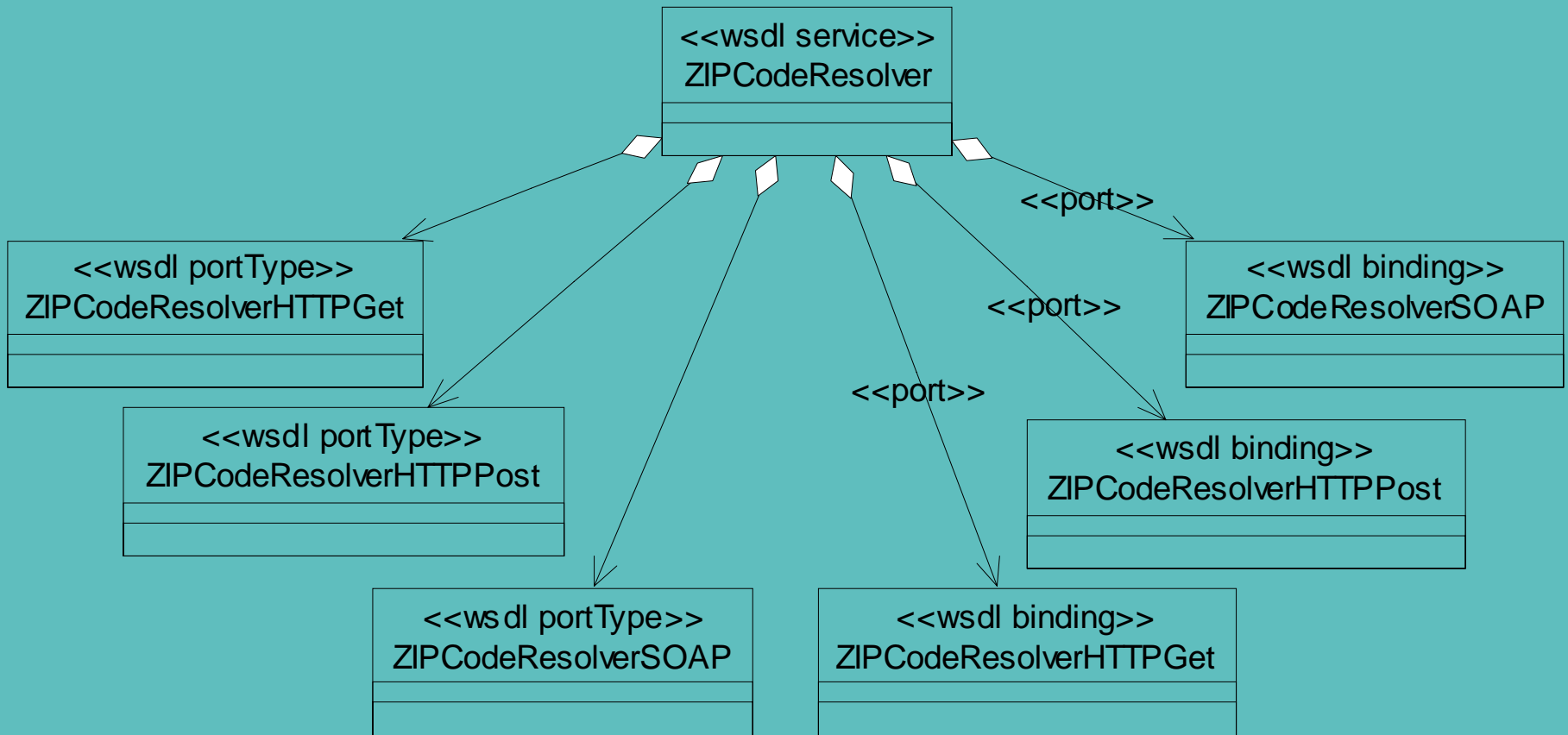
UML for WSDL

- Visually model key portions of WSDL definition
 - Other details can be modeled using tagged values
- Use one class for overall service description
 - Use <<wsdl service>> stereotype
 - For each element, use <<element>> stereotype on attributes
 - For elements that are complexTypes, model as separate class with <<element>> stereotype
 - For each message, use <<message>> stereotype on operations

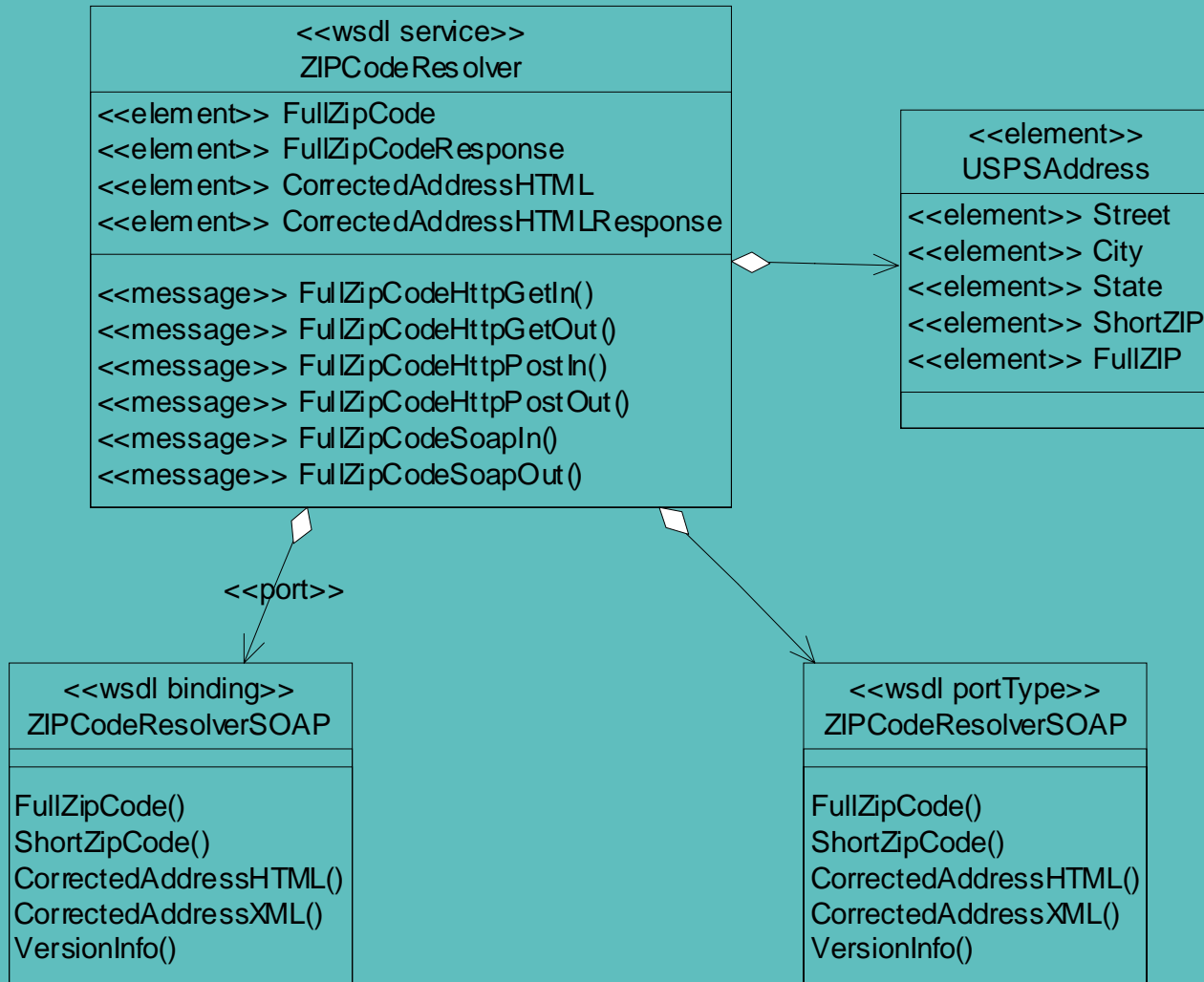
UML for WSDL

- Use one class for each portType
 - Use <<wsdl portType>> stereotype
 - Attach to service with aggregation
 - For each operation, use an operation
- Use one class for each binding
 - Use <<wsdl binding>> stereotype
 - Attach to service with aggregation with <<port>> stereotype
 - For each operation, use an operation

