أكاديمية الحكومة الإلكترونية الفلسطينية

The Palestinian eGovernment Academy

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Tutorial III:

Process Integration and Service Oriented Architectures

# Session 2
# Overview XML NS and Schema


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# About

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## Project Consortium:

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- Ministry of Telecom and IT, Palestine
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# Tutorial Map

| Intended Learning Objectives |
|---|
| **A: Knowledge and Understanding** |
| 3a1: Demonstrate knowledge of the fundamentals of middleware. |
| 3a2: Describe the concept behind web service protocols. |
| 3a3: Explain the concept of service oriented architecture. |
| 3a4: Explain the concept of enterprise service bus. |
| 3a5: Understanding WSDL service interfaces in UDDI. |
| **B: Intellectual Skills** |
| 3b1: Design, develop, and deploy applications based on Service Oriented Architecture (SOA). |
| 3b2: use Business Process Execution Language (BPEL). |
| 3b3: using WSDL to describe web services. |
| **C: Professional and Practical Skills** |
| 3c1: setup, Invoke, and deploy web services using integrated development environment. |
| 3c2: construct and use REST and SOAP messages for web services communication. |
| **D: General and Transferable Skills** |
| d1: Working with team. |
| d2: Presenting and defending ideas. |
| d3: Use of creativity and innovation in problem solving. |
| d4: Develop communication skills and logical reasoning abilities. |

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# Session Outlines

- **XML Overview**
  - XML document and Grammars
- XML information set
- XML Namespaces
- XML Schema

# Overview

- XML is a markup language, like HTML, consists of *markup* and *text*.
- Markup is composed of individual tags.
- Both HTML and XML are languages for exchanging data, but there is a difference between them.
- See next slide for and initial XML example.

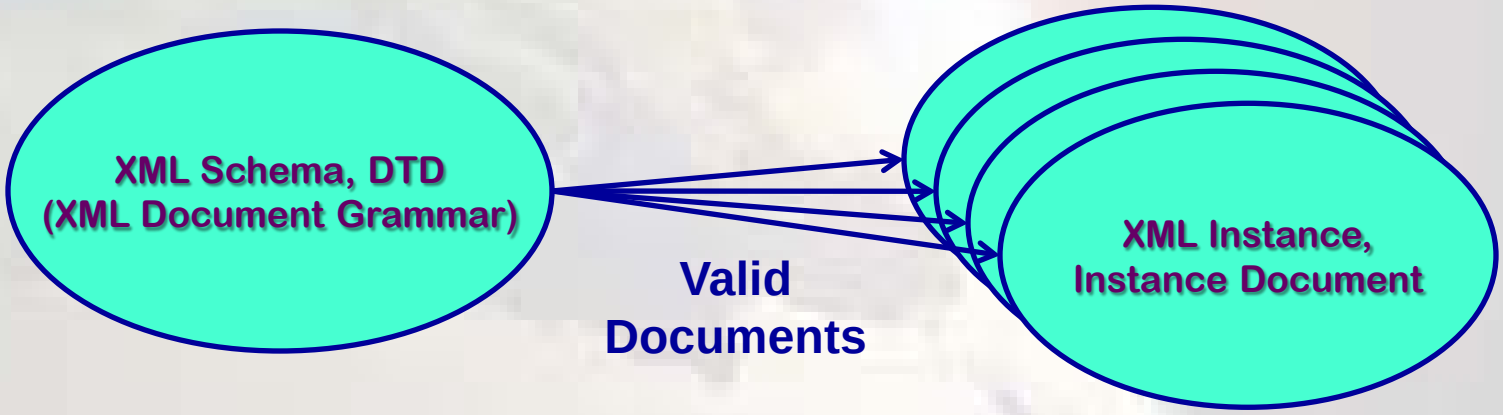
# Valid and well-formed XML document

- Valid XML document is one that comply with the constraints expressed through a given grammar.
- A well-formed XML document is one that comply with XML syntax expressed in the XML standard.
  - But not associated with a distinct grammar.

# XML grammars

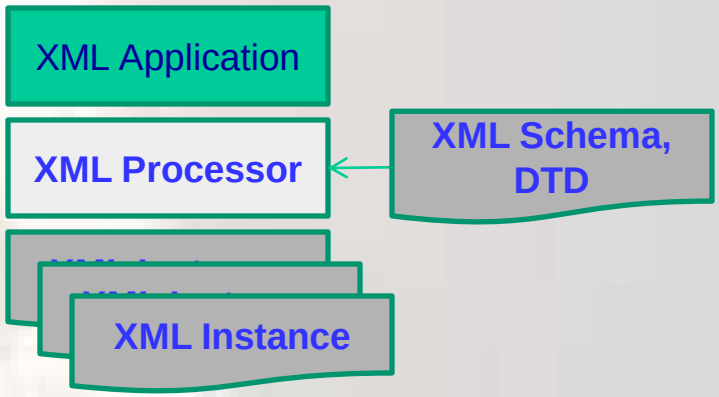
- Specified by two dominant concepts:
  - *XML schema* and *Document Type Definitions* (DTDs)
- XML schema is powerful to express structural XML document constraints than DTDs.
- XML document complying with a DTD or a schema is called and *XML instance* or *instance document*.
- See next slide, for the relationship between XML document grammar and XML instances resulting from applying the grammar.

