Lesson 6-2: Management Information Base

At a Glance

There are many different types of network devices in the world. Each device has its own set of variables for which SNMP is used to monitor and alter when necessary. These variables are stored in a database called the management information base or MIB.

The database contains information, or variables, such as:

- The number of packets sent by the agent.
- The number of packets received by the agent.
- The record of packet errors.
- The number of connections.

The network manager uses the information stored in the MIB to manage and improve the performance of each network device across a LAN. Understanding the basic structure of the MIB and how to modify it are important skills in network management.

What You Will Learn

After completing this lesson, you will be able to do the following:

- Describe MIB structure and name representation.
- Diagram MIB structure.
- Identify the top level groups in the MIB for the Nortel Networks ARN.
- Compile a current screen list using Site Manager.
- Use the Quick Get facility to browse the MIB.
- Use the Screen Builder to customize a screen.
Tech Talk

- **ASN.1**—Abstract Syntax Notation One provides a standard for writing clear and uniform definitions for each MIB object. Either a symbolic name or numeric identifier represents each object.

- **MIB Browser**—A software application that allows the network manager to view an object in a MIB.

- **Objects**—In SNMP, objects are abstract representation of information stored in a MIB. Each object has an object identifier namespace, an assigned number, and a specific location within the MIB structure.

- **Object Identifier Namespace**—Within an MIB an object identifier namespace is the name of a variable. These identifiers are not randomly assigned; rather they are assigned by an organization.

- **Object Instance**—The MIB variable that can be read or modified is called the object instance.

- **SMI**—Structure of Management Information defines how to name and organize objects in a MIB. SMI defined the tree structure for MIBs.
MIB Structure

Every MIB has a tree-like structure that consists of a root connected to a number of labeled object groups. Each group may branch to another sublayer of objects. Within each object is the object instance or variable that is read or modified by SNMP.

Management Information Base

The path from the root through the tree’s branches to a specific object identifies the object. The ISO defines the root of the tree. The vendor for its specific products defines other branches of the tree.

There are two standards that define how a MIB is written, Structure of Management Information (SMI) and Abstract Syntax Notation One (ASN.1).

- **SMI**—Defines how to name and organize objects in a MIB. SMI defined the tree structure for MIBs.
- **ASN.1**—Provides a standard for writing clear and uniform definitions for each object. Either a symbolic name or numeric identifier represents each object.

The names used for each MIB variable are based on the object identifier namespace as defined using ASN.1. The namespace for the top layers of a MIB are standardized by the International Standards Organization (ISO).
The top-level root namespace is unnamed. The next level branches to three namespaces, the ISO, the CCITT, and the joint-ISO-CCITT. (The ISO was formerly the CCITT or Consultative Committee for International Telegraph and Telephony.) The ISO branches to the name space, Organization. Organization branches to the Department of Defense, which in turn branches to the Internet, and so forth.

Each namespace has a number associated with it. As shorthand, the numbers are used to refer to a namespace rather than the actual name and the MIB is identified by the sequence of numbers, using dotted notation.

In the illustration above, the portion of the MIB from the Root to the Private namespace is referred to as 1.3.6.1.4.

The Private branch is used for objects that will be defined by individual businesses, for example, Nortel Networks. Vendors are responsible for assigning identifiers to their individual objects, which allows vendors to create their own proprietary MIB.
Nortel Networks MIB

The Nortel Networks MIB defines all the manageable variables on the router. All Nortel Networks WellFleet Router MIB variables begin with the numeric prefix 1.3.6.1.4.1.18. The number 18 was assigned by the Internet Assigned Numbers Authority to represent Wellfleet, since at the creation of the MIB, Wellfleet was the original name of the router manufacturer.

There are five object groups that serve as top-level objects for the Nortel Networks WellFleet MIB. Each group has similar functions within the MIB.

- **wfHardwareConfig**—Contains the objects for configuration of the hardware.

- **wfSoftwareConfig**—Contains the objects that pertain to the specific software loaded, for example, protocols and information required for loading the software.

- **wfSystem**—Contains the objects that pertain to the system; for example, the circuit name table.

- **wfLine**—Contains the objects that determine the function of the drivers (software that controls a hardware component) that control the data link layer media.

- **wfApplication**—Contains the objects pertaining to the applications.
All Nortel Networks version 5 software variables fall under the wfSwSeries5 namespace and all version 7-software variables fall under the wfSwSeries7 namespace.

Nortel Networks MIB Branching from the Private Namespace

In the illustration above, the MIB from the Private to the wfApplication namespace is represented as 4.1.18.3.5. The entire MIB from the Root to wfApplication is represented as 1.3. 6.1. 4. 1.18.3.5.