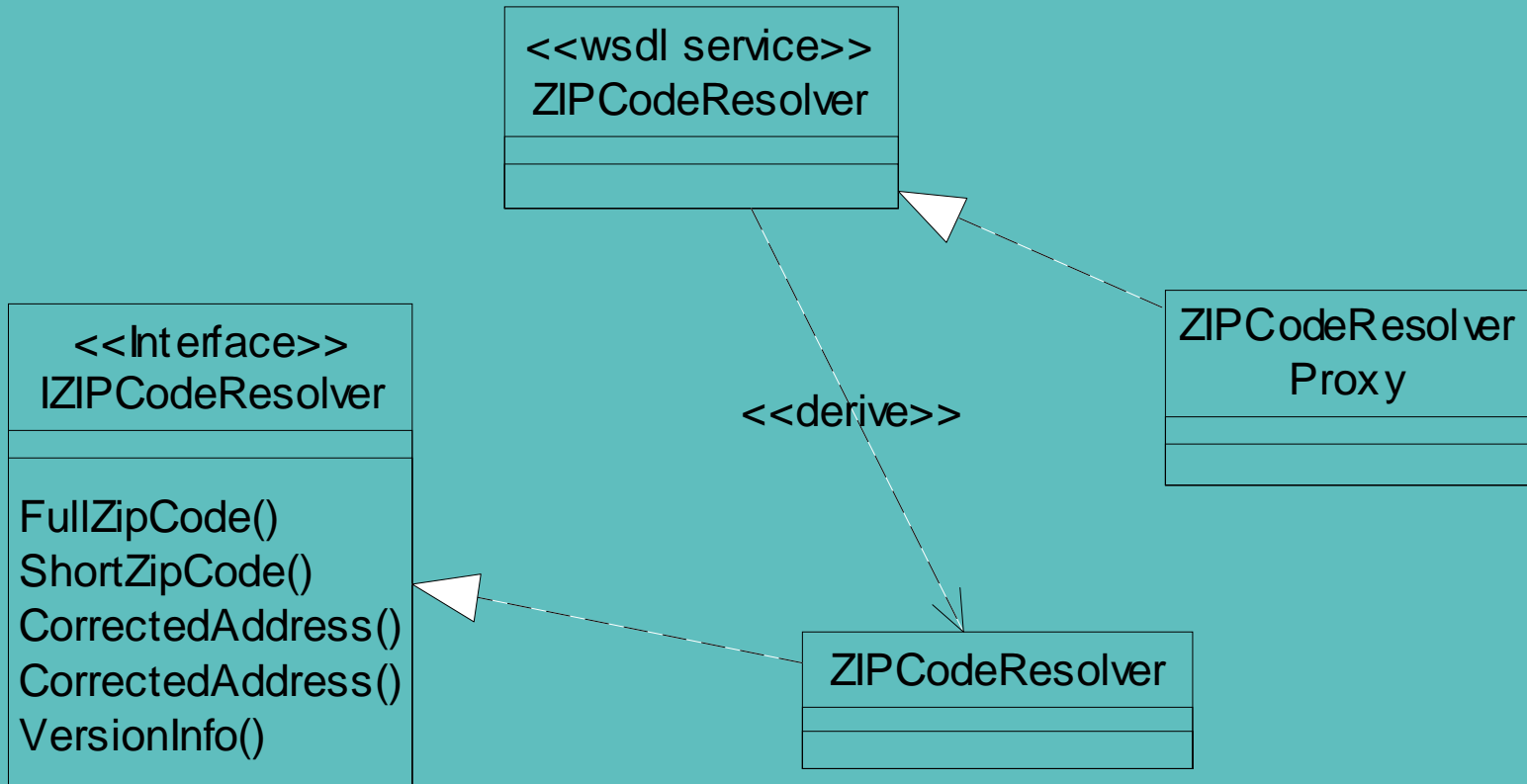
Sample UML for WSDL – High-Level



Sample UML for WSDL – Detailed



Sample UML for WSDL – Context



What is UDDI?

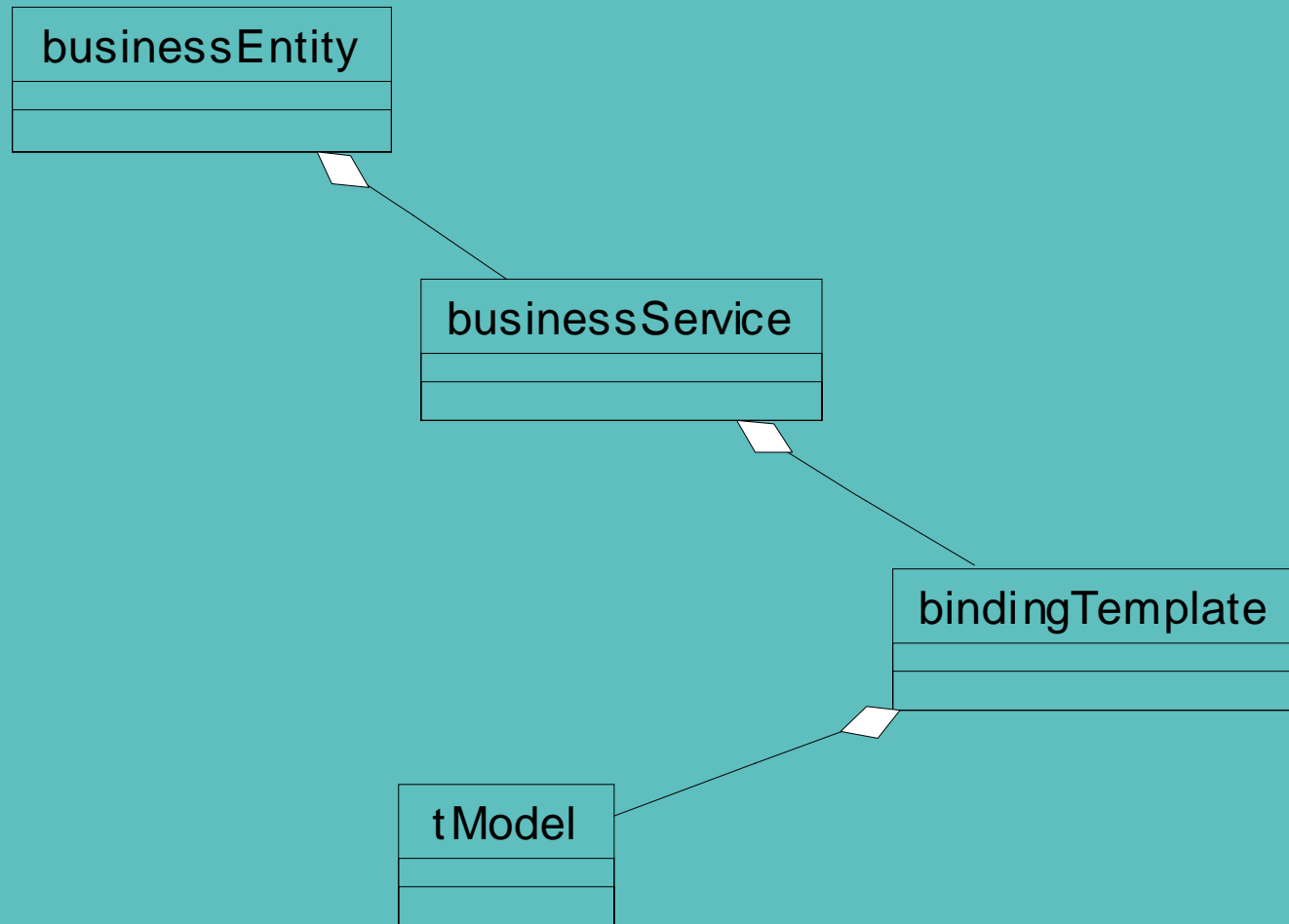
- Universal Description, Discovery and Integration (UDDI)
- A specification for distributed Web-based information registries of Web services
- Collaborative initiative
 - IBM
 - Microsoft
 - Ariba
- Create a global, platform-independent, open framework to rapidly accelerate the global adoption of B2B e-commerce
 - Enable businesses to discover each other
 - Define how they interact over the Internet
 - Share information in a global registry

What is UDDI?

