메타데이터와 XML 스키마

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채 진 석

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Terminology Clarification

- Schema
  - Refers to the W3C XML Schema
- Schemas
  - Refers to one or more industry standards
- schema (lowercase)
  - Refers to an information model
  - Can be a DTD or Schema
  - May also be a relational database schema

General Concepts

DTD and XML Schema

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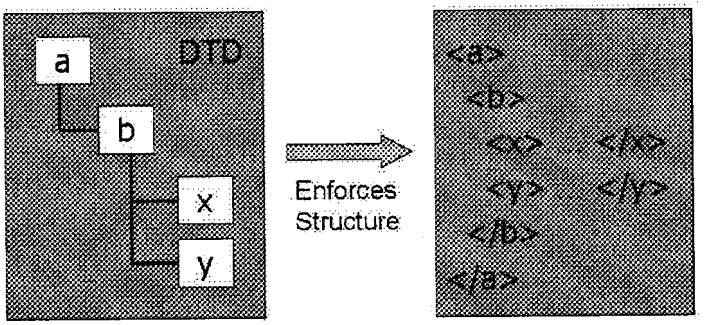
Document Type Definition

- An information modeling syntax

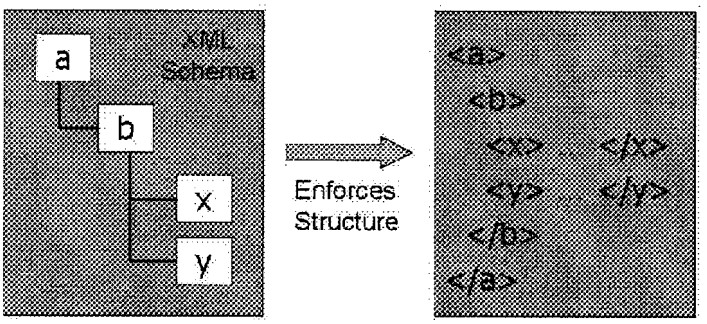


<!ELEMENT x (#PCDATA)>
<!ELEMENT y (#PCDATA)>

x and y are always interpreted as String, regardless of how they are used.

XML Schema

- An information modeling syntax in XML

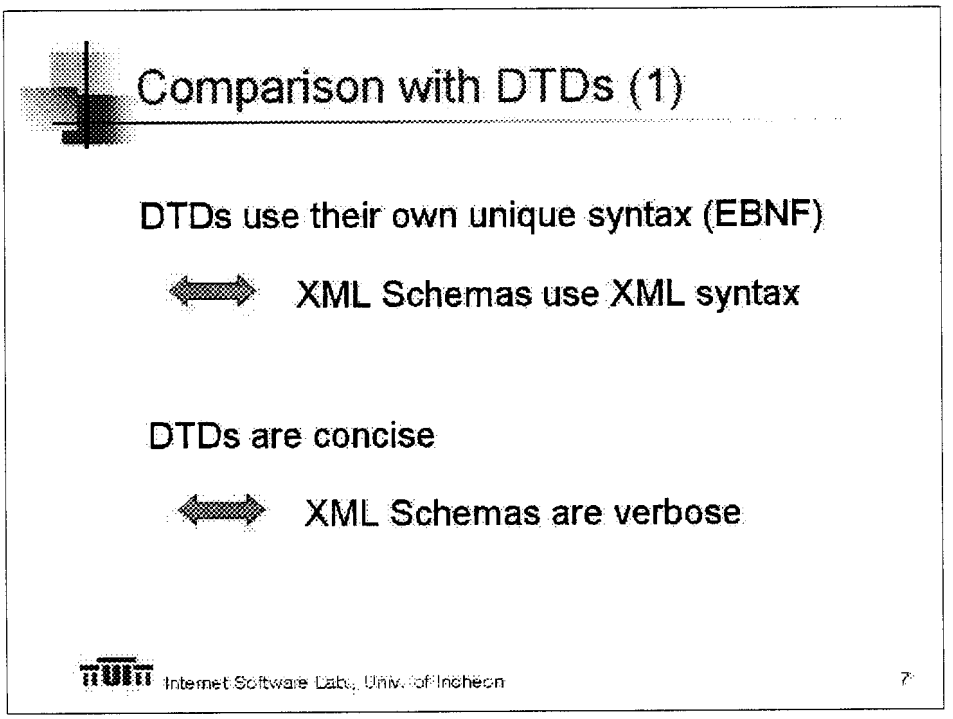


<element name="x" type="boolean" />
<element name="y" type="integer" />

x and y now have enforceable data types

Schema Validation

- Schemas can be used to validate a document in two ways
- **Content Model Validation**
  - Checks order and nesting of elements
  - Similar to DTD validation
- **Data Type Validation**
  - Checks the element content for valid type and range
  - Example: month element is an integer between 1 and 12
    - <month>15</month> INVALID!!
    - <month>5</month> VALID!!


Comparison with DTDs (1)
DTDs use their own unique syntax (EBNF)
XML Schemas use XML syntax
DTDs are concise
XML Schemas are verbose
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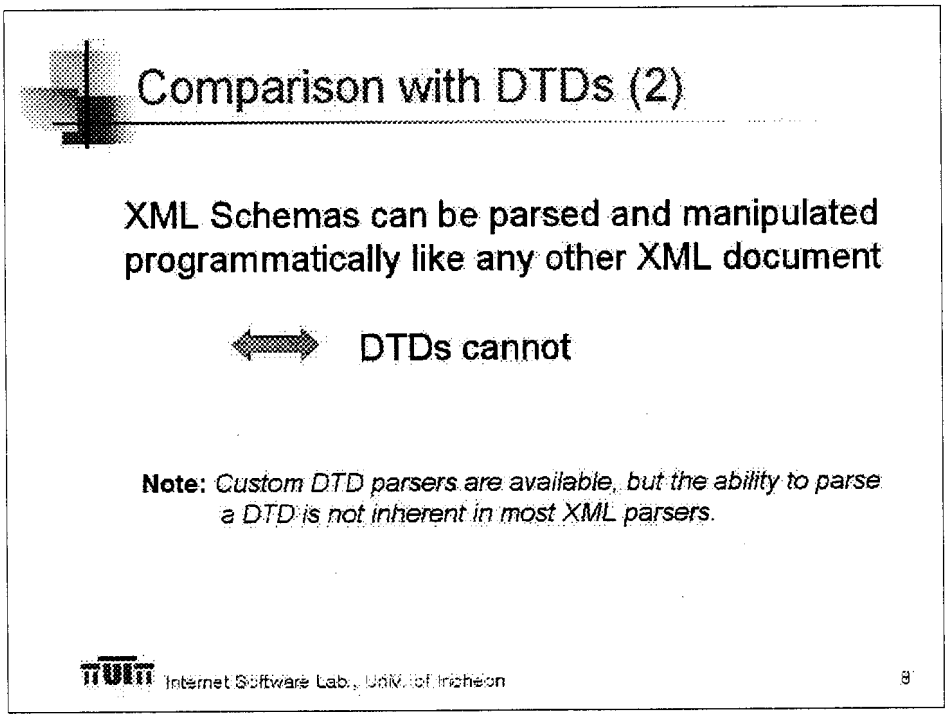
Comparison with DTDs (2)
XML Schemas can be parsed and manipulated programmatically like any other XML document
DTDs cannot
Note: Custom DTD parsers are available, but the ability to parse a DTD is not inherent in most XML parsers.
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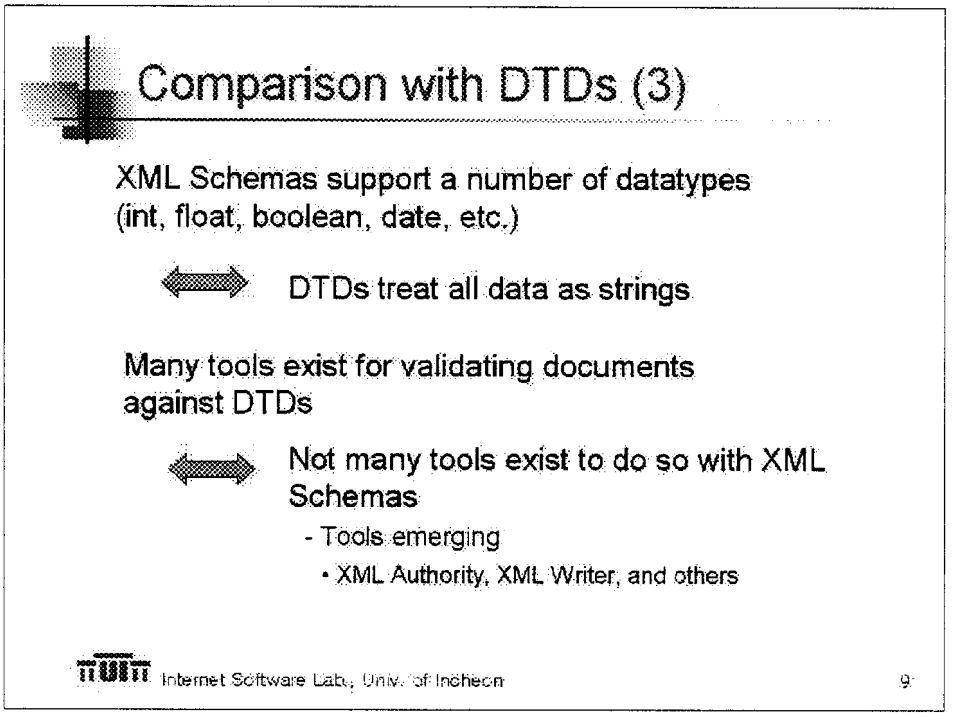
Comparison with DTDs (3)
XML Schemas support a number of datatypes (int, float, boolean, date, etc.)
DTDs treat all data as strings
Many tools exist for validating documents against DTDs
Not many tools exist to do so with XML Schemas
- Tools emerging
• XML Authority, XML Writer, and others
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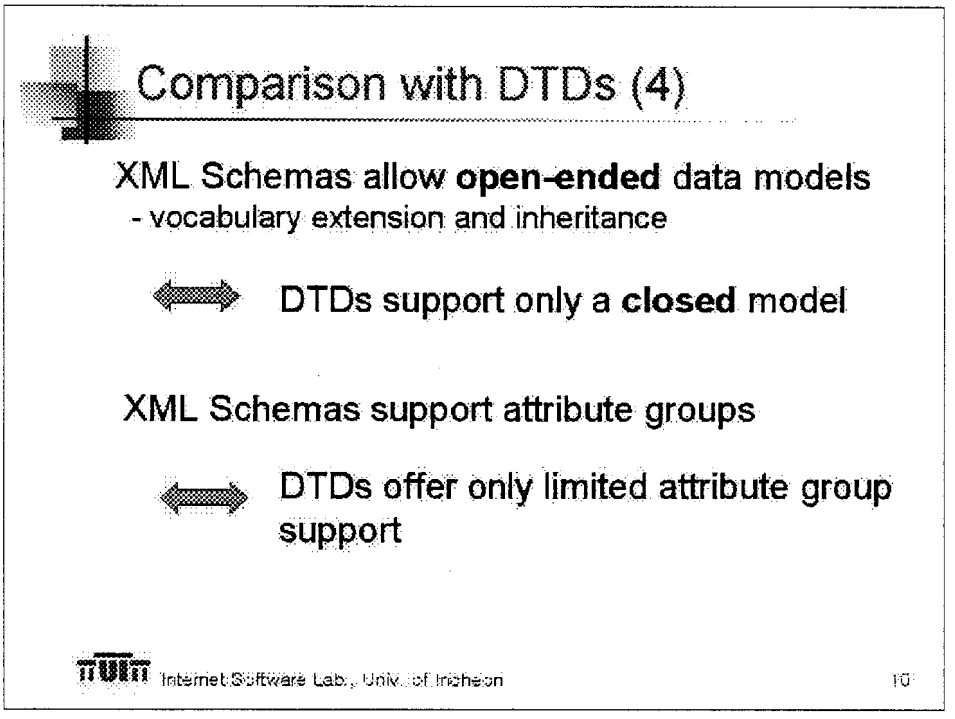
Comparison with DTDs (4)
XML Schemas allow open-ended data models
- vocabulary extension and inheritance
DTDs support only a closed model
XML Schemas support attribute groups
DTDs offer only limited attribute group support
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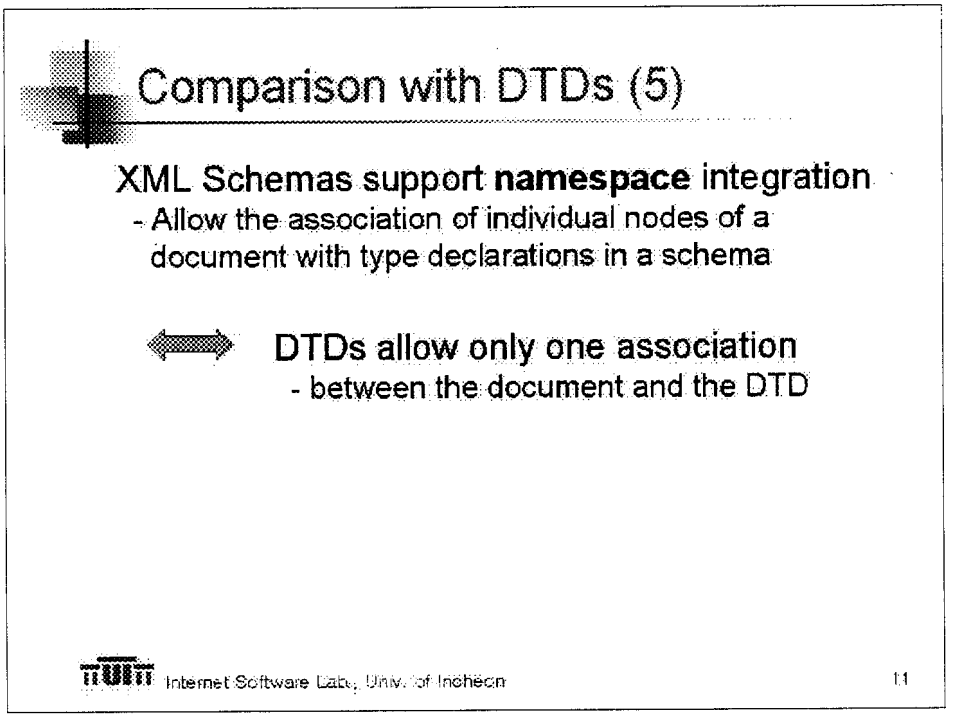
Comparison with DTDs (5)
XML Schemas support **namespace** integration
- Allow the association of individual nodes of a document with type declarations in a schema
⟺ DTDs allow only one association
- between the document and the DTD
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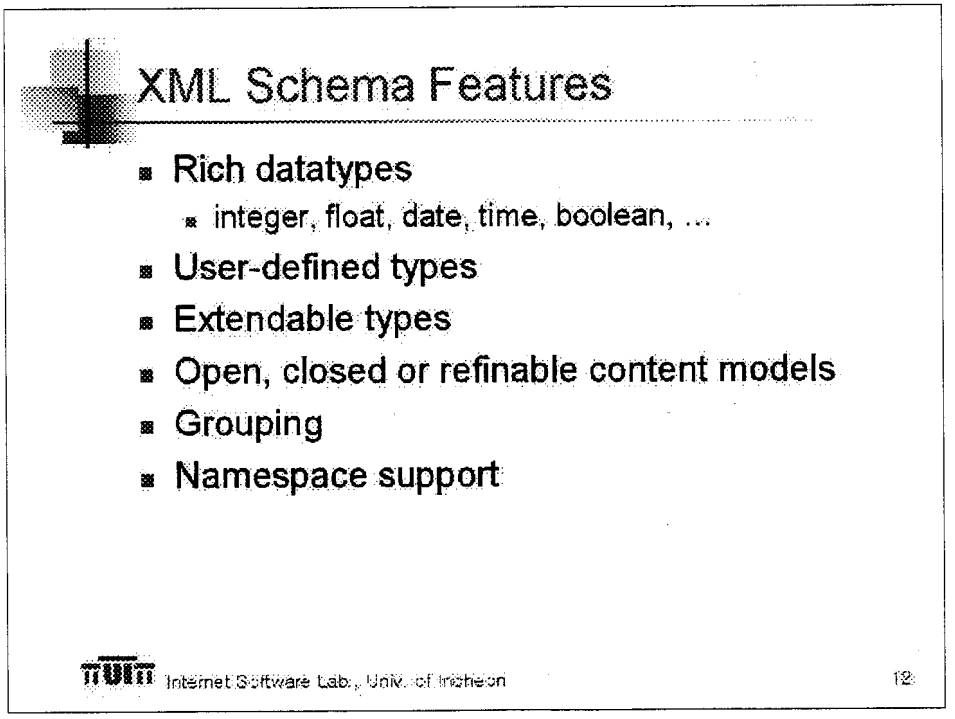
XML Schema Features
Rich datatypes
integer, float, date, time, boolean, ...
User-defined types
Extendable types
Open, closed or refinable content models
Grouping
Namespace support
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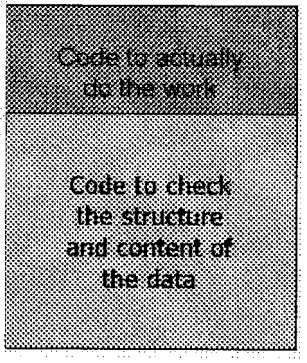
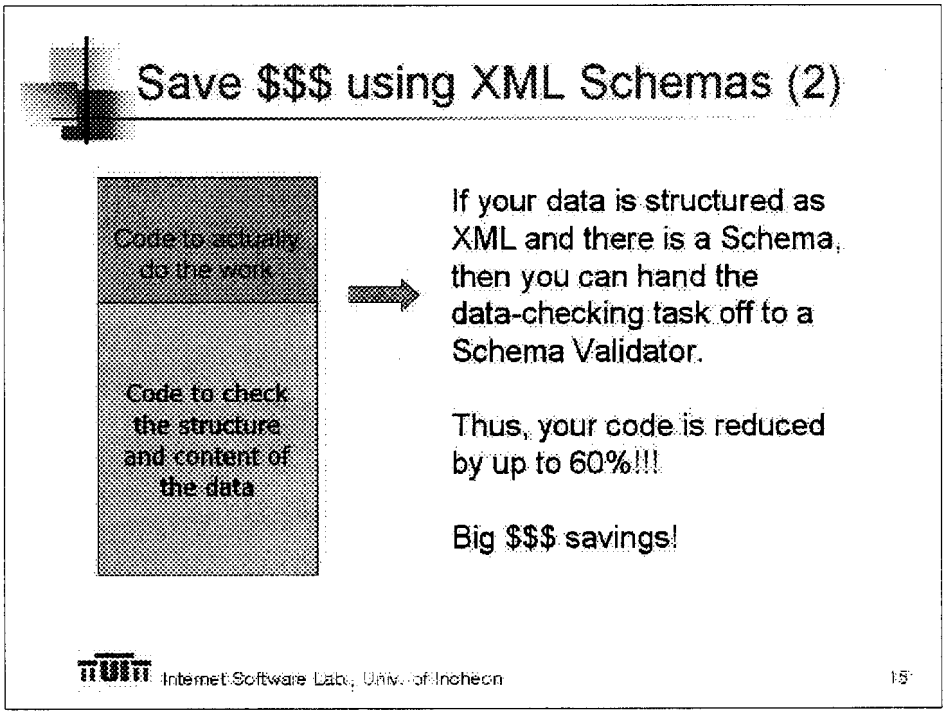
XML Schemas vs. DTDs