Note that in the Wellfleet MIB, the namespaces are written in a shorthand fashion, that is, wfSwSeries5 means “Wellfleet Software Series 5.” When the objects are displayed using a MIB browser, these shorthand names can be useful to the manager to identify the purpose of the object.
Check Your Understanding

- Given the numeric representation of a MIB as 1.3.6.1.4.1.18.3.1, diagram the MIB with the correct namespaces.
Try It Out

The Nortel Networks MIB
Statistics Manager is a utility that allows the user to load and launch
statistics screens showing information about the router.

Quick Get is a MIB browser within Site Manager that allows you to view
an object in the Nortel Networks’ MIB. Quick Get allows you to determine
the object’s type of access (for example, read or write), data type (integer,
display string, or counter), and syntax or values. It also provides a
description of the object.

Screen Builder is a utility within Site Manager that allows you to build a
customized statistic screen.

Materials Needed:
- Nortel Networks' Advanced Remote Node (ARN) Router
- Classroom Network
- Windows 95 PC
- Site Manager
- Any Word Processor (e.g., MS Word)
- Pen/Pencil and Paper
- Student Portfolio

In this lab you will learn how to:
- Compile a current screen list using Site Manager.
- Use the Quick Get facility to browse the MIB.
- Use the Screen Builder to customize a screen.

During this lab, work in teams of three. Record your experiences, results,
speculations, and conclusions in your portfolio. Write a summary of your
activities and results.
Part One: Viewing Router Statistics

1. Open Site Manager from the Start/Programs menu.

2. Highlight and record the IP address of the router with which you will be working.

3. Study the Site Manager screen and record the SNMP community name and the MIB version number.

4. From the Site Manager window, open the Statistics Manager:
   a. Click Tools.
   b. Click Statistics Manager or click the Statistics button.

5. Open the Screen Manager:
   a. Click Tools
   b. Click Screen Manager

6. Verify that you have HARDWARE.DAT as the screen in the Current Screen List.

7. If HARDWARE.DAT is not in the Current Screen List then:
   a. Find HARDWARE.DAT in the Default Screens list.
   b. Highlight it.
   c. Click Add.
   d. HARDWARE.DAT will display in the Current Screen List.
   e. Click OK.

8. Launch the HARDWARE.DAT screen:
   a. Click Tools.
   b. Click Launch Facility.
   c. Select HARDWARE.DAT.
   d. Click Launch.
9. Notice that this screen displays the following fields:
   - Module ID—The type of link module.
   - Slot—Unique value for each slot in the router.
   - Serial Number—Link module serial number.
   - Mother Board ID—Identifies the CPU.
   - File System—Identifies the presence of a volume. The volume is the memory of the router that remains unchanged when the router is turned off. The volume is also referred to as the flash.


11. Click Done in the Statistics Launch Facility window.

**Part Two: Using Quick Get**

1. Navigate to Quick Get.
   a. Click Tools.
   b. Click Statistics Manager.
   c. Click Tools.
   d. Click Quick Get.

2. Using Quick Get, start at internet and navigate down to the wfHwTable:
   a. Click Internet.
   b. Click Private.
   c. Click Enterprise.
   d. Click Wellfleet.
   e. Click wfSwSeries7.
   f. Click wfHardwareConfig.
   g. Click wfHwTable.

3. Click Read Description to read the descriptions of the variables listed in the table.

4. Click on wfHwConfigFile (scroll down).
5. Click on Retrieve Request button. This shows what configuration file is active on the router.

6. Record the purpose of each variable in the chart below.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Object Identifier</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Slot Number</td>
<td>wfHwSlot</td>
<td></td>
</tr>
<tr>
<td>Link Module rev</td>
<td>WfHwModRev</td>
<td></td>
</tr>
<tr>
<td>CPU Board Type</td>
<td>WfHwMotherBdIdOpt</td>
<td></td>
</tr>
<tr>
<td>CPU Board Rev</td>
<td>WfHwMotherBdRev</td>
<td></td>
</tr>
<tr>
<td>Volume 1</td>
<td>wfHwFileSysPresent</td>
<td></td>
</tr>
</tbody>
</table>

a. Highlight the variable under the MIB Objects list.

b. Click the Read Description button.

c. Use the Computer's ESC key to close the description window.

**Part Three: Screen Builder**

1. In the main Statistics Manager window, select the Screen Builder:
   a. Click Tools.
      b. Click Screen Builder.

2. In the same fashion you negotiated through Quick Get facility, negotiate through the MIB browser on the left side of the screen, starting with Internet.