- Similar to DNS for domain names
 - Except works for web services instead
- Business service registry
 - Logically centralized
 - Physically distributed
- API defined in an XML Schema



UDDI Logical Architecture



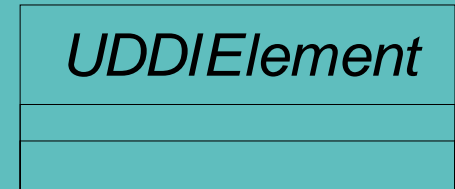
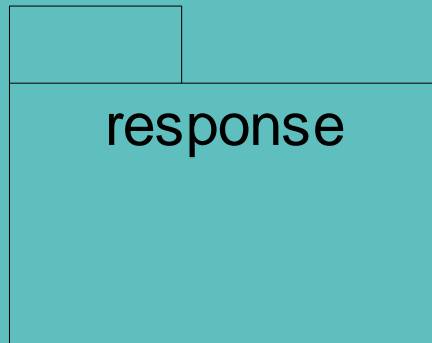
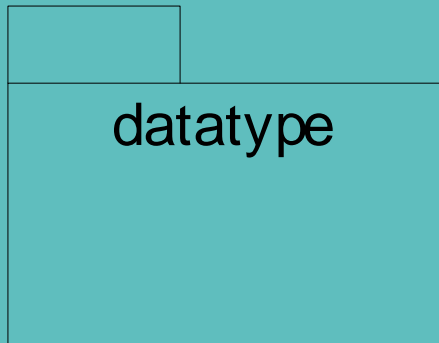
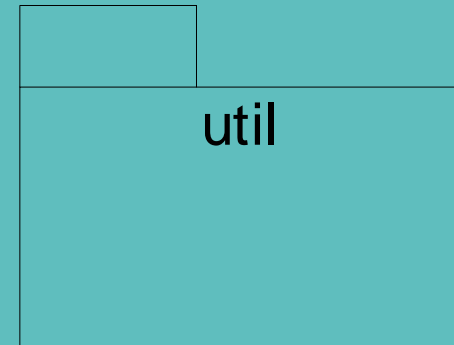
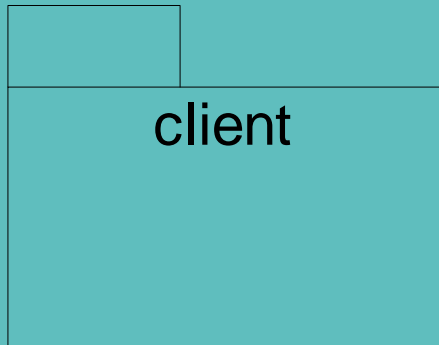
UDDI Leaders

- IBM
 - UDDI4J
- Microsoft
 - UDDI for .NET
 - SDK for Visual Studio 6.0

UDDI4J Overview

- Open source implementation of UDDI for Java by IBM
- Provides an API to interact with a UDDI registry
- Generates and parses messages sent to and received from a UDDI server
- Requirements
 - Apache SOAP 2.1 or later
 - JDK 1.2.2 or later
 - Ant

