Application of XML Tools for Enterprise-Wide RBAC Implementation Tasks

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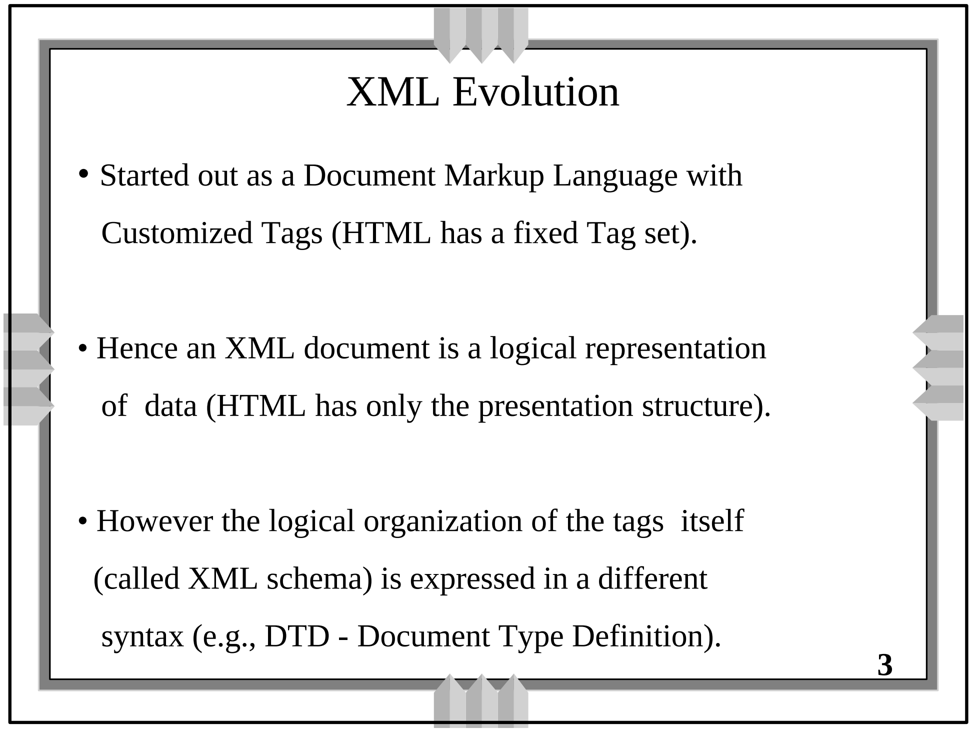
Major Topics

- Brief Introduction to XML and its APIs
- Representing an RBAC model in an XML schema
- Use of XML Tools for three Enterprise-RBAC tasks

  (1) Implementing RBAC in a DB Server

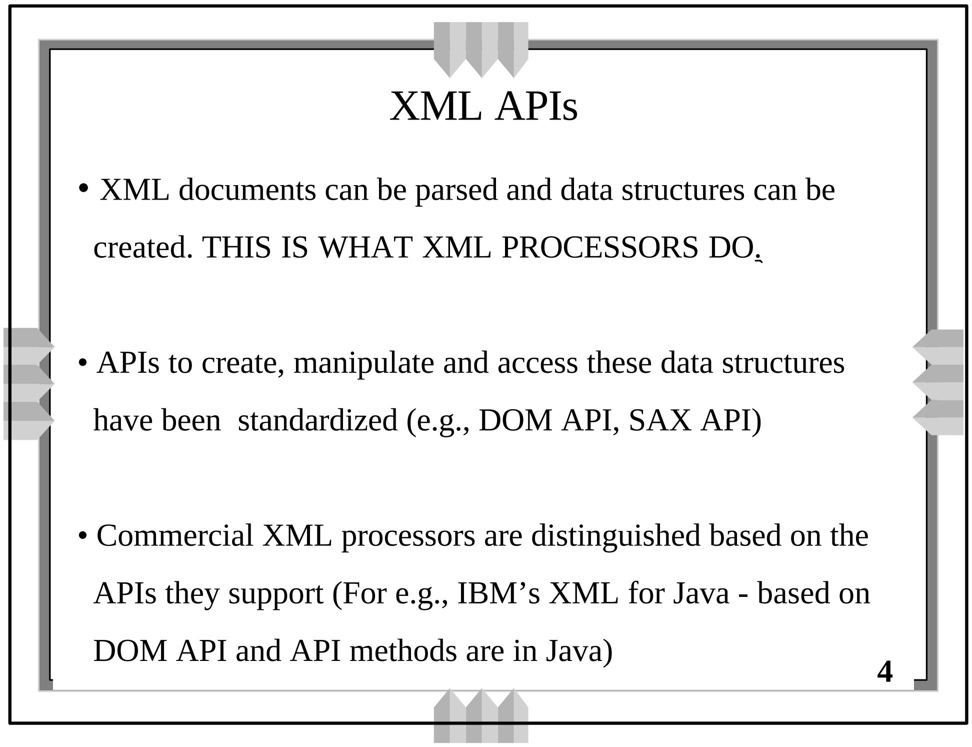
  (2) Implementing Identical RBAC Models

