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<http://download.intermapper.com/docs/DevGuide/>

## Developer Guide

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# Chapter 1

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## Introduction

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InterMapper is a network monitoring and alerting program. It continually tests routers, servers, hubs, and other computer devices that are attached to your network. If InterMapper detects a failure, it sends notifications to one or more individuals via sounds, e-mail, pagers, or by running a program to correct the problem.

Use this manual to learn about the tools you can use to customize how InterMapper monitors the network, and to display data about those results.

### [Customizing InterMapper's Probes \(Pg 8\)](#)

Explains how to create your own custom probes, and how to configure them to add power and flexibility to your network monitoring.

### [InterMapper HTTP API \(Pg 172\)](#)

Explains InterMapper's HTTP API and how to use it to import and export files and tables, and to use your own scripts to create acknowledgements.

### [Customizing Web Pages \(Pg 190\)](#)

Explains how you change the look and function of the web pages available from InterMapper's built-in Web server.

### [Retrieving Collected Data \(Pg 187\)](#)

A look at the InterMapper Database, with links to useful resources.

Please give us comments at the address listed below. Thanks!

[Help/Systems, LLC](#)

[InterMapper Feedback](#)



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Training services must be used within 6 months of being invoiced and all fees are nonrefundable.

# Chapter 2

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## Creating Your Own Probes

For many Internet services, simply "pinging" a device is not a sufficient test of whether it is operating correctly. InterMapper has a number of built-in probes that can test different aspects of a device's operation, whether it's a web server, router, database, LDAP server etc.

However, InterMapper's built-in probes may not test the kinds of devices you want to monitor, or may not test them ways that are most useful to you. In such a case, you can create your own probes. InterMapper's probes are defined by *probe files*, simple text files that can be duplicated and modified using any standard text editing utility. When you create your own probe, it becomes a first-class citizen and appears in the Set Probe window along with the built-in probes.

### What is a probe?

A probe is a text file that specifies the way in which InterMapper tests a device. It is essentially a plug-in. All of InterMapper's probes follow the same logic:

- The probe sends one or more queries, as SNMP requests or UDP datagrams or over a TCP connection to the device being tested.
- The device responds (or fails to respond).
- If there is no response, InterMapper sets the device's status to DOWN.
- InterMapper examines the response(s) from the device, and sets the device's status accordingly.

### Parts of a Probe

All of the probe types listed below follow a similar structure. This is outlined in [Anatomy of A Probe \(Pg 10\)](#), which explains the common sections of a probe, and the sections that are specific to a particular probe type.

### Types of Probes

InterMapper has several kinds of probes. You can use InterMapper's built-in probes as-is, you can copy and modify them, or you can develop your own probes from scratch. These are the different probe types:

- **[SNMP Probes \(Pg 50\)](#)** - InterMapper tests the device's status by sending SNMP queries and comparing the results to user-specified thresholds.
- **[SNMP Trap Probes \(Pg 98\)](#)** - InterMapper can receive and process SNMP traps, and can set the status of a probe based on the contents of the trap's variables. You can create custom probes that alert you to problems in a certain device based on the contents of specific trap variables.
- **[TCP Probes \(Pg 112\)](#)** - InterMapper establishes a TCP connection to a device. It then sends certain requests and evaluates the responses to determine the device's status. TCP probes uses the [TCP Probe Scripting language \(Pg 115\)](#) to create a sequence of commands, branching to different parts of the script under specified conditions.



- [Command-line Probes \(Pg 139\)](#) - InterMapper can invoke a program or script (as if "from the command line"), and use the results to determine the device's status.
- **Big Brother Probes** - Big Brother™ is an open-source network monitoring program. InterMapper listens for reports from Big Brother clients and sets the device's status accordingly.

It's fairly straightforward to modify the existing files to produce new probes. If you make a new probe file that might be useful, please consider sending it to us. See [Sharing Probes \(Pg 161\)](#) for more information.

## Anatomy of a Probe

Probe files have several sections, several of which are common to all probe types. These are described below.

Each section contains a number of lines bracketed by

```
<section-name> ... </section-name>
```

You might want to open a separate window with the [example probe file \(Pg 137\)](#) while reading the subsequent sections.

### Sections common to all probes

#### [The <header> Section \(Pg 12\)](#)

Learn about the <header> section of the probe definition, including how the probe is identified, how its name appears in the **Probe Type** menu, and the version numbering system.

#### [The <description> Section \(Pg 17\)](#)

The <description> section specifies the help text that appears in the Set Probe window and typically explains the function of the probe and the use of its parameters. Format the description using IMML, [InterMapper's Markup language \(Pg 33\)](#).

#### [The <parameters> Section \(Pg 18\)](#)

The <parameters> section defines the probe's parameters and how they are presented in the Set Probe window.

#### Display Sections

Each probe type has its own output section, which controls what appears in the device's Status window. In all probes, you format the appearance of Status window using IMML, [InterMapper's Markup language \(Pg 33\)](#).

### Type-Specific Probe Sections

Each probe type has sections that are specific to that probe type.

#### *Sections specific to SNMP Probes*

Each custom SNMP probe has:

- [An <snmp-device-variables> section \(Pg 52\)](#) - Specifies which MIB variables to collect from the device.
- [An <snmp-device-thresholds> section \(Pg 59\)](#) - Specifies how those variables are to be tested against thresholds to determine the device's status.
- [An <snmp-device-display> section \(Pg 69\)](#) - Specifies what information about the device and its links should be displayed in the Status window.
- [The <snmp-device-properties> section \(Pg 61\)](#) - Specifies certain aspects of the SNMP queries sent to the device.
- [The <snmp-device-alarmpoints> Section \(Pg 72\)](#) - Allows you to define conditions under which the device changes a particular device state.

### ***Sections specific to SNMP Trap Probes***

SNMP Trap Probes do not probe devices - they simply wait for traps to arrive. They have some sections that are common to SNMP Probes, but work somewhat differently.

- [An `<snmp-device-variables>` section \(Pg 10\)](#) - Specifies which MIB variables to collect from the device. These are set automatically when a trap is received.
- [An `<snmp-device-thresholds>` section \(Pg 59\)](#) - Specifies how those variables are to be tested against thresholds to determine the device's status.

### ***Sections Specific to TCP Probes***

Each custom TCP probe can have:

- [A `<script>` section \(Pg 115\)](#) - This contains the probe's script. Scripts are written in InterMapper's [TCP Probe Scripting Language \(Pg 115\)](#), which uses a sequence of commands and program flow that is similar to Basic. A rich set of [TCP commands \(Pg 123\)](#) is available.
- [A `<script-output>` section \(Pg 122\)](#) - This contains the probe's output, which is displayed in the Status window. Format the Status window using IMML, [InterMapper's Markup language \(Pg 33\)](#).

### ***Sections Specific to Command-line Probes***

Each command-line probe also has:

- [The `<command-line>` section \(Pg 142\)](#) - builds the command-line, specifying the command path and any parameters to be sent with the command.
- [The `<command-exit>` section \(Pg 143\)](#) - allows you to control the state of the device, depending on what is returned from the script.
- [The `<tool>` section \(Pg 144\)](#) - contains the code for a companion script that is executed by the probe.
- [The `<command-display>` section \(Pg 143\)](#) - allows you to control what appears in the device's Status window.

### ***Other Information about Probes***

#### [Comments \(Pg 35\)](#)

All probes use the same format for comments. The comment format is similar to HTML comments.

#### [Probe File Locations \(Pg 16\)](#) and [Probe File Names \(Pg 16\)](#)

To use probe files, you must import them, and should follow recommended naming conventions.

#### [Installing and Reloading Probes \(Pg 160\)](#)

Before a modification to a probe becomes effective, you need to click the ***Reload probes...*** button in the Set Probe window (circular arrow icon below the left pane of the window).

## The <header> Section

The <header> section of a probe file contains a formal description of the probe. It is defined as follows, with each header property having a name and a corresponding value.

```
<header>
..[part name] = "[value]"
</header>
```

**Note:** Information by which InterMapper uniquely identifies the probe is contained in the header. While it is not required, Help/Systems strongly recommends that you follow [probe file naming conventions](#) that correspond to the unique identifier in the probe header.

### Header Parts

#### type

Describes the type of the probe file. InterMapper supports the following probe types:

- **builtin**
- **tcp-script**
- **custom-snmp**
- **custom-snmp-trap**
- **command-line**
- **cmd-line**

```
type = "cmd-line"
```

For custom SNMP probes, use the **custom-snmp** type.

For custom SNMP Trap probes, use the **custom-snmp-trap** type.

For custom TCP probes, use the **tcp-script** type.

For command-line probes, use the **command-line** or **cmd-line** type.

#### package

The first part of the probe's full identifier. Typically, the package is made up of the domain name of the organization that created the probe, with the labels reversed.

For example, all probes created by Help/Systems, LLC the package statement is as follows:

```
package = "com.dartware"
```

The package part guarantees that different organizations can create probes without concern that their probe identifiers will conflict.

**Note:** The combination of [package].[probe\_name] together form the probe's full identifier. (In the example below, the full identifier is "com.dartware.tcp.custom") By convention, the name of the file that holds the probe definition is the same as the probe's full identifier. This is not required, but it's a good idea. See [Probe File Locations \(Pg 16\)](#) and [Probe File Names \(Pg 16\)](#) below for more information.

<b>probe_name</b>	The second part of the probe's full identifier. The probe_name may be whatever string the creating organization chooses.
<b>human_name</b>	The string that appears in the left pane of the Set Probe window. This string helps guides the user to select the probe for a particular device.
<b>version</b>	Provides a means to determine which probe file is the current one. The format of the version is "#.#".
<b>address_type</b>	A comma-separated list of one or more address types. InterMapper implements "IP" and "AT".
<b>port_number</b>	The IP port used by this probe.
<b>display_name</b>	<p>Specify the display_name to use with this probe, using forward slashes to specify the heirarchy. To do this, add the following line to the &lt;header&gt; section of the probe:</p> <pre>display_name = "[top level]/[next level]/[next level]"</pre> <p>Example:</p> <pre>display_name = "Custom/Command-line"</pre>
<b>url_hint</b>	<p>Assign a double-click action within the probe (making it the pre-defined double-click action). To do this, add the following line to your &lt;header&gt; section of the probe:</p> <pre>url_hint = "url-to-invoke"</pre> <p>The following example would invoke the web browser to the device's IP address and port</p> <pre>url_hint = "http://\${address}:\${port}"</pre>

**poll\_interval**

Set the device's default poll interval to the indicated number of seconds. This overrides the map's default setting, and might be used to avoid too-frequent polling for (physical) devices that should not be polled too often.

Setting the poll interval *\*for the device\** will override this poll\_interval setting.

```
poll_interval = "300"
```

### Sample Header Section

This is a sample header from the Custom TCP script.

```
<header>
  "type"           = "tcp-script"
  "package"        = "com.dartware"
  "probe_name"     = "snmp.example"
  "human_name"     = "Example SNMP probe"
  "display name"   = "Miscellaneous/Example SNMP Probe"
  "version"        = "1.0"
  "address type"   = "IP,AT"
  "port number"    = "161"
  "flags" = ""
</header>
```

### Header Section of Custom SNMP Probes

The `<header>` section of the probe file is similar to the [standard `<header>` section](#), (Pg 12) with the following differences:

- The "type" for a Custom SNMP probe is "custom-snmp".
- There is a `FLAGS=xxx,xxx` command that takes the following optional items as parameters:
  - `NOLINKS` - InterMapper will not poll links (interfaces) with SNMP
  - `SNMPV2C` - InterMapper will use SNMPv2c to poll the device
  - `NOICMPFALLBACK` - InterMapper will not send an ICMP ping to a device if no SNMP responses return.
  - `MINIMAL` - the probe queries only its own (specified) variables.
  - `NTCREDENTIALS` - tells InterMapper to elevate its credentials using the username and password found in the NT Services server settings panel long enough to run the command line in the probe. (Windows only.)
  - `ALLOW-LOOPS` - In some network equipment, the indices for the ifTable and related tables do not proceed in the usual strictly increasing fashion, jumping around instead. Adding this flag to the header will instruct InterMapper to allow this situation. N.B. If the SNMP agent in your network device doesn't stop returning values when every item in the table has been read, set this flag to instruct InterMapper to loop over the table continuously until 5000 reads have occurred, at which point it will stop.
  - `IFINDEX-BUG` - Some network equipment will respond incorrectly to SNMP queries for the ifTable and related tables when InterMapper queries only certain entries in a sparse ifTable, rather than trying to query each possible index in turn. Add this flag to the header to instruct InterMapper to work around this situation rather than attempting to be efficient.
  - `LINKCRITICAL` - If a link of a device goes down and the flag is set, the device status changes to critical, and not to alarm, which is the default.
  - `NAGIOS3` - Use "flags" = "NAGIOS3" in the `<header>` of a command-line probe to indicate that the return value should be treated as a Nagios Plugin. See the [Nagios Plugins](#) section.

**Note:** The **old\_protocol** and **old\_script** parts, added for backward compatibility, are deprecated, and are ignored in any older probes that use them.

### Probe File Locations

Probes files are saved in the **Probes** folder of the **InterMapper Settings** folder.

### Probe File Names

The probe files are named with two parts separated by a period ("."). The parts are:

- **package name** - must be unique for each organization creating probe files.

By convention, the package is composed of the organization's DNS domain name, with the segments reversed. Thus, the built-in probes for InterMapper all have a package of "com.dartware." Other organizations may create and share their own probes, since the file names will not collide.

- **probe name** - identifies the probe.

For example, the built-in Custom TCP probe is defined in the file named:

```
com.dartware.tcp.custom
```

The probe's package name and probe name are defined in the probe definition's header section. Help/Systems recommends that you name the file with the combination of the package name and probe name, as shown above.

The header section of the probe definition in the example above contains these two lines:

```
package = "com.dartware"  
probe name = "tcp.custom"
```

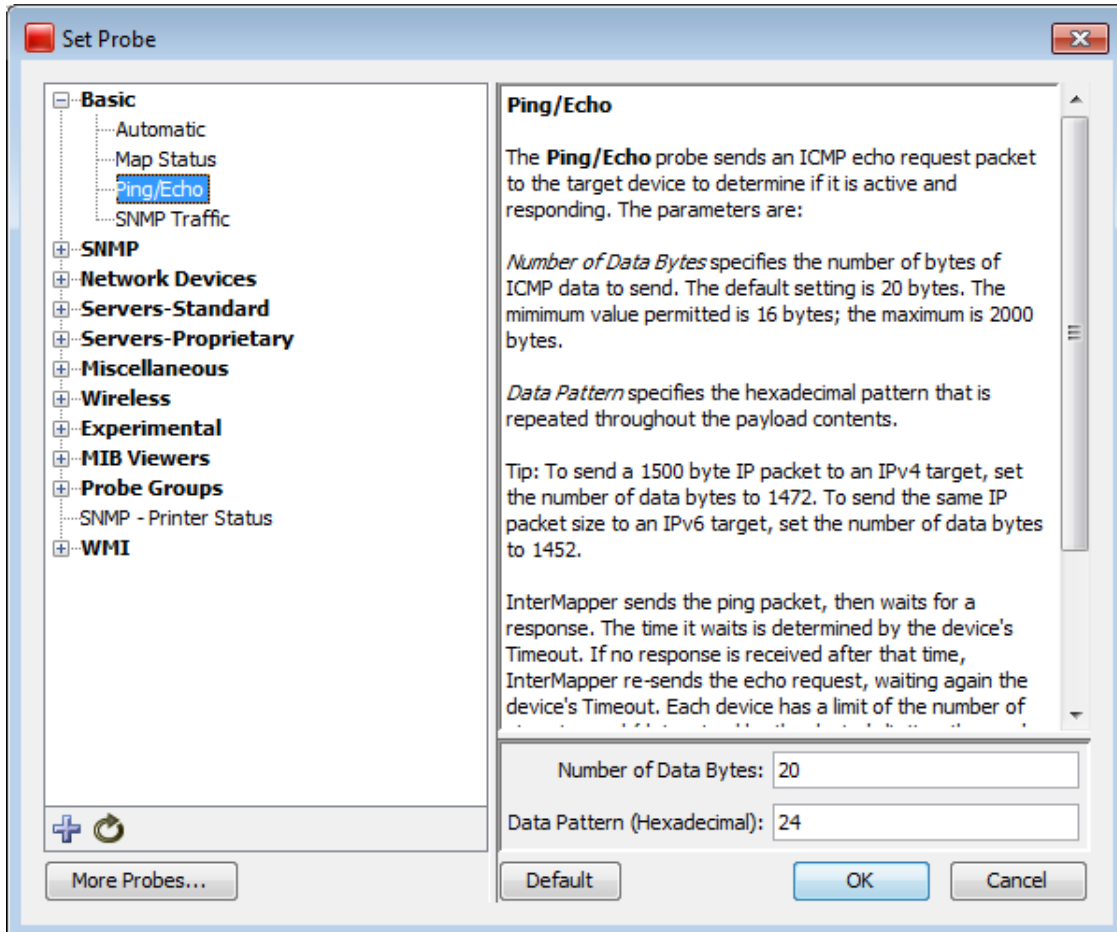


### The <description> Section

The Description section of a probe file contains text that will be displayed as a description of the probe in the Set Probe window. All probe types can have a description section. It is defined using the following tags:

```
<description> ... </description>
```

The description can be formatted using IMML, [InterMapper's Markup Language](#). The [Example Probe File \(Pg 137\)](#) shows a sample description section.



The Set Probe window, showing the description field. Note that the blue underlined links are actually links to the relevant RFC specifications.

## The <parameters> Section

A probe can have one or more parameters. These parameters are set by the user in the Set Probe window (shown below). They are used for specifying numeric thresholds or strings to be sent to or received from the device.

The *parameter* section of the defines a set of name/value pairs with the format:

```
<parameters>
  [parameter name]= "[parameter value]"
</parameters>
```

Each parameter name/value appears in its own entry field in the Set Probe window.

Probe parameters are accessed and used just like variables. They can be used in calculations, alarm/warning thresholds, and displayed in the status window. To refer to a parameter whose name contains one or more spaces, the name will need to be enclosed in curly braces. (Example: "\${Seconds to wait}").