# XML document grammar and valid XML instances, [2]



# XML processor

- Applications are interested in the structural information and the XML instance, when XML is used to exchange data between them.
- XML processor, e.g. SOAP server, must validate the XML documents against the XML grammar and pass the XML instance structure and payload to the application, e.g. SOAP message.




A validating XML processor, [2]

# Session Outlines

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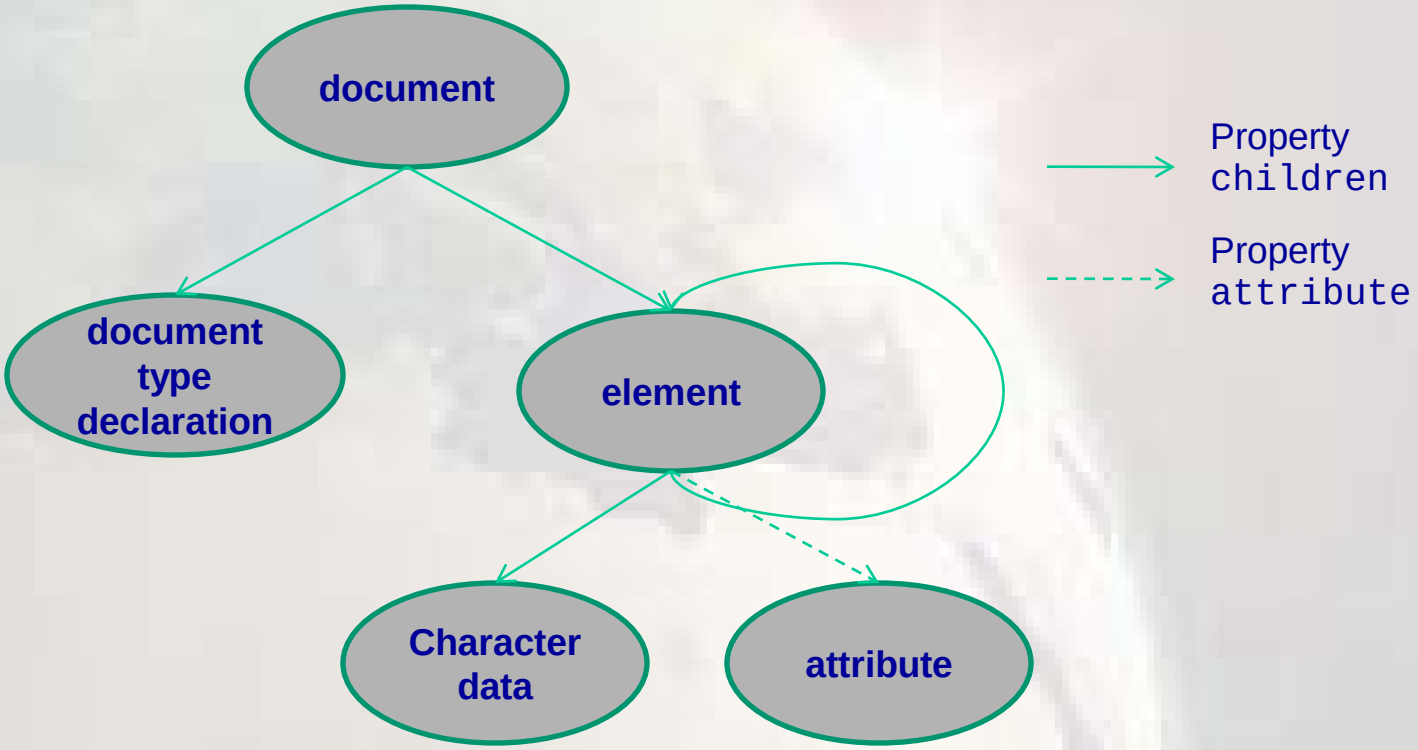
# XML information set

- XML info set, provides a set of abstract data definitions to represent the information in a well-formed XML document.
  - Each well-formed XML document has an associated info set.
- The information set consists of information items.
  - Each item describes an XML document part through a set of named properties

# Information item types of an XML information set, [2]



# Information item types of an XML information set

- `document`, consists at least of one mandatory *root element*, and:
  - XML version info (optional) & encoding info for the document. These are called *XML declaration*.
  - Document type declaration: contains markup declarations provide the grammar.
  - These together is called *prolog*.

# Information item types of an XML information set, cont.

- `element`: identified by a name and has a set of associated attributes.
- `attribute`: consists of a name and an associated value.
- `character data`: is an information item comprises the payload of an XML document.
- `comment`: `element` and `document` information items may contain comments.

