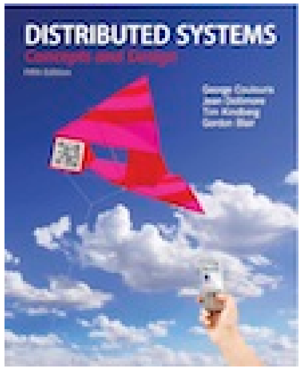
Slides for Chapter 7
Web Services



From Coulouris, Dollimore, Kindberg and Blair

Distributed Systems:

Concepts and Design

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Figure 7.1
Web services infrastructure and components

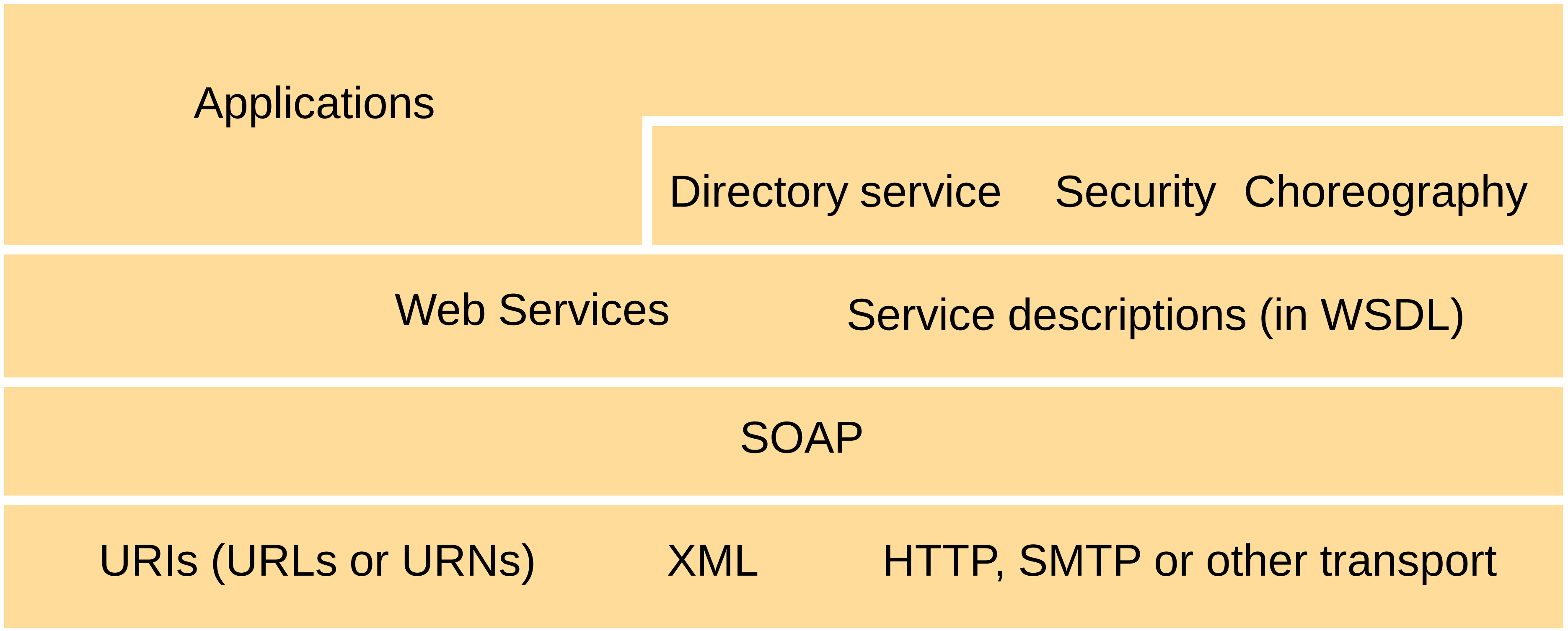


Figure 7.2

The ‘travel agent service’ combines other web services