3. Select the first MIB object, wfHwSlot. Note that the Column Information and Setup portion of the screen displays the object.

4. Click in the selection box for Column 1 if it is not already selected.

5. Click in the Heading field.

6. Enter the name for the column, in this case Slot Number.

7. Use the slide bar located below the Width field to adjust the column width.

8. Save this setting for Column 1 by clicking on the Save Column button. An asterisk (*) will appear next to the saved column.

9. Repeat steps 4-8 for each MIB object in the table, assigning each object a different column.
10. Click Save.

11. Name the Statistic Screen and choose "Table" for Orientation.

12. Click Save.

13. Click Done.

14. Return to the Screen Manager.

15. Add the screen you just created to the Current Screen List:
   a. Select your new screen.
   b. Click Add.
   c. Click OK.

16. Return to Statistics Manager to launch the new Statistics Screen.
   a. Click Tools.
   b. Click Launch Facility.
   c. Select your new statistics screen.
   d. Click Launch.

17. You should see your statistic columns fill with information. Note this information.

   Now you will build a screen that shows the total number of frames transmitted and received on your Ethernet interface.

18. Open the Screen Builder from the Tools menu.

19. Negotiate through the MIB browser to the object wfLine.

20. Click wfCSMACDTable.

21. Under wsCSMACDEntry, find Frames RxOK and Frames TxOK.

22. Click the Column 1 button.

23. Click the MIB object, Frames RxOK.

24. Under the Heading field, enter the name for the column.

25. Adjust the width of the column with the sliding bar.

26. Click the Save Column button to save the column.
27. Repeat steps 26-30 for the MIB object Frames TxOK. Remember to assign a new column for each object.

28. Once you have saved the two columns, add a Total column by:
   a. Select a new column.
   b. Click Total.
   c. In the Screen Builder Column Total window, select the columns that you want to add together.
   d. Click Save.
   e. Under the Heading field, enter Total Frames.
   f. Click on the Save Column button.

29. Once all the column variables have been saved, click Save.

30. In the Statistics Save/Load Screen window that appears, enter the file name CSMA_FRA.DAT.

31. In the description, enter Total Ethernet Frames.

32. Select Circuit as the screen orientation. This allows the table to continuously update the information gathered.

33. Click Save.

34. In the Screen Builder window, click Done.

35. Open Screen Manager from the Tools menu.

36. Highlight the CSMA_FRA.DAT file.

37. Click ADD to add the screen to the Current Screen List.

38. Click OK.

39. From the Tools menu, select Launch Facility.

40. Launch the CSMA_FRA.DAT file. (Note that the Circuit Name represents the ports on the router.)
41. Record the information presented in your table in the chart below. Make an entry in the chart for every 1 minute interval for 5 minutes total. If you are recording information for more than one circuit, make a blank copy of the chart below to record the additional circuit’s data.

<table>
<thead>
<tr>
<th>Minute</th>
<th>Received</th>
<th>Transmitted</th>
<th>Total Frames</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Rubric: Suggested Evaluation Criteria and Weightings**

<table>
<thead>
<tr>
<th>Criteria</th>
<th>%</th>
<th>Your Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group Summary (on-time delivery)</td>
<td>25</td>
<td></td>
</tr>
<tr>
<td>Analysis and synthesis of information</td>
<td>50</td>
<td></td>
</tr>
<tr>
<td>Summary organized and in format suitable for reproduction</td>
<td>25</td>
<td></td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td>100</td>
<td></td>
</tr>
</tbody>
</table>
Stretch Yourself

Sniffer Basic and Site Manager
In this activity, you will use the CSMA_FRA.DAT file created in Try It Out to monitor network traffic, generated by Sniffer Basic, across the router.

Materials Needed:
- Nortel Networks' Advanced Remote Node (ARN) Router
- Classroom Network
- Windows 95 PC
- Site Manager
- Sniffer Basic Software
- Any Word Processor (e.g., MS Word)
- Pen/Pencil and Paper
- Student Portfolio

Part One: Calculate Bytes per Second
When using Sniffer Basic's Packet Generator there are several status criteria:
- Packets Sent
- Bytes Sent
- Packets/second
- Bytes/second

There is a direct relationship between the two rates, packets/second and bytes/second.

1. How would you calculate one rate by knowing the other rate?

Answer: To calculate the number of bytes/second, you must know the number of packets/second and the size of each packet. Using standard conversion multiplication, the packets/second is multiplied by the bytes/packet.
2. Calculate the number of bytes/second for the following information. The number of packets/second traveling across the network is 100. The size of the packets is 64 bytes. Show your work.