### Input Field Types

Four types of input fields are available:

- **Text** - Input a text string
- **Password** - Input a text string, obscuring the characters
- **Dropdown** - Choose from a dropdown menu.
- **Checkbox** - Set a variable to true or false by selecting or clearing a check box.

#### Text Fields

This field type presents a simple text box for entering a string.

```
"Text" = "Text Value"
```

The line above sets the variable \${Text}

#### Password Fields

You can create input parameters that conceal the string from casual view (so-called *password parameters*.) The data is displayed as a line of asterisks ("\*\*\*\*\*") when a user types the password. To specify a password parameter, place a single asterisk ("\*") after the name of the field, like this:

```
"Password*" = ""
```

Note that the variable name remains \${Password\*} and you have to refer to it as such in your script. The "\*" is removed before displaying the name, so the above password parameter would appear as "Password" in the Set Probe window.

### **Dropdown Fields**

You can create input parameter fields that present a dropdown menu from which the user can choose from a number of choices.

To create a dropdown field, use this syntax:

```
"Test[Equal,NotEqual]" = "NotEqual" //Default value is NotEqual
```

The values between brackets define the choices available to the user. The value on right of the statement is the initial value of the dropdown field.

You can use this parameter in expressions. The full variable is `${Test[Equal,NotEqual]}`, and it returns the current value of the dropdown as selected by the user. To display the value of a dropdown in the Status window, you must use the full variable definition.

```
\4\Dropdown:\0\ ${Test[Equal,NotEqual]}\0\
```

```
<snmp-device-variables>  
  alarm: (${Dropdown[Choice1,Choice2,Choice3]} !=  
    "Choice2") "It's not Choice2!"  
</snmp-device-variables>
```

### **Check Box Fields**

To create a check box, use this syntax:

```
"Checkbox[true,false]" = "true" //Default value is "true"
```

You can use this parameter in expressions. The full variable is `${Checkbox[Equal,NotEqual]}`, and it returns the current value of the check box as selected by the user

### Parameter Section Example

This is an example parameter section that demonstrates the use of the four types of input fields. The screenshot below shows how each input field type appears.

```
<parameters>
  "Text"                                = "Text Value"
  "Password*"                           = ""
  "Dropdown[Choice1,Choice2,Choice3]"  = "Choice2"
  "Checkbox[true,false]"               = "true"
</parameters>
```

The screenshot shows a window titled "Parameter Test Probe". Inside, there is a text area with the description: "This probe shows the various data types that can be used as parameters to a custom probe." Below the text area, there are four input fields: "Text:" with the value "Text Value", "Password:" with masked characters "\*\*\*\*\*", "Dropdown:" with "Choice2" selected, and "Checkbox:" which is checked. Below these, there are two more fields: "SNMP Version:" with a dropdown menu showing "SNMPv1" and "Port:" with the value "161". At the bottom, there is a "Community:" field with masked characters "\*\*\*\*\*".

*Probe Parameters*

### The <datasets> section

Use the <datasets> section to define the datasets available for a probe. You can also specify which datasets are recorded automatically by default.

**Note:** The <datasets> section replaces the deprecated <autorecord> section. Documentation for the <autorecord> section is below.

The syntax for a <datasets> section is as follows. All columns except Column 1 should be in quotes.

```
<datasets>
  $variablename, "tag", "unitsOfMeasure", "autorecordFlag", "legend"
  ...
</datasets>
```

where:

- **\$variablename** - a variable defined by the probe
- **tag** - a short tag that identifies a particular class of dataset. Use these tags to create a report of like variables, such as CPU%, temperature, etc. See the [Automatically-Recorded Data Values \(Pg 24\)](#) page to view pre-defined tags. Probe writers are free to create their own short tags as long as they don't start with "\_".
- **unitsOfMeasure** - the unit of measure used with the dataset. Choose from the list of Units of Measures below.
- **autorecordFlag** - a boolean flag that specifies whether the dataset should be recorded or not.
- **Legend** - a human-readable text string that appears as the legend label for the dataset. This legend overrides a legend placed in a <snmp-device-variable> section.

### Example

```
<datasets>
  $temp, "temp-tag", "degrees C", "false", "The Temperature"
  $atemp, "atemp-tag", "degrees C", "true", "Autorecord Temperature"
</datasets>
```

### Auto-recording values

Certain data values collected from a device are recorded to the InterMapper Database automatically. You can specify other variables you want to record by default when data for a device is stored.

For all probes, the following data is recorded:

- response time (in msec) - tag: **BiRt**
- short-term packet loss (%) - tag: **RPkL**
- input byte rates for all visible interfaces - tag: **BytR**
- output byte rates for all visible interfaces - tag: **BytT**

In addition to the values listed above, built-in probes automatically record other values. The [Automatically-Recorded Data Values \(Pg 24\)](#) page lists those values for each built-in probe.

For your own probes, you can specify that a dataset should be recorded by setting its `autorecordFlag` value to **true**.

### Units of Measure

Use the following units in the `unitsOfMeasure` column of the <datasets> section.

Symbol	Description
percent	percent
min	minutes
sec	seconds
msec	milliseconds
bytes	bytes
kbytes	kilobytes
packets	packets
errors	errors
discards	discards
frames/sec	frames per second
bytes/sec	bytes per second
bits/sec	bits per second
mbits/sec	megabits per second
discards/min	discards per minute
errors/min	errors per minute
errors/sec	errors per second
failures/sec	failures per second
retries/sec	retries per second
packets/sec	packets per second
requests/sec	requests per second
degrees C	degrees celsius
degrees F	degrees fahrenheit
dBm	the power ratio in decibels of the measured power referenced to one milliwatt
miles	a measure of wireless transmission range, (for how many miles it is useful)
volts	volts

### The <autorecord> section (deprecated)

The <autorecord> section has been replaced by the <datasets> section, which provides a control for auto-recording any dataset. The autorecord section is available for backward compatibility; syntax is provided here for reference.

```
<autorecord>
  $var1, 'tag1', "Legend 1 :units(xxx)"
  $var2, 'tag2', "Legend 2"
  $var3, 'tag3', "Legend 3"
</autorecord>
```

where:

- **\$varX** is a variable defined by the probe
- **tagX** is a short tag that identifies a particular class of dataset. Use these tags to create a report of like variables, such as CPU%, temperature, etc. See the [Automatically-Recorded Data Values \(Pg 24\)](#) page to view pre-defined tags. Probe writers are free to create their own short tags as long as they don't start with "\_".
- **Legend X :units(xxx)** is a human-readable text string that describes the dataset, and shows the customer the kinds of data being collected for a particular device. Specify the units for the dataset using the optional ":units" attribute. This legend overrides a legend placed in a <snmp-device-variable> section. In the <datasets> section, :units(xxx) has been replaced with unitsOfMeasure.

### Example

```
<autorecord>
  $lcpu.busyPer, 'cpupercent', "CPU Percent :units(%)"
  $lcpu.avgBusyl, 'cpupercentavg', "Average CPU Percent :units(%)"
  $lmem.freeMem, 'freemem', "Available memory :units(bytes)"
</autorecord>
```

## Automatically-Recorded Data Values

When recording data from built-in probes, Help/Systems has selected values for each probe which seem sensible to record.

Probe Name/ File Name	Variable Name	Tag(30)	Units	Legend (255)
<b>Miscellaneous/Legacy/Cisco (v2c)</b>				
com.dartware.snmpv2c.cisco	\$lcpu.busyPer	cpupercent	percent	CPU Percent Busy
	\$lcpu.avgBusy1	cpupercent- avg	percent	Average CPU Percent over 1 min
	\$lcpu.avgBusy5	cpupercent- avg	percent	Average CPU Percent over 5 min
	\$lmem.freeMem	freemem	bytes	Available Memory
<b>Miscellaneous/TCP Check</b>				
com.dartware.snmp.tcpcheck	\$tcpCurrEstab	numconns		Number of TCP Connections
<b>Network Devices/Cisco/Cisco - IP SLA Jitter</b>				
com.dartware.snmp.cisco- ip-sla.txt	\$cpmCPUTotal1min	cpupercent- avg	percent	Average CPU Percent
	\$AvgJitter	jitteravg	msec	Average Jitter Value
	\$AvgLatency	latencymsec	msec	Average Latency
	\$PercentPacketLoss	pktloss	percent	Jitter Test Packet Loss
<b>Network Devices/Cisco/Cisco - Old CPU MIB</b>				
com.dartware.snmp.cisco	\$lcpu.busyPer	cpupercent	percent	CPU Percent Busy
	\$lcpu.avgBusy1	cpupercent-	percent	Avg. CPU



		avg		Percent over 1 min
	\$lcpu.avgBusy5	cpupercent-avg	percent	Avg. CPU Percent over 5 min
	\$lmem.freeMem	freemem	bytes	Available Memory
<b>Network Devices/Cisco/Cisco - Process and Memory Pool</b> com.dartware.snmp.ciscone-wmib	\$lcpu.busyPer	cpupercent	percent	CPU Percent Busy
	\$lcpu.avgBusy1	cpupercent-avg	percent	Avg. CPU Percent over 1 min
	\$lcpu.avgBusy5	cpupercent-avg	percent	Avg. CPU Percent over 5 min
	\$ciscoMemoryPoolFree1	freemem	bytes	Available Memory #1
	\$ciscoMemoryPoolFree2	freemem	bytes	Available Memory #2
<b>Network Devices/UPS/APC UPS - AP961x</b> com.dartware.ups.apc-ap961x.txt	\$leftCharge	pctcharge	percent	Percent Charge
	\$batMin	batttimeleft	min	Time left on battery
	\$inVolt	involts	volts	Input Voltage
	\$batTempC	temperature	degrees C	Battery Temperature (°C)
<b>Network Devices/UPS/APC UPS</b> com.dartware.ups.apc.txt	\$leftCharge	pctcharge	percent	Percent Charge
	\$batMin	batttimeleft	min	Time left

				on battery
	\$inVolt	involts	volts	Input Voltage
	\$batTempC	temperature	degrees C	Battery Temperature (°C)
<b>Network Devices/UPS/BestPower UPS</b> com.dartware.ups.bestpower.txt	\$cTimeOnBattery	batttimeleft	min	Time Left on Battery (min)
	\$cInputVoltage	involts	volts	Input Voltage
	\$cIntTempC	temperature	degrees C	Internal Temperature (C)
<b>Network Devices/UPS/Exide UPS</b> shef.ac.uk.ups.exide.txt	\$LeftCharge	pctcharge	percent	Battery Charge Left
	\$LeftMin	batttimeleft	min	Time Left on Battery
	\$in1Volt	involts	volts	Input 1 Voltage
<b>Network Devices/UPS/Liebert UPS - OpenComms</b> com.dartware.ups.liebert-opencomms.txt	\$LeftCharge	pctcharge	percent	Percent Charge
	\$LeftMin	batttimeleft	min	Time Left on Battery
	\$in1Volt	involts	volts	Input 1 Voltage
	\$batteryTempC	temperature	degrees C	Battery Temperature (°C)
<b>Network Devices/UPS/Standard UPS (RFC1628)</b> com.dartware.ups.standard.txt	\$LeftCharge	pctcharge	percent	Percent Charge
	\$LeftMin	batttimeleft	min	Time Left on

	\$in1Volt	involts	volts	Battery Input 1 Voltage
	\$batTempC	temperature	degrees C	Battery Tempera- ture
<b>Network Devices/UPS/TrippLite UPS</b> com.dartware.ups.tripplite.txt	\$LeftCharge	pctcharge	percent	Percent Charge
	\$LeftMin	batttimeleft	min	Time Left on Battery
	\$in1Volt	involts	volts	Input 1 Voltage
	\$envTempC	temperature	degrees C	Ambient Tempera- ture (°C)
	\$envHumid	humidity	percent	Ambient Humidity
<b>Network Devices/UPS/Victron UPS</b> de.medianet.freinet.ups.victron.txt	\$batt.rem	batttimeleft	min	Battery Time Remainin- g
	\$input.volt1	involts	volts	Input Voltage Phase 1
<b>Servers- Proprietary/Apple/OS X Server/AFP</b> com.dartware.tcp.osxserver.- afp.txt	\$currentConnections	connections		Connecti- ons
	\$currentThroughput	throughput	bytes/se- c	Throughp- ut
<b>Servers- Proprietary/Apple/OS X Server/FTP</b> com.dartware.tcp.osxserver.- ftp.txt	\$realConnectionCou- nt	authconns		Authentic- ated Connecti- ons
	\$anonymousConnec- tionCount	anonconns		Anonymo- us Connecti- ons
<b>Servers-</b>	\$cpu	cpupercent	percent	CPU

**Proprietary/Apple/OS X****Server/Info**com.dartware.tcp.osxserver.-  
info.txt

Usage

**Servers-****Proprietary/Apple/OS X****Server/NAT**com.dartware.tcp.osxserver.-  
nat.txt

\$activeTCP

tcpconns

TCP Links

\$activeUDP

udpconns

UDP  
Links

\$activeICMP

icmpconns

ICMP  
Links**Servers-****Proprietary/Apple/OS X****Server/Print**com.dartware.tcp.osxserver.-  
print.txt

\$currentQueues

queues

Current  
Queues

\$currentJobs

numjobs

Spooled  
Jobs**Servers-****Proprietary/Apple/OS X****Server/QTSS**com.dartware.tcp.osxserver.-  
qtss.txt

\$currentConnections

connections

Connecti-  
ons

\$currentThroughput

throughput

bytes/se-Throughp-  
c ut**Servers-****Proprietary/Apple/OS X****Server/Web**com.dartware.tcp.osxserver.-  
web.txt\$currentRequestsBy-  
10

requestrate

requests-Request  
/sec Rate\$cacheCurrentRequ-  
estsBy10requestrate-  
cacherequests-  
/sec  
Cache  
Request  
Rate

\$currentThroughput

throughput

bytes/se-Throughp-  
c ut\$cacheCurrentThrou-  
ghputthroughputc-  
achebytes/se-  
c  
Cache  
Throughp-  
ut**Servers-****Proprietary/Barracuda/B-  
arracuda HTTP**com.dartware.tcp.barracuda-  
.http.txt

\$in\_queue\_size

inqueue

Input  
Queue

\$out\_queue\_size

outqueue

Output

	\$avg_latency	latencysec	sec	Queue Average Message Latency
<b>Servers- Proprietary/Barracuda/B- arracuda HTTPS</b>	\$in_queue_size	inqueue		Input Queue
com.dartware.tcp.barracuda- .https.txt				
	\$out_queue_size	outqueue		Output Queue
	\$avg_latency	latencysec	sec	Average Message Latency
<b>Servers- Proprietary/Microsoft/D- HCP Lease Check</b>	\$noAddFree	dhcpcfree		Number of DHCP Leases Free
com.dartware.snmp.dhcpche- ck.txt				
	\$noAddInUse	dhcpcinuse		Number of DHCP Leases In Use
	\$noPending	dhcpcpendin- g		Number of Pending Offers
<b>Servers- Standard/Custom TCP</b>	\$_connect	conntime	msec	Time to establish connectio- n
com.dartware.tcp.custom				
	\$_active	connactive	msec	Time spent connecte- d to host
<b>Servers-Standard/Host Resources</b>	\$_CPUUtilization	cpupercent- avg	percent	Average CPU Percent
com.dartware.snmp.hrmib				
<b>Servers-Standard/HTTP &amp; HTTPS/HTTP (Follow Redirects)</b>	\$_connect	conntime	msec	Time to establish connectio- n
com.dartware.tcp.http.follow				
	\$_active	connactive	msec	Time spent connecte- d to host

<b>Servers-Standard/HTTP &amp; HTTPS/HTTP (Post)</b> com.dartware.tcp.http.cgi.post	\$_connect	conntime	msec	Time to establish connection
	\$_active	connactive	msec	Time spent connected to host
<b>Servers-Standard/HTTP &amp; HTTPS/HTTP (Proxy)</b> com.dartware.tcp.http.proxy	\$_connect	conntime	msec	Time to establish connection
	\$_active	connactive	msec	Time spent connected to host
<b>Servers-Standard/HTTP &amp; HTTPS/HTTP (Redirect)</b> com.dartware.tcp.http.redirect	\$_connect	conntime	msec	Time to establish connection
	\$_active	connactive	msec	Time spent connected to host
<b>Servers-Standard/HTTP &amp; HTTPS/HTTP</b> com.dartware.tcp.http	\$_connect	conntime	msec	Time to establish connection
	\$_active	connactive	msec	Time spent connected to host
<b>Servers-Standard/HTTP &amp; HTTPS/HTTPS (Follow Redirects)</b> com.dartware.tcp.https.follow	\$_connect	conntime	msec	Time to establish connection
	\$_active	connactive	msec	Time spent connected to host
<b>Servers-Standard/HTTP &amp; HTTPS/HTTPS (Post)</b> com.dartware.tcp.https.cgi.post	\$_connect	conntime	msec	Time to establish connection
	\$_active	connactive	msec	Time

<b>Servers-Standard/HTTP &amp; HTTPS/HTTPS (SSLv3)</b> com.dartware.tcp.https.notls- .txt	\$_connect	conntime	msec	spent connecte- d to host Time to establish connectio- n
	\$_active	connactive	msec	Time spent connecte- d to host
<b>Servers-Standard/HTTP &amp; HTTPS/HTTPS</b> com.dartware.tcp.https	\$_connect	conntime	msec	Time to establish connectio- n
	\$_active	connactive	msec	Time spent connecte- d to host
<b>SNMP/Comparison</b> com.dartware.snmp.oidcom- parison.txt	\$theOID	\$Tag	\$Units	\$Legend
<b>SNMP/High Threshold</b> com.dartware.snmp.oidhigh.- txt	\$theOID	\$Tag	\$Units	\$Legend
<b>SNMP/Low Threshold</b> com.dartware.snmp.oidlow.t- xt	\$theOID	\$Tag	\$Units	\$Legend
<b>SNMP/Range Threshold</b> com.dartware.snmp.oidrang- e.txt	\$theOID	\$Tag	\$Units	\$Legend
<b>SNMP/Single OID Viewer</b> com.dartware.snmp.oidsingl- e.txt	\$theOID	\$Tag	\$Units	\$Legend
<b>SNMP/String Comparison</b> com.dartware.snmp.oidstrco- mparison.txt	\$theOID	\$Tag	\$Units	\$Legend

## Probe Status Windows

When you create a custom probe, you can override the default contents of Status windows. How you do this depends on the type of probe, as follows:

- The [<snmp-device-display>](#) (Pg 69) **section** - for SNMP probes
- The [<snmp-device-display>](#) (Pg 103) **section** - for SNMP trap probes
- The [<script-output>](#) (Pg 122) **section** - for TCP probes
- The [<command-display>](#) (Pg 143) **section** - for Command-line probes

All of these sections can be formatted using IMML, [InterMapper's Markup Language](#). See the `<snmp-device-display>` example below.