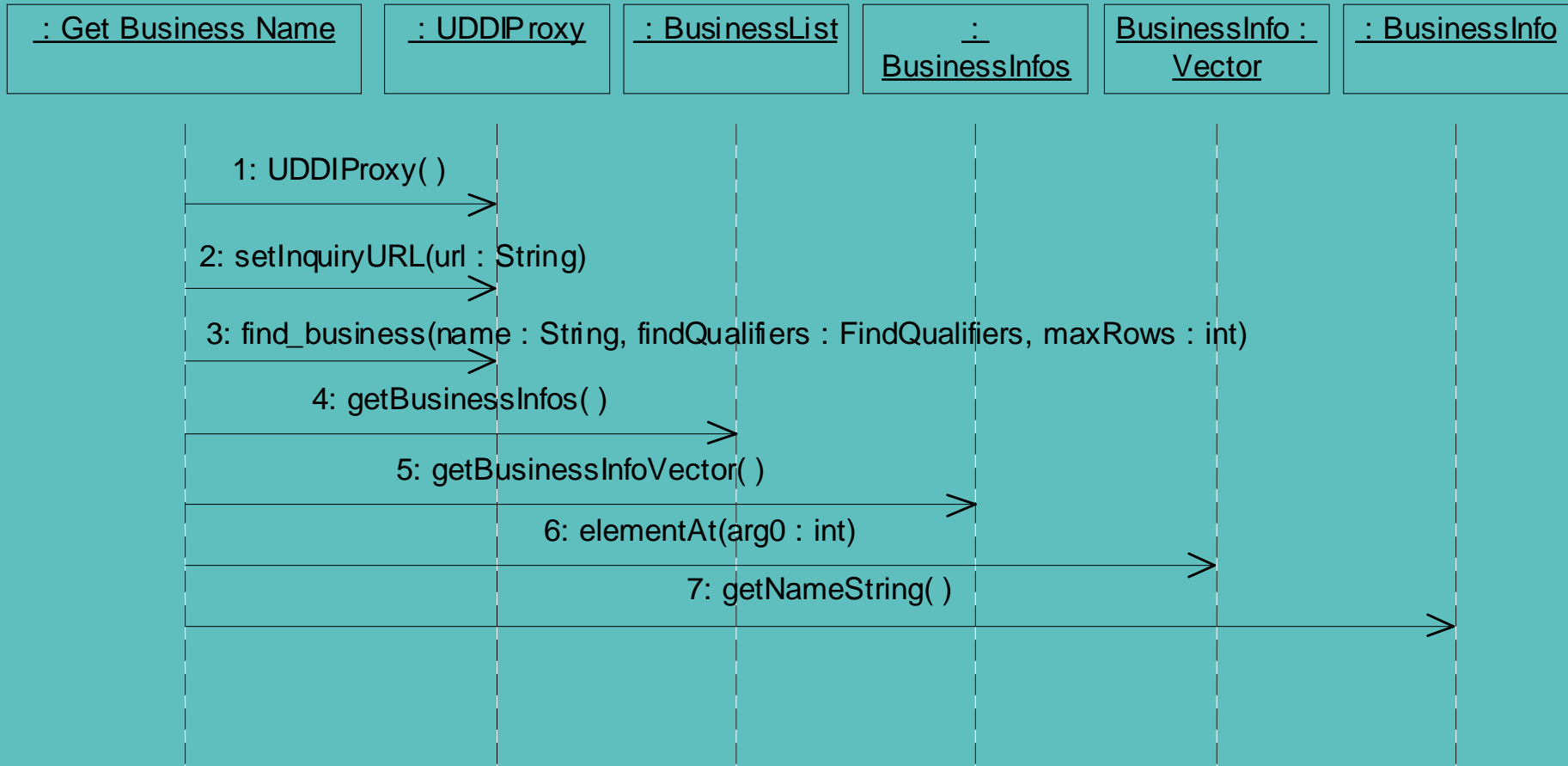
UDDI4J Key Components



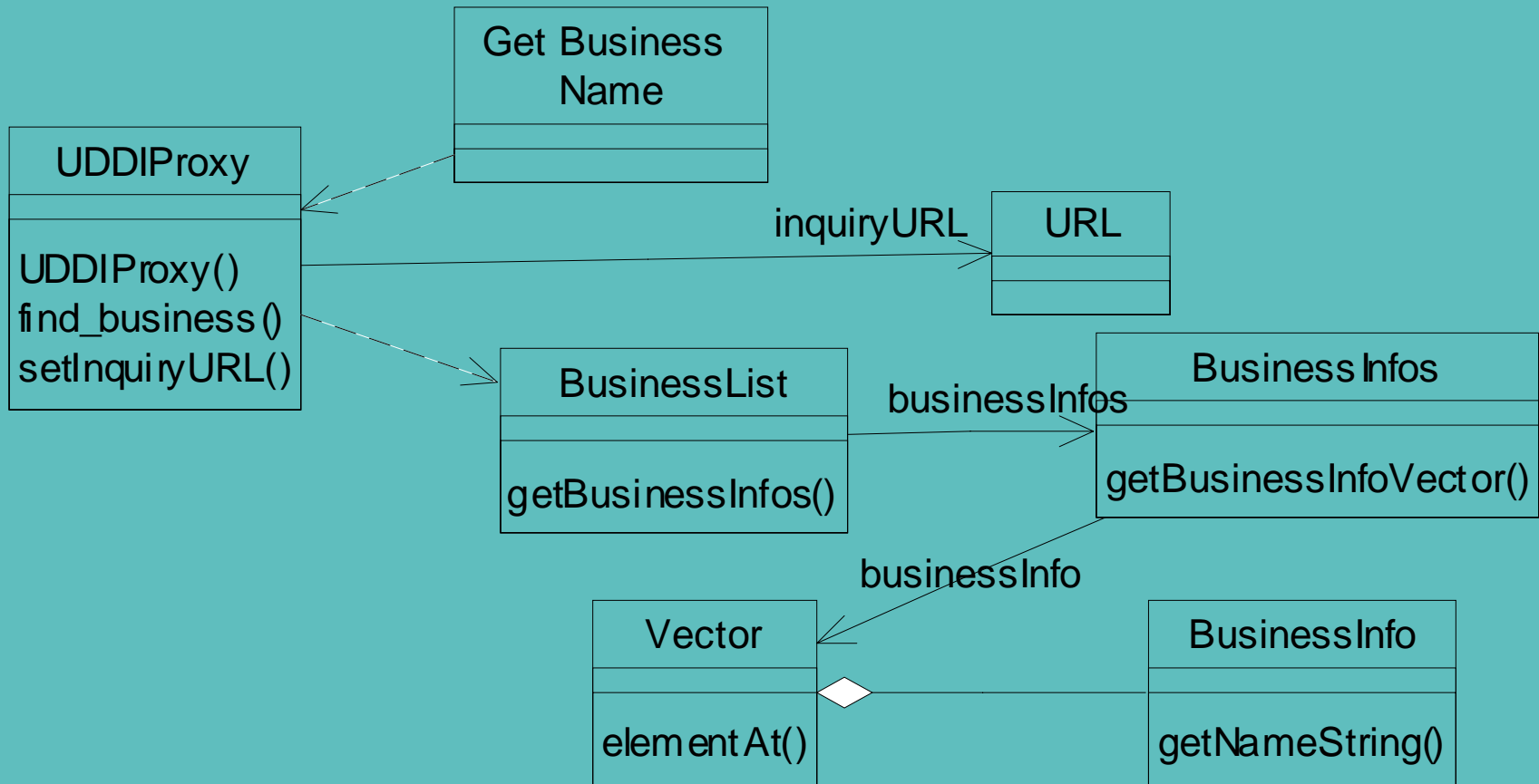
UDDI4J Key Components

- **uddi.client** package
 - Especially **UDDIProxy** class
 - Methods map to the UDDI Programmer's API Specification
- **uddi.datatype** package
 - Contains core UDDI datatypes to send and receive data from a UDDI server
- **uddi.request** package
 - Used internally by UDDIProxy for sending messages to a UDDI server
- **uddi.response** package
 - Used internally by UDDIProxy for receiving messages from a UDDI server

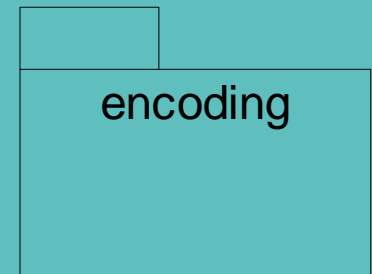
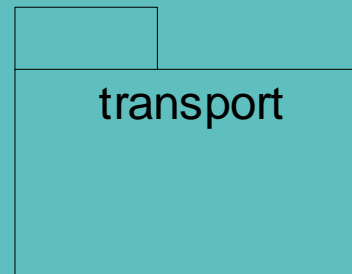
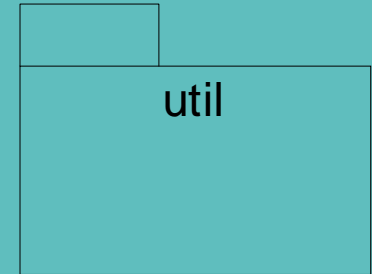
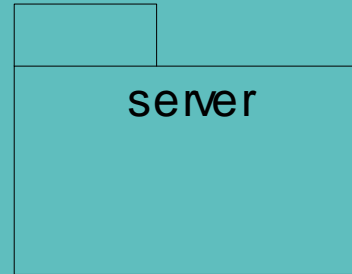
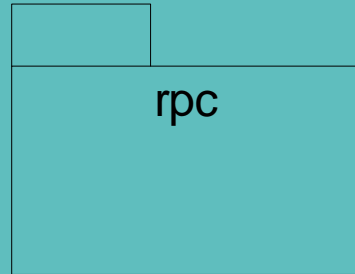
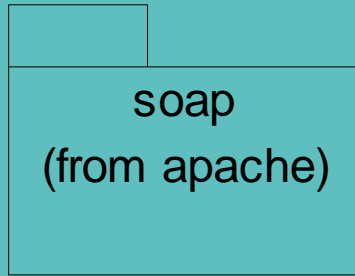
Sample UDDI Usage – Inquire – Behavior



