Lecture 19:

Web Based Management

Prof. Shervin Shirmohammadi
SITE, University of Ottawa
Using the Web for Management

- **Web browser UI** connects with the management system, allowing NMS functionality from any node browser that has access to the network.
  - Economical
  - Ubiquitous access
- **Not to confuse** Web Interface and Web-based management
- **Web Interface to Management**
  - System still primarily SNMP-based, web interface an added feature
- **Web-based management**
  - Desktop management interface
  - Web-based enterprise management
  - Java management extensions
Web Interface

- **SNMP-based** NMS
- NMS database transferred to Web-server
- View with Web browser
- Protocol between NMS and network elements is SNMP
- HTTP between Web server and browsers

![Diagram](image-url)
Embedded WBM

- Web servers are embedded in managed objects
- Data is pushed by the management agents in managed objects to the manager applications
- These management agents can have extra computing capabilities
- Opens the market for proprietary solutions that are customized to the product.

Advantages?
Disadvantages?

Figure 14.3 Embedded WBM Configuration
HP Embedded Agent

- HP AdvanceStack Assistant®
- Web agents act as RMONs
- Network element w/o Web agent can be managed
- Remote probing of switched LANs

Figure 14.4 Hewlett-Packard Embedded Agent Configuration
Desktop Management Interface (DMI)

- Industry standard generated by Desktop Management Task Force (DTMF)
- Started in 1992 to manage PCs
- Manages both hardware and software
- Two standards
  - Management information format (MIF), similar to MIB
  - Program interface with two APIs
- The DMI is in between the component and the application software that manages them.
- DMI 1.0 – Desktop management
- DMI 2.0 – Distributed desktop management.

Figure 14.5 DMI Infrastructure
DMI 2.0 Functions

- Architecture has dual representation
  - Version 1 with data block component I/F
  - Version 2 with procedural component I/F

![Figure 14.6 DMI Functional Block Diagram](image)
DMI MIB

• MIF specified using **ASN.1** syntax
• Can be managed by an **SNMP manager**
• DMTF task expanded to specify **WBEM** (Web-Based Enterprise Management)
  – Integrate existing standards, such as SNMP, CMIP, DMI, and HTTP.
Web-Based Enterprise Management

- WBEM based on **Common Information Module**, developed by Microsoft
- CIM is information-modeling framework intended to accommodate all protocols and frameworks
- Object-oriented
- Five components:
  - Web client
  - CIM object manager (CIMOM)
  - CIM schema
  - Management protocol
  - Managed objects with protocol-specific agents

![Figure 14.8 WBEM Architecture](image-url)
WBEM

• Web client is **Web browser with management applications**: Application requests use CIM schema
• Multiple instances of Web clients feasible
• CIM object manager **mediates** between Web clients, managed objects, and CIM schema
  – Microsoft Windows Management Instrumentation uses Distributed Component Object Model (DCOM)
  – Sun’s CIMOM uses JMX
• The CIM Schema is used to determine which protocol system the managed object belongs to as well as perform MIB translations.
• CIM modules:
  – **Core model**: high level framework applicable to all management domains.
  – **Common models**: applicable to protocol-specific domains. Includes information on systems, applications, devices, users, and networks.
  – **Extension model**: technology-specific extensions of the common model, such as UNIX or MS Windows OS specifics.
Common Information Module Core Model

- Solid lines indicate inheritance, dashed lines indicate association.
- PhysicalElement (e.g. interface card) and LogicalElement (e.g IP address) subclasses of ManagedSystemElement.
- Logical Device is the functionality that the Physical Element supports. e.g. a network card can support modem or NIC.

![Figure 14.9 WBEM CIM Core Model](image)

- System is aggregate of managed system elements.
- Service access point is management, measurement, and configuration of a service.
- Managed system elements may be considered as groups of components, for example network, resource, and applications.
Windows Management Instrumentation

- **WMI** is Microsoft infrastructure to support WBEM CIM
- WMI comprises management infrastructure, applications, and agents
- CIMOM has plug-in management applications
- COM/DCOM API specifies interface to CIMOM
- CIM is the CIM schema
- Object providers are management agents (e.g. SNMP agent)

![Diagram of WMI Architecture]

Figure 14.10 WMI Architecture
Java Management Extensions

- **JMX** is another approach for total management using Web technology
- JMX defines
  - Management architecture
  - APIs
  - Management services
- Based on *Java Dynamic Management Kit*, a technology introduced by *Sun Microsystems* for the development of Service Driven Networks
Service Driven Network

• Service Driven Network: network of services (instead of network of components)
• Service needs provisioning and management
• Let’s use as an example **Webphone**: Internet analogy to telephone
  – Webphone is network-centric device
  – thin client
  – hand-held device
  – a plug-in device in service network
• Java technology calls plug-in JavaBean
• MBean is management JavaBean
JDMK

- Java dynamic management tool kit to build Java-based NMS
- **MBean** is an intelligent agent; does not need polling as in SNMP agent
- JDMK library of core management services implemented as MBeans
- Java Dynamic Management agent comprises
  - **MBeans**: core management framework, MBean server
  - **Protocol adaptors**: interfaces to applications
- An MBean can be **dynamically loaded**. For example, an MBean can be downloaded to an agent to take statistical samples of a router. It can then be removed after the problem has been diagnosed. This is similar to the concept of software blades.
  - The term **blade** designates a standardized module which one can plug in to a computer system

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**Figure 14.11 Java Dynamic Management Agent Architecture**
Management Bean

- JDMK agents are under the control of master JDMK agent
  - hierarchical structure
- Manager is NMS
- Web server stores management services as applet files with the agents’ URL
- MBean pulled out of the Web server at boot time
JMX Architecture

- JMX architecture comprises **three levels**
- **Instrumentation**
  - JMX-manageable resources - network devices, applications, service entities, and systems
  - Developed in Java or Java wrappers as MBeans
  - MBeans implemented either static or dynamic
- **Agents**
  - MBean server is a set of services for handling MBeans
JMX Agents

• Agents
  – MBean server is a set of services for handling MBeans
  – JMX-manageable resources register with an agent
  – I/F adaptor to Web browser contains a Web server
  – I/F to JMX manager called a connector
  – Protocol adaptors represents MBeans in another protocol, such as SNMP
  – Agent-Manager communication infrastructure uses HTTP, CORBA/IIOP, etc.
JMX Manager

• Manager
  – Comprises management applications, network manager, and browser
  – Interfaces with agents via the connector (JMX manager) or protocol adaptors
  – CIM/WBEM APIs are grouped into CIM, client, and provider.
  – CIM API represents CIM elements as Java class objects
  – JMX manager interfaces with external database using JDBC (SQL databases)
Looking Ahead

- Future network and system management frameworks should accommodate well-established SNMP entities
- Web agents are intelligent and future points to the use of Web technology
- Web-based management offers two options
  - **WBEM** is comprehensive and centralized approach to enterprise management; accommodates both scalar and object-oriented schemes
  - **JMX** is decentralized and uses Java technology; agents embedded in objects and can be downloaded from NMS; platform independent
- Future NMS environment could be a merger of the old and the new - at least in the near future