XML Schemas	DTDs
Support namespaces	n/a
Written in XML syntax	n/a
Extensive datatype support	Very limited
Full, object-oriented extensibility	Extended via string substitutions
Open, closed or refinable content models	Closed only

Save $$$ using XML Schemas (1)



In a typical program, up to 60% of the code is spent checking the data!


Save $$$ using XML Schemas (2)
Code to actually do the work
Code to check the structure and content of the data
If your data is structured as XML and there is a Schema, then you can hand the data-checking task off to a Schema Validator.
Thus, your code is reduced by up to 60%!!!
Big $$$ savings!
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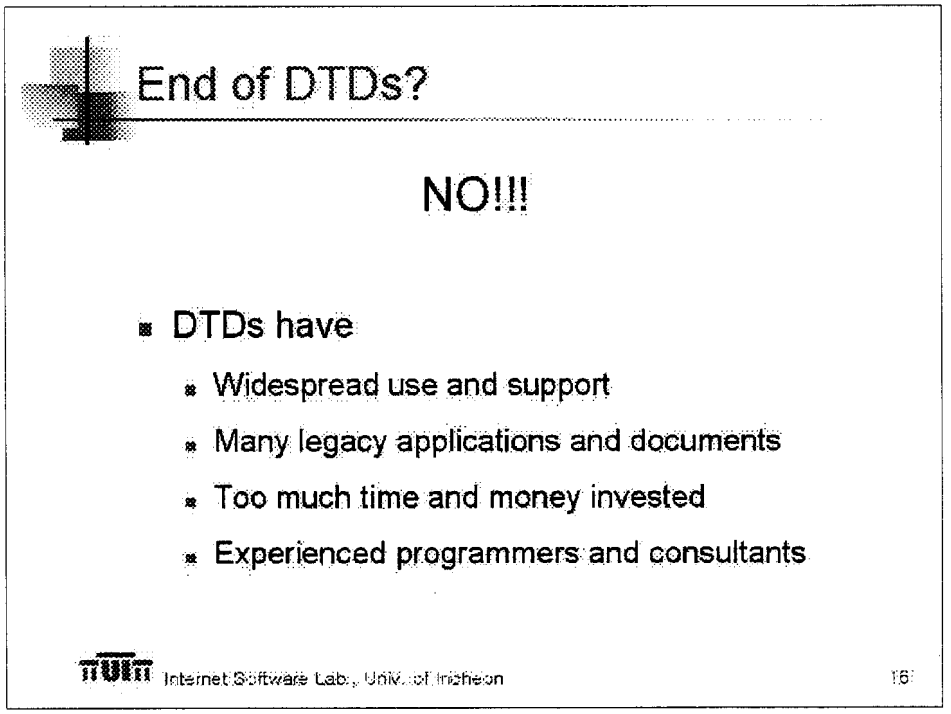
End of DTDs?
NO!!!
DTDs have
Widespread use and support
Many legacy applications and documents
Too much time and money invested
Experienced programmers and consultants
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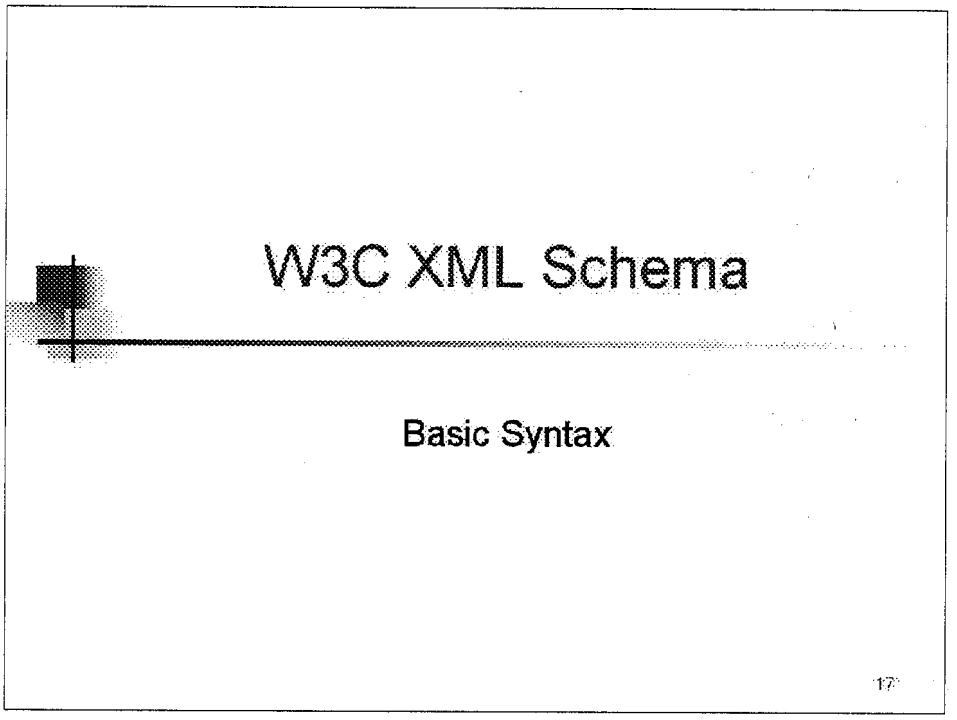
W3C XML Schema
Basic Syntax
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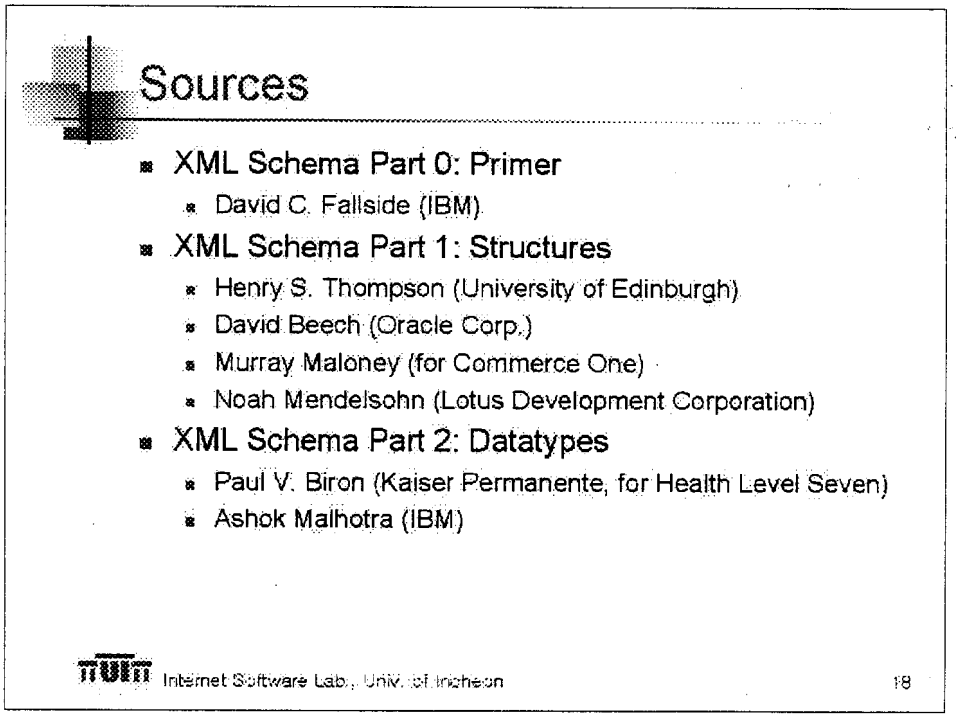
Sources
XML Schema Part 0: Primer
David C. Fallside (IBM)
XML Schema Part 1: Structures
Henry S. Thompson (University of Edinburgh)
David Beech (Oracle Corp.)
Murray Maloney (for Commerce One)
Noah Mendelsohn (Lotus Development Corporation)
XML Schema Part 2: Datatypes
Paul V. Biron (Kaiser Permanente, for Health Level Seven)
Ashok Malhotra (IBM)
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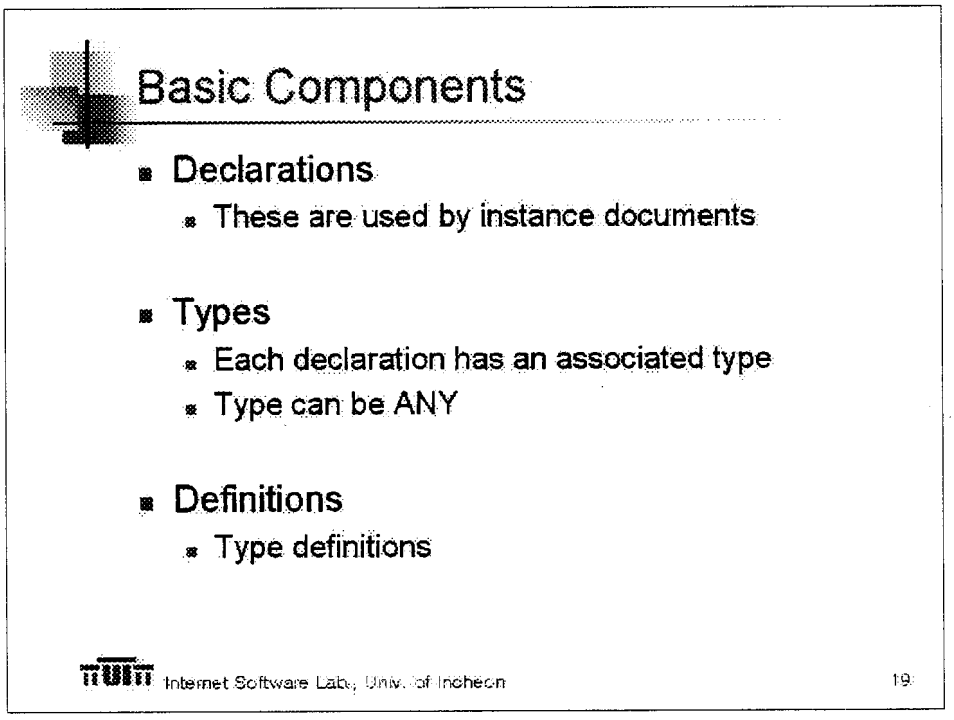
Basic Components
Declarations
These are used by instance documents
Types
Each declaration has an associated type
Type can be ANY
Definitions
Type definitions
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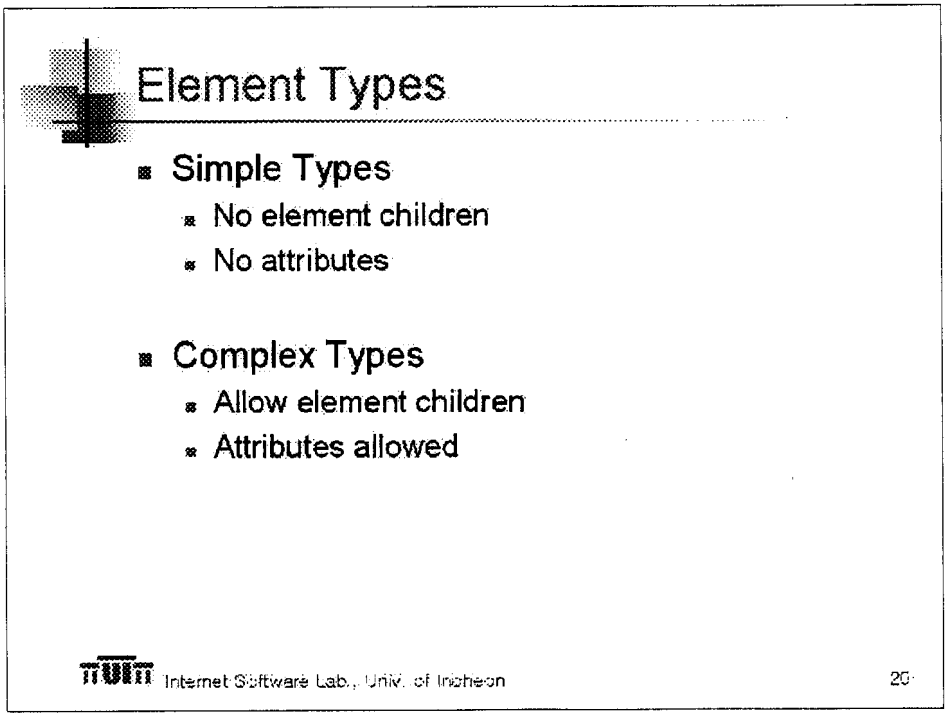
Element Types
Simple Types
No element children