   Answer: (100 packets/second) X (64 bytes/packet)= 6400 bytes/second.

3. What happens when the number of bytes per packet increases?

   Answer: The number of bytes per second increases.

4. What happens when the number of packets per second increases?

   Answer: The number of bytes per second increases.

Part Two: Monitoring the Network

Continuing to work in teams of three, one team member will launch the CSMA_FRA.DAT file while the other team members exchange data packets across the network using Sniffer Basic.

1. Using a straight through Ethernet cable (Cat.5 with RJ-45 connector), connect two PC workstations to the classroom network. Connect the PCs to different Ethernet LANs so that the packets are travelling over the classroom WAN.

   • NOTE: (This step supposes that the WAN from previous labs are still in place, this needs to be verified in Course 2 Unit 5 labs, I'm quite sure that the WAN is still setup and that the student PC's are still connected, if so, then this first step of connecting 2 PC's using a straight through Ethernet cable does not need to be performed and can be skipped.)

2. Connect a third PC to one of the routers in the classroom network. This PC will be the network management station (NMS).

   • NOTE: (This step can also be skipped if the classroom lab network is still in tact as outlined above)

3. On the NMS, launch the CSMA_FRA.DAT file from Site Manager. (Consult the instructions in Try It Out or your notes, if you do not remember how to launch this file.)

4. On the PCs connected to the hubs, open Sniffer Basic from the Start/Programs Menu.
5. To generate a stream of packets across the network, open the Packet Generator from the Tools menu.
6. The Packet Generator will open by clicking on the cable icon in the Packet Generator tool bar.

![Packet Generator Tool Bar](image)

7. A configuration window, called Send New Packet, will pop up.

![Send New Packet Window](image)

8. Click on the Configuration Tab. On this tab set the frequency of sending packets to continuous. Set the amount of delay between packets to 1 millisecond and the size of the packets to 64 bytes. (After you have completed this activity with these settings, you may want to experiment with other settings and compare the results.)

9. Once you have finished your settings, click on OK to start the generator.
10. There are two different viewing windows to watch the packets travel across the network. The first view is merely an animated illustration of the packets traveling across the network as they are generated.

11. Click on Detail and the second view will appear. This view displays the total number of packets and bytes sent, and the total number of packets and bytes sent per second.

12. Compare the Sniffer Basic display with the CSMA_FRA.DAT table. What similarities or differences are there between the two displays? Record your findings. (Perhaps you will want to take a screen shot, Alt+Prnt Scrn, of both displays for reference and inclusion in a summary of this activity.)

13. Examine Sniffer Basic's "Utilization" as the packet size is increased. Does the "Packets/second increase or decrease with the packet size?
14. Experiment with the Packet Generator and see if you can alter the information recorded in the CSMA_FRA.DAT table. Record changes you make and the results that occur due to the changes.

15. As a team, write a summary of your experiences, including any screen shots you took during the activity.

**Rubric: Suggested Evaluation Criteria and Weightings**

<table>
<thead>
<tr>
<th>Criteria</th>
<th>%</th>
<th>Your Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Enthusiastic experimentation that generates multiple results</td>
<td>40</td>
<td></td>
</tr>
<tr>
<td>Summary organized and in format suitable for reproduction</td>
<td>40</td>
<td></td>
</tr>
<tr>
<td>Cooperative group teamwork</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td>100</td>
<td></td>
</tr>
</tbody>
</table>
Network Wizards

Diagram the Nortel Networks MIB

Materials Needed:
- Nortel Networks’ Advanced Remote Node (ARN) Router
- Classroom Network
- Windows 95 PC
- Internet Connection (optional)
- Site Manager
- Any Word Processor (e.g., MS Word)
- MS PowerPoint (optional)
- Pen/Pencil and Paper

1. In Try It Out, you learned how to use Site Manager and its various facilities to browse the MIB and build a reporting table on some of the variables within the MIB. Now you will diagram part of the Nortel Networks MIB.

   a. Working with your team from Try It Out, use Site Manager to browse the MIB again. This time choose a path from Internet to one of the top layers of the Nortel Networks MIB. As your team negotiates, diagram the path and record the description of the objects.

   b. Choose one of the top layers to further investigate that portion of the MIB.

   c. Continue to negotiate through the MIB from the top layer you have chosen. Again, as your team negotiates, diagram the objects and the record the descriptions of the objects.

   d. Your team’s diagram should have the entire path and the objects associated with that path. Your diagram needs to be a clear and attractive presentation that could be used in a publication or in an oral presentation about the MIB.
e. Include in your diagram the descriptions of each object. Make sure that the diagram does not become too cluttered. Your team will need to design the diagram so that it is informative but not messy.