### Controlling the Status window in SNMP Probes with `<snmp-device-display>`

Use the optional `<snmp-device-display>` section to describe the text that appears in a custom SNMP probe's Status window. Probe variables are replaced with their values in the Status window's text.

The default font for the Status window's text is a mono-spaced font, so alignment of text is straightforward. You can change the appearance of the text in the Status window using IMML, [InterMapper's Markup Language](#).

Here is a sample `<snmp-device-display>` section. Note that the variables are replaced with the values retrieved from the device, and that formatting is controlled by IMML.

```
<snmp-device-display>
  \B5\Custom SNMP Probe\OP\
  \4\ipForwDatagrams:\0\ ${ipForwDatagrams} datagrams/sec
  \4\ipInHdrErrors:\0\   ${ipInHdrErrors} errors/minute
  \4\tcpCurrEstab:\0\    ${tcpCurrEstab} connections
</snmp-device-display>
```

### Controlling the Status window in TCP Probes with `<script-output>`

Use the optional `<script-output>` section to describe the text that appears in a TCP-based custom probe's Status window. The data in this section appears in the Status window when you click and hold the device on the map.

### Controlling the Status window in Command-Line Probes with `<command-display>`

Use the optional `<command-display>` section to describe the text that appears in a command-line-based custom probe's Status window. The data in this section appears in the Status window when you click and hold the device on the map.

The format of this section is the same as the `<snmp-device-display>` section described above.



### IMML - InterMapper Markup Language

You can apply text styles to a probe's description text or to the content in a Status window using IMML, InterMapper's markup language. IMML consists of formatting commands bracketed by backslash ("\") characters. There may be many markup commands between a pair of \...\ characters. The [Example Probe File \(Pg 137\)](#) shows a sample description section.

*Historical note:* Prior to InterMapper 4.0, the markup characters were « and » (&le; and &ge;). InterMapper still accepts these characters, although we encourage everyone to use the \...\ in new probe files as they're easier to type and will pass unchanged through all mail systems.

#### **How Markup Tags Are Applied**

- A markup commands applies to all text that follows it.
- Subsequent markup tags may add to or counteract a previous set of markup tags.

#### **Markup Tag Summary**

##### **Tag Action**

- M** Set the font to a mono-spaced font.
- G** Set the font to Geneva or other proportional-spaced font).
- +** Increase the font size by one. Multiples ("++") increase the font size by the corresponding amount.
- Decrease the font size by one. Multiples are allowed.
- B** Set following text in bold.
- I** Set following text in italic.
- P** Set following text to plain. This undoes all other stylings
- U** Set following text to underlined. See **Creating a link** below for making hyperlinks.
- !** Turn off a format that is on.

**digit** Set text color to one of the following:

- |          |               |
|----------|---------------|
| 0: Black | 4: Light blue |
| 1: Red   | 5: Green      |
| 2: Blue  | 6: Orange     |
| 3: Gray  | 7: Yellow     |

### Examples

The following description text is rendered as shown:

<code>\b\Bold \i\Bold Italic \!b\Italic \p\Plain</code>	<b>Bold <i>Bold Italic</i> Plain</b>
<code>\M1++\Big red monospace\p\</code>	Big red monospace
<code>\2U\http://www.example.com\p0\</code>	<a href="http://www.example.com">http://www.example.com</a>
<code>\2U=http://www.example.com\Text Link\p0\</code>	<a href="http://www.example.com">Text Link</a>

### Creating a link

The last two examples above shows the script code required to create a link. In both example, "\2U\" means "set the color to blue, underline the text."

### Special Cases:

- If, as in the first of the two link examples above, the only text between the opening and closing tags is a URL (e.g., `http://www.example.com`), InterMapper treats it as a link to that page.
- If, as in the last link example above, the underline tag contains "`= [URL]`", the text following the backslash ("`Text Link`" in the example) appears as blue and underlined.
- In both cases, clicking the text opens that page in a browser.

### Probe Comments

Comments in InterMapper probe files are quite similar to those in HTML. The comments may be interspersed anywhere in a probe file.

Note that HTML comments have a complicated syntax that can be simplified by following this rule:

Begin a comment with "`<!--`", end it with "`-->`", and do not use "`--`" within the comment.

Use this rule with InterMapper as well.

Example:

```
<!--  
  This is a probe comment.  
  It spans several lines.  
  It contains no double-hyphens.  
-->
```

### One-line Comments

You can also use the comment indicator "`--`" at the beginning of a line. The remainder of the line is ignored.

Example:

```
-- This line is a comment
```

## Built-in Probe Variables and Macros

Here is a list of built-in variables available in custom probes and notifiers. Note that certain variables are available only in certain contexts. The variables are listed by context.

- [Command-line Probe Variables](#) (Pg 36)
- [SNMP Probe Variables](#) (Pg 37)
- [TCP Probe Variables](#) (Pg 39)
- [Command Line Notifier Variables](#) (Pg 40)
- [The Chartable macro](#) (Pg 41)
- [The Eval Macro](#) (Pg 42)
- [The Scalable10 and Scalable2 Macros](#) (Pg 43)

### Command Line Probe Variables

The following variables are available in the specified sections of Command-line probes. (probe-type=cmd-line)

#### *The <command-line> and <command-exit> sections*

The following variables are available in <command-line> and <command-exit> sections of command line probes

Variable Name	Variable Description
<b>\${address}</b>	The network address of the device.
<b>\${devicename}</b>	The device name of the device. <b>Note:</b> In some cases, the device name may resolve to the device's IP address.
<b>\${port}</b>	The network port number that is being monitored.
<b>\${exit_code}</b>	The exit code of the command-line probe.  <b>Note:</b> The \${exit_code} variable is used in <command-exit> only.
<b>\${cscript}</b>	Evaluates to the full path to the Windows cscript.exe utility; it also automatically adds /nologo as a command-line option.
<b>\${python}</b>	<b>Note:</b> This variable is only available in Windows. Evaluates to the full path to the python interpreter installed as part of InterMapper DataCenter; it also automatically adds any necessary command-line options for normal operation.

### *The <command-display> section*

The following variables are available in the <command-display> section of command line probes. (probe-type=cmd-line)

Variable Name	Variable Description
<code>\${devicename}</code>	The device's name taken from first line of the label.
<code>\${deviceaddress}</code>	The network address of the device.
<a href="#">\${eval:} (Pg 42)</a>	The eval macro.
<a href="#">\${chartable[:fmt]:expr} (Pg 41)</a>	Evaluate <code>expr</code> and format the result as a chartable value
<a href="#">\${scalable2:fmt:expr} (Pg 43)</a>	Scales large numbers into smaller units for better readability. The values are chartable.
<a href="#">\${scalable10:fmt:expr} (Pg 43)</a>	
<a href="#">\${^stdout} (Pg 44)</a>	Any output written to the standard output of a command-line script. See below for additional information about the effect of <code>\${^stdout}</code> on the <code>reason</code> string.
<code>\${nagios_output}</code>	Parses a Nagios plugin's output for display.

### **SNMP Probe variables**

A variable name consists of letters, digits and an underscore, and must begin with a letter. Variable names are not case-sensitive. A variable name can be referred to in the probe as `$VariableName` or `${VariableName}`. Use the bracketed form for variables and parameters that have one or more spaces in the name.

The variables listed below are available in SNMP Probes. (probe-type = customsnmp)

In the <snmp-device-display> section of a probe file, an occurrence of a variable name is replaced with its value, rounded to the nearest integer.

For example, if a calculation variable has the value of 3.14159265, using it in the <display-output> section results in the value of "3"; if the variable had the value 4.75 it is displayed as "5".

This value is chartable; clicking it makes a new chart, and dragging it adds it to an existing chart. If you need to display a non-integer value for the variable, use [the `\${chartable}` macro](#) described below.

*The <snmp-device-display> section*

Variable Name	Variable Description
<b><code>\${devicename}</code></b>	The device's name taken from first line of the label.
<b><code>\${deviceaddress}</code></b>	The network address of the device.
<b><code>\${imserveraddress}</code></b>	The network address of the InterMapper Server.
<b><code>\${alarmpointlist}</code></b>	The list of alarm points.
<b><code><a href="#">\${eval:expr} (Pg 42)</a></code></b>	The eval macro.
<b><code><a href="#">\${chartable[:fmt]:expr} (Pg 41)</a></code></b>	The chartable macro.
<b><code><a href="#">\${scalable2:fmt:expr}</a></code></b> <b><code><a href="#">\${scalable10:fmt:expr} (Pg 43)</a></code></b>	Scales large numbers into smaller units for better readability. The values are chartable.
<b><code>\${[variablename]:legend}</code></b>	The variable's legend as specified in the <snmp-device-variables> section For more information, see <a href="#">SNMP Probe Variables (Pg 52)</a> .

*The <snmp-device-properties> section*

Variable Name	Variable Description
<b><code>\${ifIndex}</code></b>	The interface index.
<b><code>\${ifType}</code></b>	The interface type.
<b><code>\${ifDescr}</code></b>	The interface description.
<b><code>\${ifAlias}</code></b>	The interface's alias

*The OID column of the <snmp-device-variables> section*

Variable Name	Variable Description
<b><code>\${SpecificTrap}</code></b>	Trap Field: specific-trap (SNMP v1; generic-trap is enterpriseSpecific)
<b><code>\${GenericTrap}</code></b>	Trap Field: generic-trap (SNMP v1)
<b><code>\${TimeStamp}</code></b>	Trap Field: trap timestamp (SNMP v1, v2c)
<b><code>\${Enterprise}</code></b>	Trap Field: enterprise (SNMP v1)
<b><code>\${CommunityString}</code></b>	Trap Field: community (SNMP v1, v2c)
<b><code>\${TrapOID}</code></b>	Trap Field: trap OID (SNMPv2c, v3)
<b><code>\${SnmVersion}</code></b>	Trap Field: trap version
<b><code>\${SenderAddress}</code></b>	Trap Field: trap sender's address
<b><code>\${AgentAddress}</code></b>	Trap Field: trap agent's address (if different from sender)
<b><code>\${VarbindCount}</code></b>	Trap Field: count of varbind variables

**Note:** the next three macros do not use a colon  
`${VarbindValue8}` returns the value of the eighth  
Varbind item.

**`${VarbindOID[NNN]}`** Trap Field: ***NNNth*** varbind OID  
**`${VarbindValue[NNN]}`** Trap Field: ***NNNth*** varbind Value  
**`${VarbindType[NNN]}`** Trap Field: ***NNNth*** varbind Type

### TCP Probe Variables

These variables are available in TCP probes. (probe-type = tcp-script)

#### *The <script> section*

Variable Name	Variable Description
<b><code>\${_remoteaddress}</code></b>	The network address of the remote end of the connection.
<b><code>\${_remoteport}</code></b>	The network port number of the remote end of the connection.
<b><code>\${_localaddress}</code></b>	The network address of the local end of the connection.
<b><code>\${_localport}</code></b>	The network port number of the local end of the connection.
<b><code>\${_gmttime}</code></b>	The current time in RFC 822 format.
<b><code>\${_version}</code></b>	The version number of the InterMapper program.
<b><code>\${_line:len}</code></b>	The text of the last line received, truncated to the given length.
<b><code>\${_idletimeout}</code></b>	The idle timeout for the probe in seconds.
<b><code>\${_stringtomatch}</code></b>	The string we attempted to match in the last EXPT or MTCH command.
<b><code>\${_base64:str}</code></b>	Encode the given argument into base64.
<b><code>\${_cvspassword:str}</code></b>	Encode the given argument using the cvs password algorithm.
<b><code>\${_md5:str}</code></b>	The MD5 hash of the given argument, in hexadecimal.
<b><code>\${_idleline}</code></b>	The line number of the script where we were before the idle handler was invoked.
<b><code>\${_secsconnected}</code></b>	The number of seconds the probe spent connected to the other end. May be 0 if we were disconnected immediately or connection failed.
<b><code>\${_length:str}</code></b>	The length of the given argument in bytes.
<b><code>\${_float:num}</code></b>	The argument "pretty-printed" as a floating point number via printf %g.
<b><code>\${_hmac:key:msg}</code></b>	The HMAC-MD5 of the message, using the given key.
<b><code>\${_urlencode:str}</code></b>	Encodes the specified string for use in URLs.

*The <script-output> section*

Variable Name	Variable Description
<b><code>\${devicename}</code></b>	The device's name taken from first line of the label.
<b><code>\${deviceaddress}</code></b>	The network address of the device.
<b><code><a href="#">\${eval:} (Pg 42)</a></code></b>	The eval macro.
<b><code><a href="#">\${scalable2:fmt:expr}</a></code></b>	Scales large numbers into smaller units for better readability. The values are chartable.
<b><code><a href="#">\${scalable10:fmt:expr}</a></code></b> <b>(Pg 43)</b>	

**Variables passed to Command-line Notifiers**

The following variables are available for passing to a command line notifier. These values allow you to pass messages or URLs as command-line arguments in formats that are platform-friendly.

Variable Name	Variable Description
<b><code>\${message}</code></b>	The notifier's message text. (On Windows, each double-quote " is escaped by \".)
<b><code>\${stripped_message}</code></b>	The notifier's message text with quotes ( ' and ") removed and newlines (\r and \n) replaced by space.
<b><code>\${escaped_message}</code></b>	The notifier's message text escaped for url syntax (e.g. %20 for space, etc.)
<b><code>\${urlescape:str}</code></b>	Escapes a string specified in <b>str</b> for use in a URL. Any macros included in <b>str</b> are expanded prior to escaping.



### Macros

InterMapper supports several macros that can control and manipulate the way variables are displayed, as well as their use in charts.

#### *The `${chartable}` macro*

Use the `${chartable}` macro to evaluate **expr** and to format the result as a chartable value.

#### Usage

```
${chartable[:fmt]:expr}
```

In the output section of a probe file, the `${chartable: ...}` macro creates an underlined value that can be clicked to add it to a chart. The macro also controls the field width and number of decimal places. There are two parameters:

- **fmt** - A formatting string that indicates the number and placement of the digits near the decimal point, and the variable to be formatted. The formatting string can be either a mask composed with the '#' symbol or a quoted printf specifier like those accepted by the [sprintf \(Pg 84\)](#) function.
- **expr** - A variable or an expression (but not a macro). InterMapper evaluates the expression and displays the result according to the formatting string.

#### Examples

If the variable `$pi` is set to 3.14159265,

```
${chartable: #.## : $pi }:          --> 3.14
${chartable: #.##### : $pi }:      --> 3.1415927
${chartable: "%3d" : $pi }:          --> 3 (with 2
leading spaces)
${chartable: "%9.7f" : $pi}:          --> 3.1415927
${chartable: "%11.7f" : $pi}:         --> 3.1415927 (also
with 2 leading spaces)
${chartable: #.##### : $pi*100}:     --> 314.1592650
${chartable: "%9.7f" : $pi*1000}:     --> 3141.5926500
${chartable: "%11.7f" : $pi*10000}:   --> 31415.9265000
(no leading spaces)
```

**The `${eval}` macro**

Use the `${eval}` macro to compute a value in the output of a script. It is available in the following contexts:

- The `<command-display>` section of command-line probes
- The `<snmp-device-display>` section of SNMP probes
- The `<script-output>` section of TCP probes

**Usage**

The syntax for the `${eval}` macro is as follows:

```
${eval:[expr]}
```

The expression can use any operators or functions defined in [Probe Calculations \(Pg 81\)](#), allowing you to perform variable assignments, arithmetic calculations, relational and logical comparisons, as well as use built-in functions to perform bitwise, rounding and mathematical operations. You can also perform operations on strings using `sprintf` formatting and regular expressions.

**Examples**

Here are some examples that use the Eval macro:

```
Arithmetic: ${eval:${test} := (4-1)*(2+1)/(9/3)}
<!-- result = 3, also assigns result to ${test} -->

Modulo: ${eval:${test}%2}
<!-- result = 1, uses the ${test} variable -->

String assign: ${eval:${yes}:= "Yes"} ${eval:${no}:= "No"}
Numeric assign: ${eval:${test}:=5} (
Conditional: ${eval: $test==5 ? ($response := "Yes") : ($response :=
"No")}
<!-- result="Yes", because ${test} variable = 5
      result also assigned to ${response} variable, output on the next
line -->
${response}

subid(): ${eval:subid("1.3.6.1.2.1.4.20.1.1.10.10.2.20", -4, 4)}
<!-- result="10.10.2.20" -->

Regular Expression: ${eval: "test123" =~ "^te([st]*) ([0-9]*)"; "${1}
${2}"}
<!-- result = "st 123"-->
```

### *The `${variablename:legend}` macro*

In the `<snmp-device-display>` section of a probe file, the `${variablename:legend}` macro is replaced with the legend field defined for that variable in the `<snmp-device-variables>` section. For example, given this definition:

```
<snmp-device-variables>
  ipForwDatagrams, 1.3.6.1.2.1.4.6.0, PER-SECOND,
  "Forwarded datagrams"
</snmp-device-variables>
```

The following entry in the `<snmp-device-display>` section shows "Forwarded datagrams".

```
${ipForwDatagrams:legend}
```

### *The `${scalable10}` and `${scalable2}` macros*

Use the `${scalable10}` and `${scalable2}` macros to display numbers in the appropriate scaled units. The values are always between 1.0 and 1000, are chartable, and are scaled by a factor of 1000 or 1024:

- The `${scalable10}` macro scales by a factor 1000 (for msec, Mbps, etc.).
- The `${scalable2}` macro scales by a factor of 1024 (for KBytes, GBytes, Terabytes, etc.)

Both macros display the appropriate scale. They use the same syntax as the `${chartable}` macro.