  (3) Implementing Access Control Service based on other Models using RBAC data



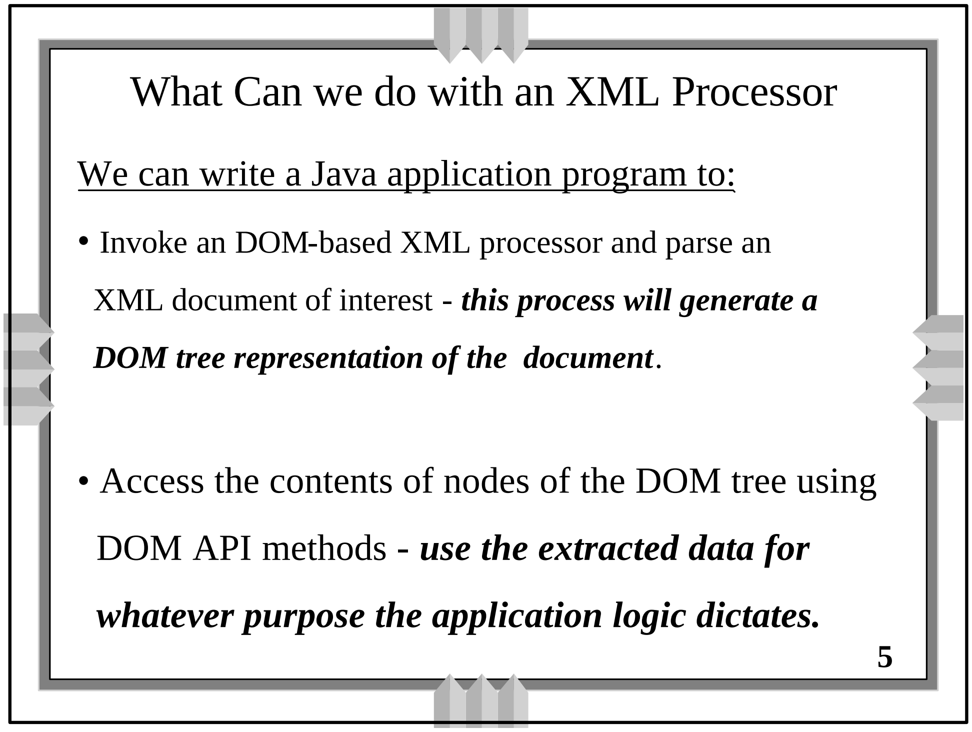
XML Evolution

- Started out as a Document Markup Language with Customized Tags (HTML has a fixed Tag set).
- Hence an XML document is a logical representation of data (HTML has only the presentation structure).
- However the logical organization of the tags itself (called XML schema) is expressed in a different syntax (e.g., DTD - Document Type Definition).



XML APIs

- XML documents can be parsed and data structures can be created. THIS IS WHAT XML PROCESSORS DO.
- APIs to create, manipulate and access these data structures have been standardized (e.g., DOM API, SAX API)
- Commercial XML processors are distinguished based on the APIs they support (For e.g., IBM's XML for Java - based on DOM API and API methods are in Java)

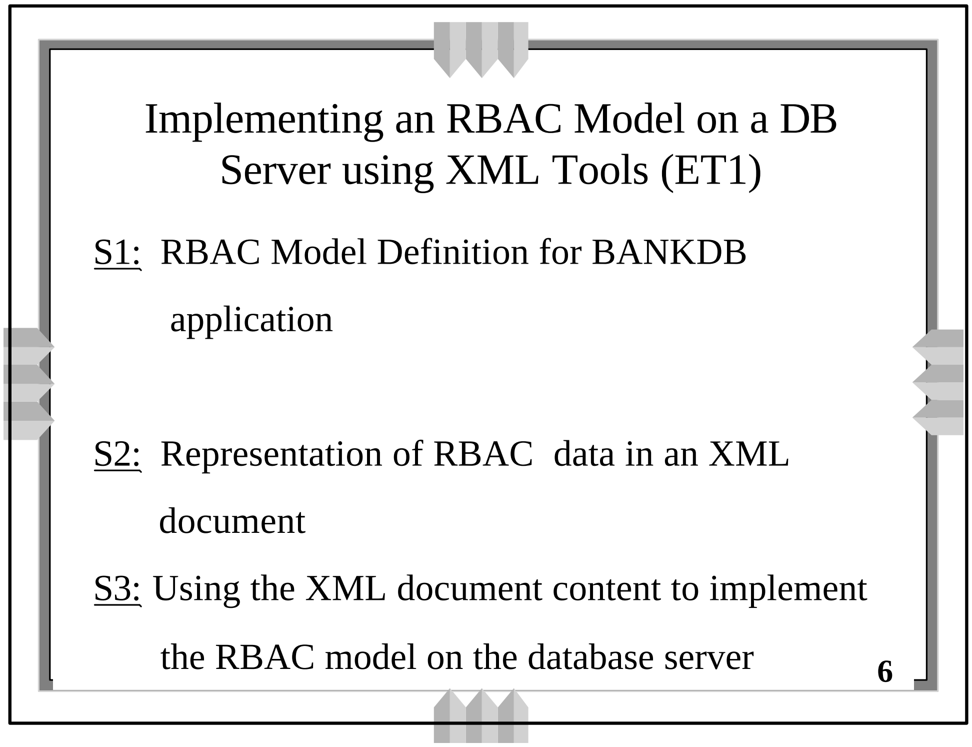


What Can we do with an XML Processor

<u>We can write a Java application program to:</u>

- Invoke an DOM-based XML processor and parse an XML document of interest - ***this process will generate a DOM tree representation of the document***.

- Access the contents of nodes of the DOM tree using DOM API methods - ***use the extracted data for whatever purpose the application logic dictates.***