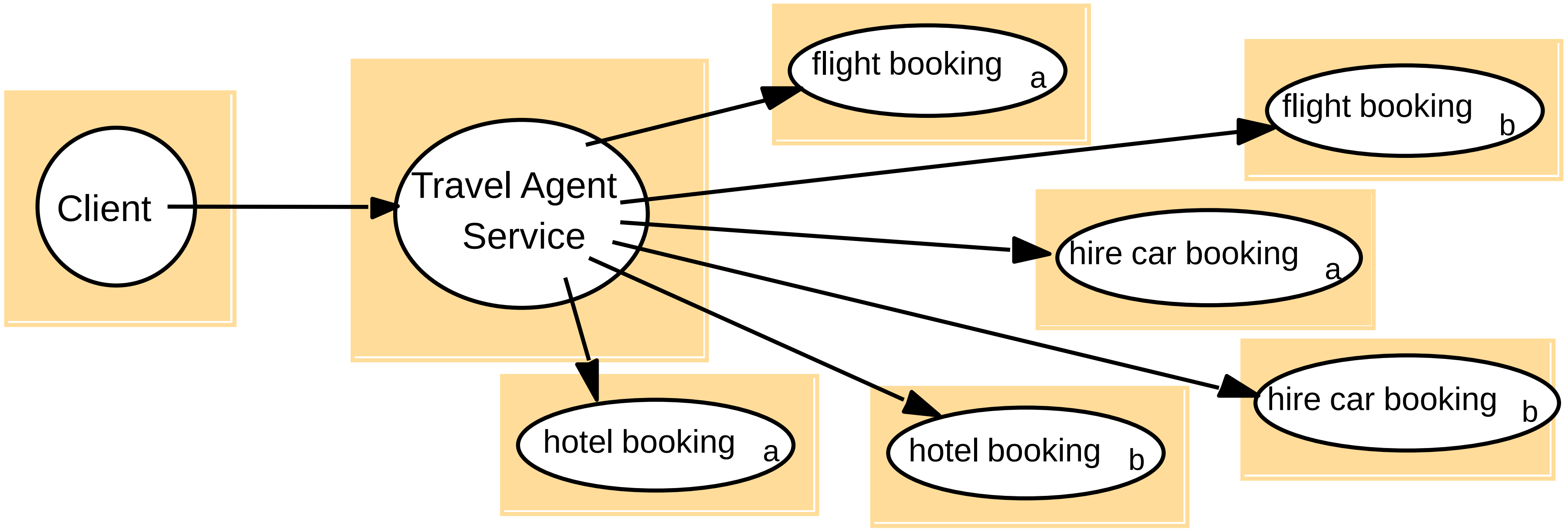


Figure 7.3
SOAP message in an envelope

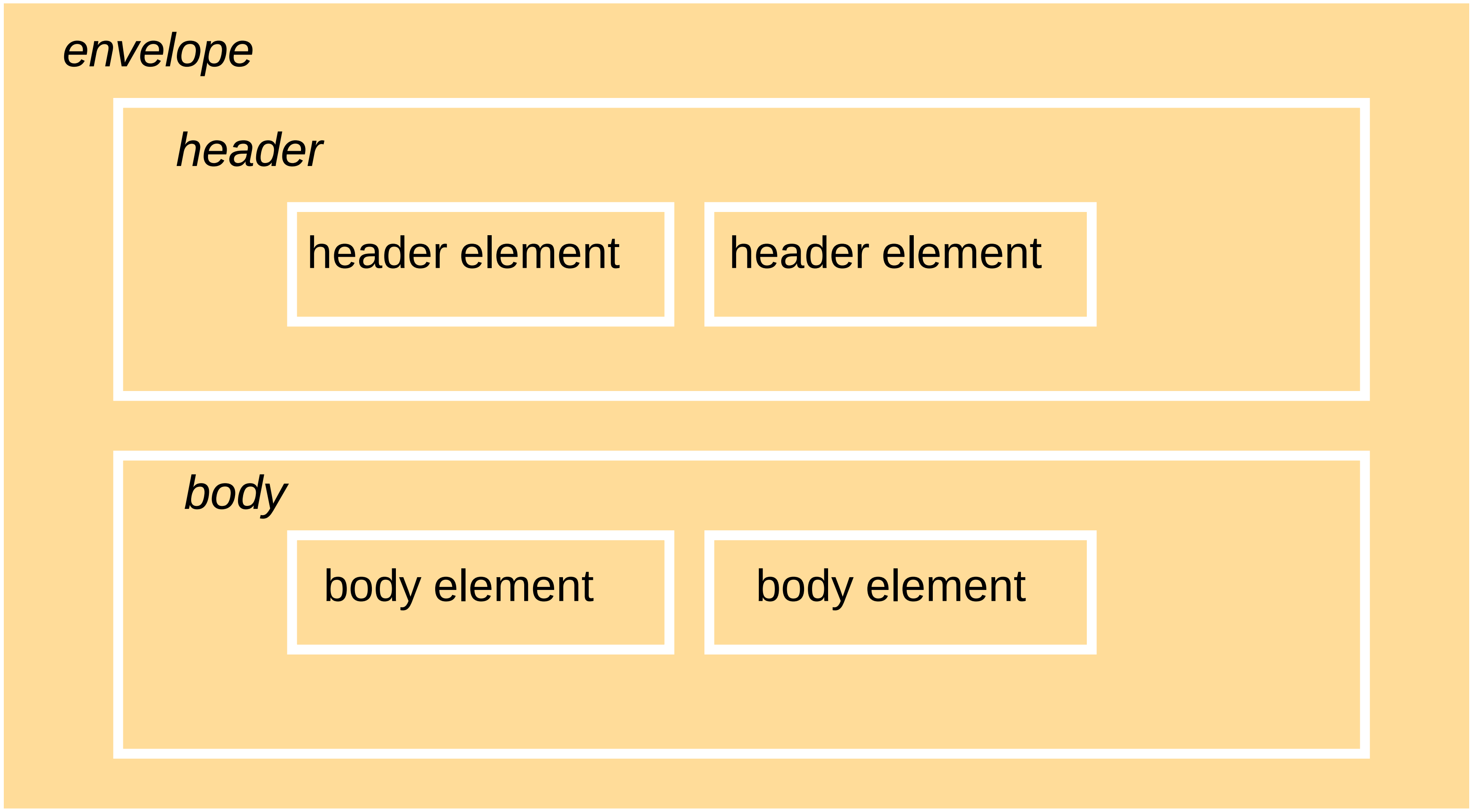
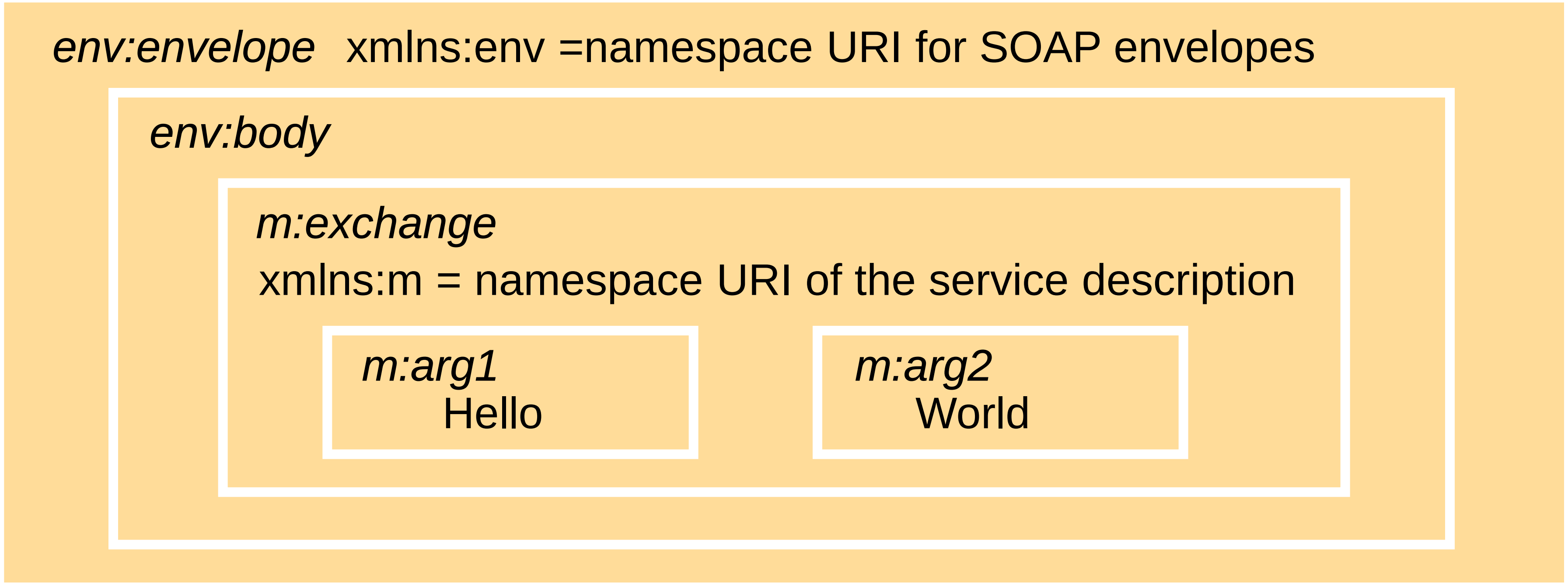