#### Usage

```
${scalable10[:fmt]:expr}
```

```
${scalable2[:fmt]:expr}
```

#### Example

```
${scalable10: #.## : 12304 }bytes => 12.30 kbytes
${scalable10: "%3.2d" : 12304 }bytes => 12.30 kbytes
```

```
${scalable2: #.## : 12304 }bytes => 12.02 kbytes
${scalable2: "%3.2d" : 12304 }bytes => 12.02 kbytes
```

The following examples use the `scalable10` macro.

char	scale	factor	short	for example	val	units	example	output
k	*	1000	kilo	12304	bytes	12.30	kbytes	
M	*	1e6	Mega	3421814	bytes	3.42	Mbytes	
G	*	1e9	Giga	125032100300	bytes	125.03	Gbytes	
T	*	1e12	Tera	1.23 x 10^12	bytes	1.23	Tbytes	

none	* 1	nothing	123	bytes	123.00 bytes
m	/ 1000	milli	0.02835	sec	28.35 msec
u	/ 1e-6	micro	0.00047658	sec	476.58 usec
n	/ 1e-9	nano	0.0000000032	sec	3.20 nsec
p	/ 1e-12	pico	1.0 x 10^-10	sec	100.00 psec

### ***The \${^stdout} variable and the Reason string***

In command-line probes, a specially formatted output string is used to define variables and their values. Normally, *anything else written to standard output is used as the reason string for the probe.*

If \${^stdout} exists in the command-display section of a command-line probe, then anything written to standard output by the probe script is assigned as the value of the \${^stdout} variable. This allows the script to programmatically define all or part of the contents of the lower part of the status window.

Using \${^stdout} means that the reason string does not get defined. To compensate, and to allow the definition of a meaningful reason string, a convention was defined. If the specially-formatted output string mentioned above defines a variable named `reason`, then its value is assigned to the reason string used in the status window.

For example, output from the WMI Top Processes probe might look like this:

```
\{ProcessTime0:=100.0,CPU:=1.0,reason:="CPU utilization is below
60%"}
\B5\WMI Top Processes\OP\
  \B4\CPU Utilization:\P0\    $CPU %
    \B4\wniprvse(3924)\P0\    $ProcessTime0 %
```

## Using Persistent Variables

SNMP and Command-line probes can make use of persistent variables. A persistent variable is one that retains its value between polls.

### SNMP Probe Example

The example below demonstrates the use of persistent variables in an SNMP probe.

```
<!--
SNMP probe with persistent variables (com.dartware.snmp.persistent)
Custom Probe for InterMapper (http://www.intermapper.com)
Please feel free to use this as a base for further development.
Original version 24 November 2003 by reb.
Updated 29 July 2005 -
Updated 28 Oct 2005 - include display_name so it displays properly in
InterMapper 4.4 -reb
21 Apr 2006 - Changed to test conversion of $variables to a condition
string.
20 Sep 2011 - Updated to talk about variable persistence -reb
18 Oct 2011 - Minor editing polish -reb
-->

<header>
  "type"          = "custom-snmp"
  "package"       = "com.dartware"
  "probe_name"    = "snmp.persistent"
  "human_name"    = "SNMP Persistent Variables"
  "version"       = "1.1"
  "address type"  = "IP,AT"
  "port number"   = "161"
  "display_name"  = "Miscellaneous/Test/SNMP Persistent Variables"
</header>

<snmp-device-properties>
  -- none required
</snmp-device-properties>

-- The <description> contains text that will be displayed in the Set
Probe window.
-- Describe the probe as much as necessary so that people will
understand what it does and how it works.
<description>
\GB\SNMP Probe with Persistent Variables \P\
Sometimes probes need to compare variables from previous invocations
o the current values. InterMapper SNMP probes can retain variables
from one invocation to the next.
This is done by setting a variable in this invocation to preserve the
value of the current calculation. This becomes the "old variable" in
the next invocation. The steps are:
- Read the new (current) value into a variable ("XYZ");
- Do the computations with it;
- Save that value in a separate variable ("oldXYZ");
- Re-run the probe. The oldXYZ will still contain its previous value.
\b\Example Probe\p\
This probe reads ifInOctets for a specified interface and computes
the difference between it and the previous ifInOctets. It also reads
the sysUpTime.0, and computes the time delta between the probe
```

```

executions. From these values, the probe computes the traffic rate.
For comparison, the probe also looks at ifInOctets using
InterMapper's standard PER-SECOND calculations.
</description>

— Parameters are user-settable values that the probe uses for its
comparisons.
— Specify the default values here. The customer can change them and
they will be retained for each device.
<parameters>
"Interface" = "24"
</parameters>

— SNMP values to be retrieved from the device, and
— Specify the variable name, its OID, a format (usually DEFAULT) and
a short description.
— CALCULATION variables are computed from other values already
retrieved from the device.
<snmp-device-variables>
actInOctets, ifInOctets.$Interface, PER-SECOND, "actual inOctets"
inOctets, ifInOctets.$Interface, INTEGER, "current value"
deltaBytes, $inOctets-$oldInOctets, CALCULATION, ""
curSysUpTime, sysUpTime.0, INTEGER, "current sysuptime"
deltaTime, $curSysUpTime - $oldSysUpTime, CALCULATION, ""
— Now update the oldXXXX variables with current values for next time
— NB: prevInOctets is only needed for display - it is not used in
— the calculations above
prevInOctets, $oldInOctets, CALCULATION, "from last time"
oldInOctets, $inOctets, CALCULATION, "old inOctets for next time"
oldSysUpTime, $curSysUpTime, CALCULATION, "old sysuptime for next
time"
</snmp-device-variables>

— Specify rules for setting the device into Alarm or Warning state
<snmp-device-thresholds>
</snmp-device-thresholds>

— The <snmp-device-display> section specifies the text that will be
appended
— to the device's Status Window.
<snmp-device-display>
\B5\Persistent SNMP Variables on Interface=$interface\0P\
\4\Old Octets:\0\ $prevInOctets \3g\bytes\0mp\
\4\Cur Octets:\0\ $inOctets \3g\bytes\0mp\
\4\Delta's:\0\ $deltaBytes \3g\bytes\0mp\ in $deltaTime \3g\centi-
seconds \0mp\
\4\Computed Rate:\0\ ${eval:sprintf("%d", ($deltaBytes) / $deltaTime
* 100) } \3g\bytes/sec\0mp\
\4\Actual Rate:\0\ ${scalable10: #.### : $actInOctets}
\3g\bytes/sec, using built-in PER-SECOND type\0mp\
</snmp-device-display>

```

### Command Line Probe Example

The example below demonstrates the use of persistent variables in a command-line probe.

```
<!--
Command-line Return (com.dartware.tool.persistent.txt)
Copyright (c) 2008-2011 Help/Systems, LLC. All rights reserved.

Test of persistent variables by round-tripping values: pass them into
script, get results back, post to status window.
20 Sep 2011 -reb
18 Oct 2011 Minor editing -reb
-->

<header>
  type = "cmd-line"
  package = "com.dartware"
  probe_name = "tool.persistent"
  human_name = "Command Line Persistent Variables"
  version = "1.1"
  address_type = "IP"
  display_name = "Miscellaneous/Test/Command Line Persistent
Variables"
</header>

<description>
\GB\Command Line Persistent Variables\p\
This is an example of passing persistent variables into a command-
line probe. The attached Python script takes the variables, updates
them, and returns them to be used for the next iteration.
The script below processes two variables: \b\${SearchString}\p\ and
\b\${numericParam}\p\ . The script appends an "a" to ${SearchString}, and
adds 1 to the ${numericParam} and returns both values. (This is a
useless script, created just to demonstrate use of persistent
variables.)
Both variables are uninitialized when the probe is executed the very
first time. The script can detect this startup condition because an
uninitialized variable is passed to the script as the variable's
name.
For example, the variable named ${SearchString} will be passed as a
string - "${SearchString}". The script can detect this value - it's the
same name that will be used to return the new result for the variable
- and treat the variable as uninitialized, by assigning a sensible
default value.
The Python script tests the passed-in values to see if they match the
expected name and initializes them accordingly.
\i\Note:\p\ This device's address should be set to \i\localhost\p\ .
\i\Note:\p\ These variables could be initialized by setting them in
the <parameter> section, but this exposes a lot of the script's
internal variables to the customer: this is generally not a good
design.
</description>

<parameters>
-- no human-editable parameters
</parameters>

<command-line>
-- Unix/OSX: Empty path forces the InterMapper Settings:Tools
```

```

directory
    path=""
    cmd="{PYTHON} persistent.py $numericParam"
    arg=""
    input="{SearchString}"
</command-line>

<command-exit>
— These are the exit codes used by Nagios plugins
    down: ${EXIT_CODE}=4
    critical: ${EXIT_CODE}=3
    alarm: ${EXIT_CODE}=2
    warn: ${EXIT_CODE}=1
    okay: ${EXIT_CODE}=0
</command-exit>

<command-display>
\b5\ Current value of SearchString and numericParam\p0\
    Search String: $SearchString
    Number: $numericParam
</command-display>

<tool:persistent.py>
#!/usr/local/imdc/core/python/bin/imdc -OO
# The line above is required to run as an IMDC plugin
# persistent.py

# Round-trip the passed-in variables, update them, and return them
# 20 Sep 2011 -reb
import os
import sys
import getopt

try:
    opts, args = getopt.getopt(sys.argv[1:], "")
except getopt.GetoptError, err:
    searchString = "getopt error %d" % (err)

if (args[0] == "$numericParam"): # check to see if the argument is
    the name of the parameter
    number = 0 # if so, set it to a good initial value
else:
    number = int(args[0]) # otherwise, convert the string to an
    integer

# Read the stdin file which contains the search String
f = sys.stdin # open stdin
searchString = f.readline().strip() # get the line & remove leading
& trailing whitespace

if (searchString == "$SearchString"): # check to see if the value is
    the name of the parameter
    searchString = "" # if so, set it to a good initial value

retcode=0
searchString = searchString + "a" # add another "a" to the end of
the string

```



```
number = number+1    # increment the number as well
retstring = "Hunky Dory!"

print "\{ $SearchString := '%s', $numericParam := '%d' } %s" %
(searchString, number, retstring)
sys.exit(retcode)
</tool>
```

## Chapter 3

---

### SNMP Probes

```
type="custom-snmp"
```

Using SNMP probes, you can monitor certain MIB variables that aren't tested by InterMapper's built-in probes. These MIB variables might include the CPU utilization of a router, temperature inside the equipment, switch closures, etc.

Like other probes, SNMP probes are invoked and return the status and condition string for the device being tested. Here's a summary of the operational flow of an SNMP probe:

1. InterMapper polls the device for the values (called *probe variables*) specified in the probe file as well as the device's built-in MIB variables (usually byte and packet rates for interfaces).
2. InterMapper also polls each interface for probe variables as needed.
3. InterMapper then evaluates a series of expressions in the probe file, comparing the probe variables to thresholds.
4. If a comparison is triggered (generally, if the probe variable is above or below the given threshold), then InterMapper sets the device status as specified in the probe, if it is "worse" than the device's current status.
5. When the user clicks and holds on a device, InterMapper processes the relevant *display* section to produce the text for the Status window.

#### Common Sections of an SNMP probe

SNMP probes follow the same general format as other probe files.

- The [<header>](#), (Pg 12) section of a command-line probe specifies the probe type, name, and a number of other properties fundamental to the operation of the probe.
- The [<description>](#) (Pg 17) section specifies the help text that appears in the Set Probe window. Format the description using IMML, [InterMapper's Markup language](#).
- The [<parameters>](#) (Pg 18) section defines the fields presented to the user in the Set Probe window.

### Sections Specific to SNMP Probes

```
<header>
  type = "custom-snmp"
</header>
```

**Note:** See [SNMP Trap Probes](#) for information on creating probes that handle SNMP traps.

Each SNMP probe also has:

- [An <snmp-device-variables> section \(Pg 52\)](#) - Specifies which MIB variables to collect from the device
- [An <snmp-device-thresholds> section \(Pg 59\)](#) - Specifies how those variables are to be tested against thresholds to determine the device's status
- [An <snmp-device-display> section \(Pg 50\)](#) - Specifies what information about the device and its links should be displayed in the Status window
- [The <snmp-device-properties> section \(Pg 61\)](#) - Specifies certain aspects of the SNMP queries sent to the device.
- [The <snmp-device-variables-ondemand> Section](#) - Many devices store information in SNMP tables. InterMapper can retrieve this tabular information and display the data "on demand".

## The <snmp-device-variables> Section

Use the <snmp-device-variables> section to specify the values you want to retrieve using a particular SNMP OID. These values, called *probe variables*, can then be compared to thresholds to create alarms, warnings, etc.

Each line of the <snmp-device-variables> section defines a particular variable to be retrieved. The definition is composed of four comma-separated attributes:

```
[Variable-name], [OID], [Type], [Chart-legend]
```

### Sample <snmp-device-variables> Section

```
<snmp-device-variables>
  --Variable-name  OID --- TYPE ---- CHART LEGEND -----
  ipForwDatagrams, 1.3.6.1.2.1.4.6.0, PER-SECOND, "Forwarded
datagrams"
  ipInHdrErrors,   1.3.6.1.2.1.4.4.0, PER-MINUTE, "IP received header
err"
  tcpCurrEstab,    1.3.6.1.2.1.6.9.0, DEFAULT,      "Number of TCP
conn's"
  sysDescr,        1.3.6.1.2.1.1.1.0, DEFAULT
</snmp-device-variables>
```

**Note:** The OIDs above have a trailing ".0" to specify their full OID.

### Status Window Text - The <snmp-device-display> Section

Use the <snmp-device-display> to control the way information gathered during polling appears in the Status window. Create a <snmp-device-display> section with the items to be displayed. For more information, see [Customized Status Windows \(Pg 32\)](#).

InterMapper retrieves MIB variables from a device and then tests them against thresholds. The <snmp-device-variables> section defines the OIDs of MIB variables that are to be retrieved. These values are called *probe variables* and can then be compared to thresholds to create alarms, warnings, etc.

Each line of the <snmp-device-variables> section defines a particular variable to be retrieved. The definition is composed of four comma-separated attributes:

```
[VariableName], [OID], [Type], [Chart Legend]
```

The definitions of these attributes are:

- **VariableName** is the name used to represent the particular MIB value in this probe. For more information, see the [Built-in Variable Reference \(Pg 36\)](#) topic.
- **OID** is the SNMP Object ID for the particular probe variable. The OID can be expressed as a string of dotted numbers or as an OID name, if the

corresponding MIB has been imported into InterMapper. An OID can also be an expression, if the type is "CALCULATION" ([see note below](#)).

- **Type**- specifies how InterMapper displays a value. The type may be one of the following:
  - **Default** - InterMapper deduces an applicable type from the SNMP type of the variable and displays it according to the "Format for DEFAULT types" table below.
  - **Integer** - values are coerced to a numeric value. If you have a string value returned "78Fred", the value as INTEGER is 78.
  - **Integer64** - values are coerced to a numeric value (up to 64-bits). If you have a string value returned "78Fred", the value as INTEGER is 78.
  - **Hexadecimal** - If the value is a number, it is displayed as a hex number, preceded by "0x" (0xFFFFFFFF). Otherwise, it is represented as a series of hex characters separated by spaces (44 61 72 77 69 6E 20 52 69 63 68 61 72). *This type is not chartable.*
  - **Hexnumber** - converts a string of hexadecimal digits into a number. For example, a string value of "FE" is converted to the number 254.
  - **Total-value** - displays the actual value of a counter or gauge, not a computed rate value. This is always an unsigned number.
  - **Total64-value** - displays the actual value of a counter or gauge, not a computed rate value. This is always an unsigned number (up to 64-bits).
  - **Per-second** and **Per-minute** - force InterMapper to compute a rate for the particular variable by computing the difference between two successive samples and dividing by the elapsed time.
  - **String** - sets a variable to the text string that corresponds to this OID's enumerated type, as defined in the MIB. (see [Enumerated Values](#) below) *This type is not chartable.*
  - **Calculation** - sets the variable to the result of the calculation shown in the OID field.
  - **TrapVariable** - sets a variable based on the value received from an SNMP trap. A complete discussion of Trap Variables is available in [About Custom SNMP Trap Probes \(Pg 98\)](#)
  - **IPADDRESS** - InterMapper displays a 4-byte octet string as an IPv4 address and a 16-byte octet string as an IPv6 address.

**Format for DEFAULT types** - All SNMP variables have an inherent type (one of the choices in the Type column below.) If a probe variable is declared as DEFAULT, InterMapper displays it according to this table:

Type	Displayed as:
Counter32, Counter64	Per-Second
Unsigned32 (Gauge)	Total-Value
Integer	Integer
OctetString	String (if 1st digit printable) Hexadecimal (if 1st digit not printable)

Object ID	String
IPAddress	String
TimeTicks	String

- **Chart-legend** is an optional field that provides a text label to be placed on any strip charts that incorporate this variable. Chart legends may contain embedded variable names in the form \$VariableName.

**Notes:**

- Calculation variables have a slightly different form, as described below.
- See [Probe Calculations \(Pg 81\)](#) for a description of the functions and operators that are available in expressions. A scalar's OID must end in ".0" according to the SNMP specifications. See [SNMP OIDs \(Pg 92\)](#) for a description of allowable formats for OIDs
- See [On-Demand SNMP Tables \(Pg 62\)](#) for a description of how your probe can display tabular information from a MIB.
- When InterMapper retrieves a value, by default it issues an SNMP Get-Next-Request for the previous OID, unless the pduType is set to "get-request" (see [Probe Properties \(Pg 91\)](#).)

Here is a sample `<snmp-device-variables>` section.

```
<snmp-device-variables>
--Variable-name  OID ---          TYPE ----   CHART LEGEND ----
---
sysDescr,        1.3.6.1.2.1.1.1.0, DEFAULT,
sysLocation,     sysLocation.0,  DEFAULT,
ipInHdrErrors,   1.3.6.1.2.1.4.4.0, PER-MINUTE, "IP received
header err"
ifInOctets1,     ifInOctets.1,      DEFAULT,      "bytes/sec
received on interface 1"
ifInOctets2,     ifInOctets.$if,    DEFAULT,      "bytes/sec
received on interface ${if}"
TempF,          ($TempC * 1.8)+32, CALCULATION, "Degrees F"
</snmp-device-variables>
```

- **\$sysDescr** is set by retrieving the OID 1.3.6.1.2.1.1.1.0 and using that value. It will be displayed as the default format, that is a string.
- **\$sysLocation** is set by querying the OID sysLocation.0 (which is equivalent to the numeric 1.3.6.1.2.1.1.6.0). It, too, will be displayed as a string. Note that you can use a human-readable SNMP variable name instead of its numeric OID.
- **\$ipInHdrErrors** is set by querying the OID 1.3.6.1.2.1.4.4.0, but will be displayed as a number of errors \*per minute\*.
- **\$ifInOctets1** is set by querying the OID ifInOctets.1 (1.3.6.1.2.1.2.2.1.10.1). Note that the final digit is "1", indicating that it is reading row 1 of the values in the table. It will be displayed as a number of octets (byte) per second, since InterMapper's default display format for a counter is "per-second".