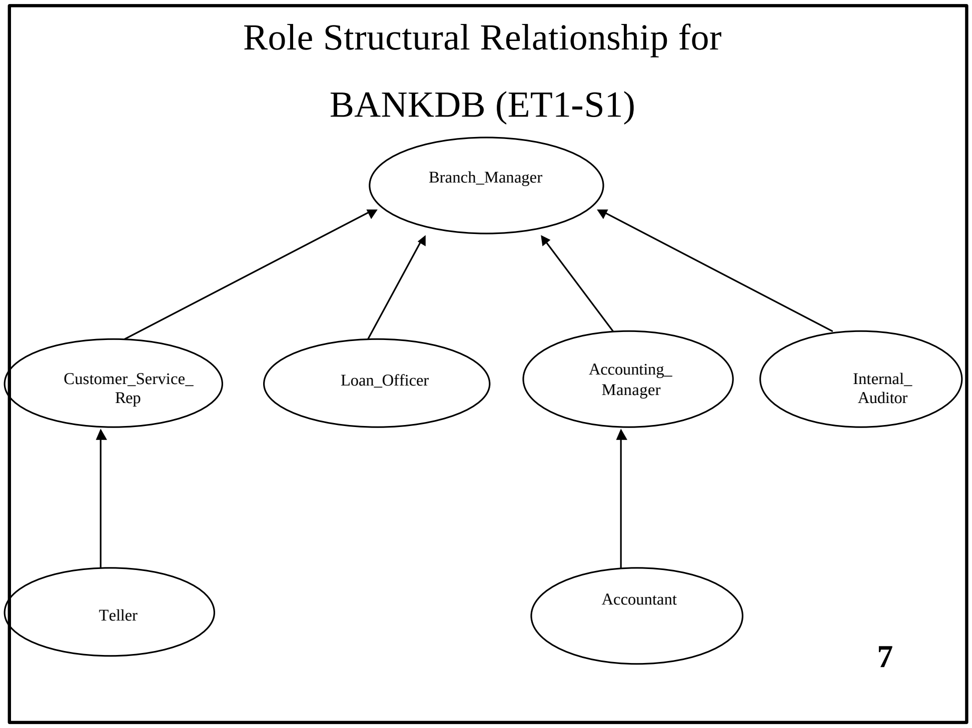


Implementing an RBAC Model on a DB Server using XML Tools (ET1)

<u>S1:</u> RBAC Model Definition for BANKDB application

<u>S2:</u> Representation of RBAC data in an XML document

<u>S3:</u> Using the XML document content to implement the RBAC model on the database server



Role Structural Relationship for BANKDB (ET1-S1)

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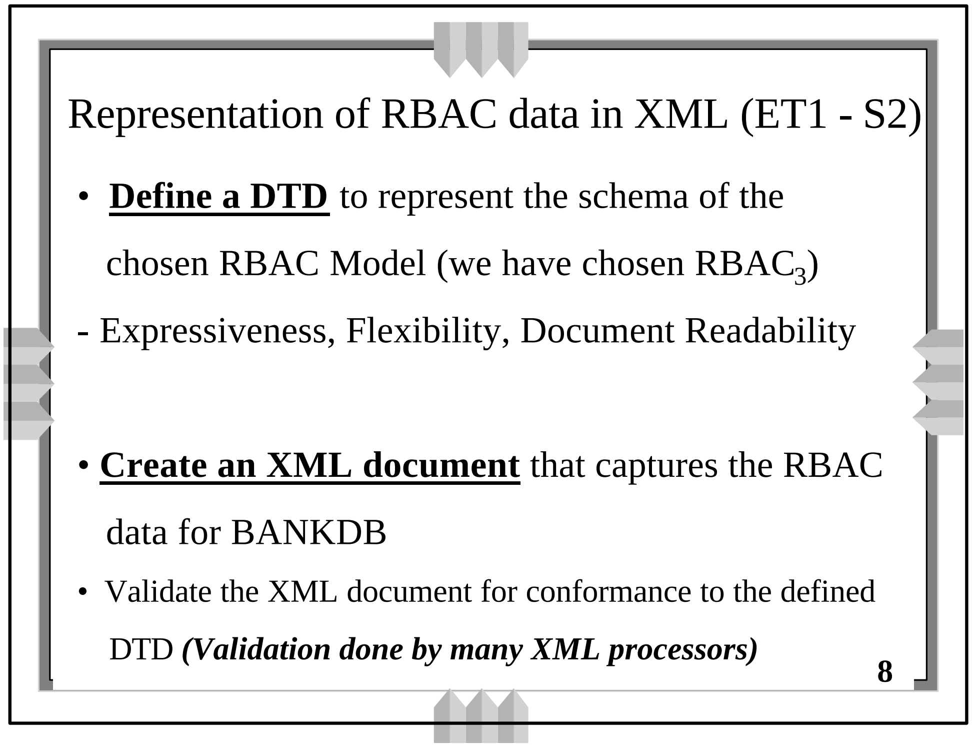

Representation of RBAC data in XML (ET1 - S2)

- **<u>Define a DTD</u>** to represent the schema of the chosen RBAC Model (we have chosen RBAC$_3$)

- Expressiveness, Flexibility, Document Readability

- **<u>Create an XML document</u>** that captures the RBAC data for BANKDB

- Validate the XML document for conformance to the defined DTD ***(Validation done by many XML processors)***

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RBAC.dtd

(Schema for $RBAC_3$ Model)

```
<!ELEMENT Role_Graph  (Application , (role )* )*>

<!ELEMENT Application  (DB_Name , Server )>
<!ELEMENT DB_Name  (#PCDATA )>
<!ELEMENT Server  (#PCDATA )>

<!ELEMENT role (Name , Cardinality? , (Parent_Role?)* , (Child_Role?)* ,
                              (SSD_Role?)* , (DSD_Role?)* )>
<!ELEMENT Name  (#PCDATA )>
<!ELEMENT Cardinality  (#PCDATA )>
<!ELEMENT Parent_Role  (#PCDATA )>
<!ELEMENT Child_Role  (#PCDATA )>
<!ELEMENT SSD_Role  (#PCDATA )>
<!ELEMENT DSD_Role  (#PCDATA )>
```

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BANKDB_RBAC.XML (fragment)

(RBAC data for Banking Application)

```
<?xml version="1.0" ?>
<!DOCTYPE Role_Graph SYSTEM  "RBAC.dtd">
<Role_Graph>
     <Application>
        <DB_Name>Bank Corporate Database</DB_Name>
        <Server>Solaris</Server>
     </Application>

     <role>
       <Name>Branch_Manager</Name>
       <Cardinality>1</Cardinality>
       <Child_Role>Customer_Service_Rep</Child_Role>
       <Child_Role>Loan_Officer</Child_Role>
      <Child_Role>Accounting_Manager</Child_Role>
      <Child_Role>Internal_Auditor</Child_Role>
     </role>
……………………….
</Role_Graph>
```