No attributes
Complex Types
Allow element children
Attributes allowed
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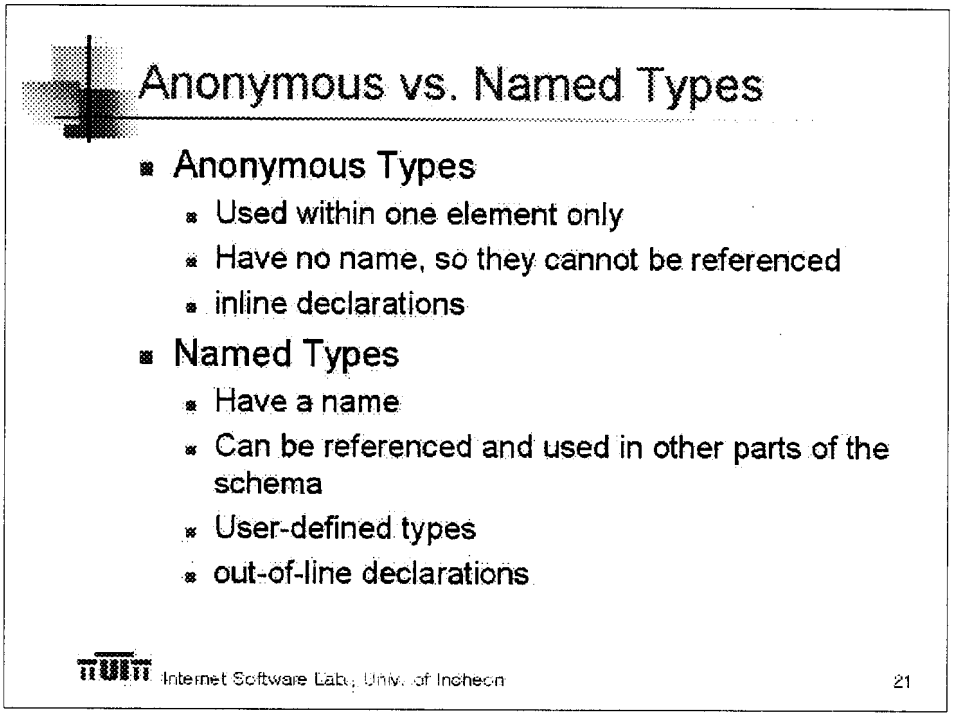
Anonymous vs. Named Types
Anonymous Types
Used within one element only
Have no name, so they cannot be referenced
inline declarations
Named Types
Have a name
Can be referenced and used in other parts of the schema
User-defined types
out-of-line declarations
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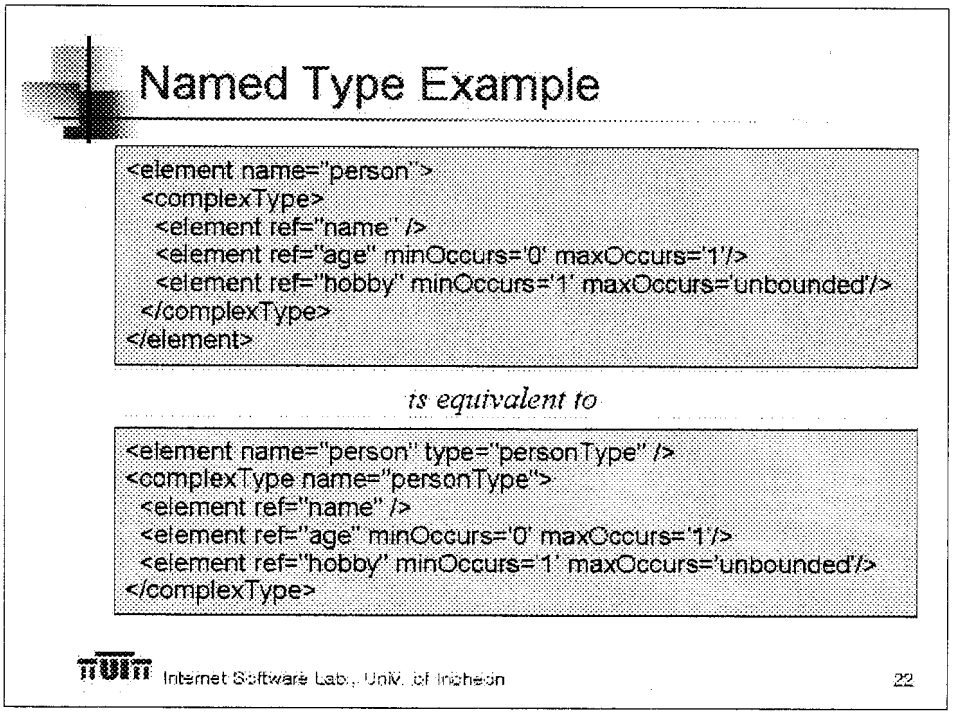
Named Type Example
<element name="person">
<complexType>
<element ref="name" />
<element ref="age" minOccurs='0' maxOccurs='1'/>
<element ref="hobby" minOccurs='1' maxOccurs='unbounded'/>
</complexType>
</element>
ts equivalent to
<element name="person" type="personType" />
<complexType name="personType">
<element ref="name" />
<element ref="age" minOccurs='0' maxOccurs='1'/>
<element ref="hobby" minOccurs='1' maxOccurs='unbounded'/>
</complexType>
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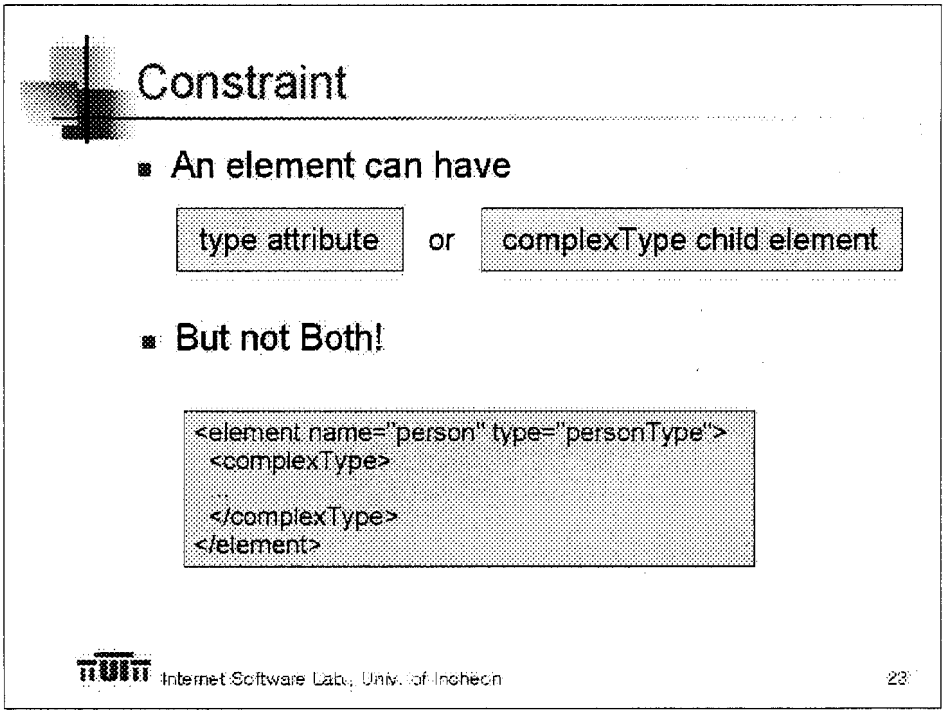
Constraint
An element can have
type attribute
or
complexType child element
But not Both!
<element name="person" type="personType">
<complexType>
...
</complexType>
</element>
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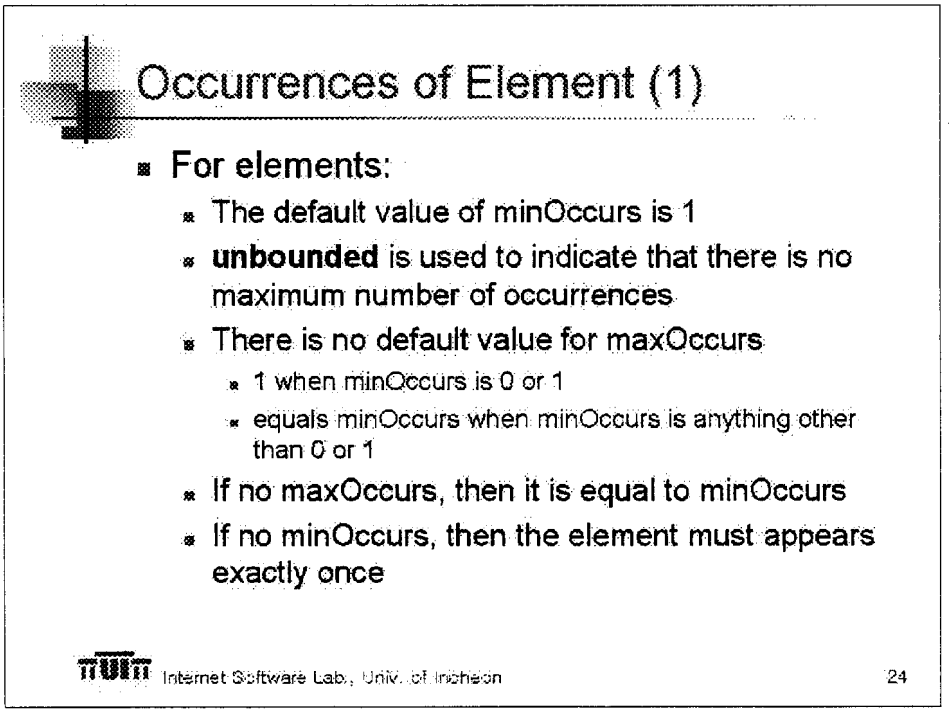
Occurrences of Element (1)
For elements:
The default value of minOccurs is 1
unbounded is used to indicate that there is no maximum number of occurrences
There is no default value for maxOccurs
1 when minOccurs is 0 or 1
equals minOccurs when minOccurs is anything other than 0 or 1
If no maxOccurs, then it is equal to minOccurs
If no minOccurs, then the element must appears exactly once
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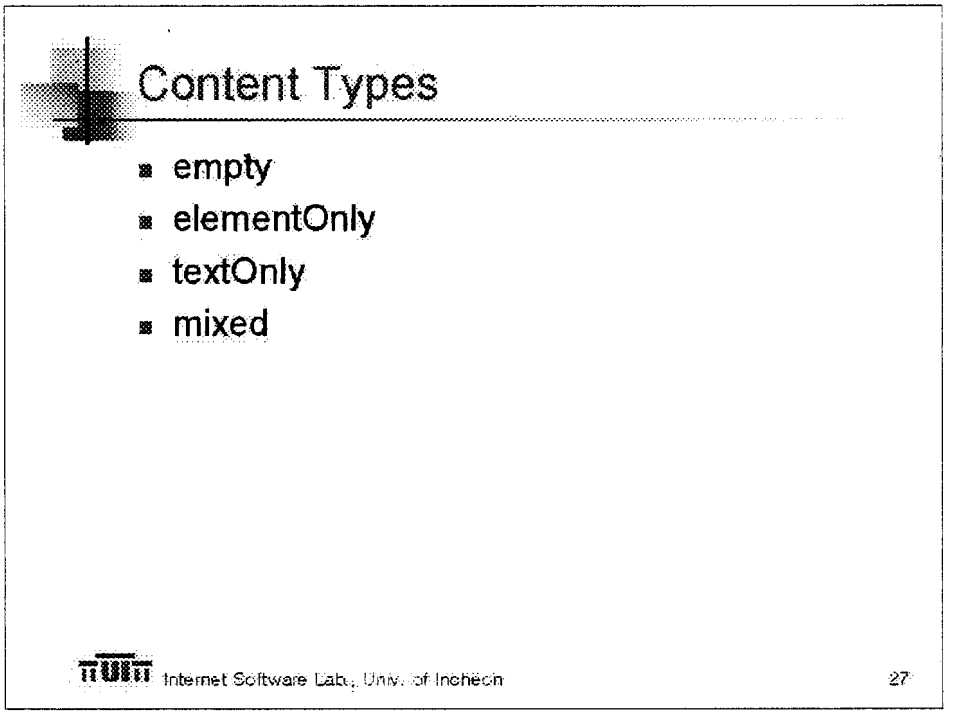
Occurrences of Element (2)