Figure 7.4
Example of a simple request without headers


env:envelope xmlns:env =namespace URI for SOAP envelopes
env:body
m:exchange
xmlns:m = namespace URI of the service description
m:arg1
Hello
m:arg2
World

In this figure and the next, each XML element is represented by a shaded box with its name in italic followed by any attributes and its content

Figure 7.5
Example of a reply corresponding to the request in Figure 9.4

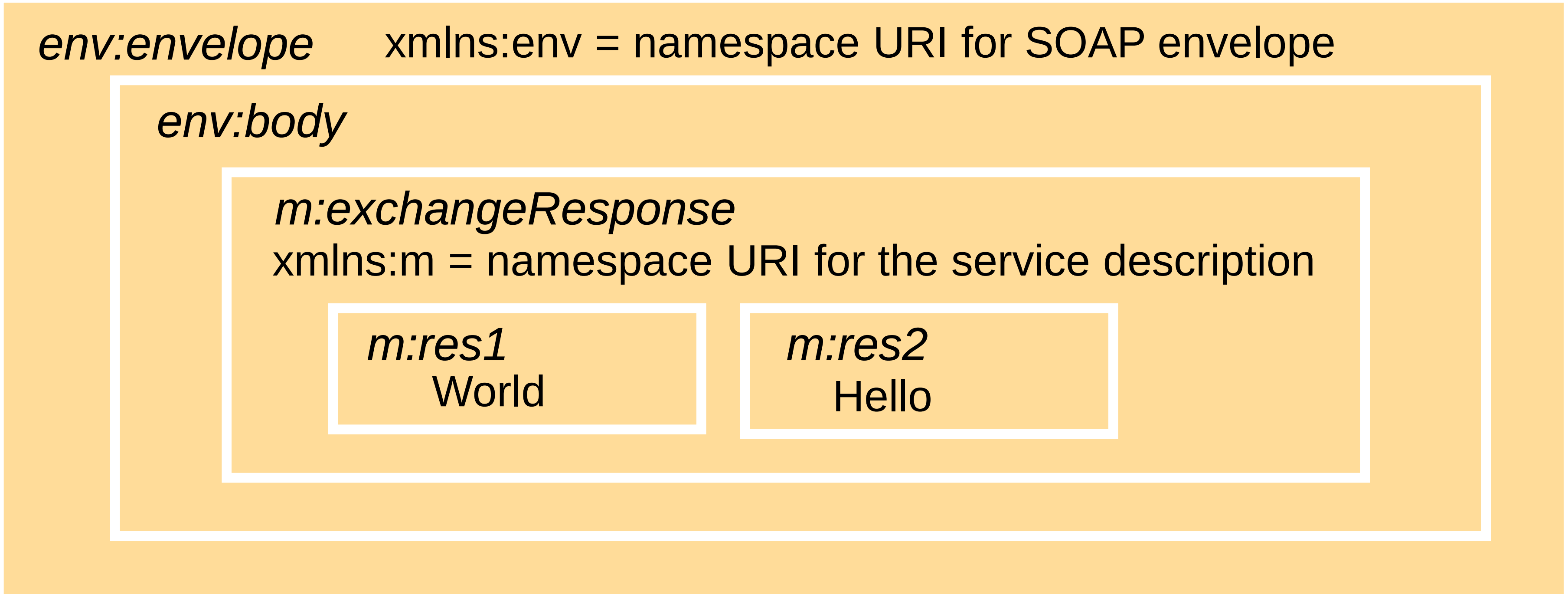
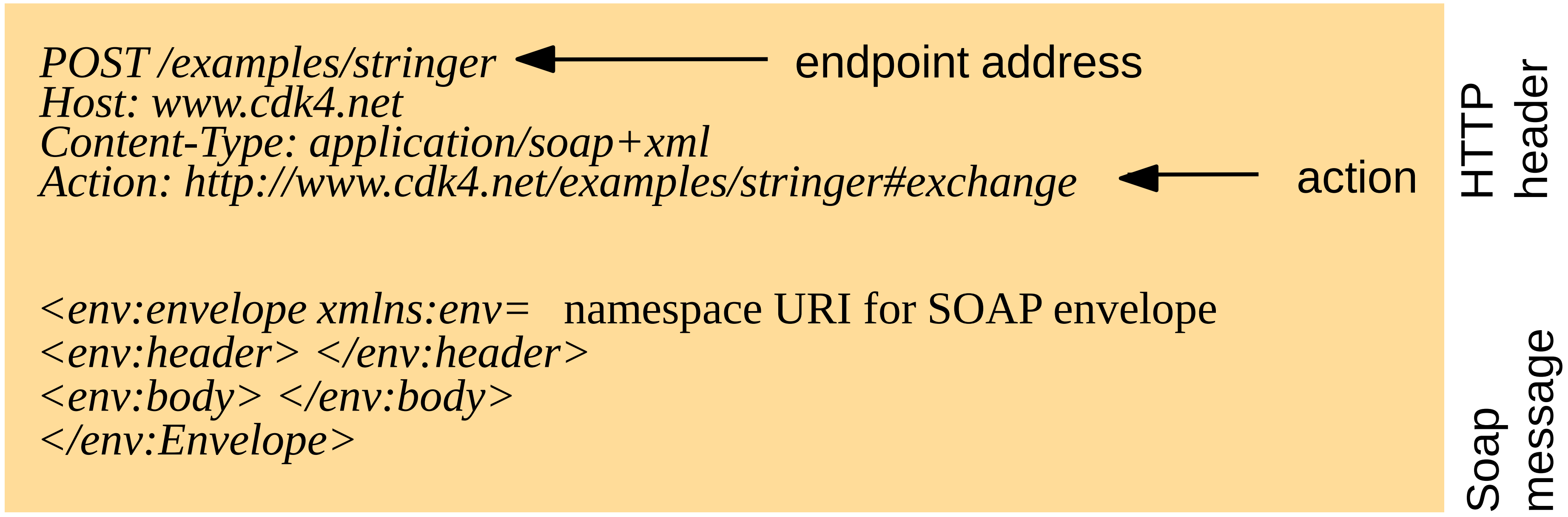

env:envelope xmlns:env = namespace URI for SOAP envelope
env:body
m:exchangeResponse
xmlns:m = namespace URI for the service description
m:res1
World
m:res2
Hello

Figure 7.6
Use of HTTP POST Request in SOAP client-server communication



```
POST /examples/stringer
Host: www.cdk4.net
Content-Type: application/soap+xml
Action: http://www.cdk4.net/examples/stringer#exchange

<env:envelope xmlns:env=   namespace URI for SOAP envelope
<env:header> </env:header>
<env:body> </env:body>
</env:Envelope>
```

Figure 7.7
Java web service interface ShapeList

```
import java.rmi.*;
public interface ShapeList extends Remote {
        int newShape(GraphicalObject g) throws RemoteException; 1
        int numberOfShapes()throws RemoteException;
        int getVersion() throws RemoteException;
        int getGOVersion(int i)throws RemoteException;
        GraphicalObject getAllState(int i) throws RemoteException;
}
```

Figure 7.8
Java implementation of the ShapeList server

```
import java.util.Vector;
public class ShapeListImpl implements ShapeList {
        private Vector theList = new Vector();
        private int version = 0;
        private Vector theVersions = new Vector();
        public int newShape(GraphicalObject g) throws RemoteException{
                version++;
                theList.addElement(g);
                theVersions.addElement(new Integer(version));
                return theList.size();
        }
        public int numberOfShapes(){}
        public int getVersion() {}
        public int getGOVersion(int i){   }
        public GraphicalObject getAllState(int i) {}
}
```