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RBAC_E.dtd

(A more Expressive Schema for RBAC$_3$ Model)

```
<!ELEMENT Role_Graph  (Application, (role )*)>

<!ELEMENT Application (DB_Name,Server)>
<!ELEMENT DB_Name (#PCDATA)>
<!ELEMENT Server (#PCDATA)>

<!ELEMENT role  (Parent_Roles? , Child_Roles? , SSD_Roles? ,
DSD_Roles? )>
<!ATTLIST role  name        CDATA     #REQUIRED
                cardinality CDATA     #IMPLIED
                a-dtype     NMTOKENS  'cardinality int' >
<!ELEMENT Parent_Roles  (role )*>
<!ELEMENT Child_Roles  (role )*>
<!ELEMENT SSD_Roles  (role )*>
<!ELEMENT DSD_Roles  (role )*>
```

1
1

BANKDB_RBAC.XML (fragment)
(Conforming to RBAC_E.dtd)

```
<?xml version="1.0" ?>
 <!DOCTYPE Role_Graph SYSTEM "RBAC_E.dtd">
 <Role_Graph>
   <Application>
     <DB_Name>Bank Corporate Database</DB_Name>
     <Server>Solaris</Server>
   </Application>

   <role name="Branch_Manager" cardinality="1">
    <Child_Roles>
        <role name="Customer_Service_Rep"/>
        <role name="Loan_Officer"/>
        <role name="Accounting_Manager"/>
        <role name="Internal_Auditor"/>
    </Child_Roles>
   </role>
```

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2

BANKDB_RBAC.XML (fragment) (contd …) (Conforming to RBAC_E.dtd)

```
<role name="Customer_Service_Rep">
    <Parent_Roles>
        <role name="Branch_Manager"/>
    </Parent_Roles>
    <Child_Roles>
        <role name="Teller"/>
    </Child_Roles>
    <SSD_Roles>
        <role name="Accounting_Manager"/>
        <role name="Internal_Auditor"/>
    </SSD_Roles>
    <DSD_Roles>
        <role name="Loan_Officer"/>
    </DSD_Roles>
  </role>
   ……..(other role element definitions) …..
</Role_Graph>
```

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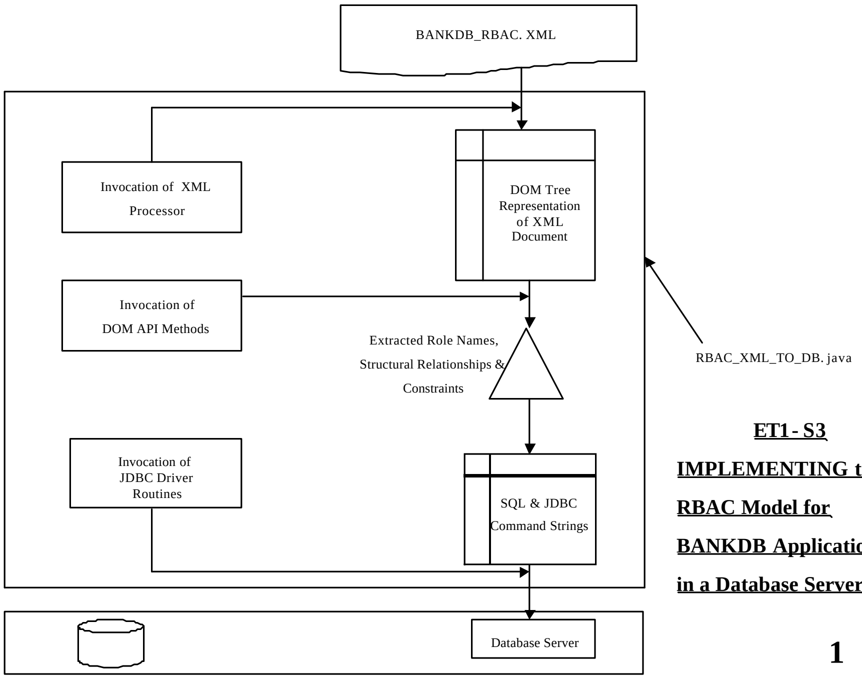
BANKDB_RBAC. XML
Invocation of XML Processor
DOM Tree Representation of XML Document
Invocation of DOM API Methods
Extracted Role Names, Structural Relationships & Constraints
RBAC_XML_TO_DB. java
Invocation of JDBC Driver Routines
SQL & JDBC Command Strings
Database Server

ET1- S3

IMPLEMENTING the RBAC Model for BANKDB Application in a Database Server

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Implementing an RBAC Model with Identical Data on two Servers (ET2)

S1: Retrieve access control data from DBServerA and generate an XML document that conforms to our RBAC schema RBAC.dtd

S2: Use the XML document generated above to implement RBAC model on DBServerB

(same as ET1)

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Generating an XML document conforming to RBAC.dtd (ET2 - S1) "Validating Generation"

(1) Retrieve Role Names, Structural relationships and constraints by reading DBServerA.

(2) Build a DOM tree representation using that data by simultaneously reading the DTD definitions.

(3) Generate the XML document file from the DOM tree data in memory.

