Lecture 17:

OSI Management

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### OSI Characteristics

- **OSI**:
  - International Standards Organizations (ISO OSI)
  - Deals with all 7 layers
  - Most complete
  - Object oriented representation
  - Well structured and layered
  - Consumes large resources in implementation
    - Because it tries to be generic and solve all problems (it can foresee).
    - Also because it’s object oriented, but today this should not be an impediment in implementation anymore.

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Management Architecture

- This architecture is used for both OSI and SNMP-based management
- Consists of a number of models

Figure 3.1 OSI Network Management Model

OSI Models

- **Organization**
  - Network management components
  - Functions of components
  - Relationships

- **Information**
  - Structure of Management Information (SMI)
    - Syntax and semantics
  - Guidelines for Definition of Managed Objects (GDMO)
    - Rules for object-oriented definitions
  - Management Information Base (MIB)
    - Organization of management information

- **Communication**
  - Transfer syntax with bi-directional messages
  - Transfer structure (PDU)

- **Functions**
  - Fault
  - Performance
  - Security
  - Accounting
Organizational Model

- **Manager System**
  - Sometimes referred to as Managing System
  - Monitors alarms
  - Houses applications
  - Provides user interface
- **Agent System**
  - Gathers information from objects
  - Configures parameters of objects
  - Responds to managers’ requests
  - Generates alarms and sends them to managers
- **Managed Object**
  - Network element that is managed
  - Houses management agent
  - All objects are not managed / manageable

**OSI vs. SNMP**

- In OSI, a system can perform the dual role of manager and agent, switching from one role to the other dynamically.
- In SNMP, the two functions can coexist but are distinct processes

Information Model

- Being OO, OSI information model is based on the abstraction of information on the managed objects.
- Information model deals with SMI, managed objects and object classes, management information trees, and GDMO

**OSI vs. SNMP**

- OSI: OO
- SNMP: Scalar

**Figure 3.9(b) OSI Perspective**

- Object Class: Circular object
- Attributes: circle, dimension
- Operations: Push
- Behaviour
- Notifications: Notify changes in attribute values
- Object Class: Elliptical object
- Attributes: ellipse, dimension
- Operations: Pull
SMI

- Based on ASN.1, similar to SNMP SMI in many ways
- In OSI SMI, the concept of a managed object refers to a \textbf{managed object class}: a group of objects having similar properties.
  - A collection of objects whose attributes and behavior are similar and support a common set of operations and notifications.
- A managed object class can be created from other managed objects classes, referred to as packages. \textbf{Mandatory package} properties must be supported, whereas properties of \textbf{conditional packages} may or may not be supported.
  - E.g., a transport protocol in OSI includes OSI transport class 4, which applies to any transport protocols, but may or may not include transport class 0 and 2, depending on if it’s connection-oriented or connectionless.

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Managed Object Class and Instance

- A \textbf{managed object class} is a group of managed objects with common \textbf{attributes} and \textbf{behavior}, can be subjected to similar \textbf{operations}, and emit a set of similar \textbf{notifications}.
- A \textbf{managed object} is an instance of a \textbf{managed object class}.
- For example, \texttt{hub} can be defined as a managed object class, with attributes manufacturer, serial number, number of ports, etc. Different instances of a hub can then have different values for those attributes.
- Managed objects have:
  - Attributes
  - Behaviour: internal actions
  - Operations: actions allowed to be applied from outside
  - Notification: responses
- Objects can \textbf{inherit} from other objects.
  - Both single and multi inheritance are supported.

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Somewhat similar to SNMPv2’s Module Identity, Object Identity and Object Type
Management Information Trees

- Different types of MITs
- Inheritance tree: Defines relationship between subclasses and superclasses
  - Similar to the figure on the previous page
- Naming tree: used in the naming of a managed object, which is a specific instance of a managed object class, in order to give it a unique identifier.
- Registration tree: used to officially registering managed object classes (from the inheritance tree), names of the managed objects (from the naming tree), attribute definitions, attribute groups, action types, notifications, and packages.
  - Similar to SNMP.

```
System
  SystemId = "BCD"

log
  logId = "SMK"

alarmRecord
  recordId = "5"
```