Figure 7.9
Java implementation of the *ShapeList* client

```
package staticstub;
import javax.xml.rpc.Stub;
public class ShapeListClient {
        public static void main(String[] args) { /* pass URL of service */
          try {
                Stub proxy = createProxy();                                              1
                proxy._setProperty                                                       2
                  (javax.xml.rpc.Stub.ENDPOINT_ADDRESS_PROPERTY, args[0]);
                ShapeList aShapeList = (ShapeList)proxy;                                 3
                GraphicalObject g = aShapeList.getAllState(0);                           4
          } catch (Exception ex) { ex.printStackTrace(); }
        }
        private static Stub createProxy() {                                            5
                return
                  (Stub) (new MyShapeListService_Impl().getShapeListPort());             6
  }
}
```

Figure 7.10
The main elements in a WSDL description

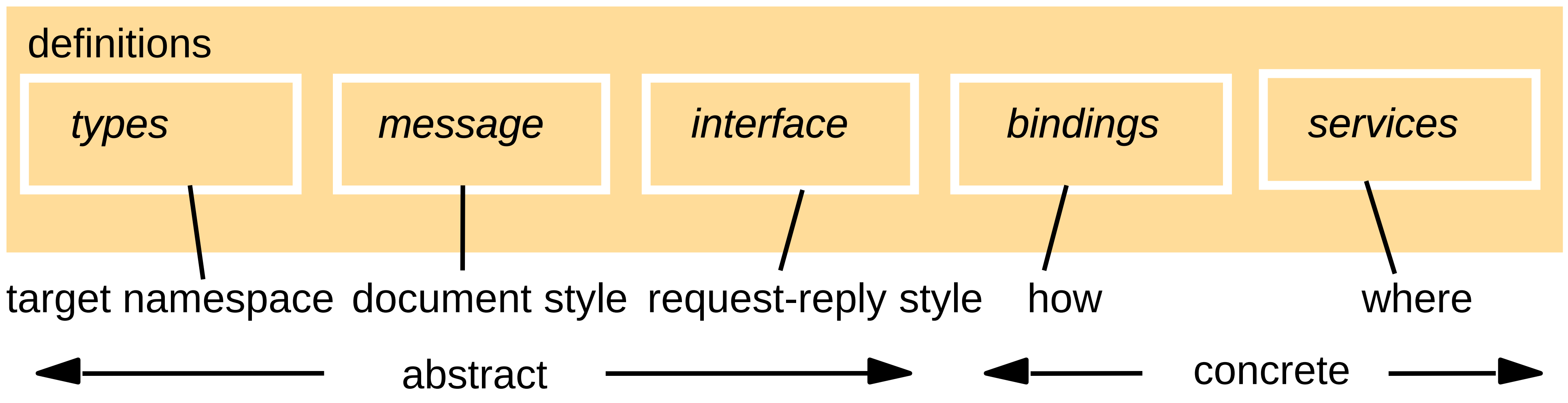
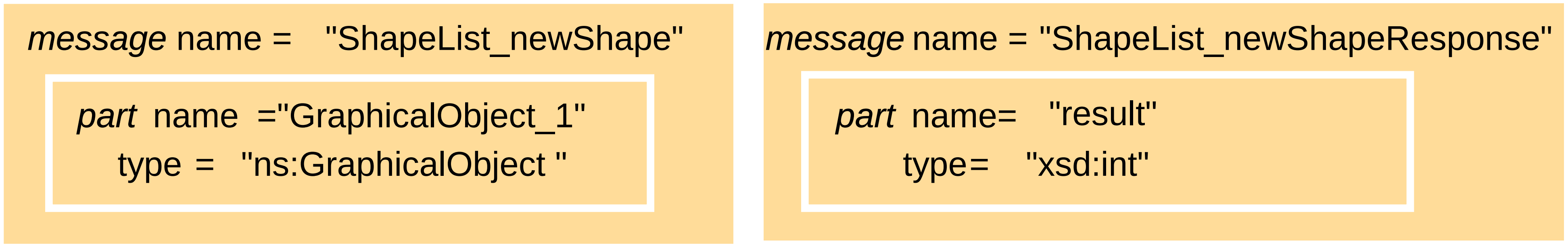


Figure 7.11
WSDL request and reply messages for the newShape operation



message name = "ShapeList_newShape"

part name ="GraphicalObject_1"
type = "ns:GraphicalObject "

message name = "ShapeList_newShapeResponse"