The next two examples are controlled by variables that have been set elsewhere, perhaps set manually in the `<parameters>` section of the probe.

- **\$ifInOctets2** is set by first evaluating the variable `$if`, then substituting that value into the OID. If `$if` were set to "1", then `$ifInOctets2` would retrieve `ifInOctets.1`, and would result in the same value as `$ifInOctets1`. Note that `$if` is also used in the variable's legend.
- **\$TempF** is a "calculation" variable. It is set by evaluating the expression `($TempC * 1.8)+32` where `$TempC` was set elsewhere.

### SNMP Scalar and Table Values

SNMP has two kinds of values: *table* and *scalar* values.

- A **table** value is an element of a table: the variable name (e.g. `ifInOctets`) is the name of a column; the final digit (or digits) is the index for the element; it defines the table row containing the element. Thus `ifInOctets.1` is the full OID for the value in the first row of the `ifInOctets` column.
- A **scalar** value is "one of a kind" - there is only a single value, so you must specify a ".0" after the name to indicate that it's the only "row". For example, `sysDescr` can be represented as `1.3.6.1.2.1.1.1.0` or `sysDescr.0`. Both OIDs end in ".0".

## Using Variables in OIDs and Legends

You can use SNMP variables in OIDs and legends. The example below uses `$if` as the OID index, and displays it in the legend.

```
ifInOctets2, ifInOctets.$if, DEFAULT, "bytes/sec
received on interface ${if}"
```

## Calculation Variables

A *Calculation* type variable receives the result of an arithmetic expression. After all variables have been polled, InterMapper calculates the expression, and sets the value of its variable to the result. In the example above:

```
TempF, ($TempC * 1.8)+32, CALCULATION, "Degrees F"
```

The variable "TempF" is set to the value of the expression `(10 * sin(0.01 * time()))`. This gives a sine wave that makes an attractive chartable value. Use "\$SineValue" to refer to the variable elsewhere in the probe.

## Built-in Variables

InterMapper provides a number of built-in variables, detailed in the [Built-in Variable Reference \(Pg 36\)](#) topic.

## Macros

InterMapper also supports several macros that can help control the output of variables, as well as their use in charts.

- `${chartable[:fmt]: expr}`
- `${variablename:legend}`
- `${eval: expr}`
- `${scalable10}` and `${scalable2}`

These are detailed in the Built-in Variable Reference topic's [Macros section \(Pg 41\)](#).

## Enumerated Values

Many MIBs use an integer to represent one of several states. For example, `ifOperStatus` (1.3.6.1.2.1.2.2.1.8.x) is defined in MIB-II as:

```
INTEGER { up(1), down(2), testing(3) }
```

This means that the value 1 represents the "up" condition; 2 represents "down"; and 3 represents "testing".

The type you use when you define the variable affects the result:

- If you define a variable to retrieve this value as `INTEGER` or `DEFAULT`, the probe displays the value as a number.



- If you define it as a STRING, the probe uses the MIB to find the string representation, and sets the variable (in this case) to the value "up", "down", or "testing".

```
-- If the MIB has been imported, the string is
displayed in the output if the variable is declared as
STRING.
```

```
variable1, ifOperStatus.3, STRING, ""
```

```
-- The integer value is always used in the output if
the variable is declared as DEFAULT or INTEGER.
```

```
variable2, ifOperStatus.3, DEFAULT, ""
variable3, ifOperStatus.3, INTEGER, ""
```

If the OID or MIB name isn't defined (because the corresponding MIB hasn't been imported or because of a typo), the probe displays the integer value.

### Alternatives to Enumerated Values

If no MIB file is available, you can create a calculation variable to select a string based on the numeric value returned.

#### Example: Two choices

```
-- If you have two choices, use a conditional expression:
xxxx ? yyyy : zzzz
```

```
-- It can be read as:
if xxxx is true then
    return yyyy
otherwise
    return zzzz
```

```
-- The variable looks like this:
xxxxStr, ($xxxx = 0 ? "yyyy" : "zzzz"), CALCULATION, "replacement
string for $xxxx"
```

#### Example: Three or more choices

```
-- Chain the expression:
aaaa ? bbbb : cccc ? dddd : eeee ? ffff : gggg
```

```
-- Can be read as:
if aaaa is true then
    return bbbb
else if cccc is true
    return dddd
else if eeee is true
    return ffff
else return gggg
```

```
-- Generally, aaaa, cccc, and eeee test to see if a single variable
is equal to 1, 2, 3, etc.
```

— The calculation variable then looks like this:  
aaaaStr, (\$aaaa=0 ? "bbbb" : \$aaaa=1 ? "dddd" : \$aaaa=2 ?  
"ffff" : "gggg"), CALCULATION, "replacement string for aaaa"

### The `<snmp-device-thresholds>` Section

Use the `<snmp-device-thresholds>` section to specify the comparisons that should be made between probe variables and other values.

Each line in the threshold section contains a *status*, a *comparison*, and an optional *condition string* for probe variables. If the comparison is *triggered*, (if the expression comparing the probe variable to a constant or other variable is true) then the device is changed to the corresponding status (if that exceeds its current status.)

A threshold can be one of the following (they are case-sensitive), and should be presented in this order:

- down
- critical
- alarm
- warning
- okay

### Sample `<snmp-device-threshold>` Section

```
<snmp-device-thresholds>
  down: ${ifOperStatus} = 0 "Device Down"
  critical: ${ipInHdrErrors} > 15 "ipInHdrErrors critical"
  alarm: ${ipForwDatagrams} > 10 "ipForwarded datagrams too
high"
  alarm: ${tcpCurrEstab} >= 1
  alarm: ${ipInHdrErrors} > 10 "ipInHdrErrors too high"
  warning: ${ipForwDatagrams} > 5
  warning: ${ipForwDatagrams} <= 2
  warning: ${ipInHdrErrors} > 5
  okay: 1 = 1 "Everything is OK"
</snmp-device-threshold>
```

### Creating Comparisons

As implied above, comparisons are evaluated *in order from top to bottom until a comparison is triggered* (result is true). It is important to put the *Critical comparisons first, followed by Alarm, Warning, and OK.*

At that point, if the associated status is more severe than the device's current status, the device now uses its status and condition. No further comparisons are made once one has triggered.

When a comparison is triggered, it is written to the log file as well as being added to the bottom of the device's Status window. If the condition string is present, it is displayed in addition to the comparison string.

### ***Numeric Comparisons***

The following numeric comparison operators are legal:

```
>, >=, <, <=, =, and !=.
```

### ***String Matches***

By default, InterMapper performs numeric comparisons.

#### **To compare values as strings:**

- Enclose one or both of the operands in double-quotes ("). For example, the comparison

```
warning: ${sysContact} != "Fred Flintstone"
```

performs a string comparison because the name is enclosed in quotes.

- Use the =~ and !~ operators to provide partial string matches. They perform "contains" and "doesn't contain" comparisons, respectively.

### The <snmp-device-properties> Section

The <snmp-device-properties> section specifies certain aspects of the SNMP queries sent to the device. Like other sections, it is closed with a </snmp-device-properties> tag. The items that may be set include:

- **nomib2="true"** - InterMapper does not query the sysUptime MIB-2 variable
- **pdutype="get-request"** - InterMapper uses SNMP Get-Request, instead of Get-Next-Request queries
- **apcups="false"** - If apcups is false, InterMapper does not query the APC-UPS MIB even for devices that auto-detect as one.
- **maxvars="10"** - maxvars controls the maximum number of variables to put in each SNMP request. If a custom probe requires more variables than maxvars, InterMapper sends multiple queries containing up to maxvars variables.

```
<snmp-device-properties>
  nomib2="true"
  pdutype="get-request"
  apcups="false"
  maxvars="10"
</snmp-device-properties>
```

## The <snmp-device-variables-ondemand> Section

Many devices store information in SNMP tables. InterMapper can retrieve this tabular information and display the data "on demand", that is, when requested by user action. When you view a table, InterMapper retrieves the information from the device immediately and displays it in a separate window. The information in an on-demand window is not part of the regular polling cycle, nor is it refreshed until you specifically request it. The image below shows a sample on-demand window.

Index	Description	Link Type	Link Speed	MAC Address	Opn'l	Admin
1	FastEthernet0/1	ethernetCsmacd	100000000	00:15:62:BA:8F:01	down	up
2	FastEthernet0/2	ethernetCsmacd	100000000	00:15:62:BA:8F:02	down	up
3	FastEthernet0/3	ethernetCsmacd	100000000	00:15:62:BA:8F:03	up	up
4	FastEthernet0/4	ethernetCsmacd	100000000	00:15:62:BA:8F:04	up	up
5	FastEthernet0/5	ethernetCsmacd	100000000	00:15:62:BA:8F:05	down	up
6	FastEthernet0/6	ethernetCsmacd	100000000	00:15:62:BA:8F:06	up	up
7	FastEthernet0/7	ethernetCsmacd	100000000	00:15:62:BA:8F:07	down	up

26 rows

On-demand tables are useful for digging down into a device when you suspect there might be a problem. You can create on-demand tables to view a routing table, ARP table, or other statistics that are kept within tables.

### Background on SNMP Tables

The SNMP protocol provides access to two types of variables:

- **Scalar variables** contain single values such as strings (that could represent system description or firmware version), integers (number of interfaces), counters (number of errors), gauges (CPU temperature and memory utilization), etc.
- **Table variables** hold information about similar entities within a device. These entities could be interfaces in a router or switch, users associated with a wireless access point, virtual machines in a server, etc. Each entity's information is represented by a row, whose columns are variables (which are themselves scalars) that hold information about the entity. A row is often called an "entry" in a MIB; each column is specified by an OID prefix plus a unique index that specifies a particular row.

For example, MIB-II defines a table named "ifTable" that gives information about a device's interfaces. An outline of ifTable looks like this:

```
+ ifTable
+ ifEntry [ifIndex]
- ifIndex      "Interface Index"
- ifDescr      "Description"
- ifType       "Link type"
- ifSpeed      "Link speed"
- ifPhysAddress "MAC Address"
- ifOperStatus "Operational status"
- ifAdminStatus "Administrative status"
- ... and so on...
```

Here's how to interpret this information. The *ifTable* is composed of a sequence of *ifEntries* which form the rows of the table. Each row (each *ifEntry*) has a number of variables: we show only some of them, starting with ifIndex and ending with ifAdminStatus. These variables become the columns of each row.

The image above shows the window of an on-demand table for ifTable. The columns match the variables mentioned above. The window also shows the number of rows in the table (at lower left), the time the data was retrieved, and the Refresh button to retrieve current data.

### Table Indexes

Each row of an SNMP table has a unique index. The index for ifTable is the "interface index", that loosely represents the port number of the interface. Individual values are represented by the column name followed by its index. For example:

```
ifSpeed.3 (or the OID 1.3.6.1.2.1.2.2.1.3)
```

would represent the ifSpeed for row 3 of the table. The "column name" is ifSpeed (1.3.6.1.2.1.2.2.1), and the index is the ".3".

## Table Syntax

An on-demand table in a custom SNMP probe mirrors the outline above. Its definition consists of a sequence of lines of comma-separated values defining the variables of one or more tables:

```
<snmp-device-variables-ondemand>
  ifTable, .1, TABLE,
  "Information about the physical interfaces"
  ifTable/ifIndex, 1.3.6.1.2.1.2.2.1.1, DEFAULT, "Interface
Index" <!-- using OID for column -->
  ifTable/ifDescr, 1.3.6.1.2.1.2.2.1.2, DEFAULT,
  "Description" <!-- using OID for column -->
  ifTable/ifType, 1.3.6.1.2.1.2.2.1.3, STRING, "Link Type
" <!-- using OID for column -->
  ifTable/ifSpeed, 1.3.6.1.2.1.2.2.1.5, DEFAULT, "Link
Speed" <!-- using OID for column -->
  ifTable/ifPhysAddress, ifPhysAddress, HEXADEDECIMAL, "MAC
Address" <!-- using column name from MIB -->
  ifTable/ifOperStatus, ifOperStatus, STRING, "Opn'l"
  <!-- using column name from MIB -->
  ifTable/ifAdminStatus, ifAdminStatus, DEFAULT, "Admin"
  <!-- using column name from MIB -->
</snmp-device-variables-ondemand>
```

This example shows an on-demand table for ifTable.

**Note:** The <snmp-device-variables-ondemand> section must contain fewer than 50 queries.

The remainder of the table is composed of comma-separated lines describing each variable.

- The first line creates a table. The first field is the table's name that can be used to represent the table elsewhere in the probe file. The second field should be ".1". The third field ("TABLE") indicates that this is a new table. The fourth field is a human-readable description that is displayed in the on-demand window.
- The remaining lines follow the format of <snmp-device-variables>. See their page for more information. The names in the first column contain the table name, a "/", and the name for the column.
- The next four lines define variables (ifIndex, ifDescr, ifType and ifSpeed) that are to be columns of the table. They are defined using the numeric OID that represents the column for those values.
- The final three lines define ifPhysAddress, ifOperStatus, and ifAdminStatus. They are defined using the name of the column from the MIB. This is entirely equivalent to writing out the full numeric OID.

The tables described here are available as the **SNMP/Table Viewer** probe that's built into InterMapper. In addition, the probe file is available on the Table Viewer page of this manual.



## Augmenting Tables

Certain MIB's define a table that "augments" another table. This simply means that the augmenting table uses the same index variables as another table. Since the index variables are the same, you can visualize this as adding columns to an existing table.

For example, in the IF-MIB, the ifXTable augments ifTable, providing a number of useful additions.

InterMapper's table syntax easily supports mixing columns from one or more tables that share the same table definition:

```
<snmp-device-variables-ondemand>
  ifXTable, .1, TABLE,
  "Extended ifTable"
  ifXTable/ifIndex, IF-MIB::ifIndex, DEFAULT,
  "Interface index"
  ifXTable/ifDescr, IF-MIB::ifDescr, DEFAULT,
  "Description"
  ifXTable/ifName, IF-MIB::ifName, DEFAULT, "Name"
  <!-- ifXTable -->
  ifXTable/ifAlias, IF-MIB::ifAlias, DEFAULT, "Alias"
  <!-- ifXTable -->
  ifXTable/ifType, IF-MIB::ifType, STRING, "Link
Type "
  ifXTable/ifSpeed, IF-MIB::ifSpeed, DEFAULT, "Link
Speed"
  ifXTable/ifHighSpeed, IF-MIB::ifHighSpeed, DEFAULT,
  "Mbit/sec"
  ifXTable/ifPhysAddress, IF-MIB::ifPhysAddress, HEXADECIMAL, "MAC
Address "
  ifXTable/ifOperStatus, IF-MIB::ifOperStatus, STRING, "Opn'l"
  ifXTable/ifAdminStatus, IF-MIB::ifAdminStatus, DEFAULT, "Admin"
</snmp-device-variables-ondemand>
```

In the example, ifName and ifAlias come from the ifXTable while the others are part of ifTable. Yet they all can be shown in the same on-demand window.

## Index-Derived Variables

Certain SNMP equipment uses the value of one of more columns as part of the row index. In many cases, the column itself is not accessible, and thus cannot be queried directly.

InterMapper has a facility that allows you to derive the values of these columns from the index itself, even from columns that are not accessible. The notation `oid[a:b]` means to fetch the OID `oid` and compute the value from the index:

```
oid[a:b] - remove the subid's for "oid" then start with the a'th
subid and collect b subids.
oid[a:] - remove the subid's for "oid" then start with the a'th
subid and collect the remaining subids
```

Here is an example of retrieving the four columns of `ipNetToMediaTable`. Note that the table has been given the name "ARPTable", although the OID is `ipNetToMediaEntry`.

```
<snmp-device-variables-ondemand>
  ARPTable, .1, TABLE,
  "Map from IP addresses to physical addresses."
  ARPTable/ipNetToMediaIfIndex, ipNetToMediaType[0:1],
DEFAULT, "Interface index"
  ARPTable/ipNetToMediaNetAddress, ipNetToMediaType[1:4],
DEFAULT, "IP Address"
  ARPTable/ipNetToMediaPhysAddress, ipNetToMediaPhysAddress,
HEXADECIMAL, "MAC Address"
  ARPTable/ipNetToMediaType, ipNetToMediaType, STRING,
  "Type"
</snmp-device-variables-ondemand>
```

The `ipNetToMediaTable` is defined to use two index values:

- `ipNetToMediaIndex` (the row number of the interface)
- `ipNetToMediaNetAddress` (the IP address of the device)

The full OID used to retrieve a value from the table is its prefix (for example, `ipNetToMediaType` is 1.3.6.1.2.1.4.22.1.4) followed by a single subid for `ipNetToMediaIndex` followed by the four subid's of `ipNetToMediaNetAddress`.

When InterMapper displays the table, it retrieves `ipNetToMediaType`, removes the prefix, then starts at position 0 of the remainder and uses one subid for the `ipNetToMediaIfIndex`, and then starts at position 1 and takes the next four subid's for the value of `ipNetToMediaNetAddress`.