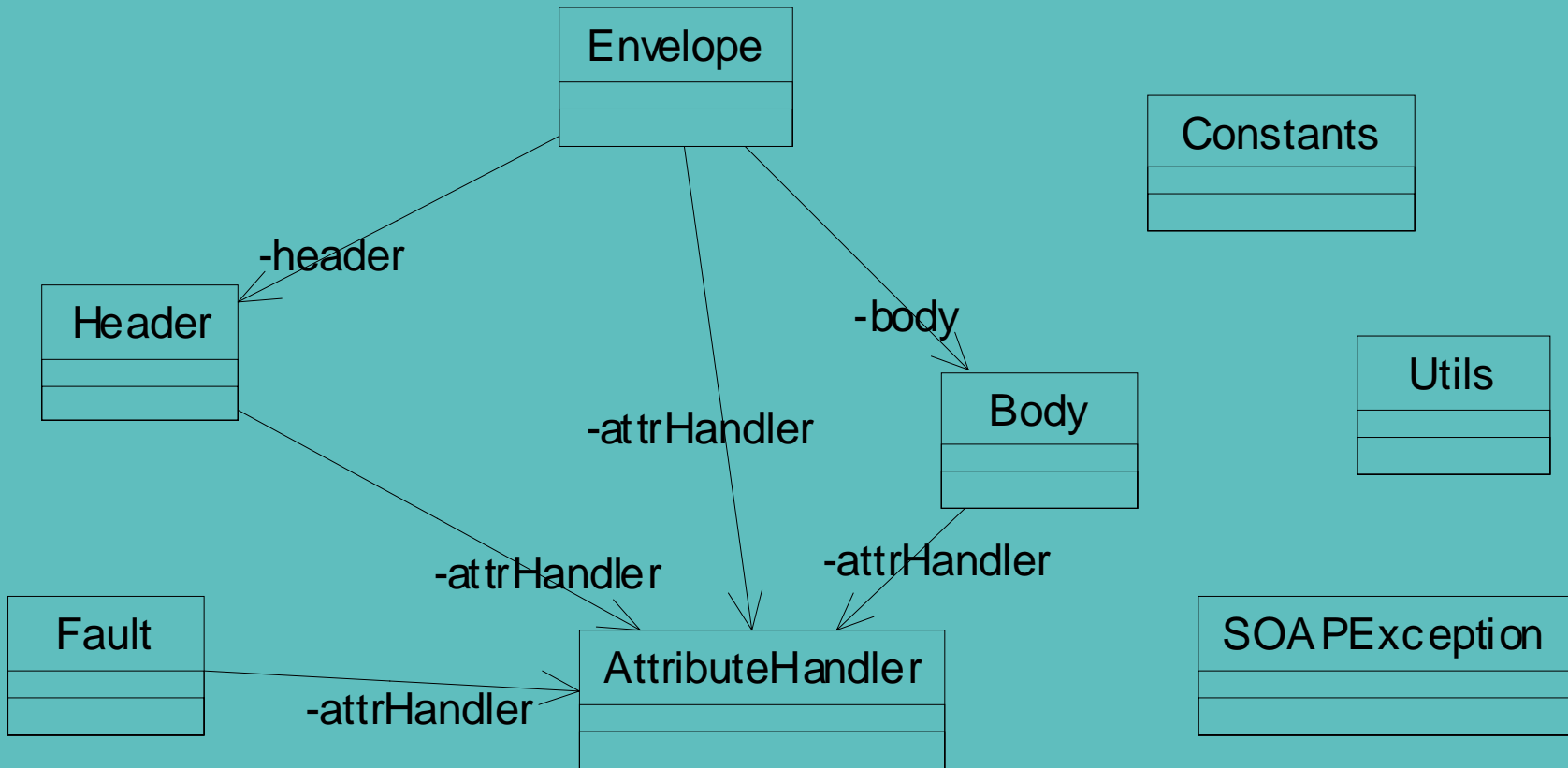
Sample UDDI Usage – Inquire – Structure



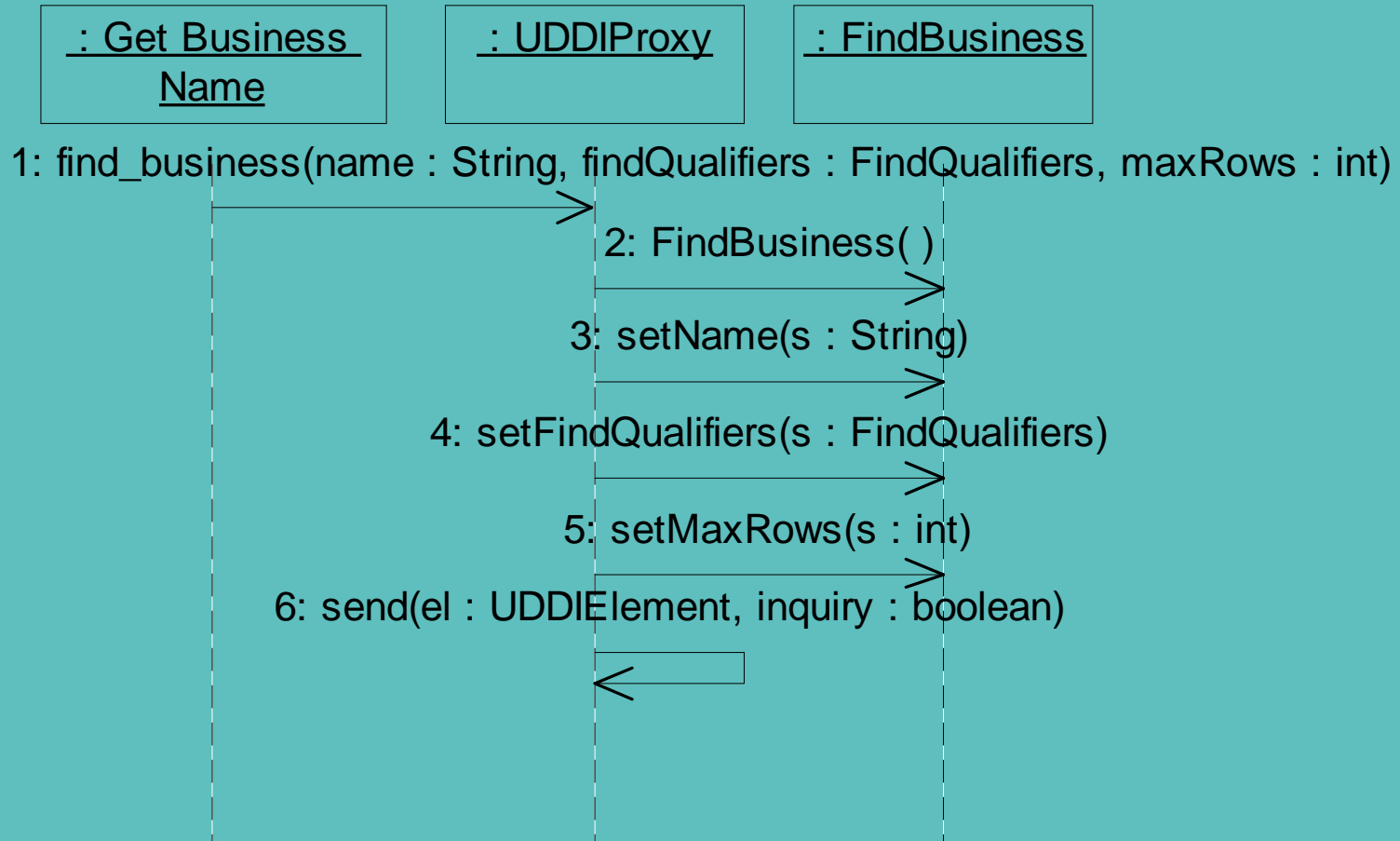
Apache SOAP Overview – Main Packages



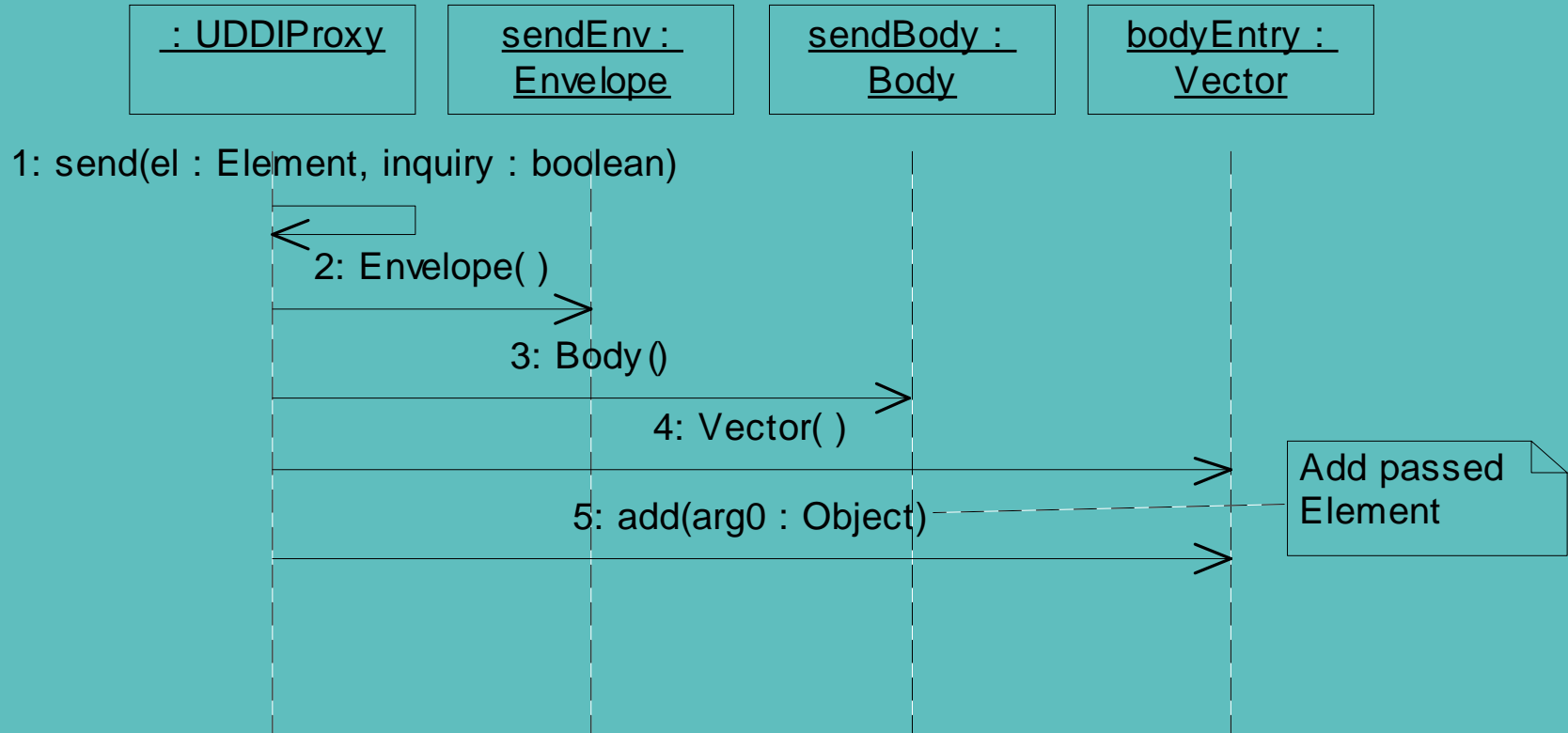
Apache SOAP Overview – Main Classes



SOAP Usage by UDDI – Part 1