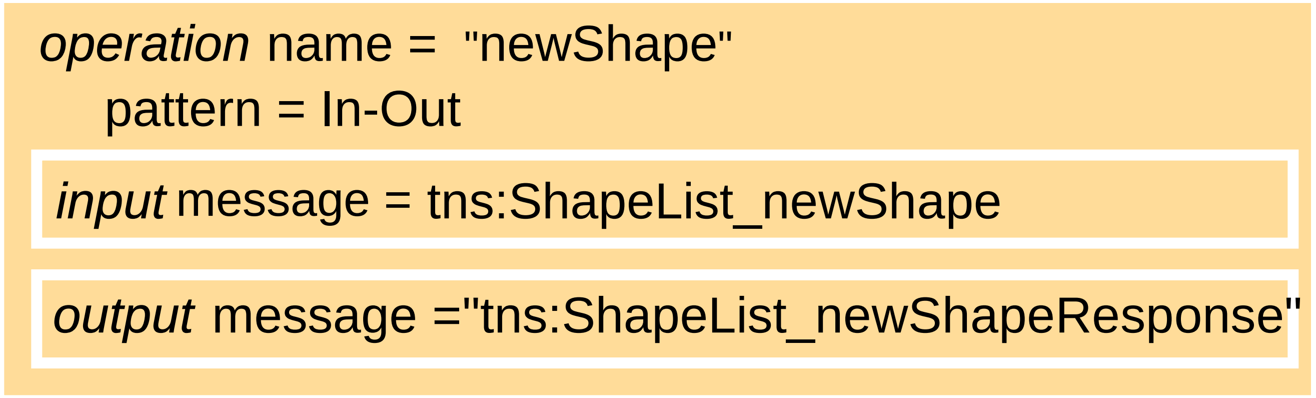
part name= "result"
type= "xsd:int"

tns – target namespace xsd – XML schema definitions

Figure 7.12
Message exchange patterns for WSDL operations

Name	*Messages sent by*			
	Client	*Server*	*Delivery*	*Fault message*
In-Out	*Request*	*Reply*		may replace *Reply*
In-Only	*Request*			no fault message
Robust In-Only	*Request*		guaranteed	may be sent
Out-In	*Reply*	*Request*		may replace *Reply*
Out-Only		*Request*		no fault message
Robust Out-Only		*Request*	guaranteed	may send fault

Figure 7.13
WSDL operation newShape


operation name = "newShape"
    pattern = In-Out

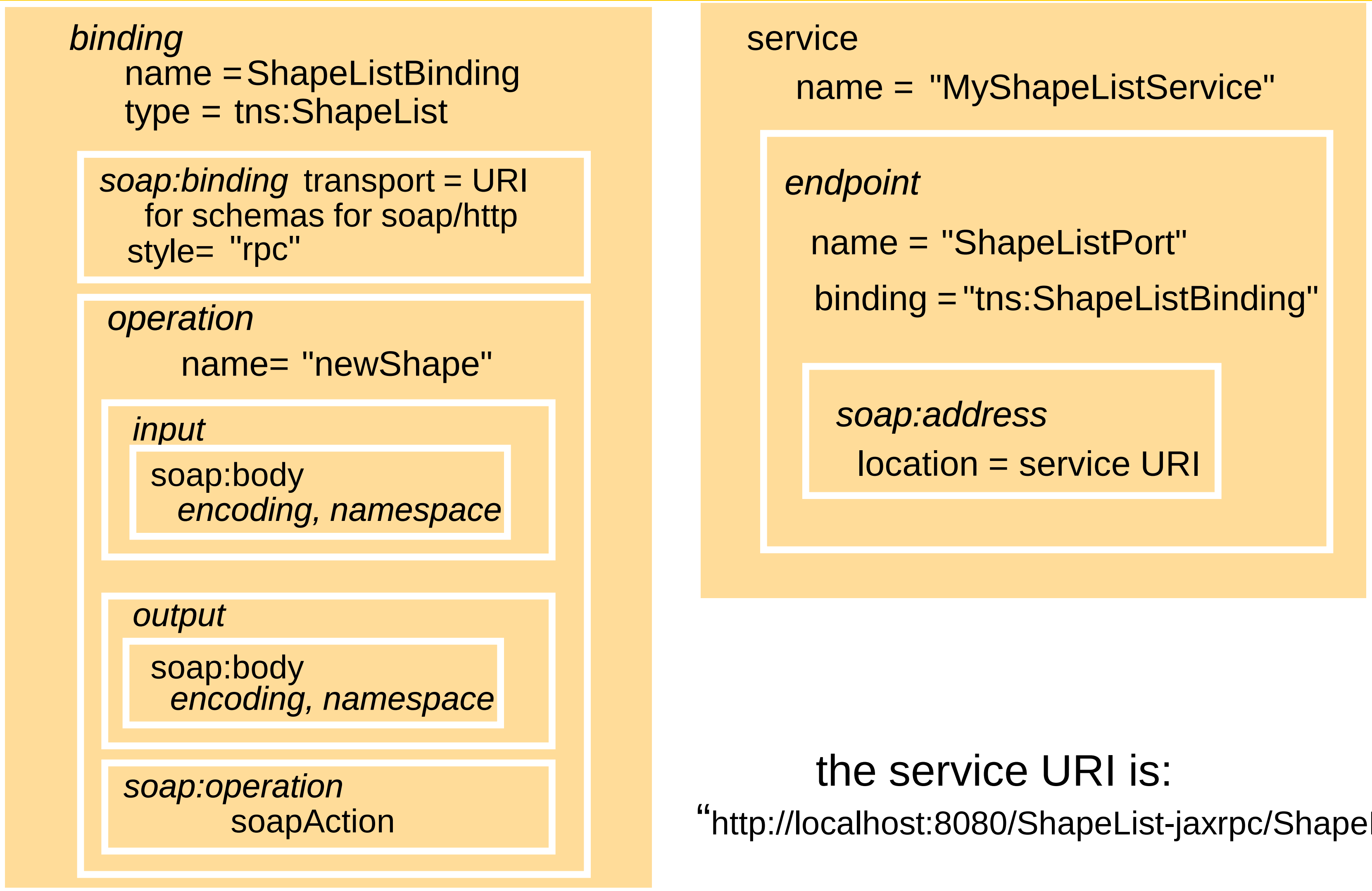
input message = tns:ShapeList_newShape

output message ="tns:ShapeList_newShapeResponse"

tns – target namespace xsd – XML schema definitions

The names *operation*, *pattern*, *input* and *output* are defined in the XML schema for WSDL