Element	minOccurs	maxOccurs	DTD
A	1	1	A
A	0	1	A?
A	1	unbounded	A+
A	0	unbounded	A*

Occurrences of Attribute

- For attributes:
  - Attributes may appear once or not at all
  - A **use** attribute is used in an attribute declaration to indicate whether the attribute's value is **required** or **optional**
  - If **optional**, whether the attribute's value is **fixed** or whether there is a **default** value can also be specified
  - An attribute, **value**, provides any value that is called for


Content Types
empty
elementOnly
textOnly
mixed
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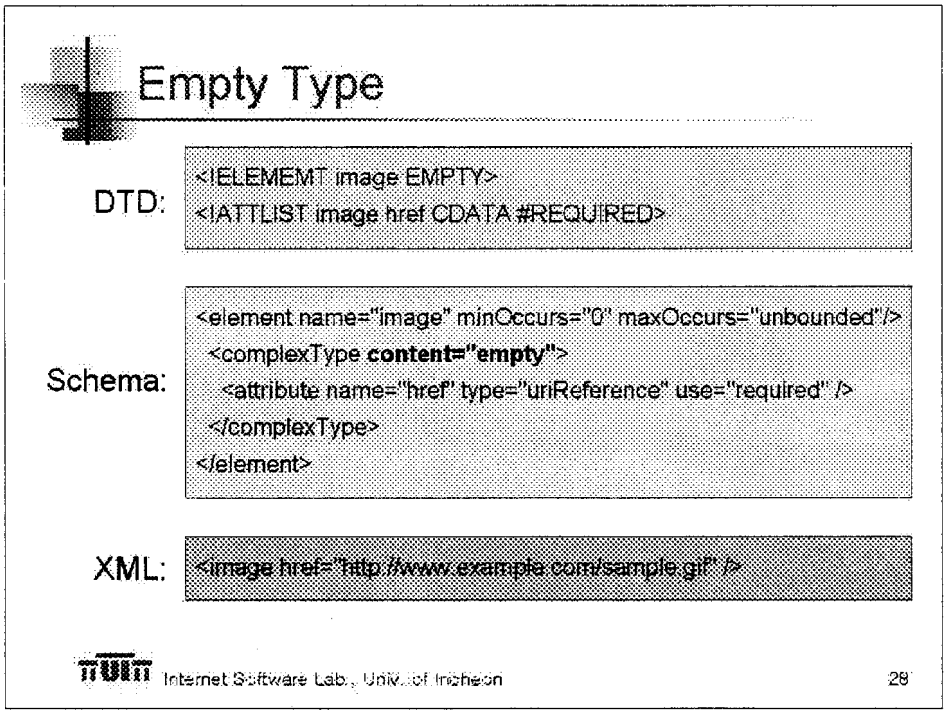
Empty Type
DTD:
<!ELEMEMT image EMPTY>
<!ATTLIST image href CDATA #REQUIRED>
Schema:
<element name="image" minOccurs="0" maxOccurs="unbounded"/>
<complexType content="empty">
<attribute name="href" type="uriReference" use="required" />
</complexType>
</element>
XML:
<image href="http://www.example.com/sample.gif" />
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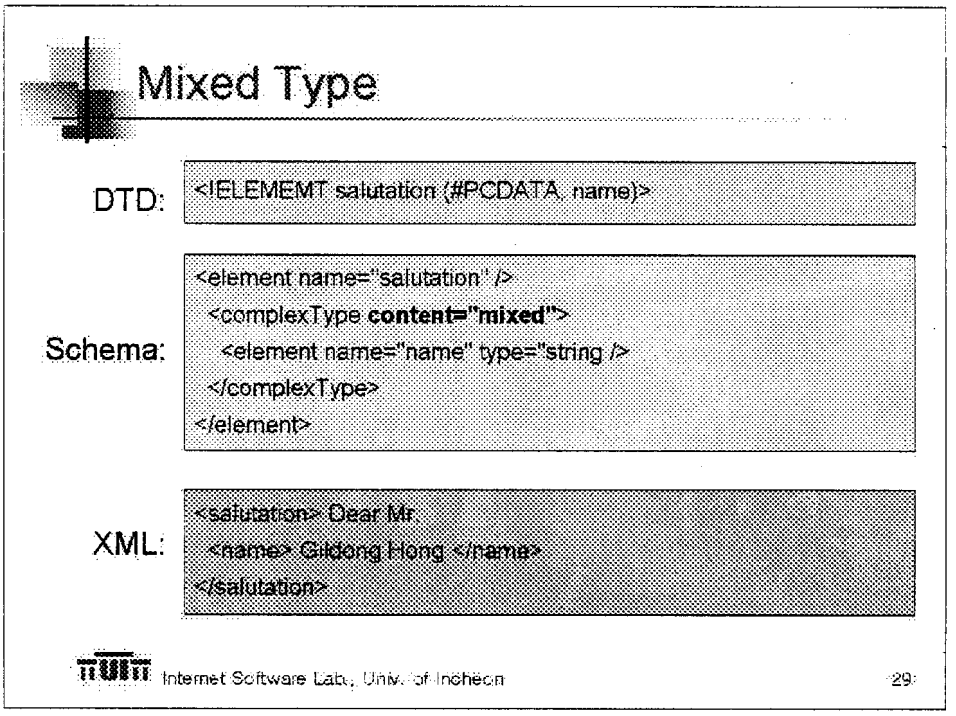
Mixed Type
DTD:
<!ELEMEMT salutation (#PCDATA, name)>
Schema:
<element name="salutation" />
<complexType content="mixed">
<element name="name" type="string />
</complexType>
</element>
XML:
<salutation> Dear Mr.
<name> Gildong Hong </name>
</salutation>
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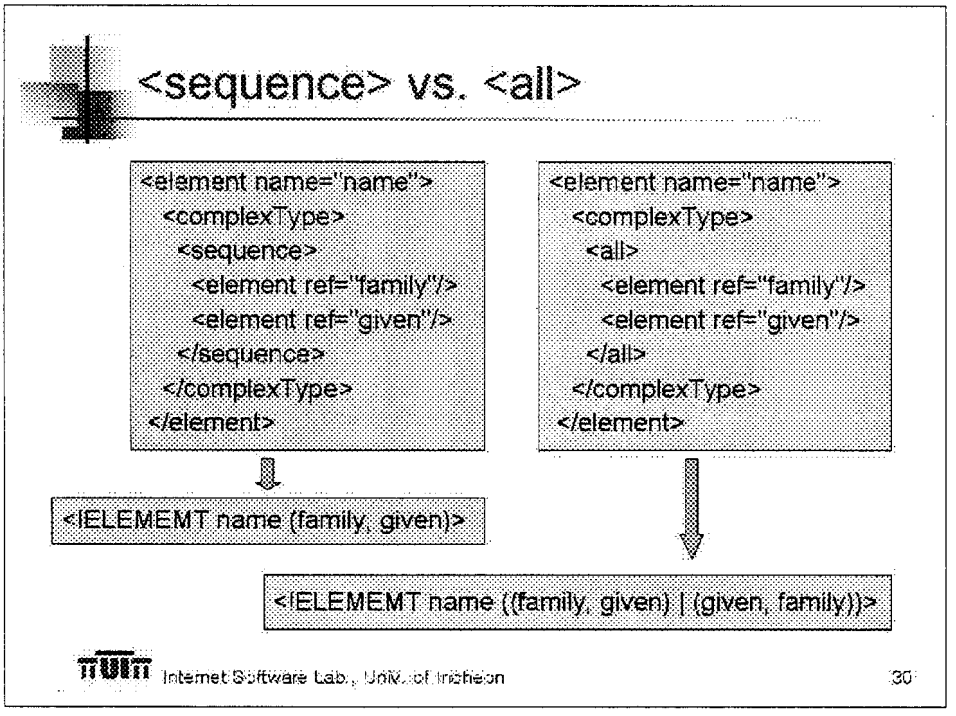
<sequence> vs. <all>
<element name="name">
<complexType>
<sequence>
<element ref="family"/>
<element ref="given"/>
</sequence>
</complexType>
</element>
<element name="name">
<complexType>
<all>
<element ref="family"/>
<element ref="given"/>
</all>
</complexType>
</element>
<!ELEMEMT name (family, given)>
<!ELEMEMT name ((family, given) | (given, family))>
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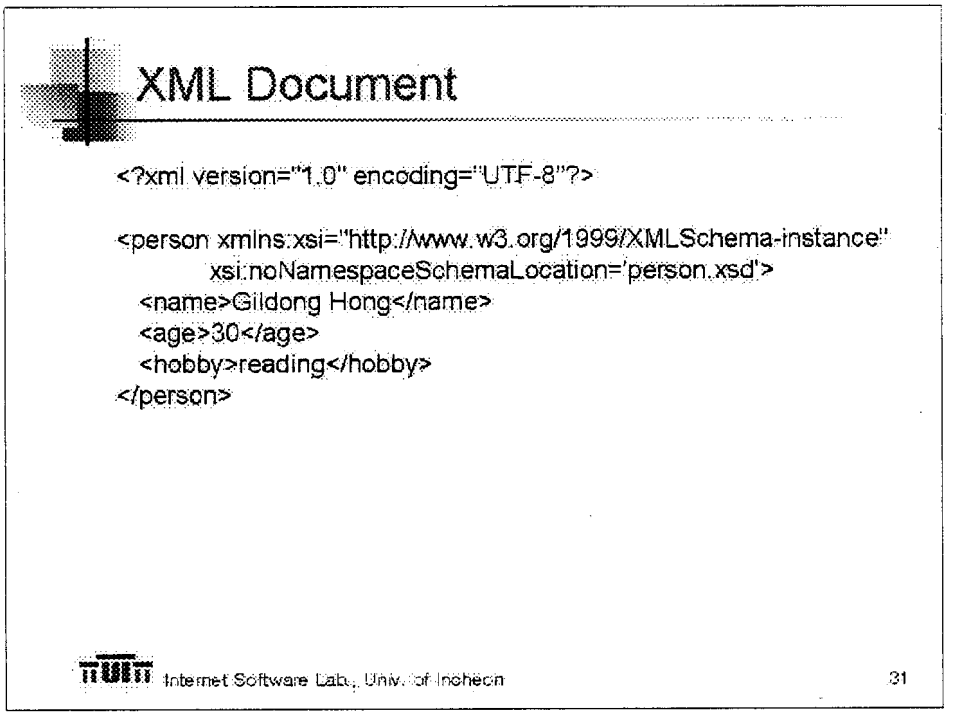
XML Document
<?xml version="1.0" encoding="UTF-8"?>
<person xmlns:xsi="http://www.w3.org/1999/XMLSchema-instance"
xsi:noNamespaceSchemaLocation='person.xsd'>
<name>Gildong Hong</name>
<age>30</age>
<hobby>reading</hobby>
</person>
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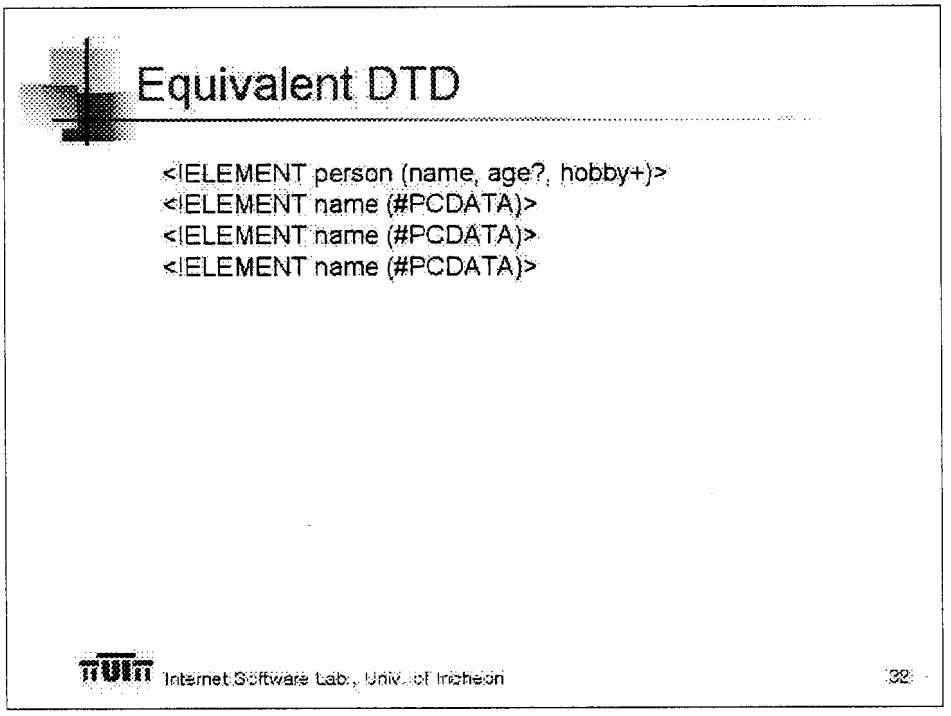
Equivalent DTD
<!ELEMENT person (name, age?, hobby+)>
<!ELEMENT name (#PCDATA)>
<!ELEMENT name (#PCDATA)>
<!ELEMENT name (#PCDATA)>
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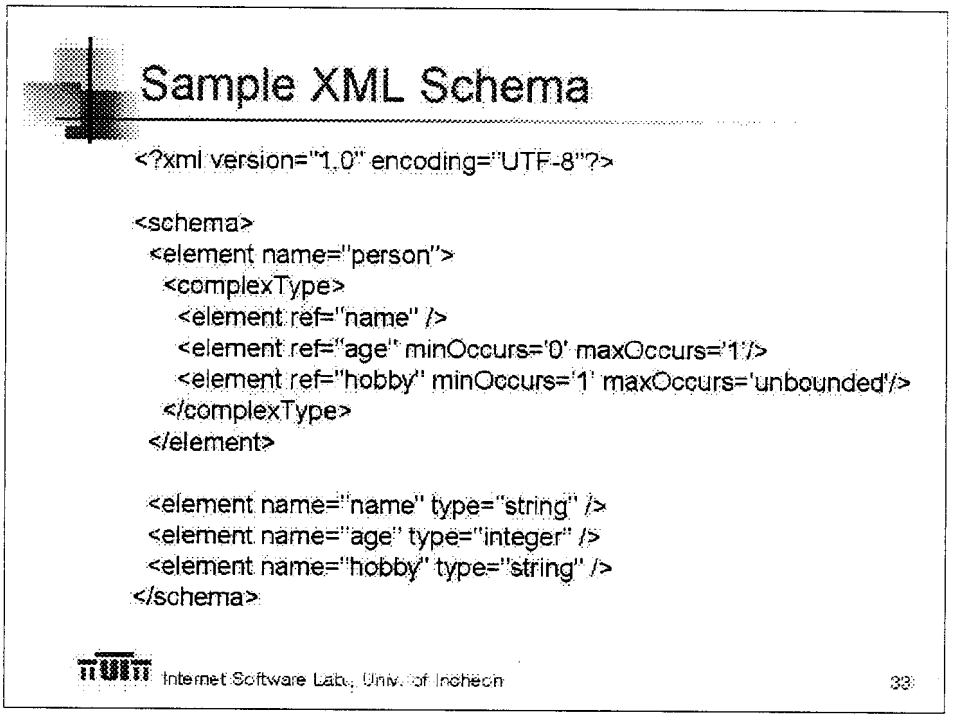
Sample XML Schema
<?xml version="1.0" encoding="UTF-8"?>
<schema>
<element name="person">
<complexType>
<element ref="name" />
<element ref="age" minOccurs='0' maxOccurs='1'/>
<element ref="hobby" minOccurs='1' maxOccurs='unbounded'/>
</complexType>
</element>
<element name="name" type="string" />
<element name="age" type="integer" />
<element name="hobby" type="string" />
</schema>
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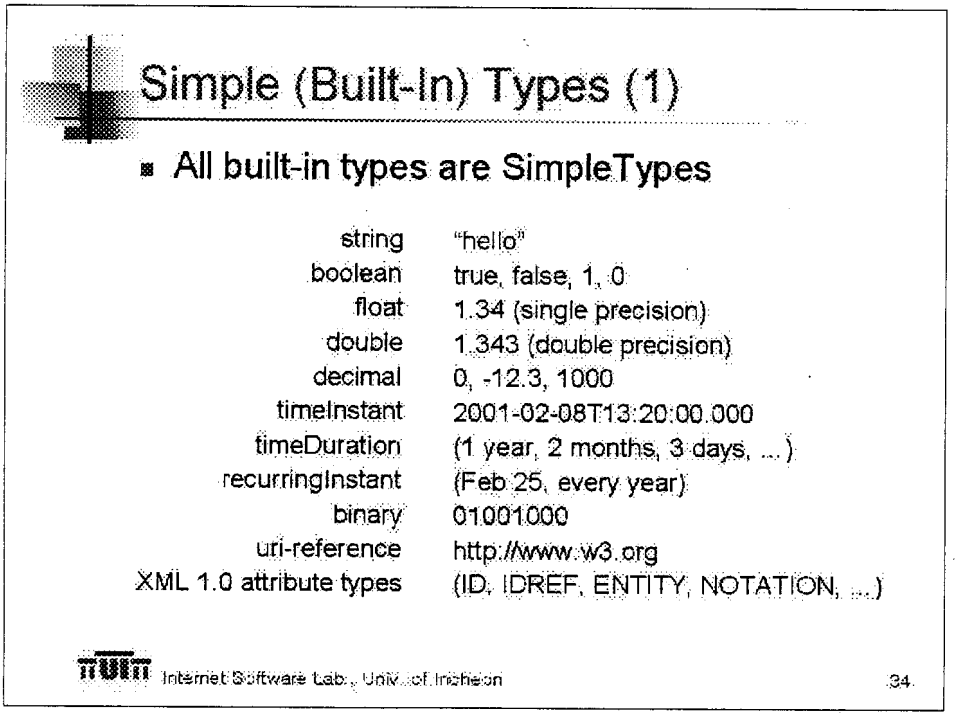
Simple (Built-In) Types (1)