SOAP Usage by UDDI – Part 2



SOAP Usage by UDDI – Part 3

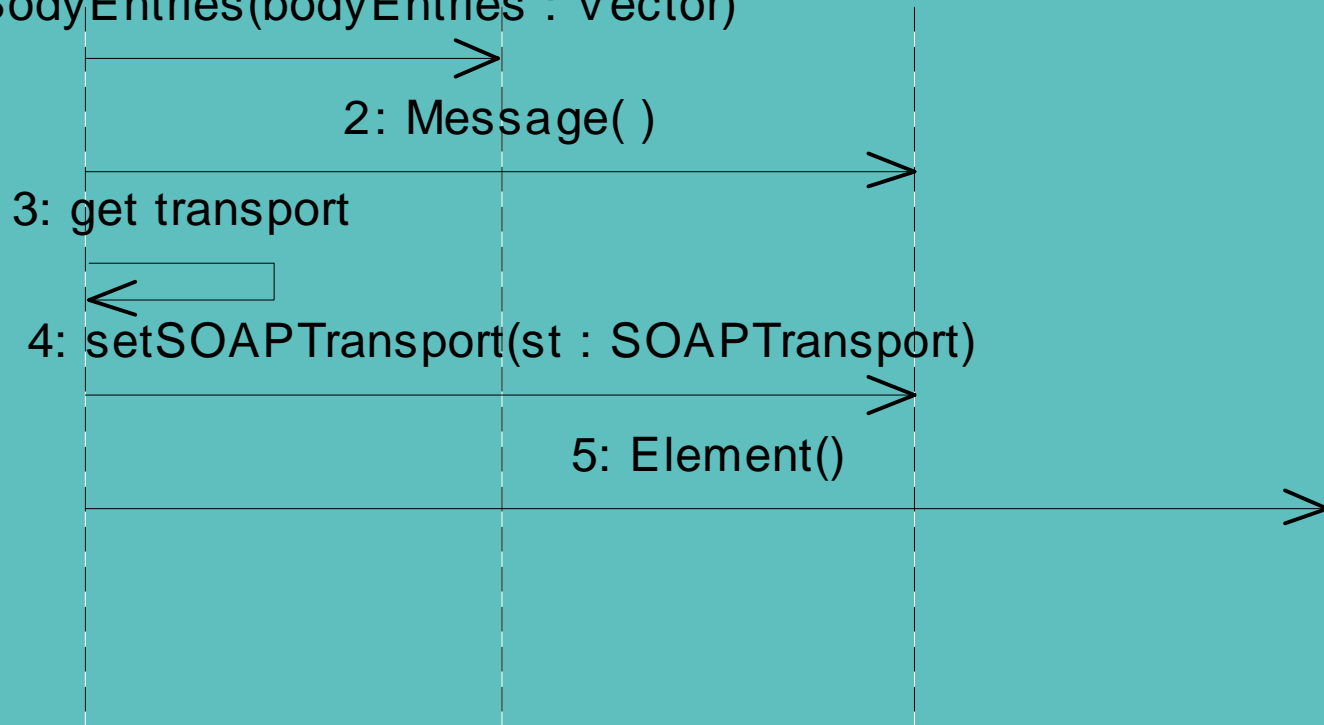
: UDDIProxy

sendBody :
Body

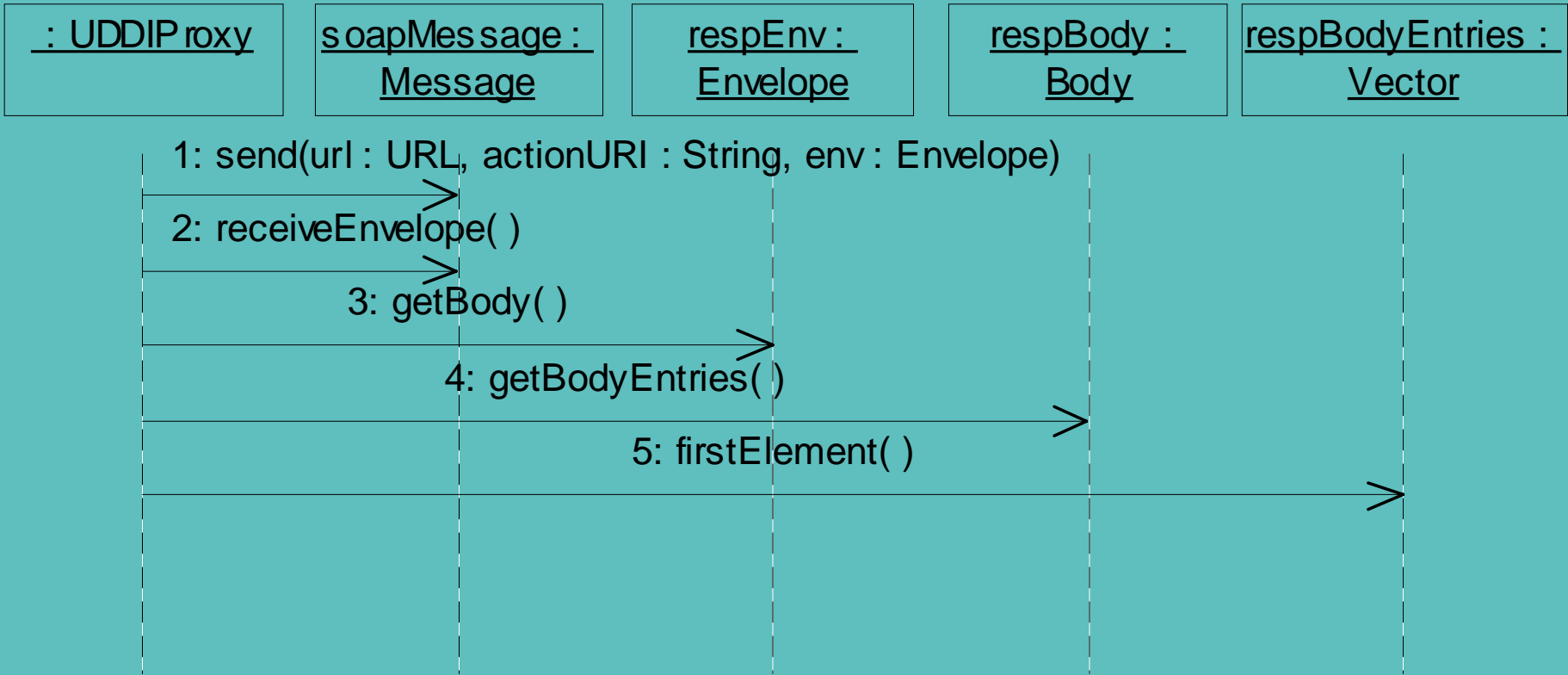
soapMessage :
Message

response :
Element

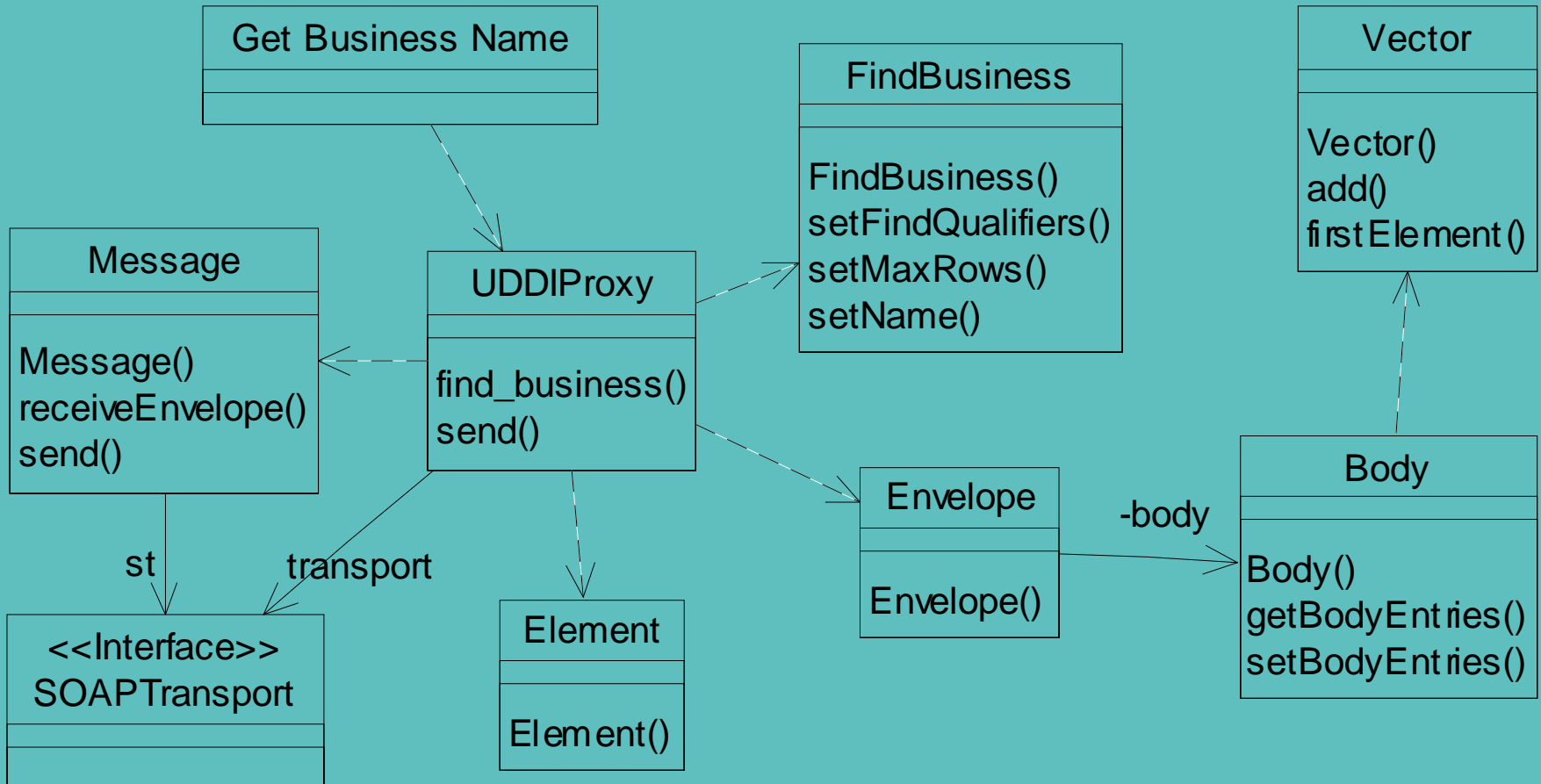
1: setBodyEntries(bodyEntries : Vector)