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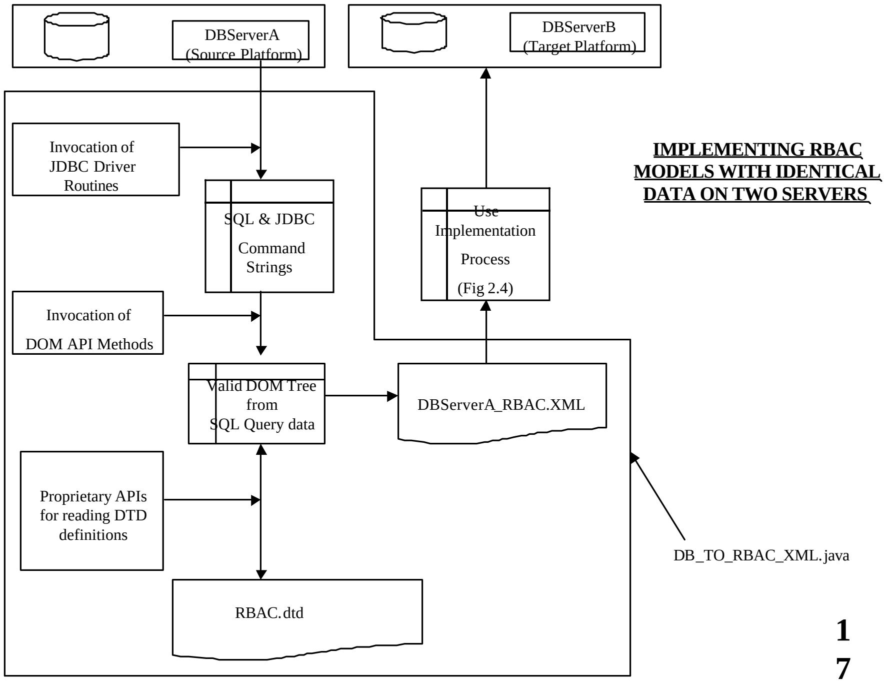
IMPLEMENTING RBAC MODELS WITH IDENTICAL DATA ON TWO SERVERS



DBServerA (Source Platform)

DBServerB (Target Platform)

Invocation of JDBC Driver Routines

SQL & JDBC Command Strings

Use Implementation Process (Fig 2.4)

Invocation of DOM API Methods

Valid DOM Tree from SQL Query data

DBServerA_RBAC.XML

Proprietary APIs for reading DTD definitions

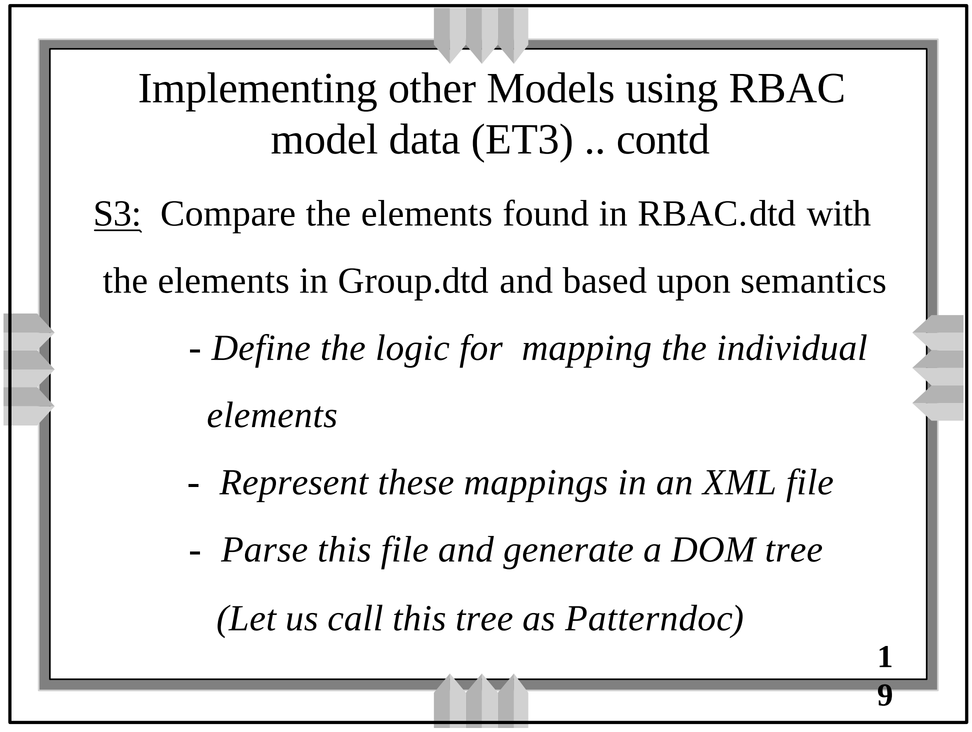
RBAC.dtd

DB_TO_RBAC_XML.java

Implementing other Models using RBAC model data (ET3)

S1: Parse the XML document containing RBAC data and generate a DOM tree representation (Let us call this tree object as *Sourcedoc*)

S2: Make a copy of this DOM tree representation This will be the initial target DOM tree (Let us call this tree object as *Targetdoc*)



Implementing other Models using RBAC model data (ET3) .. contd

S3: Compare the elements found in RBAC.dtd with the elements in Group.dtd and based upon semantics

- *Define the logic for mapping the individual elements*
- *Represent these mappings in an XML file*
- *Parse this file and generate a DOM tree*

(Let us call this tree as Patterndoc)

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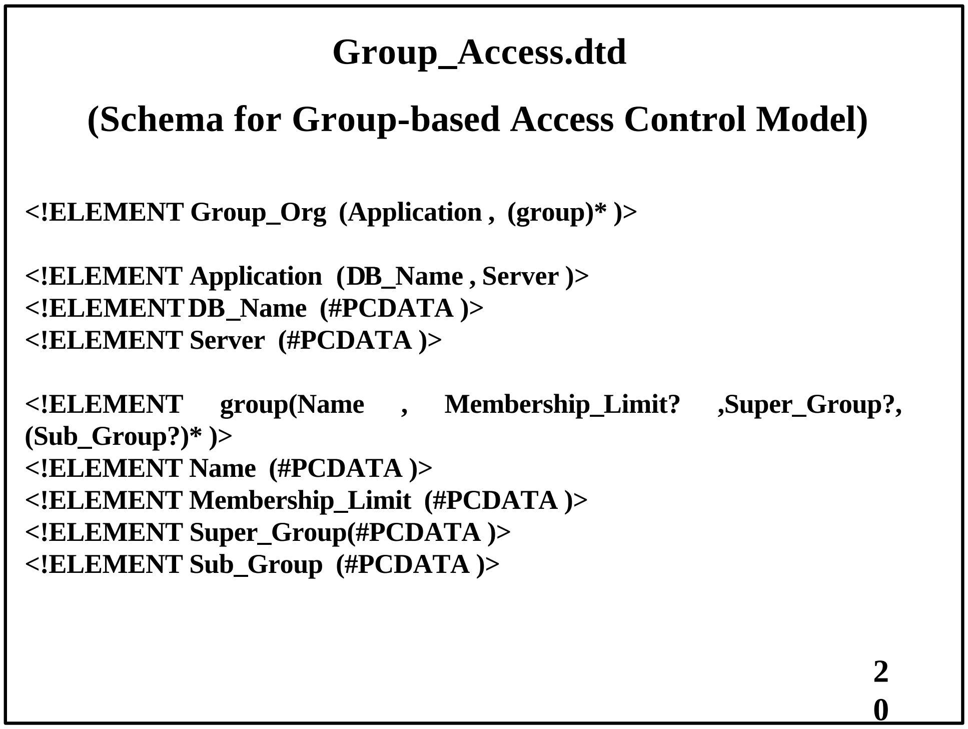