# Information item types examples [2]

- Comment info item “may span multiple lines”:
  - `<!– This is a comment -->`
- Element info item:
  - element may have no content e.g.: `<address/>` or `<address></address>`

```
<address>
        <name>Mr Ahmad Ahmad</name>
        <street>11 Alquds Street</street>
        <city>Ramallah</city>
        <postal-code>100</postal-code>
        <country>Palestine</country>
</address>
```

# Information item types examples [2]

- An attribute is specified in the start tag of an element and consists of a name-value pair.
  - This example links an attribute named `targetAddress` with the "PS" to the `address` elements:

```
<address targetAddress="PS">
        <name>Mr Ahmad Ahmad</name>
        <street>11 Alquds Street</street>
        <city>Ramallah</city>
        <postal-code>100</postal-code>
        <country>Palestine</country>
</address>
```

# Information item types examples [2]

- Document info item: look to the following prolog:

```
<?xml version="1.0" encoding=UTF-16"?>
<! DOCTYPE address [<!– DTDs go here --> ]>
<address> <!– XML instances go here --> </address>
```

- Document type declaration identified by keyword DOCTYPE must be identical to the corresponding root element

# Information item types examples

- element content: if declared to be character data, this is indicated by the term #PCDATA. "*Parsed Character Data*"
  - Thus, a valid declaration would be:

```
<?xml version="1.0" encoding=UTF-16"?>
<! DOCTYPE address [<!ELEMENT address (#PCDATA)> ]>
```

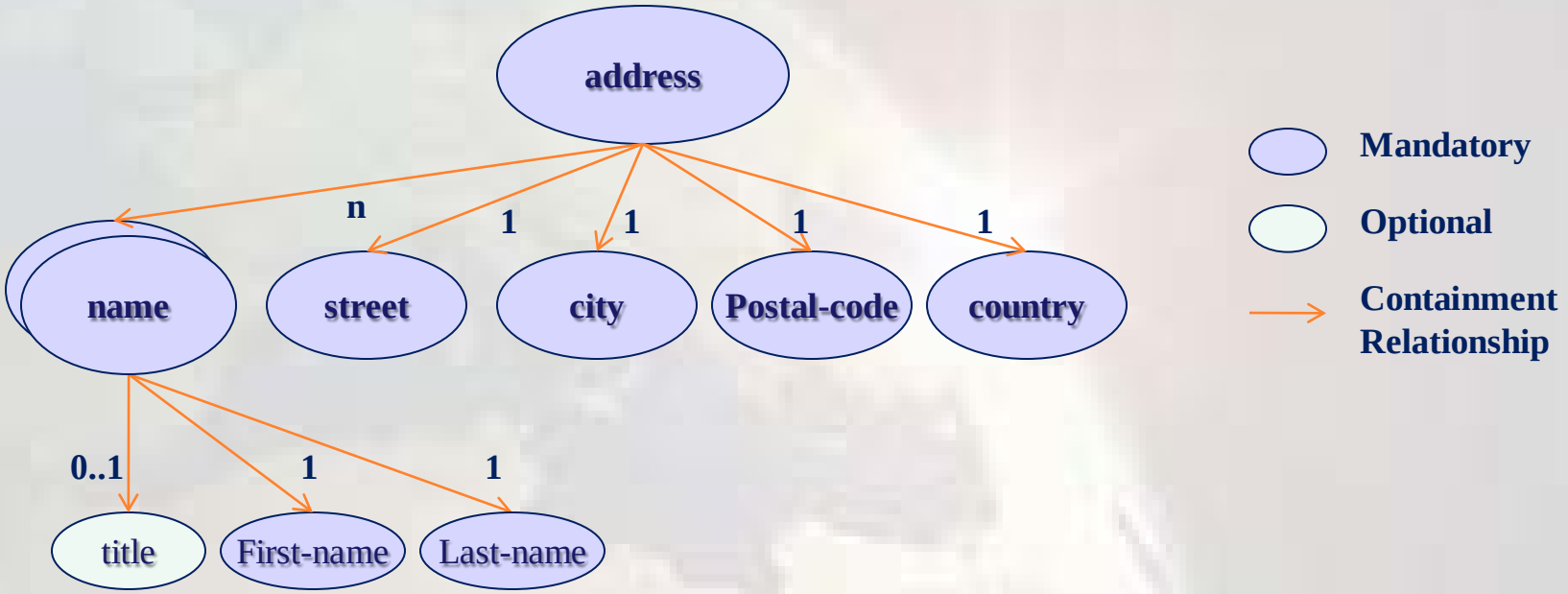
- In an XML instance the address element could appear as follows:

```
<address>
        Mr Ahmad Ahmad
        11 Alquds Street
        Ramallah
        100
        Palestine
</address>
```

# Element content and mixed content

- We can combine elements and build nested element declarations.
- DTD syntax provides 5 symbols used to describe manners of combination.
- Assume `e1`, `e2` and `e3` to be elements:
  - `e1?` : `?` means none or one element `e1`.
  - `e1*` : `*` means none, one or more element `e1`.
  - `e1+` : `+` means one or more than one element `e1`.
  - `e1, e2, e3` : `,` means list of element are chained.
  - `e1 | e2`: means `e1` or `e2` can be chosen but not both.