All built-in types are SimpleTypes
string "hello"
boolean true, false, 1, 0
float 1.34 (single precision)
double 1.343 (double precision)
decimal 0, -12.3, 1000
timeInstant 2001-02-08T13:20:00.000
timeDuration (1 year, 2 months, 3 days, ...)
recurringInstant (Feb 25, every year)
binary 01001000
uri-reference http://www.w3.org
XML 1.0 attribute types (ID, IDREF, ENTITY, NOTATION, ...)
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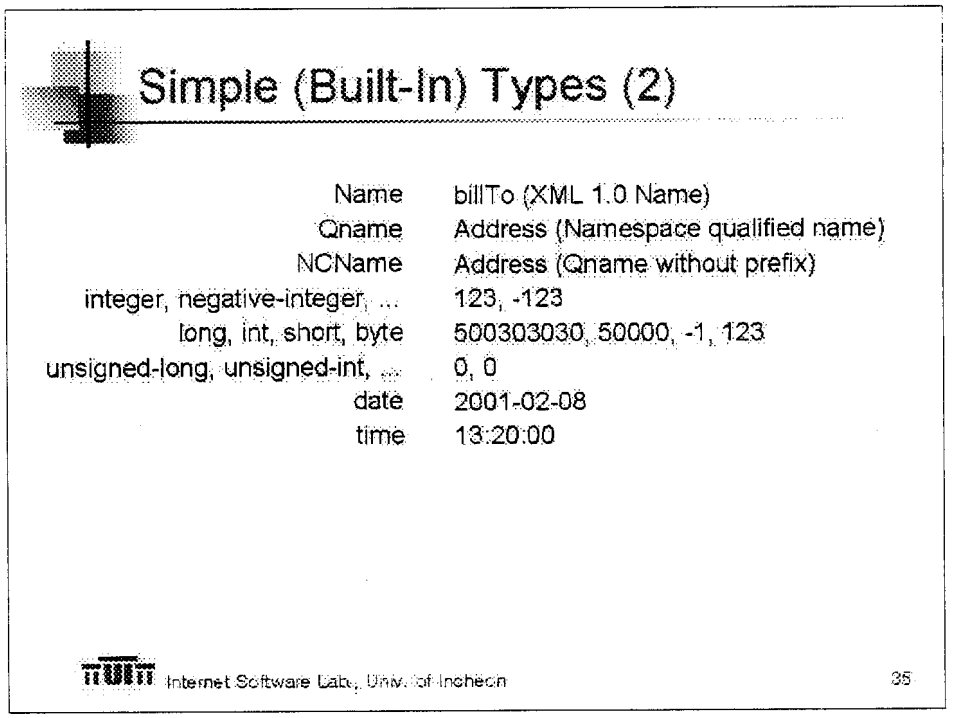
Simple (Built-In) Types (2)
Name billTo (XML 1.0 Name)
Qname Address (Namespace qualified name)
NCName Address (Qname without prefix)
integer, negative-integer, ... 123, -123
long, int, short, byte 500303030, 50000, -1, 123
unsigned-long, unsigned-int, ... 0, 0
date 2001-02-08
time 13:20:00
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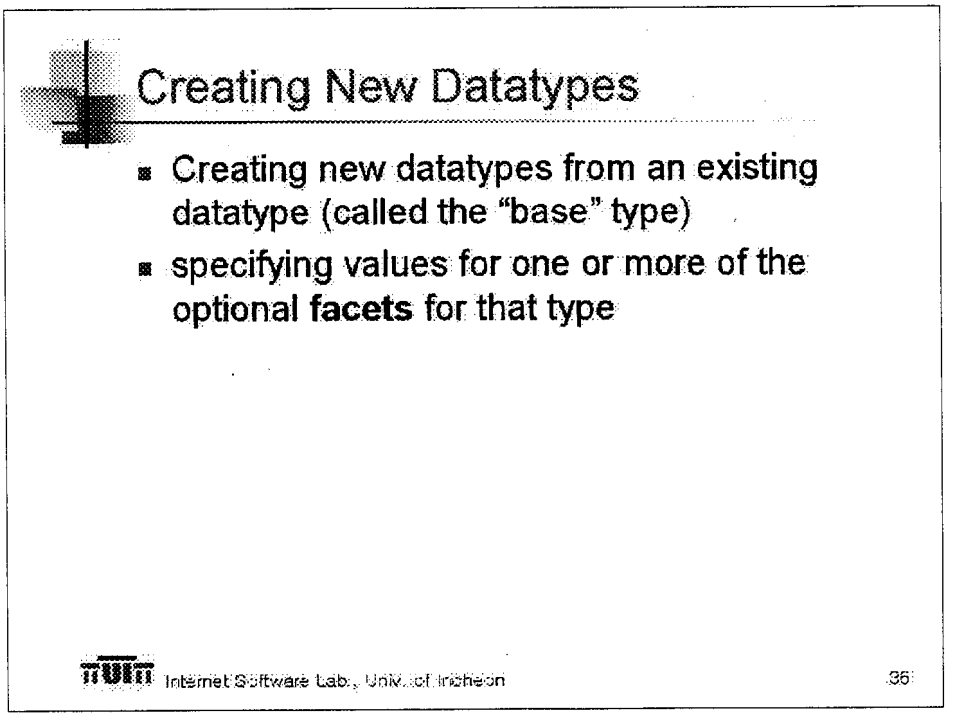
Creating New Datatypes
Creating new datatypes from an existing datatype (called the "base" type)
specifying values for one or more of the optional facets for that type
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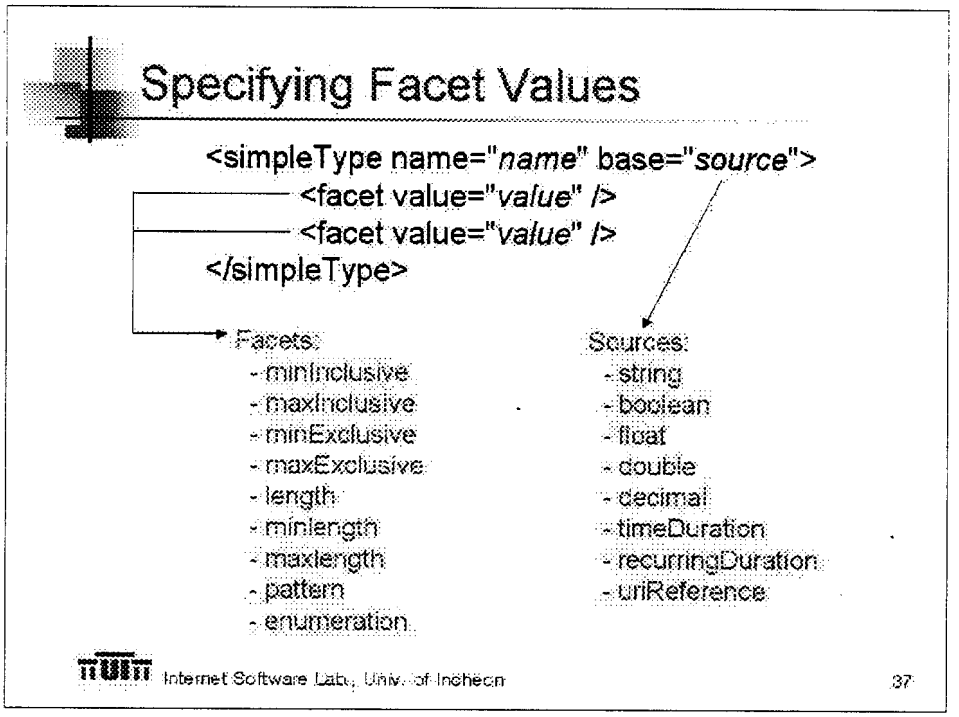
Specifying Facet Values
<simpleType name="name" base="source">
<facet value="value" />
<facet value="value" />
</simpleType>
Facets:
- minInclusive
- maxInclusive
- minExclusive
- maxExclusive
- length
- minlength
- maxlength
- pattern
- enumeration
Sources:
- string
- boolean
- float
- double
- decimal
- timeDuration
- recurringDuration
- uriReference
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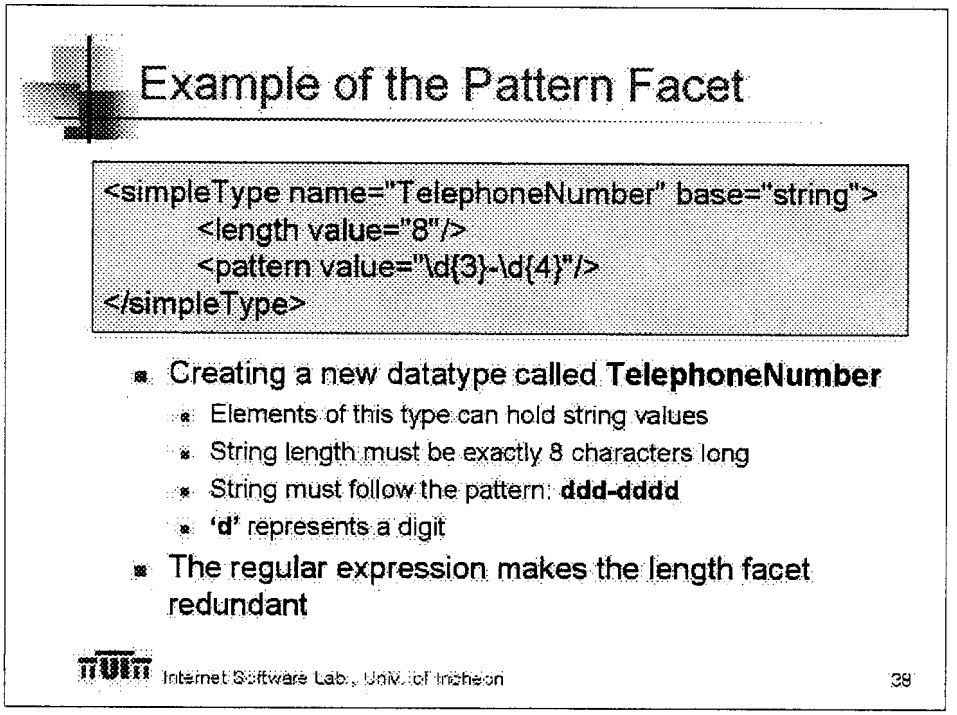
Example of the Pattern Facet
<simpleType name="TelephoneNumber" base="string">
<length value="8"/>
<pattern value="\d{3}-\d{4}"/>
</simpleType>
Creating a new datatype called TelephoneNumber
Elements of this type can hold string values
String length must be exactly 8 characters long
String must follow the pattern: ddd-dddd
'd' represents a digit
The regular expression makes the length facet redundant
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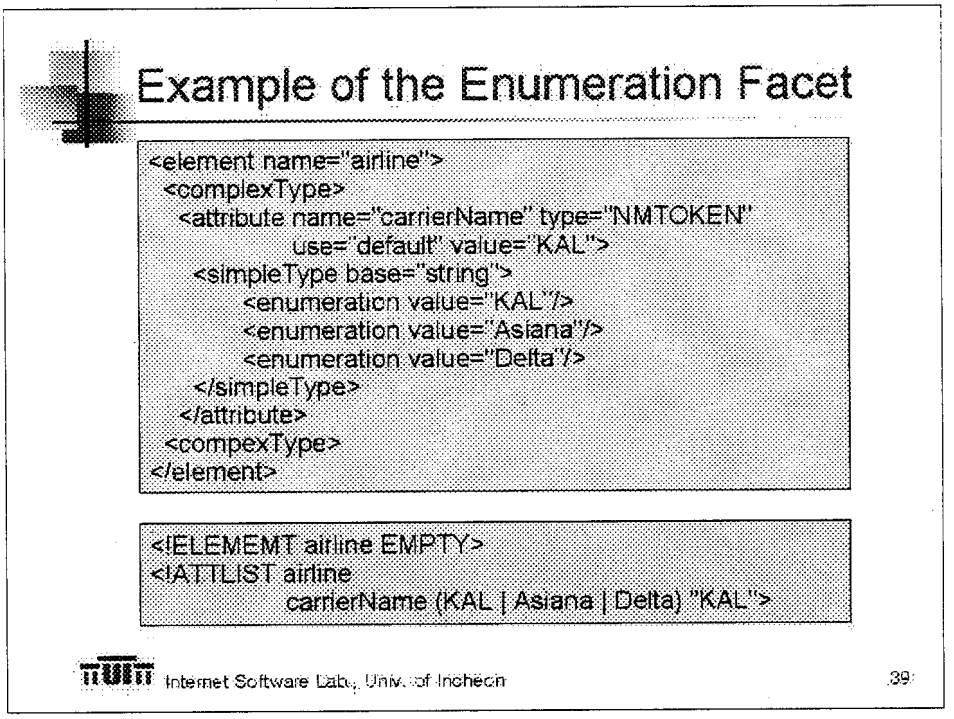
Example of the Enumeration Facet
<element name="airline">
<complexType>
<attribute name="carrierName" type="NMTOKEN"
use="default" value="KAL">
<simpleType base="string">
<enumeration value="KAL"/>
<enumeration value="Asiana"/>
<enumeration value="Delta"/>
</simpleType>
</attribute>
<compexType>
</element>
<!ELEMEMT airline EMPTY>
<!ATTLIST airline
carrierName (KAL | Asiana | Delta) "KAL">
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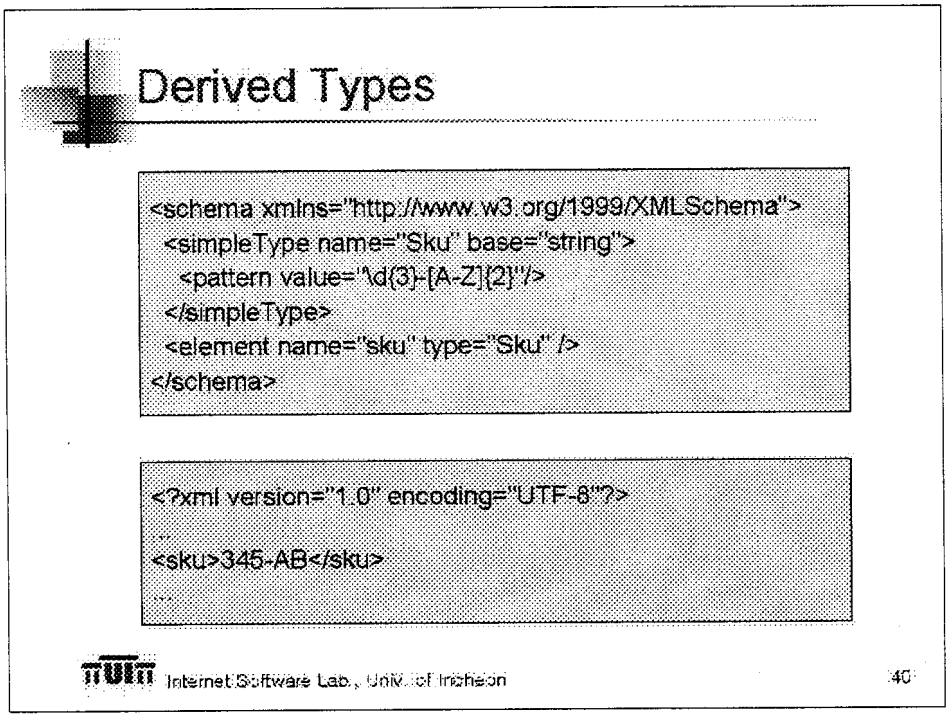
Derived Types
<schema xmlns="http://www.w3.org/1999/XMLSchema">
<simpleType name="Sku" base="string">
<pattern value="\d{3}-[A-Z]{2}"/>
</simpleType>
<element name="sku" type="Sku" />
</schema>
<?xml version="1.0" encoding="UTF-8"?>
...
<sku>345-AB</sku>
...
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Guidelines for implementing Dublin Core in XML