Rubric: Suggested Evaluation Criteria and Weightings

<table>
<thead>
<tr>
<th>Criteria</th>
<th>%</th>
<th>Your Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quality illustration suitable for reproduction</td>
<td>40</td>
<td></td>
</tr>
<tr>
<td>Accurate descriptions of each object</td>
<td>40</td>
<td></td>
</tr>
<tr>
<td>Cooperative group teamwork</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>100</strong></td>
<td></td>
</tr>
</tbody>
</table>

2. Research SNMPv2, CMIP, MIB I and II. Compare these concepts to the information you have gained in the SNMP and MIB lessons. Report your findings in one of the following means:

a. Write a research report on your findings. Include in your report if you recommend using one protocol or MIB over the other and why. Document your resources.

b. Create a PowerPoint presentation demonstrating the similarities and differences in these concepts. Include in your presentation if you recommend using one protocol or MIB over the other and why. Document your resources.

c. Create a collage that demonstrates the similarities and differences in these concepts. If you recommend using one protocol or MIB over the other, include in your collage a conceptual representation of this recommendation. Document your resources.

Rubric: Suggested Evaluation Criteria and Weightings

<table>
<thead>
<tr>
<th>Criteria</th>
<th>%</th>
<th>Your Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quality project suitable for reproduction</td>
<td>30</td>
<td></td>
</tr>
<tr>
<td>Analysis and synthesis of research</td>
<td>30</td>
<td></td>
</tr>
<tr>
<td>Well thought out comparison</td>
<td>30</td>
<td></td>
</tr>
<tr>
<td>Resources</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>100</strong></td>
<td></td>
</tr>
</tbody>
</table>
Summary

In this lesson, you learned the following:

• The MIB structure and name representation.
• How to diagram MIB structure.
• The identification of the top level groups in the MIB for the Nortel Network ARN.
• How to compile a current screen list using Site Manager.
• How to use the Quick Get facility to browse the MIB.
• How to use the Screen Builder to customize a screen.

Review Questions

Lesson 6-2 : Management Information Base

Part A

1. Describe MIB structure and the name representation used to identify each object within the MIB.

Part B

1. Diagram the MIB represented by the dotted notation 1.3.6.1.4.1.18. Include in your diagram the object identifier namespace.
**Part C**

Place an X in the box next to an object group that is part of the top layer of the Nortel Networks MIB. Write a short definition for each of your choices.

<table>
<thead>
<tr>
<th>MIB Objects</th>
<th>Definitions</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. wfLine</td>
<td></td>
</tr>
<tr>
<td>2. wfHwModRev</td>
<td></td>
</tr>
<tr>
<td>3. wfHardwareConfig</td>
<td></td>
</tr>
<tr>
<td>4. wfEnterprise</td>
<td></td>
</tr>
<tr>
<td>5. wfSystem</td>
<td></td>
</tr>
<tr>
<td>6. wfApplication</td>
<td></td>
</tr>
<tr>
<td>7. wfHwSlot</td>
<td></td>
</tr>
<tr>
<td>8. wfSwSeries5</td>
<td></td>
</tr>
<tr>
<td>9. wfSoftwareConfig</td>
<td></td>
</tr>
</tbody>
</table>
## Scoring

### Rubric: Suggested Evaluation Criteria and Weightings

<table>
<thead>
<tr>
<th>Criteria</th>
<th>%</th>
<th>Your Score</th>
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</thead>
<tbody>
<tr>
<td>Part A: Describe MIB structure and name representation</td>
<td>40</td>
<td></td>
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<tr>
<td>Part B: Diagram MIB structure</td>
<td>30</td>
<td></td>
</tr>
<tr>
<td>Part C: Identify the top level groups in the MIB for the Nortel Network ARN</td>
<td>30</td>
<td></td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td>100</td>
<td></td>
</tr>
<tr>
<td><strong>Try It Out</strong>: Compile a current screen list using Site Manager.</td>
<td>100</td>
<td></td>
</tr>
<tr>
<td><strong>Stretch Yourself</strong></td>
<td>100</td>
<td></td>
</tr>
<tr>
<td><strong>Network Wizards</strong></td>
<td>100</td>
<td></td>
</tr>
<tr>
<td><strong>FINAL TOTAL</strong></td>
<td>400</td>
<td></td>
</tr>
</tbody>
</table>
Resources