# address element can have this structure, [2]




Source, [2]

# A DTD describing the address structure, [2]

```
<?xml version="1.0" encoding="UTF-16"?>
<!DOCTYPE address [
<!ELEMENT address (name+, street, city, postal-code,
country)>
<!ELEMENT name (title?, first-name, last-name)>
<!ELEMENT title (#PCDATA)>
<!ELEMENT first-name (#PCDATA)>
<!ELEMENT last-name (#PCDATA)>
<!ELEMENT street (#PCDATA)>
<!ELEMENT city (#PCDATA)>
<!ELEMENT postal-code(#PCDATA)>
<!ELEMENT country(#PCDATA)>
]>
```

# An instance document could be as shown here

```
<address>
        <name>
            <title selectTitle="Mr"/>
            <first-name>Ahmad M.</first-name>
            <last-name>Ahmad</last-name>
        </name>
        <street>11 Alquds Street</street>
        <city>Ramallah</city>
        <postal-code>100</postal-code>
        <country>Palestine</country>
</address>
```

# A valid address XML instance

```
<address targetAddress="PS">
        <name>
            <title selectTitle="Mr"/>
            <first-name>Ahmad M.</first-name>
            <last-name>Ahmad</last-name>
        </name>
        <street>11 Alquds Street</street>
        <city>Ramallah</city>
        <postal-code>100</postal-code>
        <country>Palestine</country>
</address>
```

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- **XML Namespaces**
- XML Schema

# XML Namespaces

- XML processor must be able to differentiate our XML address instances from someone else's address instances.
  - Identification using element type names is not sufficient.
- Some global naming mechanism is required.
- XML *namespaces* ensure that XML definitions are unique.
- Using XML namespaces, XML elements can be distinguished, even if they have identical names.

# XML Namespaces concept

- An XML namespace comprises a collection of element type names & attribute names.
- An XML namespace, is identified by a URI reference.
- The collection of element type names & attribute names, belonging to the same namespace are identified by the namespace URI reference.
- See next slide for namespaces example!

# Identical markup belonging to different namespaces

http://companyx.com/ns/orders

<order>
<order-number>
<order-date>
<name>
<address>

http://companyx.com/ns/employees

<employee-id>
<dept-number>
<name>
<address>

http://clubx.com/ns/members

<member>
<member-id>
<member-since>
<name>
<address>

**Source, [2], with modifications**

# Qualified names

- A name from a namespace appears in a document as a *qualified name* (*Qname*).
- A Qname consists of a *prefix* and a *local part*.
- e.g. `cX` is the prefix and `address` is the local part:

  `cX:address`
- Prefix selects the namespace and local part take care of the naming within the scope of the namespace.

# Declaring XML namespaces

- Done through the reserved namespace attribute `xmlns`.
- Also, can be done through `xmlns:` followed by a name without colons.
- The value of the namespace attribute is the URI reference.
- Linking a namespace to a prefix, e.g.:

```
<address xmlns:cX="http://companyx.com/ns/employees">
```

  - `cX` is the prefix for all qualified names belonging to the namespace
- Using a default namespace, e.g.:

```
<address xmlns="http://companyx.com/ns/employees">
```

  - All subordinate elements are in the same default namespace, unless a subordinate element overwrites the default namespace.

# Declaring a namespace for the address document, using prefix namespace attribute

```
<cX:address xmlns:cX="http://companyx.com/ns/employees"
            targetAddress="PS">
        <cX:name>
            <cX:title selectTitle="Mr"/>
            <cX:first-name>Ahmad M.</cX:first-name>
            <cX:last-name>Ahmad</cX:last-name>
        </cX:name>
        <cX:street>11 Alquds Street</cX:street>
        <cX:city>Ramallah</cX:city>
        <cX:postal-code>100</cX:postal-code>
        <cX:country>Palestine</cX:country>
</cX:address>
```

# Using a default namespace name declaration

```
<address xmlns="http://companyx.com/ns/employees"
         targetAddress="PS">
      <name>
         <title selectTitle="Mr"/>
         <first-name>Ahmad M.</first-name>
         <last-name>Ahmad</last-name>
      </name>
      <street>11 Alquds Street</street>
      <city>Ramallah</city>
      <postal-code>100</postal-code>
      <country>Palestine</country>
</address>
```

# An example for an entry of the phone book maintained by the company

```
<phonebook xmlns="http://companyx.com/ns/phonebook"
      <location>Company X Office</location>
      <roomNumber>03.02</roomNumber>
      <!-- Extension -->
      <officePhone>*2911111</officePhone>
</phoneBook>
```