Group_Access.dtd

(Schema for Group-based Access Control Model)

```
<!ELEMENT Group_Org  (Application ,  (group)* )>

<!ELEMENT Application  (DB_Name , Server )>
<!ELEMENT DB_Name  (#PCDATA )>
<!ELEMENT Server  (#PCDATA )>

<!ELEMENT    group(Name    ,    Membership_Limit?    ,Super_Group?,
(Sub_Group?)* )>
<!ELEMENT Name  (#PCDATA )>
<!ELEMENT Membership_Limit  (#PCDATA )>
<!ELEMENT Super_Group(#PCDATA )>
<!ELEMENT Sub_Group  (#PCDATA )>
```

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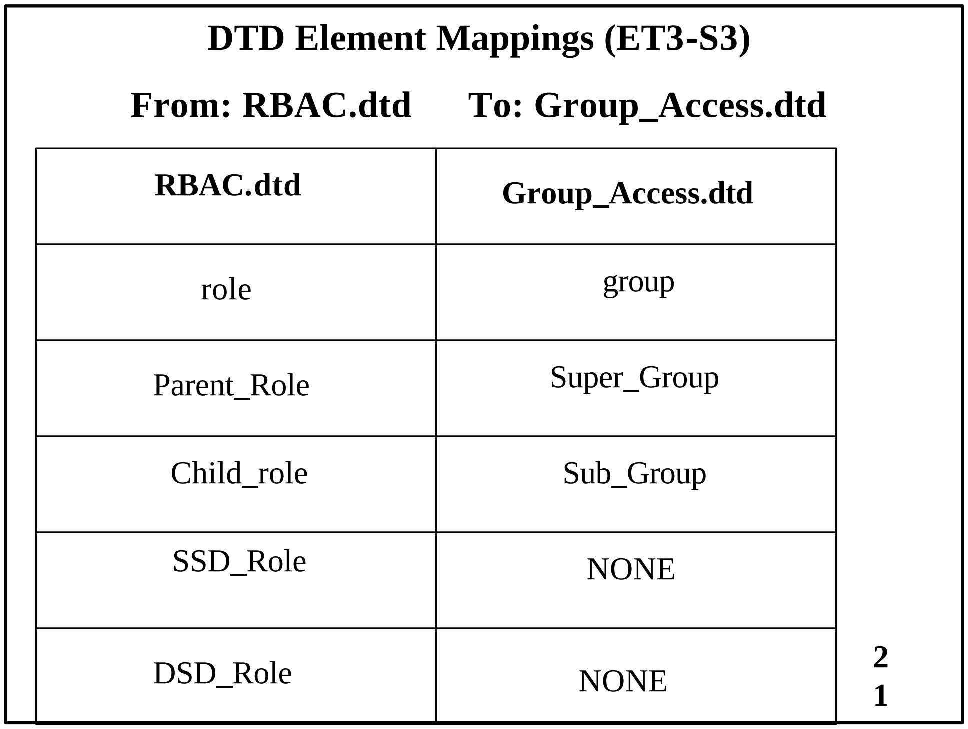
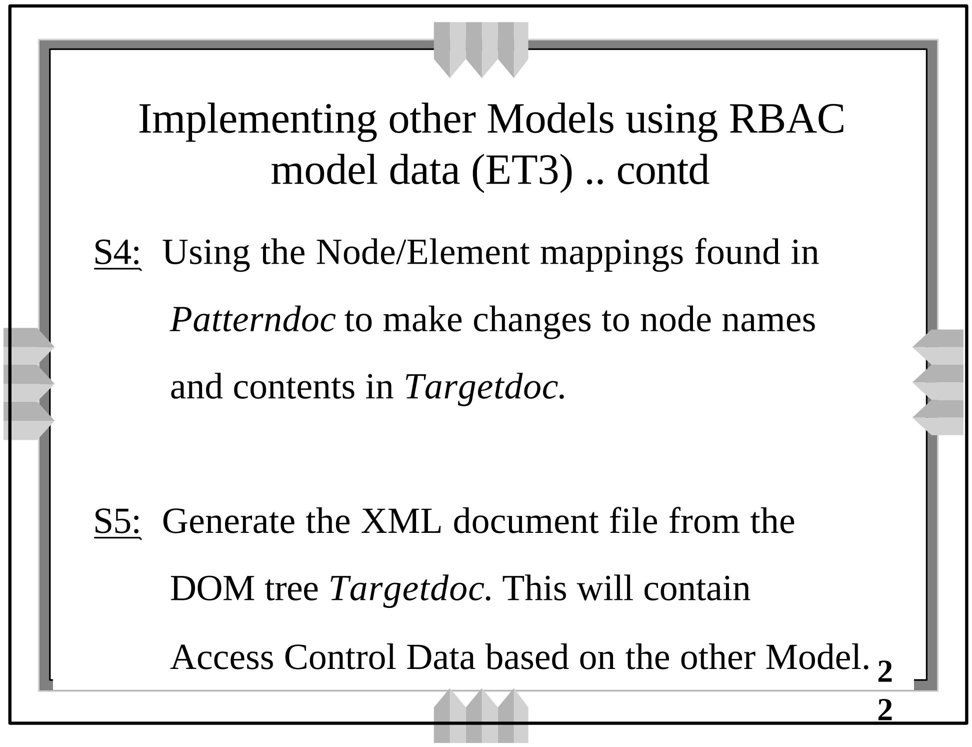