UKOLN
University of Bath

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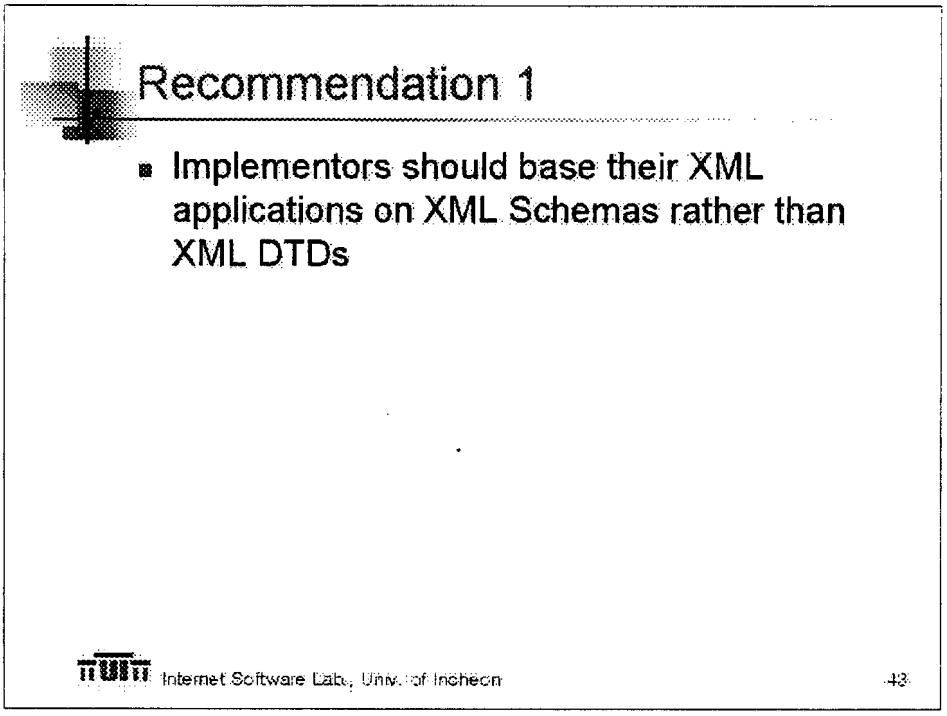
URLs