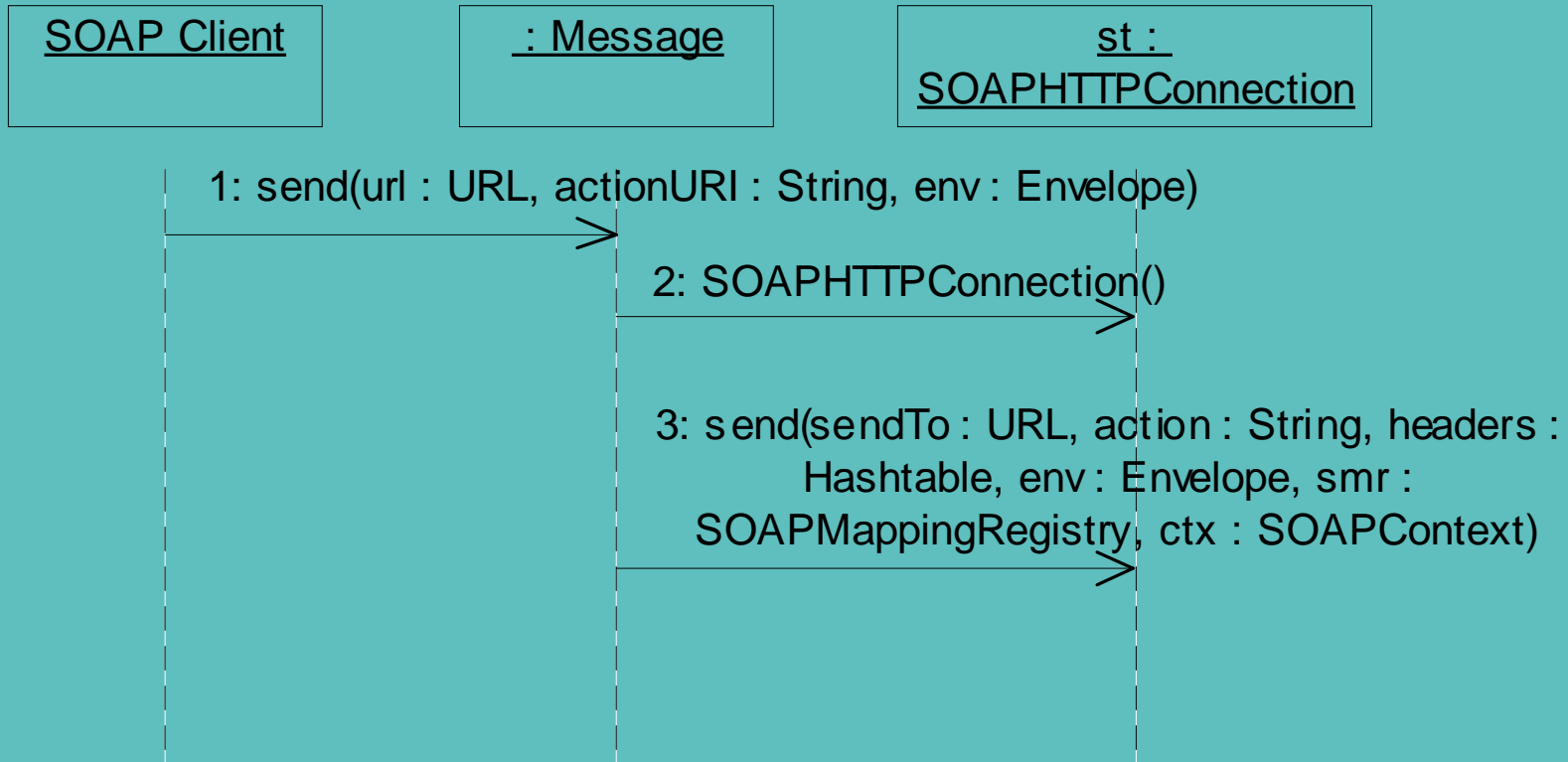
SOAP Usage by UDDI – Part 4



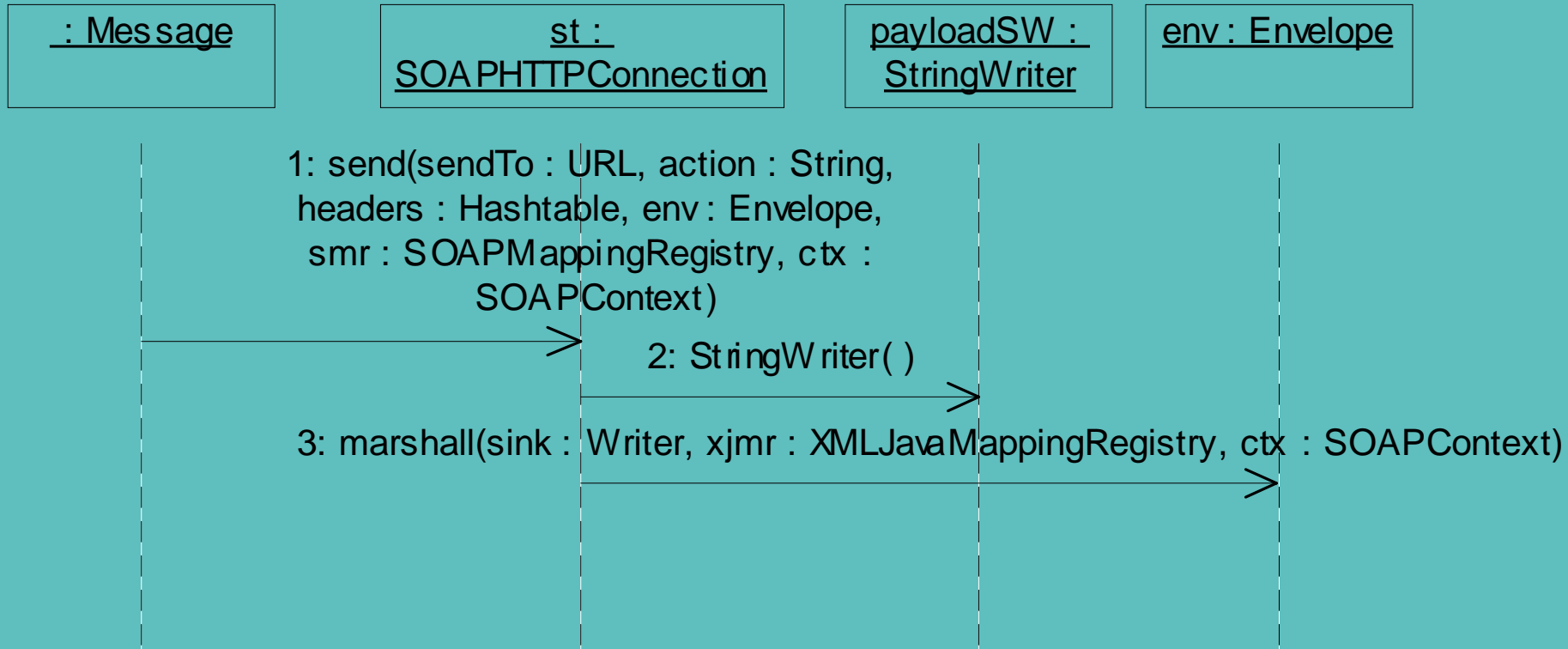
SOAP Usage by UDDI – Structure



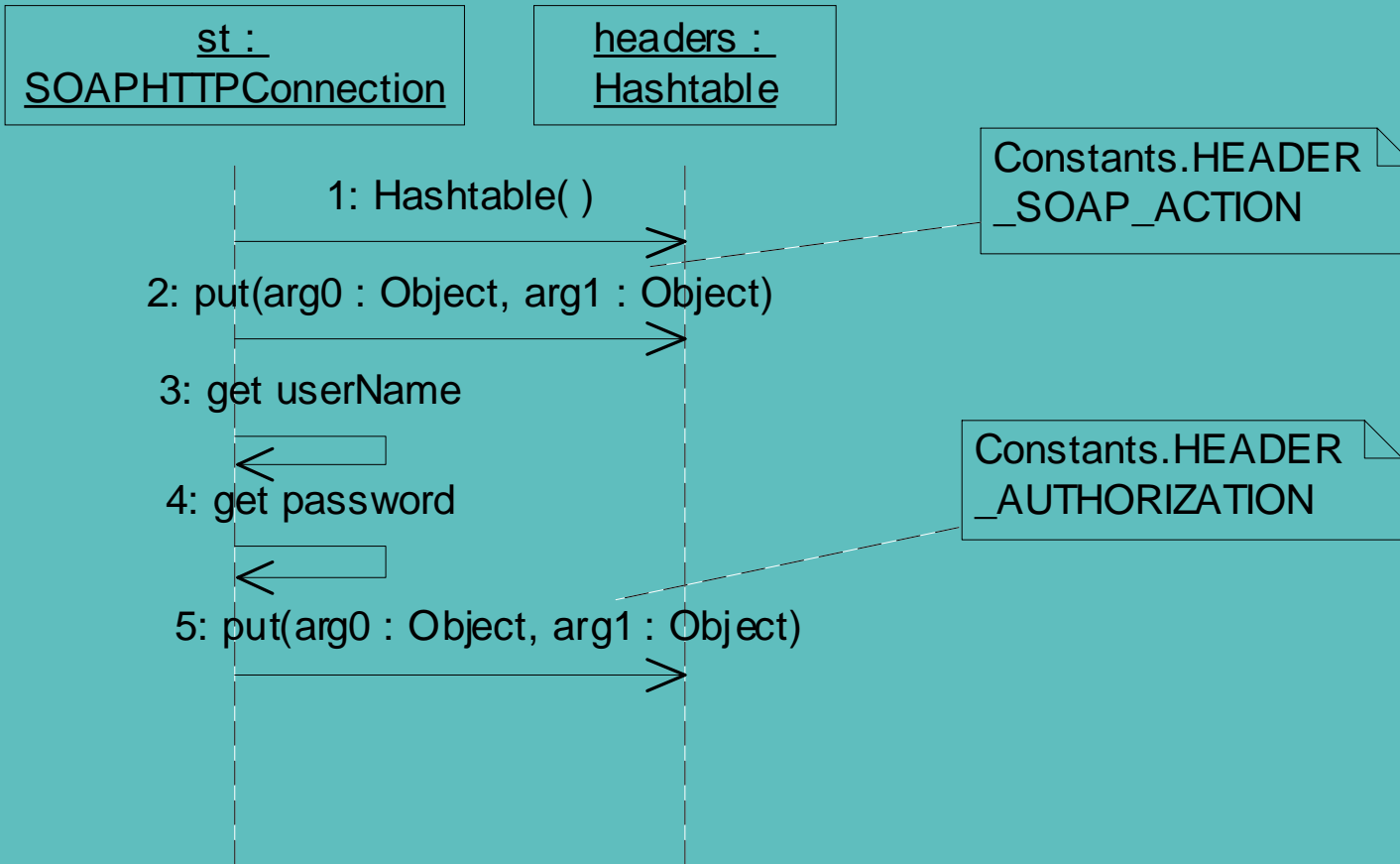
SOAP Message Sending – Part 1



SOAP Message Sending – Part 2



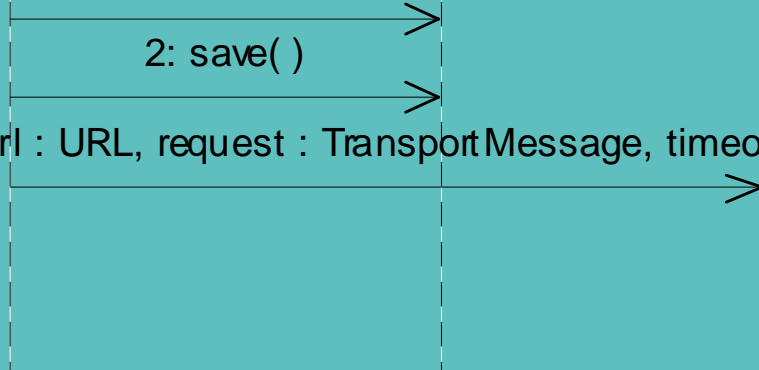
SOAP Message Sending – Part 3



SOAP Message Sending – Part 4

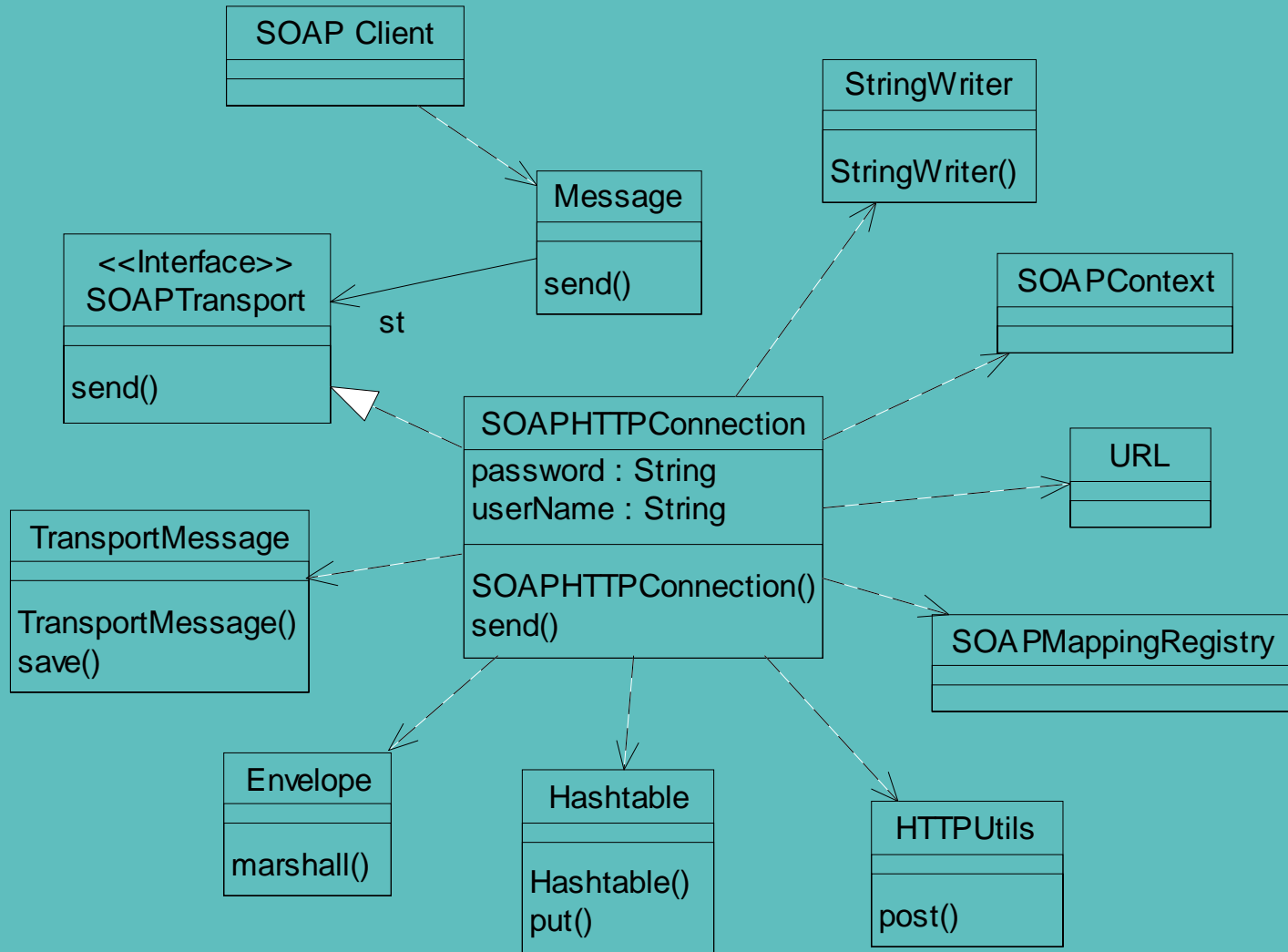


1: TransportMessage(envelope : String, ctx : SOAPContext, headers : Hashtable)



3: post(url : URL, request : TransportMessage, timeout : int, httpProxyHost : String, httpProxyPort : int)

SOAP Message Sending - Structure



Web Resources

- UDDI
 - www.uddi.org
 - uddi.microsoft.com
 - www.ibm.com/services/uddi
- SOAP
 - www.soap.org
 - www.soaprpc.com
 - www.soapware.org
 - www.soapclient.com
 - www.soap-wrc.com
- Web Services
 - www.webservices.org
 - www-106.ibm.com/developerworks/webservices
 - www.xmlmodeling.com