DTD Element Mappings (ET3-S3)

From: RBAC.dtd To: Group_Access.dtd

RBAC.dtd	**Group_Access.dtd**
role	group
Parent_Role	Super_Group
Child_role	Sub_Group
SSD_Role	NONE
DSD_Role	NONE

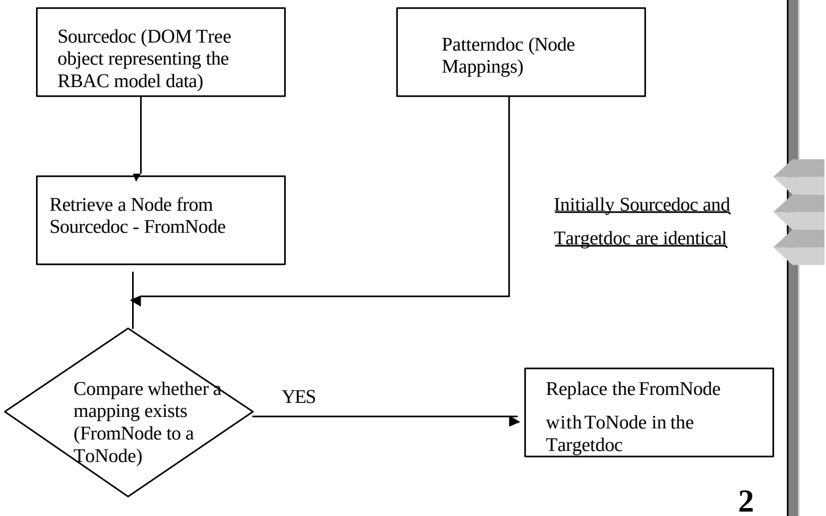


Implementing other Models using RBAC model data (ET3) .. contd

S4: Using the Node/Element mappings found in *Patterndoc* to make changes to node names and contents in *Targetdoc.*

S5: Generate the XML document file from the DOM tree *Targetdoc.* This will contain Access Control Data based on the other Model.

DOM Tree Conversion (ET3-S4)



Sourcedoc (DOM Tree object representing the RBAC model data)

Patterndoc (Node Mappings)

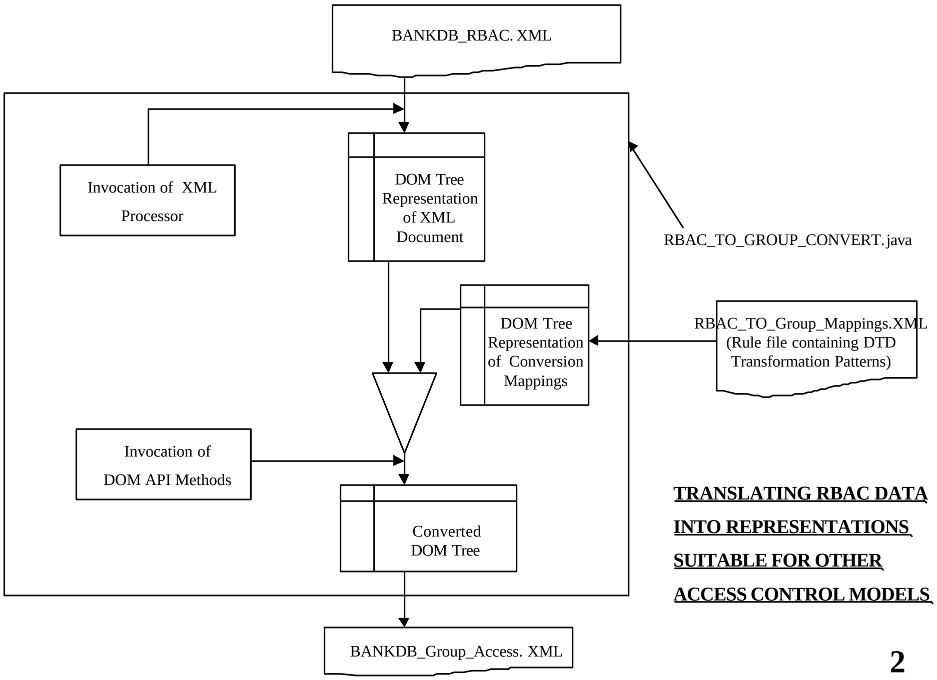
Retrieve a Node from Sourcedoc - FromNode

Compare whether a mapping exists (FromNode to a ToNode)