Figure 7.14
SOAP binding and service definitions



the service URI is:
"http://localhost:8080/ShapeList-jaxrpc/ShapeList"

Figure 7.15
The main UDDI data structures

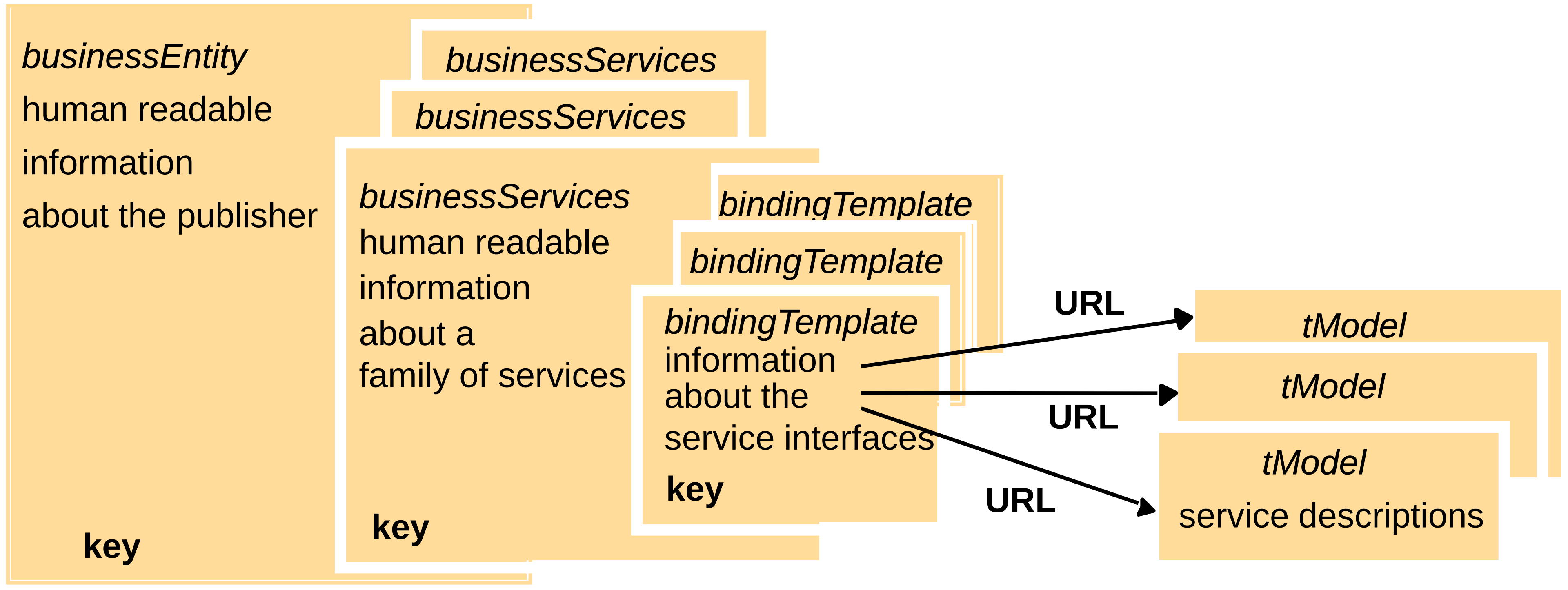


Figure 7.16
Algorithms required for XML signature

Type of algorithm	*Name of algorithm*	*Required*	*reference*
Message digest	SHA-1	Required	Section 7.4.3
Encoding	base64	Required	[Freed and Borenstein 1996]
Signature	DSA with SHA-1	Required	[NIST 1994]
(asymmetric)	RSA with SHA-1	Recommended	Section 7.3.2
MAC signature (symmetric)	HMAC-SHA-1	Required	Section 7.4.2 and Krawczyk *et al.* [1997]
Canonicalization	Canonical XML	Required	Page 810