# XML namespaces and attributes

- Default namespaces are not applied to attributes that do not have a prefix.
- The following example is a valid XML instance.
  - Although the local part of the `location` element attribute is Identical.

```
<!-- Declare a namespace prefix
<phoneOwner xmlns:phone="http://companyx.com/ns/phonebook"
  <!-- for illustrative purposes, not a good XML practice. -->
  <phonebook xmlns="http://companyx.com/ns/phonebook"
      <location department="HR" phone:department="HR">
        Company X Office</location>
  </phoneBook>
</phoneOwner>
```

# Session Outlines

- XML Overview
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- **XML Schema**

# XML schema

- If we want to insert the `roomNumber` element to the phone book as follows:
  - A `roomNumber` value must start with 2 digits describing the building floor, followed by a dot.
  - Then, a 2 more digits to represent the room number on that floor.
- No way to specify this pattern through a DTD.
- XML schema allows us to express such a constraints.
- Various data types can be defined with XML schema and new data types can be derived from existing ones.

# An initial XML schema example

**Type** definition

It is a simple type based on XML schema built-in type "string" restricting the string to a distinct string pattern (the string pattern is also called a *facet*)

```
<simpleType name="roomNumberType">
   <restriction base="string">
      <pattern value="[0-9]{2}\.[0-9]{2}"/>
   </restriction>
</simpleType>
```

```
<element name="roomNumber" type="roomNumberType"/>
```

**Element declaration**

The element named `roomNumber` is of type `roomNumberType`

**Source, [2]**

# The structure of an XML schema definition

- An *XML Schema Definition* (XSD) is itself an XML instance.
  - An advantage of the XML schema.
- The top element of the `xsd` is name `schema`.
- The XML namespace for a schema definition is `http://www.w3.org/2001/XMLSchema`, linked to prefix `xsd`. Start a schema definition as:

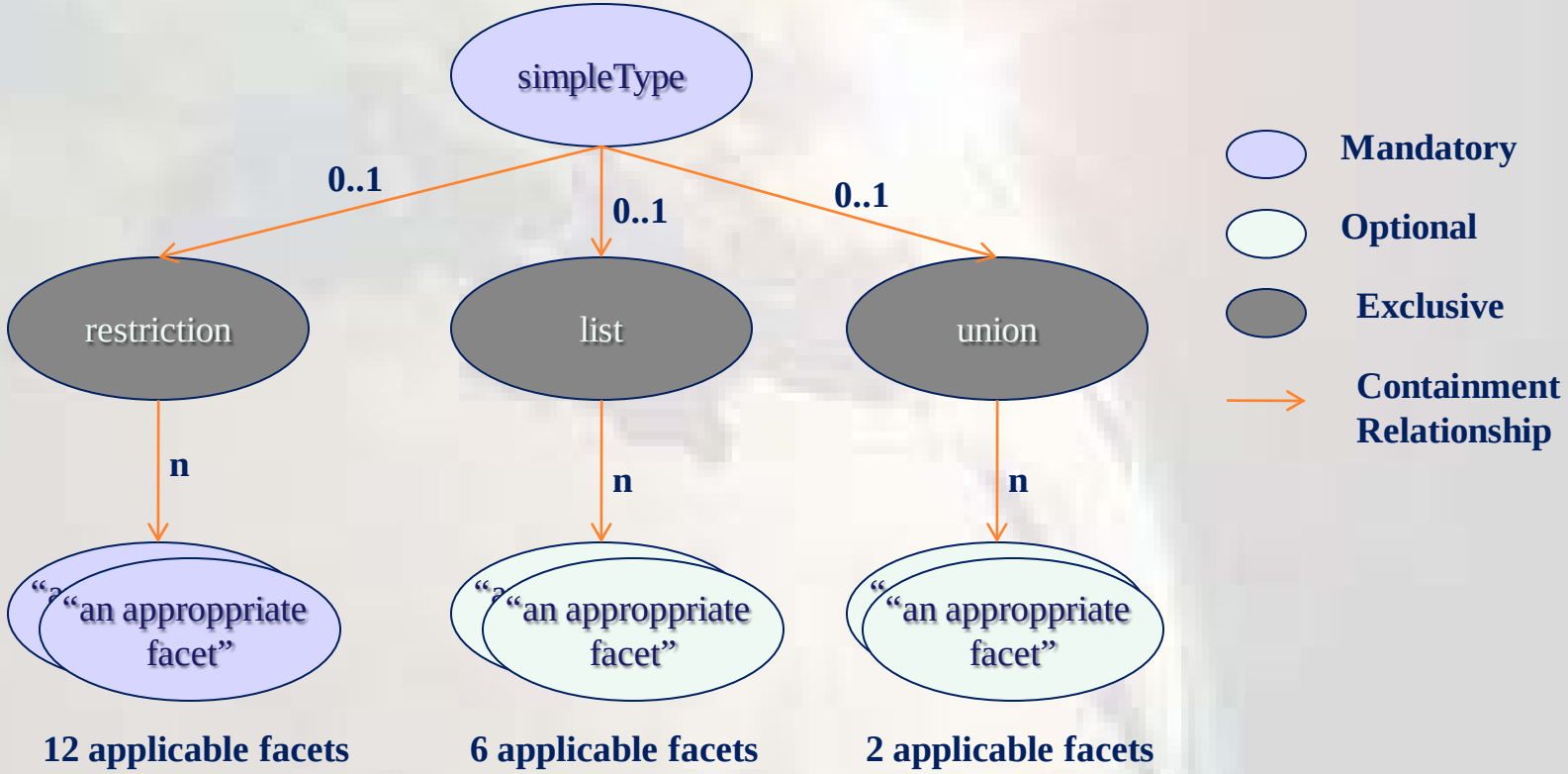
```
<xsd:schema
      xmlns:xsd="http://www.w3.org/2001/XMLSchema">
.. .. </xsd:schema>
```