**Calculations within On-demand Tables**

InterMapper provides the ability to have calculations in on-demand tables. This is useful for making calculations from values within the same row of the table. The calculations may also use constant values as well as parameters to the probe. In the example below:

- 1) declares the column "ifIndex"
- 2) calculates the value of (column "ifIndex" plus 1) times 2
- 3) uses the previous column to get the original ifIndex back
- 4) and 5) display the current value of ifInOctets and ifOutOctets
- 6) the calculated ratio between these two columns
- 7) and 8) show a circular reference which fails gracefully - Circular1 and Circular2 refer to each other and simply display "-" as a value.

```
<snmp-device-variables-ondemand>
  ifTableTest, .1, TABLE
  ifTableTest/ifIndex, IF-MIB::ifIndex, DEFAULT
  <!-- #1 -->
  ifTableTest/ifIndexPlus1Times2, ($ifIndex + 1)*2,
CALCULATION <!-- #2 -->
  ifTableTest/ifIndexBack, $ifIndexPlus1Times2/2-1,
CALCULATION <!-- #3 -->
  ifTableTest/TInOctets, IF-MIB::ifInOctets, DEFAULT
  <!-- #4 -->
  ifTableTest/TOutOctets, IF-MIB::ifOutOctets, DEFAULT
  <!-- #5 -->
  ifTableTest/ifRatio, $TInOctets/$TOutOctets,
CALCULATION <!-- #6 -->
  ifTableTest/Circular1, $Circular2 - 1,
CALCULATION <!-- #7 -->
  ifTableTest/Circular2, $Circular1 + 1,
CALCULATION <!-- #8 -->
</snmp-device-variables-ondemand>
```

## Displaying On-demand Tables

After you define a TABLE variable in the "ondemand" section of the probe, you can specify that status window should display a link to the ondemand window. To do this, add the variable name to the <snmp-device-display> section of the probe:

```
<snmp-device-display>
...
  $ARPTable
</snmp-device-display>
```

The status window displays the table name as a hyperlink. Clicking on the hyperlink opens the on-demand table window shown at the top of the page.

If you want to replace the default table name displayed with your own text, you can specify the "alternate text" in the expanded variable form:

```
<snmp-device-display>
...
  ${ARPTable:View the entire ARP Table}
</snmp-device-display>
```

## Limitations

- On-demand variables must be in table form with a "/" in the variable name.
- You cannot query tables in the regular <snmp-device-variables> section.
- You cannot reference on-demand tables defined in other probes.
- You cannot specify non-accessible MIB variables by their symbolic OID. Instead, use the "derived values" syntax to determine the correct index-derived OID expression.
- You must declare no more than 50 variables in the <snmp-device-variables-ondemand> section or the query will not work.

## The <snmp-device-display> Section

### Controlling the Status window in SNMP Probes with <snmp-device-display>

Use the optional <snmp-device-display> section to describe the text that appears in a custom SNMP probe's Status window. Probe variables are replaced with their values in the Status window's text.

The default font for the Status window's text is a mono-spaced font, so alignment of text is straightforward. You can change the appearance of the text in the Status window using IMML, [InterMapper's Markup Language](#).

Here is a sample <snmp-device-display> section. Note that the variables are replaced with the values retrieved from the device, and that formatting is controlled by IMML.

```
<snmp-device-display>
  \B5\Custom SNMP Probe\OP\
  \4\ipForwDatagrams:\0\  ${ipForwDatagrams} datagrams/sec
  \4\ipInHdrErrors:\0\    ${ipInHdrErrors} errors/minute
  \4\tcpCurrEstab:\0\     ${tcpCurrEstab} connections
</snmp-device-display>
```

### Using Disclosure Widgets

A disclosure widget, also called a disclosure control, is a user interface element that allows the user to expand or collapse text in a window.

The basic syntax of a disclosure control area is as follows:

```
\#hide:[disclosureblock name]\ Title for Disclosure Block \#begin:
[disclosureblock name]\
  First line of disclosureblock
  Second line of disclosureblock
  Third line of disclosureblock
  Fourth line of disclosureblock
\#end:[disclosureblock name]\
```

Use the #hide and #show to specify the default state of the block.

You can also nest disclosure controls, as demonstrated below.

```
<!--
  Testing Disclosure Widgets (com.dartware.reb.expander.txt)
  Probe for InterMapper (http://www.intermapper.com)
  Please feel free to use this as a base for further development.

  Original version - 6 Aug 2010 -reb
-->

<header>
  "type" = "custom-snmp"
  "package" = "com.dartware"
```

```

"probe_name" = "reb.expander_control"
"human_name" = "Test Expander Control"
"version" = "1.0"
"address_type" = "IP,AT"
"port_number" = "161"
display_name = "Miscellaneous/Test/Test Expander Controls"
</header>

<snmp-device-properties>
  — none required
</snmp-device-properties>

<description>
  \GB\Testing Disclosure Widgets\P\

  This probes is for testing out the disclosure widget ("expander
  control") feature
  in Status Windows.
</description>

<parameters>
  — none
</parameters>

<snmp-device-variables>
  — none
</snmp-device-variables>

<snmp-device-thresholds>
  — none
</snmp-device-thresholds>

<snmp-device-display>
  — The <snmp-device-display> section specifies the text that will
  be appended
  — to the device's Staus Window.
  \B5\Displaying Expander_ Controls\0P\

  \#hide:expander 1\ Title for Expander_1 (initially hidden)
  \#begin:expander 1\
  First line of Expander 1
  Second line of Expander 1
  Third line of Expander 1
  Fourth line of Expander 1
  \#end:expander 1\
  \#show:expander 2\ Title for Expander_2 (initially shown)
  \#begin:expander 2\
  First line of Expander 2
  Second line of Expander 2
  Third line of Expander 2
  Fourth line of Expander 2
  \#hide:expander 3\ Expander_3 nested within Expander_2
  \#begin:expander 3\
  First line of Expander 3
  Second line of Expander 3
  \#end:expander 3\
  \#end:expander 2\
  \#hide:expander 4\ Title for Expander_4 (controlled by Expander_1)

```

```
\#begin:expander 1\  
  First line of Expander 4  
  Second line of Expander 4  
  Third line of Expander 4  
  Fourth line of Expander 4  
  \#end:expander_1\  

```

```
</snmp-device-display>
```

## The <snmp-device-alarmpoints> Section

InterMapper can monitor multiple conditions within a single device (e.g., a single piece of hardware) and give separate, independent notifications for each. For example, it can send notifications for a high temperature alarm independent of a low-memory condition in the same device.

Each of these conditions is called an "alarm point". InterMapper's custom SNMP probe facility allows you to define multiple alarm points for a device, along with their thresholds and the notifications to be sent.

InterMapper tracks the state of each alarm point separately. Alarms on one point will not affect the status, logging, or notifications of any other alarm point. However, the visual appearance of a device will reflect the most serious condition of any of its contained alarm points.

Alarm points have the following five severities. Each severity is assigned a color for quick visual identification.

Severity	Color	Description
Clear	Green	Nothing exceptional to report
Minor	Yellow	Device has departed from its normal "clear" state
Major	Orange	Device's operation is significantly affected
Critical	Solid Red	Device's operation is seriously degraded
Down	Blinking red	Device is unresponsive, actual state is not known

Every time an alarm point changes from one severity to another:

- The the new condition is logged to the log file.
- A notification is sent using the existing InterMapper notifiers, including sounds, e-mail, paging modem or SNPP, or running scripts.

### Alarm Points - What the User Sees

InterMapper displays devices with alarm points much the way it shows "regular" devices. A device's icon is colored according to the most serious condition of all its alarm points.

Note that these colors correspond closely with InterMapper's OK/Warning/Alarm/Down coloring. The Critical state is new, and gets a solid red color to indicate that it's "worse" than the orange Alarm or Major severity.

A device's icon takes on the color of its most serious alarm point. For example, a device with two alarm points, one in Critical and one in Minor severity is colored a solid red.



### Acknowledgements

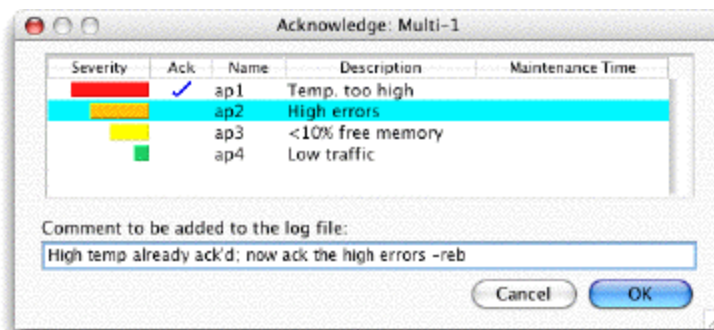
Acknowledging an alarm lets the operator indicate that they know about a problem and that they are working on it. An acknowledgement blocks further notifications for that alarm, and colors the icon blue to show that, although the problem remains, someone has taken responsibility for it.

The blue-acknowledged color makes it easy to see new problems at a glance. When all icons are green (working properly) or blue (in alarm, but being worked on) any new alarm appears as a yellow, orange, or red icon.

Alarm points can be acknowledged independently. That is, acknowledging one alarm point does not affect the state of other alarm points. Acknowledging an alarm point leaves the device's color set to its most serious un-acknowledged alarm point. When all alarm points have been acknowledged, the device icon turns blue.

The Acknowledge window for devices with alarm points will look much like the current Acknowledge window, with these differences:

- When acknowledging one device, the Acknowledge window will display a list of the alarm points, sorted in order of severity. The operator may select one, many, or all the alarm points to acknowledge at a single time.
- The operator may select one, many, or all the alarm points of a device and acknowledge them at the same time.
- Selecting multiple devices and acknowledging them at once acknowledges each alarm point of each device in that one action.
- The Acknowledge window also contains a text field that is used to enter a comment about who is acknowledging the alarm, and why.



## Notifications

Alarm points can use the same notification settings as the device, or they can have independent notifications. That is, each alarm point's set of notifications can be separate from any others, and each transition to a new severity can have its own notification.

Notifications for alarm points follow the current InterMapper scheme of sending the notification to an identity. Each identity is configured to use a single notification method (sound, e-mail, modem paging, SNPP, running a script, etc.) to send the desired message.

Alarm point notifications can have independent repeats, delays, and counts, as well. They are defined in the probe file as described in the [Alarm Point Notifier List \(Pg 80\)](#) section.

## Log File Messages

InterMapper writes messages to the Event Log file for individual alarm point actions. The entries will be written on a change of severity, for notifications, acknowledgements, or for maintenance mode changes. The lines will have tab-delimited fields in this order:

- **Date-time** Date and time the entry was made into the log file
- **Severity** A four or five-character severity of the event (clear, minor, major, crit, unkn)
- **Identity** The identity of the alarm point, with the map, device, and the alarm point names separated by colons. (e.g., MapName:DeviceName:PointName)
- **Explanatory-text** The condition string or result-description of the alarm point

## Configuring Alarm Points

Alarm points are configured in a Custom SNMP Probe. The details are contained in the [Alarm Point Format \(Pg 75\)](#) section of the manual.

### Alarm Point File Format

Alarm points are defined in the <snmp-device-alarmpoints> section that contains several lines of the format:

```
name: severity (condition-to-test) Condition-String [ =>
Notifier-list ]
```

Here is an example:

```
<snmp-device-alarmpoints>
-- Name:      Severity (Condition-to-Test)      Condition-String
=> Notifier-List
   SiteTemp: critical ($Temp > $CriticalHighTemp) "VERY_HIGH_TEMP" =>
PageFred
   SiteTemp:  major ($Temp > $MajorHighTemp)    "HIGH_TEMP"      =>
PageFred
</snmp-device-alarmpoints>
```

The fields of each entry are:

- **Name** is the name of the alarm point. If multiple lines in this section contain the same Name, then they will be treated as the different thresholds for the same alarm point.
- **Severity** is one of 'critical', 'major', 'minor' or 'clear'. It defines the resulting severity of the given point test.
- **Condition-to-test** is an expression that evaluates to a boolean result, e.g. "(\$Temp > \$CriticalHighTemp)" You can use variables from the <snmp-device-variables> section or the <parameters> section in your expression. See the Probe Calculations topic's [Expression Syntax section \(Pg 81\)](#) for details about valid expressions. In the example, \$Temp is a variable read from the SNMP device; \$CriticalHighTemp and \$MajorHighTemp are parameters set by the user.
- **Condition-String** is a string that describes the resulting status if the Condition-to-test evaluates to true.
- **Notifier-list** is an optional, comma-delimited list of notifier names. The notifier names listed here are mapped to actual "InterMapper Notifier Names" via the <snmp-device-notifiers> section.

When InterMapper evaluates alarm point expressions, it scans the list for a particular alarm point, and sets its status based on the first expression that "triggers". If no expression triggers, then InterMapper sets the alarm point severity to "Clear"

## Macros

InterMapper supports several macros that show information about an alarm point:

- **`${alarmpointname}`** shows the alarmpoint's severity as a five-character string. The strings are colored to match the severity. To use this facility, enter the alarmpoint name enclosed in `${...}`. For example, to show the SiteTemp alarm point's severity (above), enter:

```
${SiteTemp}
```

and it would generate the strings "CRIT ", "MAJOR", "MINOR", or "CLEAR", with the appropriate color.

- **`${alarmpointname:condition}`** shows the alarmpoint's condition string, as defined in the `<snmp-device-alarmpoints>` section. For example, to show the SiteTemp alarm point's condition above, type:

```
${SiteTemp:condition}
```

and it would generate the string "VERY\_HIGH\_TEMP". This string may contain any markup as described on the [Probe File Description \(Pg 17\)](#) page.

## AlarmPoint Facilities

InterMapper provides several alarm point facilities:

### *Underscore Feature*

Use the Underscore feature to control whether an alarm point is cleared permanently or temporarily when you reset the AlarmPointList.

A device's AlarmPointList contains the following important information:

- alarm points that are **currently in alarm** (i.e., not in Clear state)
- alarm points that were **recently in alarm**, but are now Clear.

This minimizes the clutter in the AlarmPointList, so that it only contains relevant and interesting information. (All the other alarm points are assumed to be clear, and therefore can be ignored.)

The "recently in alarm" qualifier deserves explanation. There is a link in the device's Status Window that allows you to "reset the alarm point list" and remove the cleared alarm points

Alarm point names that begin with an underscore ("\_") are treated in this way (hence the name of the facility.) For example: `_SWO_PROC_SWO_PROC` is an underscore alarm point, whereas `SWO_PROC_SWO_PROC` is treated as a normal alarm point.

### *State Transitions*

- **Startup** When a map is opened, devices with alarm points are in the Unknown (grey) state, and their AlarmPointList is empty.
- **Normal Operation:** As InterMapper receives information about a device's state, either from a poll or a received trap, it sets its icon color accordingly. If this information sets a new non-underscore alarm point (one whose state is currently not known), it is added to the AlarmPointList, in the proper color/severity. If it is for a new underscore alarm point, it is added to the AlarmPointList only if the severity is not Clear. If this new information updates an existing alarm point, then that point's severity will be updated in the AlarmPointList.
- **Resetting the AlarmPointList:** When the user clicks an AlarmPointList's **Reset** link in the status window, all the Clear alarm points are removed from the device's AlarmPointList. All alarm points that are in alarm (not Clear) remain in the list.

**Note:** The **Reset** link removes all "clear" alarm points, but the effect is permanent only for "underscore" alarm points. non-underscore alarm points are cleared temporarily; the cleared non-underscore alarm points reappear in the status page in the next refresh (unless the condition that resulted in "clear" severity has changed).

### *Resetting to Neutral Alarm State*

InterMapper can receive a trap or some other command that sets a device into the "Startup" state described above. This is useful for the process of re-synchronizing InterMapper's notion of a device's state with its actual state. A single trap could indicate, "I don't know the state of a device" (perhaps because it had gone down, and now came back up), and InterMapper reflects that lack of certainty by clearing the alarm point list and turning the device grey.

InterMapper provides a "reset" severity that resets the device to its "power on" state. That is, the device and all its alarm points are set to the Unknown state. Such an alarm point is never listed in the AlarmPointList.

Usage:

```
DeviceResetRule: reset ( reset-condition ) condition-string =>  
Notifier-List
```

If reset-condition is true and there are alarms to be cleared, an event log entry will be created for the action. If the condition-string is not empty, a notification will be sent to the Notifier-List.

### ***Facilities to speed up rule evaluation***

We will implement a "Break" severity that will abort the processing of the remaining rules of the probe if ever its expression is true. Such an alarm point will never be listed in the AlarmPointList.

Usage:

```
BreakRule: break ( break-condition ) condition-string => Notifier-List
```

In a break rule, Notifier-List is not used. If the condition-string is not empty, an event log message will be created everytime this rule fires (this is done for debugging purposes).

### **Sample probe**

Below a sample probe that uses all the features described above. To test the probe, use the net-snmp *snmptrap* program to send traps to the device. For example, to set \$trapVar to 5, use the following command line:

```
snmptrap.exe -v2c -c community computername ' 1.3.6.1.4.1.11898.2.1
1.3.6.1.4.1.11898.2.1.18.1.18 i 5
```

In the sample probe below, three trap variables are used in three separate alarm points. The first group of alarm points (\_trapVarAP) is an "underscore" alarm point, the state is not shown unless the alarm point reaches a non-clear state (minor, major, critical). Note that setting the \$trapVar variable to 4 never brings the alarm point state to critical since there is a break rule right before the rule that brings the state to critical state:

```
<header>
  type           =      "custom-snmp"
  package        =      "com.dartware"
  probe_name     =      "snmp.testalarmpoint"
  human_name     =      "Alarm point test example"
  version        =      "0.1"
  address_type   =      "IP,AT"
  flags          =      "SNMPv2c"
  port_number    =      "161"
</header>

<description>
  ...
</description>

<snmp-device-variables>
  trapVar,       1.3.6.1.4.1.11898.2.1.18.1.18, TRAPVARIABLE,
"trap variable 1"
  trapVar2,      1.3.6.1.4.1.11898.2.1.18.1.19, TRAPVARIABLE,
"trap variable 2"
  trapVar3,      1.3.6.1.4.1.11898.2.1.18.1.20, TRAPVARIABLE,
```

```
"trap variable 3"
</snmp-device-variables>

<snmp-device-notifiers>
  NotifySomeone: "NotifyFred:0:0:0"
</snmp-device-notifiers>

<snmp-device-alarmpoints>
  -- sample underscore alarm point
  -- the three reset alarm point have the same effect: resetting
  the device state to initial state

    trapVarAP: clear ($trapVar = "2") "trapVar - clear" =>
NotifySomeone
    trapVarAP: reset ($trapVar = "3") "trapVar - reset" =>
NotifySomeone
    trapVarAP: minor (${trapVar} = "4") "trapVar - minor" =>
NotifySomeone
    trapVarAP: critical (${trapVar} = "5") "trapVar - major" =>
NotifySomeone
    trapVarAP: break ($trapVar = "6") "trapVar - break" =>
NotifySomeone
    trapVarAP: critical (${trapVar} >= "6") "trapVar - critical" =>
NotifySomeone

    -- other, normal alarm points
    trapVarAP2: clear ($trapVar2 = "2") "trapVar2 - clear" =>
NotifySomeone
    trapVarAP2: reset ($trapVar2 = "3") "trapVar2 - reset" =>
NotifySomeone
    trapVarAP2: break ($trapVar2 = "4") "trapVar2 - break" =>
NotifySomeone
    trapVarAP2: critical (${trapVar2} >= "4") "trapvar2 - critical"
=> NotifySomeone

    trapVarAP3: clear ($trapVar3 = "2") "trapVar3 alarm" =>
NotifySomeone
    trapVarAP3: reset ($trapVar3 = "3") "trapVar3 alarm" =>
NotifySomeone
    trapVarAP3: break ($trapVar3 = "4") "trapVar4 alarm" =>
NotifySomeone
    trapVarAP3: critical (${trapVar3} >= "4") "trapvar alarm" =>
NotifySomeone
</snmp-device-alarmpoints>

<snmp-device-display>
  \B5\Trap variable values\0P\
  \4\trapvar:\0\ $trapVar, ${ trapVarAP:condition}\0P\
  \4\trapvar2:\0\ $trapVar2, ${trapVarAP2:condition} \0P\
  \4\trapvar3:\0\ $trapVar3, ${trapVarAP3:condition} \0P\

  $alarmpointlist
</snmp-device-display>
```

## Alarm Point Notifier List

The `<snmp-device-notifiers>` section contains several lines of the format:

```
NotifierName: "notifier-rule" [ , "notifier-rule" ]
```

where the *NotifierName* is an identifier that can be used in the notifier-list section of the alarm-points section, and the *notifier-rule* is a quoted specification for a notification rule.