- Guidelines for implementing Dublin Core in XML
  - http://www.ukoln.ac.uk/metadata/dcmi/dc-xml-guidelines/
- Example Dublin Core XML Schemas
  - http://www.ukoln.ac.uk/metadata/dcmi/dcxml/examples.html


Recommendation 1
Implementors should base their XML applications on XML Schemas rather than XML DTDs
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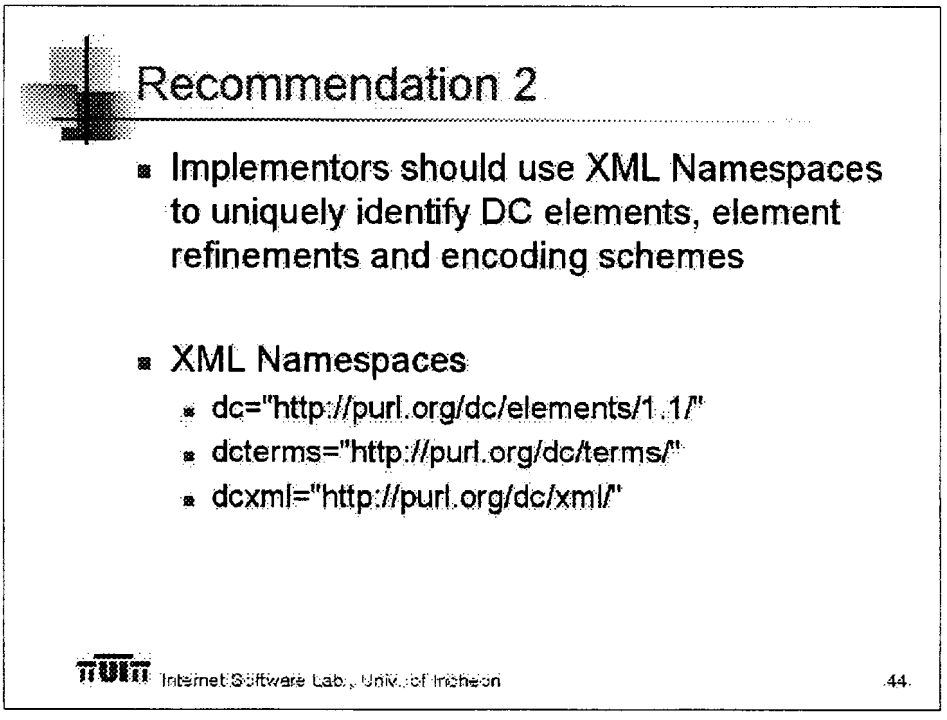
Recommendation 2
Implementors should use XML Namespaces to uniquely identify DC elements, element refinements and encoding schemes
XML Namespaces
dc="http://purl.org/dc/elements/1.1/"
dcterms="http://purl.org/dc/terms/"
dcxml="http://purl.org/dc/xml/"
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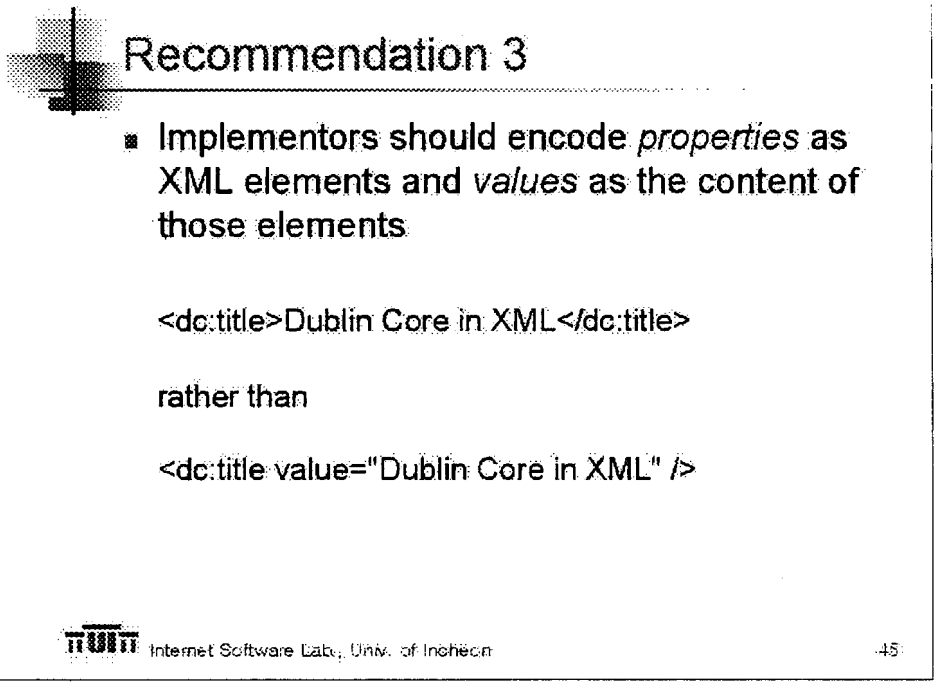
Recommendation 3
Implementors should encode properties as XML elements and values as the content of those elements
<dc:title>Dublin Core in XML</dc:title>
rather than
<dc:title value="Dublin Core in XML" />
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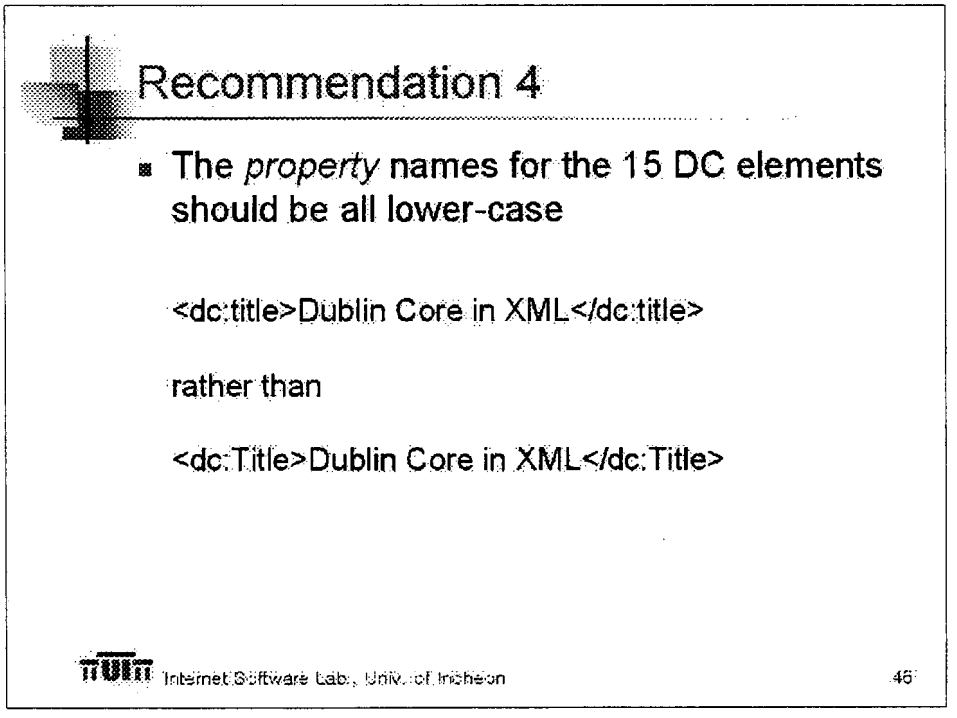
Recommendation 4
The property names for the 15 DC elements should be all lower-case
<dc:title>Dublin Core in XML</dc:title>
rather than
<dc:Title>Dublin Core in XML</dc:Title>
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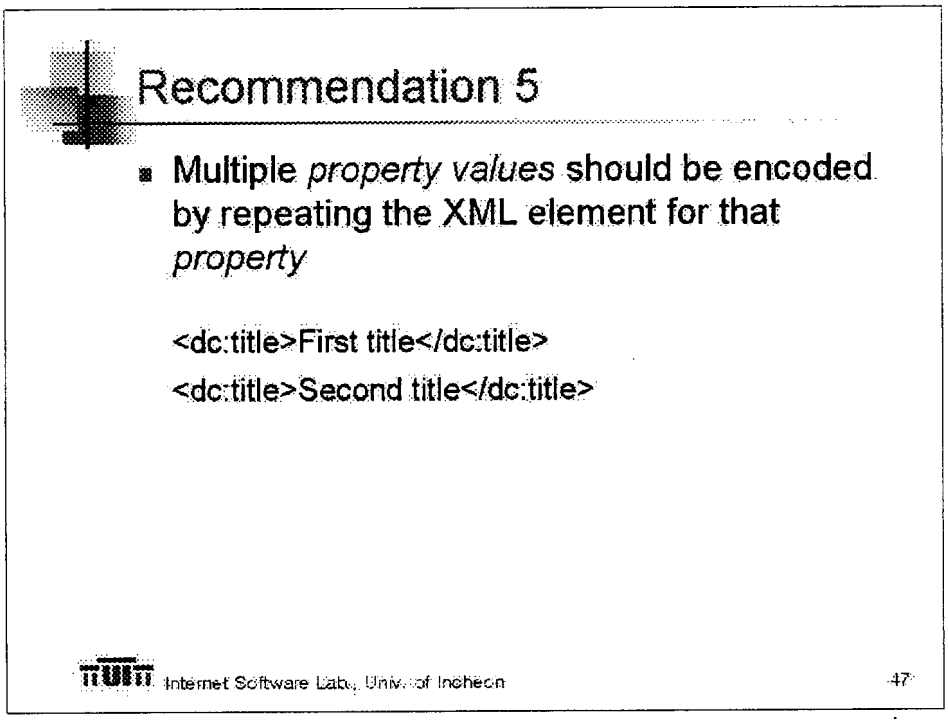
Recommendation 5
Multiple property values should be encoded by repeating the XML element for that property
<dc:title>First title</dc:title>
<dc:title>Second title</dc:title>
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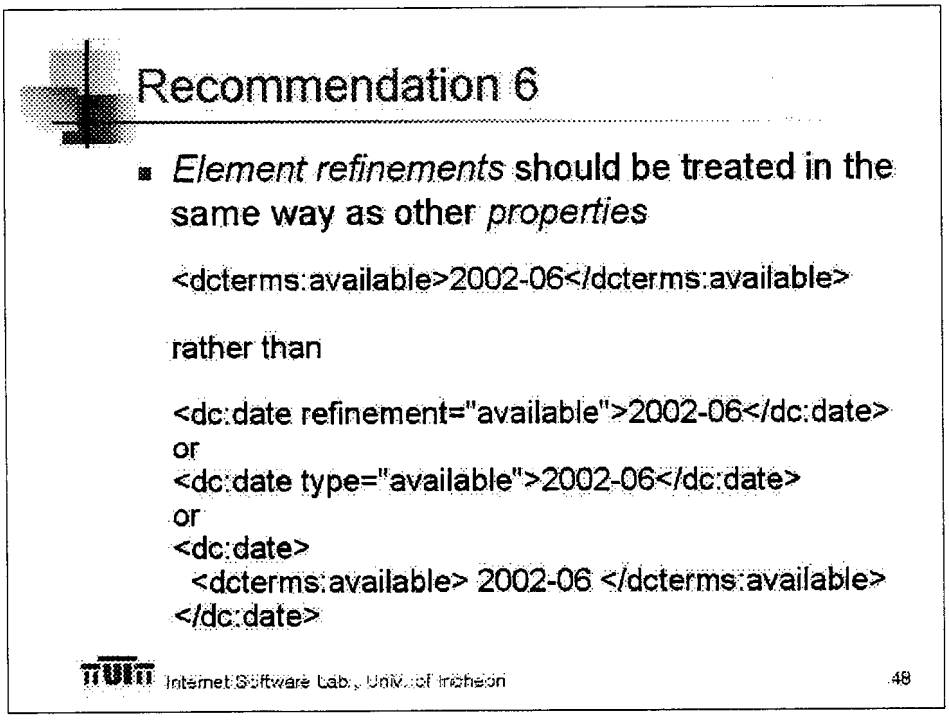
Recommendation 6
Element refinements should be treated in the same way as other properties
<dcterms:available>2002-06</dcterms:available>
rather than
<dc:date refinement="available">2002-06</dc:date>
or
<dc:date type="available">2002-06</dc:date>
or
<dc:date>
<dcterms:available> 2002-06 </dcterms:available>
</dc:date>