# Some of subordinate element types of schema element.

- `element`: declares an element used in an XML instance.
- `attribute`: declares an attribute used in an XML instance.
- `simpleType`: this element defines a simple type, which is an XML schema *built-in* type.
- `complexType`: this definition typically contains XML elements and carry attributes, all declared within the type definition.

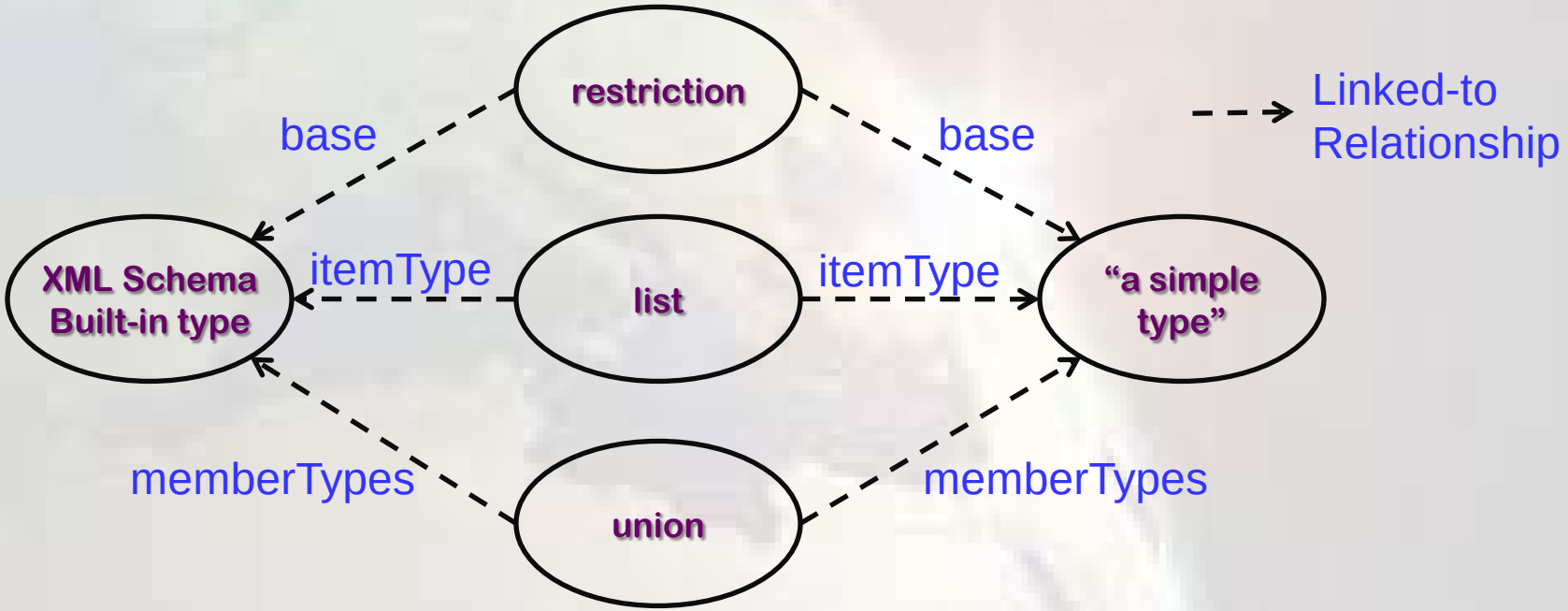
# XML schema containment structure of a simple type definition

- Only one exclusive element must be contained in the superior element.