A *notifier-rule* contains the name of the actual InterMapper notifier and the notification delay, repeat and count, using the format below (the quote characters are required):

```
"name:delay:repeat:count"
```

Delay and repeat are specified in minutes. If values for delay and repeat are omitted, the value is zero. The count is the number of additional times the notification is repeated. If repeat is zero, the count will be ignored because there is no repeat. If repeat is non-zero and the count is omitted, the count is infinite (repeat forever).

```
<snmp-device-alarmpoints>
  -- Name:      Severity (Condition-to-Test)      Condition-String
=> Notifier-List
  SiteTemp: critical ($Temp > $CriticalHighTemp) "VERY_HIGH_TEMP"
=> PageFred
  SiteTemp:      major ($Temp > $MajorHighTemp)   "HIGH_TEMP"
=> PageFred
</snmp-device-alarmpoints>

<snmp-device-notifiers>
  PageFred: "Fred via Pager:0:0:0"
</snmp-device-notifiers>
```

In this example, either of the SiteTemp alarms triggers the "PageFred" notifier. Looking farther down in the `<snmp-device-notifiers>` section, we see that "PageFred" sends the notification to the "Fred via Pager" (which is defined in the **Notification list**.)



### Probe Calculations

InterMapper can compute values from data retrieved from devices, including SNMP MIB variables, round-trip time, packet loss, availability, etc. The results of these computations can be compared to thresholds to set device status and indicate problems.

### Expression Syntax

InterMapper's Expression Syntax has the following features:

- Supports arithmetic expressions using +, -, \*, /, %, and unary minus.
- Supports the use of parentheses to group sub-expressions for calculation first.
- Stores all intermediate and final results as double-precision floating point numbers.
- Supports relational operators <, >, <=, >=, =, <>, ==, !=. The value for TRUE is "1.0". The value for FALSE is "0.0".
- Supports short-circuit logical operators 'and', 'or', 'not' as well as &&, ||, !, .
- Supports variables and functions from a provided symbol table. Variables may use \$var syntax or \${var} syntax.
- Supports built-in functions for bitwise operations, rounding, and other common mathematical functions.
- Supports embedded string comparisons and simple regular expression tests. A variable in double-quotes will be treated as a string. All double-quoted strings are interpolated for variables in a Perl-like fashion. The use of + as the concatenation operator is supported. See below for [an example that uses Regular Expressions \(Pg 89\)](#).

The set of capabilities are derived from C, Perl, Excel, and expr(1).

### Reserved keywords

- and
- or
- not

### Precedence Table (Least to Most)

1. Assignment: :=
2. Conditional Expression: ?:
3. Logical Or: 'or', ||
4. Logical And: 'and', &&
5. Equality Tests: ==, =, !=,
6. Relational Tests: <, >, <=, >=
7. Addition, Subtraction, Concatenation: +, -
8. Multiplication, Division, Modulo: \*, /, %
9. String Matching: =~, !~
10. Unary: -, !, 'not'

**Built-in Numeric Functions**

- `abs( x )` - Absolute value of 'x'.
- [round \(Pg 83\)](#)(x), `round(x,y)` - Round 'x' to nearest integer.
- `trunc( x )` - Remove all digits after the decimal point; e.g. `trunc( 3.987 ) = 3`.
- `min( x1, x2, ... , xn )` - Minimum value of x1, x2, ..., xn.
- `max( x1, x2, ... , xn )` - Maximum value of x1, x2, ..., xn.
- `bitand( x, y )` - Bitwise 'and' of 'x' and 'y'.
- `bitor( x, y )` - Bitwise 'or' of 'x' and 'y'.
- `bitlshift( x, y )` - Bits of 'x' shifted left by 'y' bits.
- `bitrshift( x, y )` - Bits of 'x' shifted right by 'y' bits.
- `bitxor( x, y )` - Bitwise exclusive-or of 'x' and 'y'.
- `sin( x )` - sine of 'x' where 'x' is in radians.
- `cos( x )` - cosine of 'x' where 'x' is in radians.
- `tan( x )` - tangent of 'x' where 'x' is in radians.
- `pi()` - value of PI (e.g. 3.14159...)
- `pow( x, y )` - 'x' to the power of 'y'.
- `sqrt( x )` - square root of 'x'.
- `exp( x )` - e to the power of 'x', where e is the base of the natural logarithms.
- `log( x )` - natural logarithm of 'x'.
- `log( x, y )` - logarithm of 'x' to base 'y', e.g. `log( 100, 10 ) = 2`
- `time()` - Time in seconds since 1 January 1970 UTC.

**Built-in String Functions**

- [defined \(Pg 83\)](#)(str) - Takes a string argument, and returns a non-zero value (1) if the variable name specified in the input string is defined.
- [strfind \(Pg 83\)](#)( strToBeSearched STRING, substrToFind STRING ) - Case sensitive match returns the position of the first matching substring.
- [strifind \(Pg 83\)](#)\_ ( strToBeSearched STRING, substrToFind STRING ) - Case insensitive match returns the position of the first matching substring.
- [strlen \(Pg 84\)](#)(str) - Returns the length in bytes of the string 'str' or the combined length of all string arguments.
- [sprintf \(Pg 84\)](#)( fmt, ... ) - Returns formatted string using format specifier 'fmt'. Format specifier 'fmt' contains format codes that begin with '% '.
- [strftime \(Pg 87\)](#)( fmt, [secs] ) - Returns formatted date/time string using format specifier 'fmt'.
- [strptime \(Pg 87\)](#)( str, fmt ) - Returns the number of seconds since UTC 1970 represented by the given date/time string, as interpreted using the specified format code.
- [subid \(Pg 88\)](#)(oid, start, length) - Gets the specified length sub-OIDs from a given OID string, starting from index start (the index starts from 0).
- [substr \(Pg 88\)](#)( str, offset, len )
- [unpack \(Pg 89\)](#)( binary str, fmt )
- Regular Expressions - See below for [an example that uses Regular Expressions \(Pg 89\)](#).

### Function Descriptions

#### *defined*

FUNCTION defined(variable:STRING):INTEGER;

Returns a non-zero value (1) if the variable name specified in the input string is defined (it has already been assigned a value).

**Note:** This function takes a string argument. Note the usage below.

Example:

```
defined("var2") = 1 ? "$var2 is defined" : "$var2 is undefined"
```

#### *round*

FUNCTION round(x:DOUBLE, y:INTEGER):DOUBLE;

FUNCTION round(x:DOUBLE):INTEGER;

Rounds a given double value (**x**) to the nearest integer or to the given number of decimal places (**y**).

Examples:

```
round(8.6) --> 9  
round(3.14159, 3) = 3.142
```

#### *strfind*

FUNCTION strfind( strToBeSearched:STRING, substrToFind:STRING ):INTEGER

Case-sensitive string match returns an integer representing the position of the first occurrence of a substring in the string. If the substring is not found, the function returns a value of -1.

Example:

```
strfind( "Ethernet Interface", "int")  
returns -1 (did not find the substring)
```

#### *strifind*

FUNCTION strifind( strToBeSearched:STRING, substrToFind:STRING ): INTEGER

Case-insensitive string match returns an integer representing the position of the first occurrence of a substring in the string. If the substring is not found, the function returns a value of -1.

Example:

```
strifind( "Ethernet Interface", "int")
returns 9 (found the substring at position 9)
```

### ***strlen***

FUNCTION strlen(str[, ...]:STRING):INTEGER

Returns the length of the string ***str*** in bytes.

Returns the combined length of all string arguments in bytes.

Examples:

```
strlen( "Help/Systems" ) --> 8
strlen( "Help/Systems", "2000" ) --> 12
```

### ***sprintf***

FUNCTION sprintf( fmt:STRING, ... ):STRING

Returns formatted string using format specifier ***fmt***. Format specifier ***fmt*** contains format codes that begin with '%'. The following format codes are supported:

- c - Formats numeric argument as ascii character
- d - Formats numeric argument as decimal integer
- o - Formats numeric argument as octal integer
- x - Formats numeric argument as hexadecimal number (lower case)
- X - Formats numeric argument as hexadecimal number (upper case)
- u - Formats numeric argument as decimal integer (unsigned)
- s - Formats argument as an ascii string (NUL terminated)
- a - Formats argument as a hexadecimal string with bytes separated by ':'
- f - Formats numeric argument as floating point (fixed precision)
- e - Formats numeric argument as floating point (scientific notation)
- g - Formats numeric argument as floating point (easy to read)
- % - Prints a percent sign

The general specification for a format code is:

```
% [-] [<width>] [. <precision> ] <code>
```

### String Formatting

For string data using %s, the width specifies the minimum width of the output field, and the precision specifies the number of characters to output. If the number of output characters is less than the minimum field width, the output is padded with spaces.

Example:

```
printf( "%10s", "Help/Systems" )  
Results in "    Help/Systems"  
printf( "%s", "Help/Systems" )  
Results in "Help/Systems"
```

The default alignment is to the right; so padding is added to the beginning of the string. To left align the output of %s, you need to include a '-' immediately following the '%':

```
printf( "%-10s", "Help/Systems" )  
Results in "Help/Systems "  
printf( "%-10.4s", "Help/Systems" )  
Results in "Dart      "
```

### Integer Formatting

Integers format similar to strings, except the <precision> field specifies the maximum field width, and this is enforced by padding with 0's if necessary.

```
printf( "%5d", 12 )  
Results in "   12"  
printf( "%-5d", 12 )  
Results in "12  "  
printf( "%6.5d", 12 )  
Results in " 00012"  
printf( "%-2X", 15 )  
Results in "F "  
printf( "%-2.2x", 15 )  
Results in "0f"
```

**Floating Point Formatting**

The floating point format codes use the <precision> field to specify the number of decimal places following the decimal point. %f uses the format '[-]ddd.ddd', and %e uses the format '[-]d.ddde+-dd'.

```
sprintf( "%f", 1/2 )  
    Results in "0.500000"  
sprintf( "%5.3f", 1/2 )  
    Results in "0.500"  
sprintf( "%e", 1/2 )  
    Results in "5.000000e-01"  
sprintf( "%g", 1/2 )  
    Results in "0.5"
```

**Address Formatting**

The %a format code outputs a string in hexadecimal.

```
sprintf( "%a", "\x01\x02\x03" )  
    Results in "01:02:03"  
sprintf( "%a", "Help/Systems" )  
    Results in "44:61:72:74:77:61:72:65"
```

### ***strftime***

FUNCTION `strftime( fmt [, time] )`

Returns formatted date/time string using format specifier 'fmt'. Format specifier 'fmt' contains format codes that begin with '%'. If a time argument is provided, it must be in seconds since UTC 1970. If no time argument is provided, it defaults to the current time. The following format codes are supported on all platforms:

- a - Abbreviated weekday name
- A - Full weekday name
- b - Abbreviated month name
- B - Full month name
- c - Date and time formatted something like "Tue Feb 06 10:25:22 2007"
- d - Day of month (01-31)
- H - Hour number (00-23)
- I - Hour number (01-12)
- j - Day of the year number (001-366)
- m - Month number (01-12)
- M - Minute number (00-59)
- p - "AM" or "PM"
- S - Second number (00-61)
- U - Week of the year number (00-53). First Sunday is day 1 of week 1.
- w - Weekday number (0-6). Sunday is 0.
- W - Week of the year number (00-53). First Monday is day 1 or week 1.
- x - Date.
- X - Time.
- y - Two-digit year number (00-99)
- Y - Year with century (e.g. 2007)
- z - Time zone.
- % - Prints a percent sign

The `strftime` function is implemented using the identically named function in the underlying system. Other format codes may work, but these are not portable.

```
strftime( "%c")
Results in "Tue Feb  6 11:19:24 2007"
strftime( "%Y-%m-%d", 1170778895)
Results in "2007-02-06"
```

### ***strptime***

FUNCTION `strptime( str , fmt )`

Returns the number of seconds since UTC 1970 represented by the given date/time string, as interpreted using the specified format code. Basically, this function can be used to parse dates.

This function uses the same underlying format codes as `strftime`.

Example:

```
strftime( "%Y", strtotime( "1990", "%Y"))
Results in "1990"
```

### **subid**

FUNCTION subid(oid, start, length)

Gets the specified length sub-OIDs from a given OID string, starting from index start (the index starts from 0). When the start index is negative, it will be counted from the end of the OID string.

Examples:

```
subid("1.3.6.1.2.1.4.20.1.1.10.10.2.20", 0, 2)    --> "1.3"
subid("1.3.6.1.2.1.4.20.1.1.10.10.2.20", -4, 4)   --> "10.10.2.20"
subid("\1.3.6.1.2.1.4.20.1.1.10.10.2.20\", 0, 2)  --> \"1.3\"
subid("\1.3.6.1.2.1.4.20.1.1.10.10.2.20\", -4, 4) --> \"10.10.2.20\"
subid("\1.3.6.1.2.1.4.20.1.1.10.10.2.20\", 4, 4)  --> \"2.1.4.20\"
subid("\1.3.6.1.2.1.4.20.1.1.10.10.2.20\", -2, 4) --> \"2.20\"
subid("\1.3.6\", 3, 4)    --> \"\"
subid("\1.3.6\", 2, 4)    --> \"6\"
subid("\1.3.6\", -4, 4)   --> \"1.3.6\"
subid("\1.3.6\", -2, 4)   --> \"3.6\""
```

### **substr**

FUNCTION substr(str:STRING, offset:INTEGER):STRING;

FUNCTION substr(str:STRING, offset:INTEGER, length:INTEGER):STRING;

Extract a substring out of **str** and return it. The substring is extracted starting at **offset** characters from the start of the string.

- If **offset** is negative, the substring starts that far from the end of the string instead; **length** indicates the length of the substring to extract.
- If **length** is omitted, everything from **offset** to the end of the string is returned.
- If **length** is negative, the length is calculated to leave that many characters off the end of the string. If neither **offset** nor **length** is supplied, the function will return **str**. (See Perl *substr*).

Examples:

```
substr( "0123456789", 7)    --> "789"
substr( "0123456789", 4, 2) --> "45"
substr( "0123456789", 4, -2) --> "4567"
substr( "0123456789", -2, 1) --> "8"
```



***unpack***

FUNCTION `unpack(str:STRING, format:STRING):VALUE`

Take a string ***str*** representing a data value and convert it into a scalar value. The format string specifies the type of value to be unpacked. (See perl *unpack*).

- If the input string is shorter than the expected number of bytes to be unpacked, treat the input string as if it is padded with zero bytes at the end.

```
unpack("\1\2\3", ">L")
```

is the same as

```
unpack("\1\2\3\0", ">L")
```

- If the input string is longer, the remaining bytes in the input are ignored.
- If the endian modifier is not supplied, we will use the target platform's byte order (little endian on Windows, big endian on Mac).
- If format specifier is not supplied, the function will return *str*.

<b>Format specifier</b>	<b>Description</b>
-------------------------	--------------------

c	signed character value (1 byte)
C	unsigned character value (1 byte)
l	signed long value (4 bytes)
L	unsigned long value (4 bytes)
s	signed short value (2 bytes)
S	unsigned short value (2 bytes)
#B	a base64 string (all bytes)
>	big-endian modifier
<	little-endian modifier
H	decodes the given hexadecimal value and returns an integer (up to 32-bits)
#H	decodes the given hexadecimal value and returns a string

Examples:

```
unpack( "\1", "c")          --> 1
unpack( "\1\2\3\4", ">L")    --> 16909060
unpack( "\1\2\3\4", "<L")    --> 67305985
unpack( "BS64", "#B")       --> "... " (where "... "
is "\x5\x2e\xb8")
unpack( "\1\2\3", ">L")      --> 16909056
unpack( "1F", "H")          --> 31
unpack( "42696c6c207761732068657265", "#H") --> "Bill was here"
```

**Note:** The `unpack()` function supports one format code in the format string.

## Using Regular Expressions In Custom SNMP Probes

You can use a regular expression to divide a string into separate variables after retrieving it from a device. In the example below, a customer had a piece of equipment that returned the following information in sysDescr.0:

```
FW TR6-3.1.4Rt_F213E4, 2.4GHz, 0dBi ext. antenna
```

They created a probe that retrieved sysDescr.0 and then parsed out those strings with the following commands in the <snmp-device-variables> section of the probe:

```
<snmp-device-variables>
  sysDescr, 1.3.6.1.2.1.1.1.0,
    DEFAULT, "system description"
  firmware, "$sysDescr" =~ "^FW ([^,]+), (.+)Hz, (.+) antenna"
; "${1}", CALCULATION, "Firmware"
  frequency, "${2}",
    CALCULATION, "Frequency"
  antenna, "${3}",
    CALCULATION, "Antenna"
</snmp-device-variables>
```

1. Retrieve sysDescr.0 (OID of 1.3.6.1.2.1.1.1.0) and assign it to the variable \$sysDescr.
2. Set the value of \$firmware based on the calculation. There are many things going on in this line:
  - The "=~" operator indicates that the \$sysDescr variable should be parsed using the regular expression string that follows.
  - This regular expression breaks the string at the comma characters. The "[^,]" matches any single character that isn't a comma; adding a "+" forms a pattern that matches multiple non-comma characters.
  - Parentheses around a pattern serve to memorize a string. Each pair of paren's matches a string whose value is placed in variables numbered \${1}, \${2}, \${3}, etc.
  - The semicolon followed by "\${1}" indicates that the entire CALCULATION should return the value of \${1} as a string.
  - The variable \$firmware thus gets assigned the value of \${1}
3. Assign the variable \$frequency with the result of the second match (\${2}).
4. Assign the variable \$antenna with the result of the third match (\${3}).