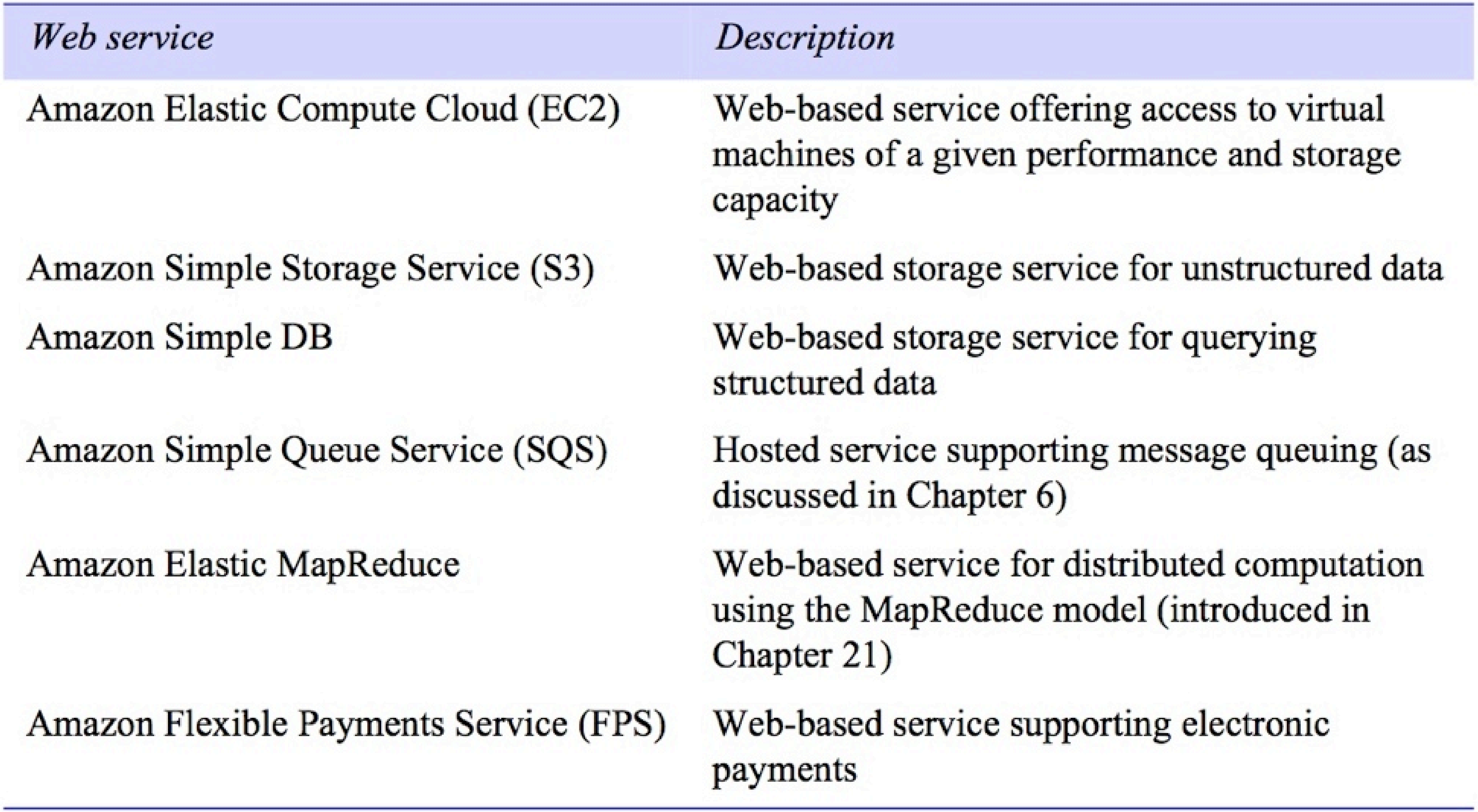
Figure 7.17
Algorithms required for encryption(in Figure 9.16 are also required)

Type of algorithm	*Name of algorithm*	*Required*	*reference*
Block cipher	TRIPLEDES, AES 128 AES-256	required	Section 7.3.1
	AES-192	optional	
Encoding	base64	required	[Freed and Borenstein 1996]
Key transport	RSA-v1.5, RSA-OAEP	required	Section 7.3.2 [Kaliski and Staddon 1998]
Symmetric key wrap (signature by shared key)	TRIPLEDES KeyWrap, AES-128 KeyWrap, AES 256KeyWrap	required	[Housley 2002]
	AES-192 KeyWrap	optional	
Key agreement	Diffie-Hellman	optional	[Rescorla, 1999]

Figure 7.18
Travel agent scenario

1. The client asks the travel agent service for information about a set of services; for example, flights, car hire and hotel bookings.
2. The travel agent service collects prices and availability information and sends it to the client, which chooses one of the following on behalf of the user:
(a) refine the query, possibly involving more providers to get more information, then repeat step 2;
(b) make reservations;
(c) quit.
3. The client requests a reservation and the travel agent service checks availability.
4. Either all are available;
or for services that are not available;
either alternatives are offered to the client who goes back to step 3;
or the client goes back to step 1.
5. Take deposit.
6. Give the client a reservation number as a confirmation.
7. During the period until the final payment, the client may modify or cancel reservations

Figure 7.19
A selection of Amazon Web Services



Web service	*Description*
Amazon Elastic Compute Cloud (EC2)	Web-based service offering access to virtual machines of a given performance and storage capacity
Amazon Simple Storage Service (S3)	Web-based storage service for unstructured data
Amazon Simple DB	Web-based storage service for querying structured data
Amazon Simple Queue Service (SQS)	Hosted service supporting message queuing (as discussed in Chapter 6)
Amazon Elastic MapReduce	Web-based service for distributed computation using the MapReduce model (introduced in Chapter 21)
Amazon Flexible Payments Service (FPS)	Web-based service supporting electronic payments