YES

Replace the FromNode with ToNode in the Targetdoc

Initially Sourcedoc and Targetdoc are identical



BANKDB_RBAC. XML

Invocation of XML Processor

DOM Tree Representation of XML Document

RBAC_TO_GROUP_CONVERT.java

DOM Tree Representation of Conversion Mappings

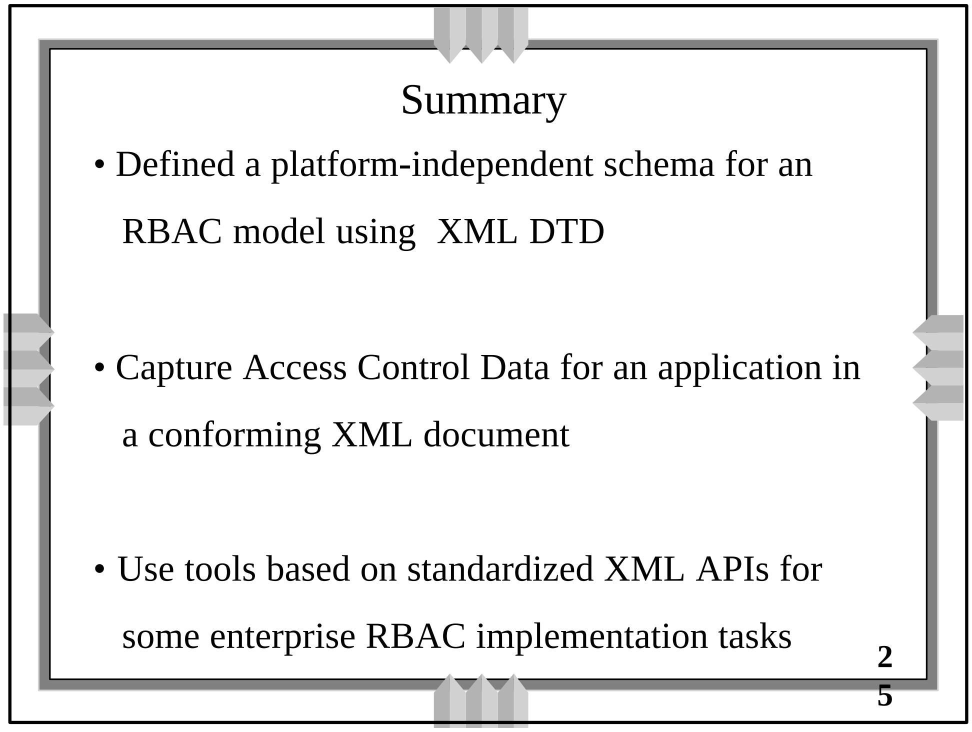
RBAC_TO_Group_Mappings.XML (Rule file containing DTD Transformation Patterns)

Invocation of DOM API Methods

Converted DOM Tree

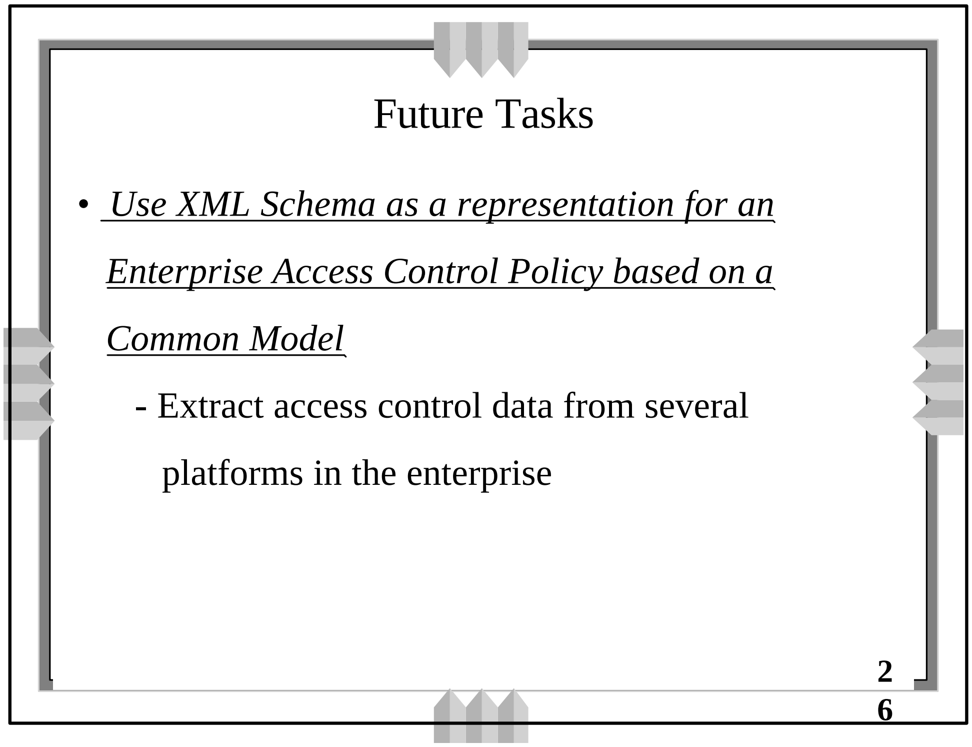
BANKDB_Group_Access. XML

TRANSLATING RBAC DATA INTO REPRESENTATIONS SUITABLE FOR OTHER ACCESS CONTROL MODELS



Summary

- Defined a platform-independent schema for an RBAC model using XML DTD
- Capture Access Control Data for an application in a conforming XML document
- Use tools based on standardized XML APIs for some enterprise RBAC implementation tasks



Future Tasks

- *Use XML Schema as a representation for an Enterprise Access Control Policy based on a Common Model*
  - Extract access control data from several platforms in the enterprise

Future Tasks .. contd

- *If you have an XML schema representing the Enterprise Access Control Policy based on a Common Model*

  - You can create create appropriate schema mapping files and use them with Enterprise schema for access control implementation on various native platforms.

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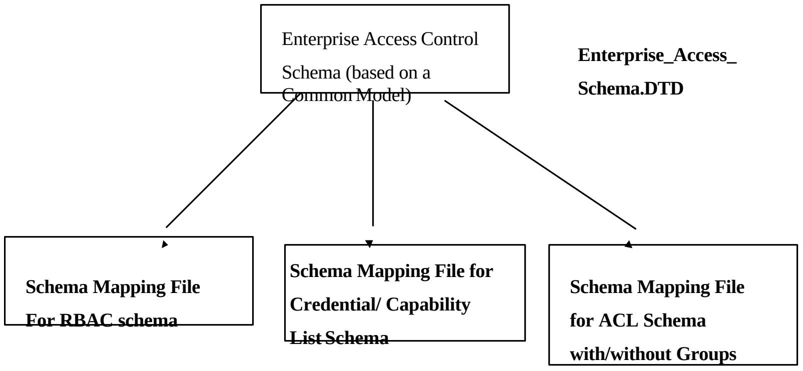
Implementing Access Control on Native Platforms from an Enterprise Schema



Enterprise Access Control Schema (based on a Common Model)

Enterprise_Access_ Schema.DTD

Schema Mapping File For RBAC schema

Schema Mapping File for Credential/ Capability List Schema

Schema Mapping File for ACL Schema with/without Groups

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