Source, [2]

# Attribute links between simple type XML schema elements




**Source, [2]**

# A type definition for the title element

```
<xsd: simpleType name="titleTypeUK">
   <xsd:restriction base="xsd:string">
      <xsd:enumeration value="Miss"/>
      <xsd:enumeration value="Mr"/>
      <xsd:enumeration value="Mrs"/>
      <xsd:enumeration value="Ms"/>
   </xsd:restriction>
</xsd:simpleType>
```

Global elements may appear at the top level of an XML instance:

```
<xsd:schema xmlns:xsd="http://www.w3.org/2001/XMLSchema">
      . . .
      <!-- "titleTypeUK" definition goes here -->
      <xsd:element name="title" type="tns:titleTypeUK"/>
</xsd:schema>
```

# A type definition for the first-name element

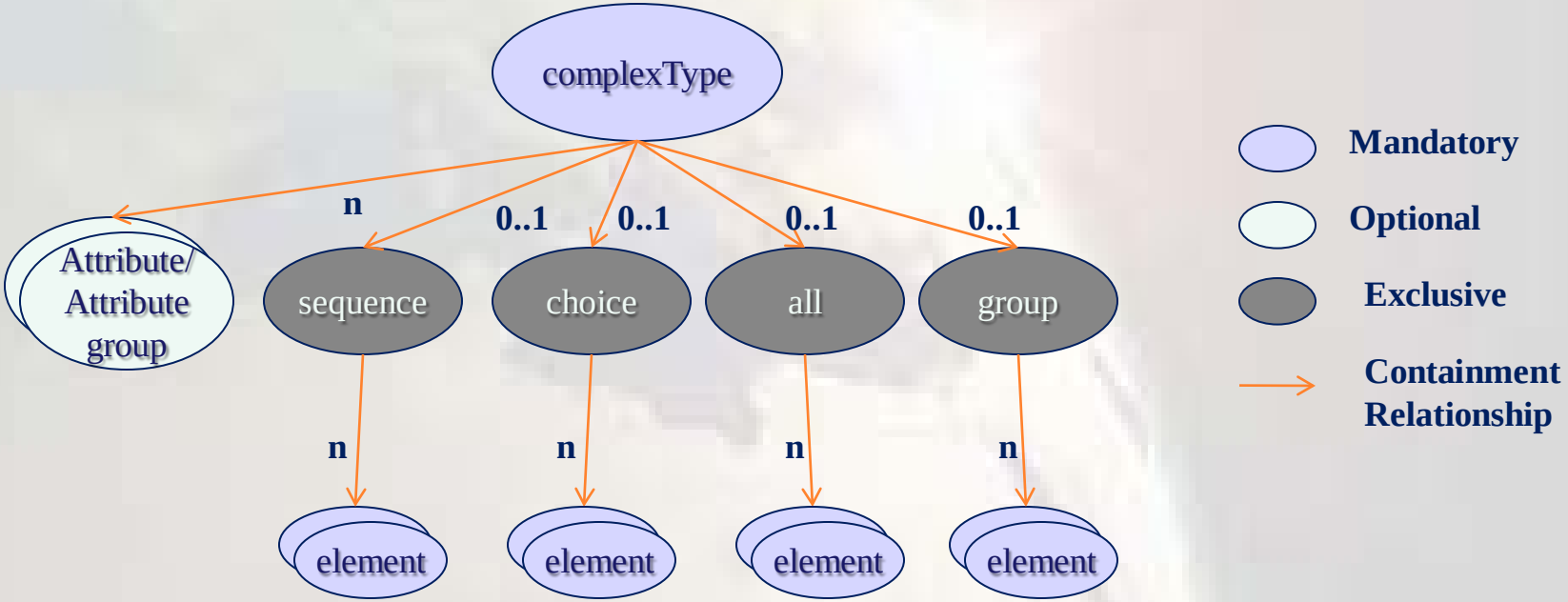
```
<xsd: simpleType name="firstNameType">
   <xsd:restriction base="xsd:string">
      <xsd:pattern value="[A-Z][a-z]*"/>
   </xsd:restriction>
</xsd:simpleType>
```

## minLength and maxLength

```
<xsd: simpleType name="firstNameType">
   <xsd:restriction base="xsd:string">
      <xsd:pattern value="[A-Z][a-z]*"/>
      <xsd:minLength value="2"/>
      <xsd:maxLength value="20"/>
   </xsd:restriction>
</xsd:simpleType>
```

# XML schema containment structure of a complex type definition

- Only one exclusive element must be contained in the superior element. And an arbitrary number of attribute.