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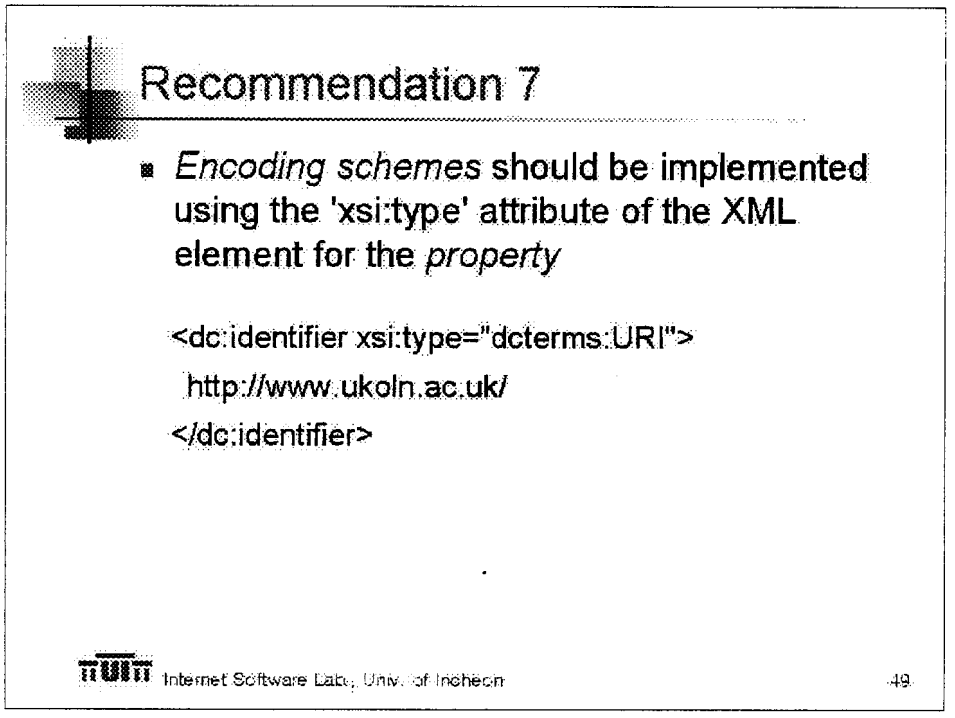
Recommendation 7
Encoding schemes should be implemented using the 'xsi:type' attribute of the XML element for the property
<dc:identifier xsi:type="dcterms:URI">
http://www.ukoln.ac.uk/
</dc:identifier>
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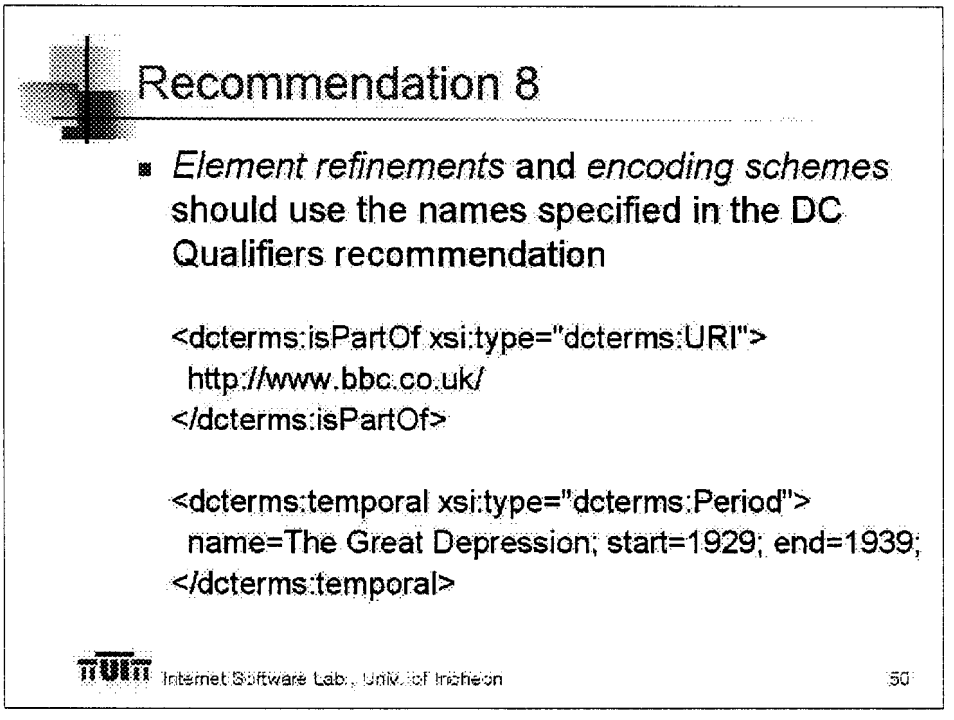
Recommendation 8
Element refinements and encoding schemes should use the names specified in the DC Qualifiers recommendation
<dcterms:isPartOf xsi:type="dcterms:URI">
http://www.bbc.co.uk/
</dcterms:isPartOf>
<dcterms:temporal xsi:type="dcterms:Period">
name=The Great Depression; start=1929; end=1939;
</dcterms:temporal>
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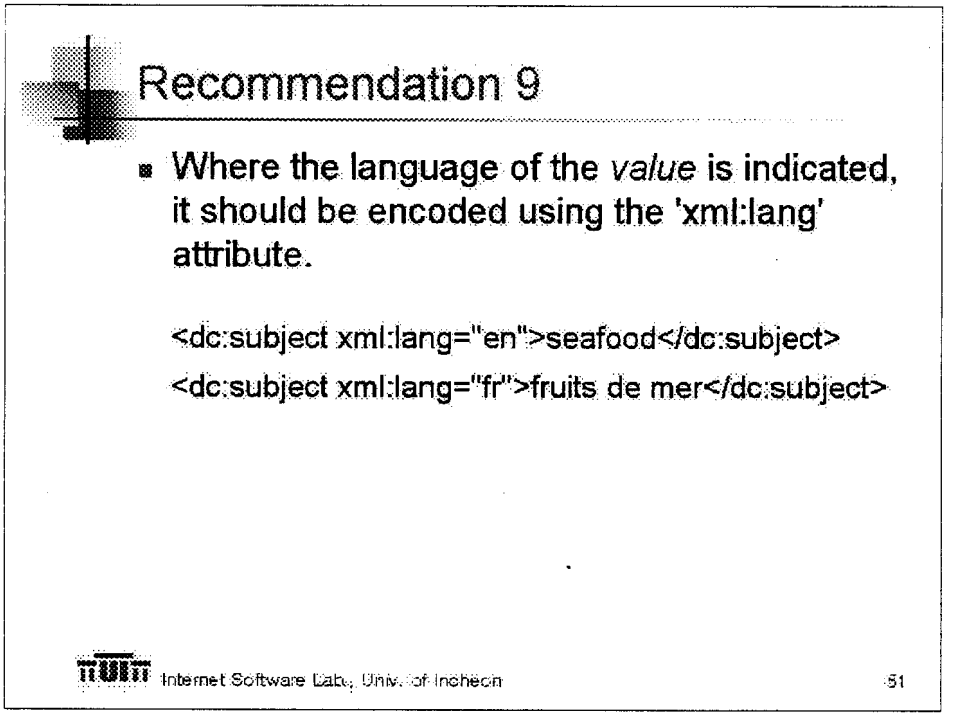
Recommendation 9
Where the language of the value is indicated, it should be encoded using the 'xml:lang' attribute.
<dc:subject xml:lang="en">seafood</dc:subject>
<dc:subject xml:lang="fr">fruits de mer</dc:subject>
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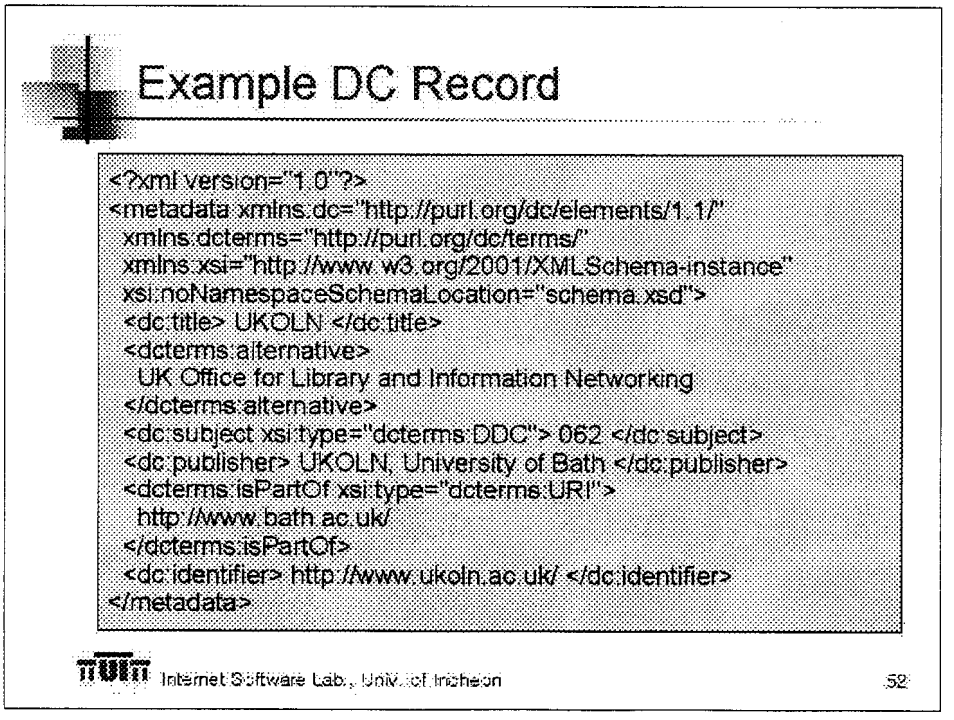
Example DC Record
<?xml version="1.0"?>
<metadata xmlns:dc="http://purl.org/dc/elements/1.1/"
xmlns:dcterms="http://purl.org/dc/terms/"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xsi:noNamespaceSchemaLocation="schema.xsd">
<dc:title> UKOLN </dc:title>
<dcterms:alternative>
UK Office for Library and Information Networking
</dcterms:alternative>
<dc:subject xsi:type="dcterms:DDC"> 062 </dc:subject>
<dc:publisher> UKOLN, University of Bath </dc:publisher>
<dcterms:isPartOf xsi:type="dcterms:URI">
http://www.bath.ac.uk/
</dcterms:isPartOf>
<dc:identifier> http://www.ukoln.ac.uk/ </dc:identifier>
</metadata>
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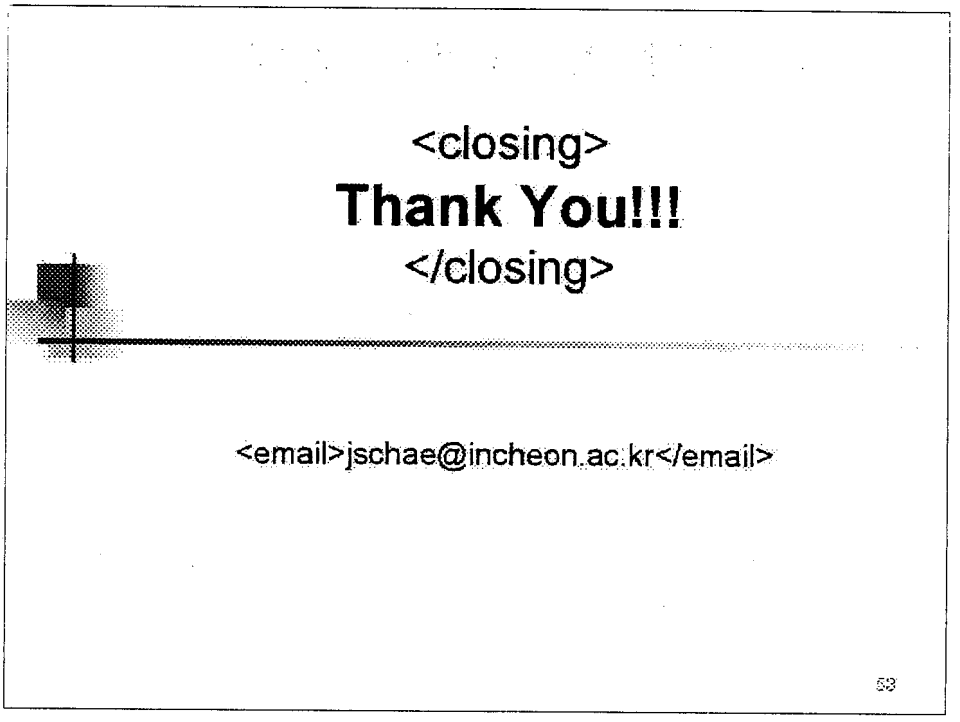
<closing>
Thank You!!!
</closing>
<email>jschae@incheon.ac.kr</email>
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