GDMO

- Guidelines for Definition of Managed Objects
- Can be viewed as a set of forms with a list of properties that can be filled with values.
- MANAGED OBJECT CLASS is the keyword that defines the managed object class
- DERIVED FROM identifies the course document and the relationship to a superclass or a subclass
- CHARACTERIZED BY identifies the mandatory packages and properties
- CONDITIONAL PACKAGES defines the optional packages
- REGISTERED AS defines the official registered name

```
lamp MANAGED OBJECT CLASS
  DERIVED FROM ITU-T Rec. X.721 (1992) : top;
  CHARACTERIZED BY lampPackage
  CONDITIONAL PACKAGES intensityPackage PRESENT IF
    (resourceSupportsIntensity(self())->lampId);
  REGISTERED AS
    { gdmoPlusExamplesModule.lampObjectIdentifier managedObjectClass (3)
      lamp(0) }
```
Communication Architecture

OSI Manager Application

- M-GET
- M-SET
- M-ACTION
- M-EVENT-REPORT
- M-CREATE
- M-DELETE
- M-CANCEL-GET

Application Entity

- Presentation ITU-T X.216 and X.226
- Session ITU-T X.215 and X.225
- Transport ITU-T X.214
- Network ITU-T X.25
- DL
- PHY

OSI Agent Application

- M-GET
- M-SET
- M-ACTION
- M-EVENT-REPORT
- M-CREATE
- M-DELETE
- M-CANCEL-GET

Application Entity

- Presentation ITU-T X.216 and X.226
- Session ITU-T X.215 and X.225
- Transport ITU-T X.214
- Network ITU-T X.25
- DL
- PHY

OSI vs. SNMP

No equivalent in SNMP:
- M-ACTION
- M-CREATE
- M-DELETE
- M-CANCEL-GET

Communication Model

- Seven Messages representing seven services, called Common Management Information Service Elements (CMISE)
- Communication protocol used by CMISE is the Common Management Information Protocol (CMIP).
- M-GET consists of request and response messages, analogous to SNMP’s getRequest and getResponse.
- M-SET sets up attribute values, and may or may not require confirmation.
- M-ACTION used to perform actions on objects, confirmation optional.
- M-CANCEL-GET cancels an M-GET message.
- M-EVENT-REPORT is similar to SNMP’s trap message.
- M-CREATE and M-DELETE are used to create and delete objects, both requiring confirmation.
System Management Application

• The System Management Application Process (SMAP), which could be a manager or an agent, communicates with another SMAP by invoking System Management Application Entity (SMAE).

• SMAE consists of several modules:
  – System Management Application Service Entity (SMASE) provides services for the 5 management applications (configuration, fault, performance, security, accounting).
  – CMISE, as described previously, which uses
  – Association Control Service Element (ACSE) which sets up and coordinates activities of setting up and releasing association between applications.
  – Remote Operation Service Elopement (ROSE) which issues requests to remote systems and receives responses in an asynchronous mode.

Network Communication Model
CMIP

- Common Management Information Protocol
- The communication interface with the CMISE.
- Responsible for generating PDUs.
- The PDU is a modified version of the generic ROSE PDU
- **Invoke ID**: PDU identifier used for correlating the response.
- **Information**: carries operation-specific data

<table>
<thead>
<tr>
<th>Invoke ID</th>
<th>Operation Value</th>
<th>Managed/ Base Object Class</th>
<th>Managed/ Base Object Instance</th>
<th>Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>Service</td>
<td>Operation Value (confirmed/unconfirmed)</td>
<td>0/1</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>M-EVENT-REPORT</td>
<td>6/7</td>
<td>8</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>M-GET</td>
<td>4/5</td>
<td>8</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>M-SET</td>
<td>4/5</td>
<td>8</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>M-ACTION</td>
<td>4/5</td>
<td>8</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>M-CREATE</td>
<td>4/5</td>
<td>8</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>M-DELETE</td>
<td>4/5</td>
<td>8</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>M-CANCEL-GET</td>
<td>4/5</td>
<td>8</td>
<td>9</td>
<td></td>
</tr>
</tbody>
</table>

Functional Model

**Management Application Functional Areas**
- Configuration
- Fault
- Performance
- Security
- Accounting

**System Management Functions**
- Object Management
- State Management
- Management Knowledge Function
- Event Report Management
- Log Control
- Alarm Reporting
- Test Management
- Scheduling
- Security Audit
- Account Metering
- Confidence and Diagnostic Test
- Workload Monitoring
- Object and Attribute Access Control
- …

**Common Management Information Service Elements**
- M-GET
- M-SET
- M-ACTION
- M-CREATE
- M-DELETE
- M-EVENT-REPORT
- M-CANCEL-GET