Source, [2]

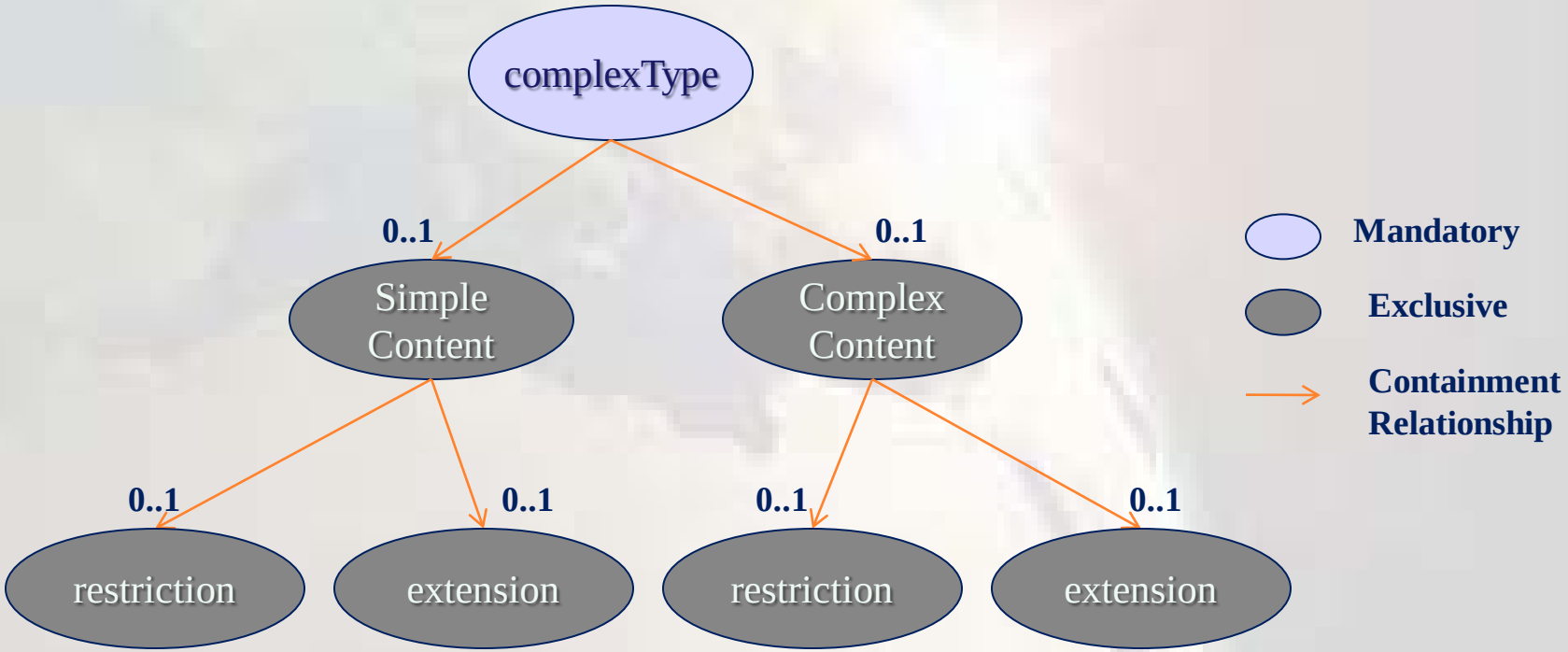
# Complex type definitions

- The following XML schema presents a group named `nameGroup` that is referred to within a complex type definition, [2].

```
<!-- this is the named group definition.
<xsd:group name="nameGroup">
  <xsd:sequence>
    <!-- Here is the type definition of a name -->
  </xsd:sequence>
</xsd:group>
<!-- Here the named group if referred to within a complex type. -->
<xsd:complexType name="addressType">
 <xsd:sequence>
    <!-- Here is the reference to the above defined group -->
    <xsd:group ref="nameGroup"/>
       . . .
  </xsd:sequence>
</xsd:complexType>
```

# XML schema containment structure for deriving types by extension

- `simpleContent` and `complexContent` elements must be superior to either restriction or extension elements.




**Source, [2]**

# Linking XML schemas to XML instances

- `schemaLocation` attribute contains value pairs:
  - The first value is a namespace.
  - The second, provides a link to the schema used for validating elements and attributes contained in this namespace.

# Linking schemas to instances

- To link the address document instance to the address schema via the `schemaLocation` attribute, we need to add this attribute to the instance document.

Example

```
<cX:address
  xmlns:cX="http://companyx.com/ns/employees"
  xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance
  xsi:schemaLocation="http://companyx.com/ns/employees
                      http://localhost/address.xsd">
      . . .
   <!-- the first URI defines the namespace for elements and   -->
   <!-- attributes in this document, for which the second URI  -->
   <!-- points to the schema location of the schema that       -->
   <!-- can be used to validate these elements and attributes  -->
</cX:address>
```

# Summary

During this session we have explained with examples the following:

1. XML namespaces
2. XML schema

Next session will cover Xpath and Xquery.

# References


1. Bray T, Paoli J, Sperberg-McQueen C M, Maler E. Extensible Markup Language (XML) 1.0 (Second Edition), W3C Recommendation 6 October 2000, http://www.w3.org/TR/REC-xml, 2000.
2. Olaf Zimmermann, Mark Tomlinson, Stefan Peuser, “Perspectives on Web services-Applying SOAP, WSDL and UDDI to real-world projects, 2nd edition, Springer, 2005.

# Thanks

*Mohammed Aldasht*