**Note:** It is beyond the scope of this manual to describe the full capabilities of regular expressions. There are a number of tutorials available on the web. One example is the [Perl Regular Expression Tutorial](#).

## Probe Properties

The `<snmp-device-properties>` section specifies certain aspects of the SNMP queries sent to the device. Like other sections, it is closed with a `</snmp-device-properties>` tag. For example:

```
<snmp-device-properties>
  nomib2           = "true"
  pdutype          = "get-request"
  apcups           = "false"
  maxvars          = "10"
  interface_numbered = ($ifIndex == 2 or $ifDescr =~ "en2")
  interface_visible = ($ifIndex == 2 or $ifDescr =~ "en2")
</snmp-device-properties>
```

The properties that may be set include:

- **nomib2="true"** -- InterMapper does not query the sysUptime MIB-2 variable.
- **pdutype="get-request"** -- InterMapper uses SNMP Get-Request, instead of Get-Next-Request queries.
- **apcups="false"** -- If apcups is false, InterMapper will not query the APC-UPS MIB even for devices that auto-detect as one.
- **maxvars="10"** -- maxvars controls the maximum number of variables to put in each SNMP request. If a custom probe requires more variables than maxvars, InterMapper sends multiple queries containing up to maxvars variables.
- **interface\_visible = <expression>** - specifies a "filter expression" for use in determining which interfaces are made visible. By default, InterMapper makes the numbered interfaces visible. Setting this property allows you to make certain *unnumbered* interfaces visible if they match the expression that can use \$ifIndex, \$ifDescr, \$ifType, or \$ifAlias variables.  
**Note:** This property does not allow you to make numbered interfaces hidden.
- **interface\_numbered = <expression>** - specifies a "search expression" for use in determining which interface is made numbered. By default, the ipAddrTable specifies which interface is numbered. This property allows the probe file to override that choice.

## Specifying SNMP OIDs in Custom Probes

### Introduction

InterMapper supports two kinds of OID's: Numeric and Symbolic. The Symbolic OIDs become available when a MIB has been imported into InterMapper.

In addition, InterMapper supports three kinds of OID expressions: Get-Next, Trap-Conditional, and Index-Derived.

### Numeric OID's

Numeric OID's contain only numbers separated by periods. Preceding periods are ignored. A trailing period is allowed if there is only one subid.

#### Examples:

```
.1  
1.  
1.3.6
```

#### Invalid examples:

```
1 (no period)  
1.3.6. (trailing period but with multiple subids)  
1.3.6.blah (not numeric)  
1.3.6.1.2.1.system.sysUpTime.0 (not numeric)
```

Unlike Net-SNMP, InterMapper ascribes no special meaning to OID's that begin with a period; all numeric OID's are considered absolute.

Errors in numeric OID's are reported by the system to the Event Log when the error is in a custom probe. The error message will have the form:

```
Syntax error in OID "1.3.6.1..1.2"
```

### Symbolic OID's

A symbolic OID begins with a letter, after ignoring any preceding periods. InterMapper must be able to locate a MIB file that defines the symbols used. There are three types of symbolic OID's:

1. Simple symbols specify a starting symbol and zero or more trailing subid's.
2. Relative symbols specify a starting symbol and one or more subid symbols.
3. Scoped symbols specify the name of the MIB, the scope operator ::, followed by a simple or relative symbol.

Relative and scoped symbols are handy when a symbol is ambiguous, i.e. the same symbol name is defined differently in two separate MIB files. You should prefer the scoped OID form, when possible.

Symbolic names are case-sensitive.

### Examples:

```
Simple: sysUpTime
        sysUpTime.0
        enterprises.9.2.3.4.5

Relative: system.sysUpTime
          system.sysUpTime.0

Scoped: SNMPv2-MIB::sysUpTime
        SNMPv2-MIB::system.sysUpTime.0
```

### Invalid Examples:

```
Simple: sysUpTiime    (misspelled; not found)
        sysupTime    (wrong case)
        sys%pTime    (disallowed character %)
        sysUpTime.0.  (bad; trailing period)

Relative: system.ifIndex (bad; ifIndex isn't under system)

Scoped: SNMPv2-MIB.sysUpTime (bad; must use :: for scoped OID)
        IF-MIB::sysUpTime    (bad; wrong MIB module for sysUpTime)
```

Errors in symbolic OID's are reported by the system to the Event Log when the error is in a custom probe. The error message will have the form:

```
Syntax error in OID "sys%pTime"
```

### *OIDs indexed by Strings*

Certain MIBs specify tables that are indexed by strings. The net-snmp documentation at

<http://www.net-snmp.org/tutorial/tutorial-5/commands/output-options.html>

describes this. A convenient way to enter these OIDs is:

```
NET-SNMP-EXTEND-MIB::nsExtendOutLine."LOG"
```

and a SNMP variable could be created like this:

```
outLine, NET-SNMP-EXTEND-MIB::nsExtendOutLine."LOG",
DEFAULT, ""
```

***Limitations of Symbolic OID's***

1. Symbolic OID's will only work if the necessary MIB file is loaded into InterMapper. If InterMapper cannot resolve the symbolic OID using a MIB file, this is considered a syntax error in the symbolic OID. At this time, there is no way to bundle a MIB file with a probe as one file; this is a future direction.
2. It may happen that two or more MIB files define the same symbol. When this happens, InterMapper may pick the wrong definition. You can avoid this by using the scoped OID form.

**Get-Next OID Expressions**

InterMapper has a special syntax for "get-next" style OID's - attach a + to the end of the OID.

Normally, when you specify a variable to query in a custom SNMP probe, you specify the complete OID, including the instance. For example, you might specify "sysUpTime.0" or "ifInOctets.13". For sysUpTime, the .0 specifies the (only) instance. For ifInOctets, the .13 specifies the value for ifIndex 13.

There are occasions when you want to query a variable using a preceding OID. For example, you might want to query the value of ifInOctets for the first interface, but you can't assume the ifIndex of the first interface is 1. Here's how you would specify the OID:

```
ifInOctets+
```

To retrieve the value of ifInOctets for the interface whose ifIndex follows 13, specify the OID with a plus:

```
ifInOctets.13+
```

The plus sign must immediately follow the OID. Technically, it's not part of the OID, but considered an operator in InterMapper's OID expression language.

Note: Get-Next OID expressions will not work for custom SNMP probes that specify get-request queries.

### Trap-Conditional OID Expressions

Trap-conditional OID expressions allow you to assign a variable only when it occurs in the varbind list of a certain trap. For example, you might want to set the value of your probe's "sysUpTimeCrashed" variable to value of the "sysUpTime.0" variable included in the varbind list of a "systemCrashed" trap. However, you don't want to set "sysUpTimeCrashed" when you see the sysUpTime.0 value in any other received trap. To restrict the assignment of sysUpTime.0 to only the systemCrashed trap, you need to specify both the systemCrashed trap OID and the sysUpTime.0 OID using the ?: operator. This combination is called a "Trap-Conditional" OID, or "Trap OID" for short.

Examples:

```
systemCrashed?:sysUpTime.0
sysTrapOID?:sysContact
SOMEMIB::sysTrapOID.1?:SMIV2-MIB::sysContact
```

Supported in 4.4, the legacy format for trap OID's is a numeric OID followed by an OID:

```
1.3.6.1.2.1::sysUpTime.0
```

The legacy format does not allow use of a symbolic name for a trap OID; this conflicts with the scoped format above. The use of :: for Trap-conditional OID expressions is deprecated. Please use ?: in the future.

### Index-Derived OID Expressions

When querying tables from SNMP devices, it is often useful to assign the value of a variable from a row's OID index. This technique will work even if the values used to index the row have an access of "not-accessible".

For more information, see [Index-Derived Variables](#) in the <snmp-device-variables-ondemand> Section topic.

## SNMP Probe Example

```

<!--
  Single OID Custom Probe
  (com.dartware.snmp.oidsingle.txt)
  Custom Probe for InterMapper
  (http://www.intermapper.com)
  Please feel free to use this as a base for further
  development.

  10 May 2007 Cloned from High Threshold probe -reb
  3 Jul 2007 Changed probe name to Single OID Viewer -
reb
  4 Sep 2012 Added a datasets section -jpd

  You can read the Developer Guide to learn more about
  InterMapper Probes. It's at:

  http://intermapper.com/go.php?to=intermapper.devgui-
de
-->

<header>
  "type"          = "custom-snmp"
  "package"       = "com.dartware"
  "probe_name"    = "snmp.oidsingle"
  "human_name"    = "SNMP - Single OID Viewer"
  "version"       = "1.4"
  "address_type"  = "IP,AT"
  "port_number"   = "161"
  "display_name"  = "SNMP/Single OID Viewer"
  "flags"         = "Minimal"
</header>

<snmp-device-properties>
  nomib2 = "true"
  pduType = "get-request"
</snmp-device-properties>

<description>
\GB\Single OID Viewer\P\

This probe retrieves a single SNMP MIB variable and
displays it in the device's Status Window.

\ib\Variable\p\ specifies the MIB name or OID for the
value to retrieve. If you have imported the MIB for
this device, you may enter the symbolic name for this
value, otherwise, simply enter its OID here.

\bi\Legend\p\ is a text string used to identify the
variable in the status window and any strip charts. If
left blank, the variable's name or OID will be used.

\bi\Units\p\ is a text string that will be displayed
next to the value in the Status Window. You can use it
for the unit of measure (packets/sec, degrees, etc.)

```



```
\bi\Tag\p\ is a short text string that identifies a
particular class of dataset. Tags will be used to
correlate different variables from different probes
that describe the same thing, such as CPU% or
temperature.
</description>

-- Parameters are user-settable values that the probe
uses for its comparisons.
-- Specify the default values here. The customer can
change them and they will be retained for each device.

<parameters>
  "Variable"   = "ifNumber.0"
  "Legend"     = ""
  "Units"      = ""
  "Tag"        = "exampletag"
</parameters>

-- SNMP values to be retrieved from the device, and
-- Specify the variable name, its OID, a format
(usually DEFAULT) and a short description.
-- CALCULATION variables are computed from other values
already retrieved from the device.

<snmp-device-variables>

    theLegend, ($Legend!="" ? "$Legend" :
"$Variable"), CALCULATION, "Legend/OID"
    theOID,      $Variable ,      DEFAULT, "$theLegend"

</snmp-device-variables>

-- The <snmp-device-display> section specifies the text
that will be appended
-- to the device's Status Window.

<snmp-device-display>
\B5\ $theLegend:\0P\ $theOID \3G\ $Units\mp0\
</snmp-device-display>

<datasets>
  $theOID, "$Tag", "$Units", "false", "$Legend"
</datasets>
```

## Chapter 4

---

### SNMP Trap Probes

```
type = "custom-snmp-trap"
```

A *trap* is an unsolicited packet sent from a device to InterMapper (or other SNMP management console). The trap generally contains one or more data values that give information about the device's state.

When a trap arrives, InterMapper first determines which device(s) on the enabled maps should receive information from the trap. InterMapper examines the Agent Address (for relayed traps) or the Source IP address, and passes a copy of the trap packet to *each* device on the maps whose IP address matches. For example, if a device with the IP address is on two maps, or is present twice on the same map, each of those devices will receive a copy of the trap.

InterMapper then parses out all the values from the trap and assigns them to trap variables for use in the remainder of the probe.. InterMapper then re-evaluates the expressions in the probe, and sets the device status appropriately. If a particular trap variable is not set by an incoming trap, expressions containing that variable are *not* evaluated. See the [The <snmp-device-variables> Section for Traps \(Pg 99\)](#) section below for details of defining trap variables.

Finally, as a result of receiving the trap, InterMapper re-polls the device that sent the trap. This guarantees that InterMapper has the most up-to-date information about the device's state. If another trap arrives before the final response of this new poll has returned, InterMapper will complete the current poll and initiate another round of polling to get the new state.

**Note:** A trap is sent as a UDP packet. If something on your network is causing packet loss, it is possible to lose a trap packet. Therefore, Help/Systems recommends that you don't rely completely on traps as a means for monitoring the health of a device. There is no substitute for regular polling.

The [Example Trap Probe \(Pg 104\)](#) demonstrates how to retrieve and display the contents of a trap.

### The `<snmp-device-variables>` Section For Traps

A **Trap Variable** is a variable defined in a custom probe file whose value is set to a value received in a trap. InterMapper has three kinds of Trap Variables, only one of which can be declared in a probe:

- **Packet Trap Variables** - a set of variables automatically set by InterMapper when a trap is received.
- **Positional Trap Variables** - a set of variables automatically set by InterMapper. Use positional Trap Variables to access data from the trap's VarBind list by position in the list.
- **Named Trap Variables** - variables you define by associating an SNMP OID with a name. If the OID exists in the trap's VarBind list, the variable is set to the value in the trap.

A Trap Variable will never be polled: that is, InterMapper never sends an SNMP GetRequest or GetNextRequest to retrieve its value.

#### **Packet Trap Variables**

In addition to the variables in the VarBind List, a probe can set variables based on the fields of the trap packet's header.

- **\$GenericTrap** - The GenericTrap field in the trap (SNMPv1). This field can take on the values:
  - 0 - coldStart;
  - 1 - warmStart;
  - 2 - linkDown;
  - 3 - linkUp;
  - 4 - authenticationFailure;
  - 5 - egpNeighborLoss;
  - 6 - An enterprise-specific value.
- **\$SpecificTrap** - The value of the SpecificTrap field in the trap. If the \$GenericTrap value is 0-5, the \$SpecificTrap is zero (0); otherwise it is a positive 32-bit value specified by the vendor (SNMPv1).
- **\$TimeStamp** - The TimeStamp field in the trap, in hundredths of a second.
- **\$Enterprise** - The value of the SNMPv1 enterprise field (SNMPv1)
- **\$CommunityString** - The value of the CommunityString field in the trap (SNMPv1, SNMPv2c).
- **\$TrapOID** - The value of the TrapOID field in the trap (SNMPv2c, SNMPv3).
- **\$AgentAddress** - The IP address of the SNMP agent that generated the trap.
- **\$SenderAddress** - The IP address of the device that sent the trap. This could be different from the \$AgentAddress when the sender is forwarding traps for the agent.
- **\$SnmVersion** - Represents the version of the trap. Values can be 0 (v1), 1 (v2c) or 3 (v3).
- **\$VarbindCount** - The number of variables contained in the VarBind list.

***Positional Variables from the Varbind List***

You can access values from the VarBind List by ***position*** using variables of the form:

- **\$VarbindValueN** - The value of the N'th variable in the trap's VarBind List
- **\$VarbindTypeN** - The type of the N'th variable in the trap's VarBind List
- **\$VarbindOIDN** - the OID of the N'th variable in the trap's VarBind List

**Note:** N may be from 1 to 50.

***Named Trap Variables***

The only way to set a named Trap Variable value is to receive a trap that contains the OID in its VarBind List, or the set the named variable to the value of a positional variable. The [Probe Variables section \(Pg 52\)](#) of this document describes the file format. Here is an example:

```
<snmp-device-variables>
  InterMapperTimeStamp, 1.3.6.1.4.1.6306.2.1.1.0, TRAPVARIABLE,
  "Timestamp"
</snmp-device-variables>
```

In this example, the variable \$InterMapperTimeStamp is set every time a trap arrives containing the OID 1.3.6.1.4.1.6306.2.1.1.0 in the VarBind List. Trap Variables that don't have values set by an incoming trap are left undefined.

A full [example trap file \(Pg 104\)](#) is available.

Here's how several useful trap variables might be defined

```
<snmp-device-variables>
  genericTrapVar,      $GenericTrap,      TRAPVARIABLE,      "Generic
Trap"
  specificTrapVar,    $SpecificTrap,      TRAPVARIABLE,      "Specific
Trap"
  timeStampVar,       $TimeStamp,         TRAPVARIABLE,      "Timestamp"
  enterpriseVar,      $Enterprise,        TRAPVARIABLE,
  "Enterprise"
  commStringVar,      $CommunityString,   TRAPVARIABLE,      "Community
String"
  trapOIDVar,         $TrapOID,           TRAPVARIABLE,      "Trap OID"
  agentAdrsVar,       $AgentAddress,       TRAPVARIABLE,      "Agent
Address"
  senderAdrsVar,      $SenderAddress,      TRAPVARIABLE,      "Sender
Address"
  snmpVersionVar,     $SnmVersion,        TRAPVARIABLE,      "SNMP
Version"
  varbindCountVar,    $VarbindCount,      TRAPVARIABLE,      "Varbind
Count"
  — the first and second values from the Varbind List by position
  trap_var1, $VarbindValue1, TRAPVARIABLE, "First value"
  trap_var2, $VarbindValue2, TRAPVARIABLE, "Second value"
</snmp-device-variables>
```

**Note:** The TRAPVARIABLE type causes the value to be displayed in the most useful format. You can also use one of following to force the display to a certain format. These variables are equivalent to their non-trapvariable counterparts, whose complete descriptions of the formats are available in [Probe Variables \(Pg 52\)](#):

- TRAPVARIABLE-TOTAL-VALUE
- TRAPVARIABLE-PER-SECOND
- TRAPVARIABLE-PER-MINUTE
- TRAPVARIABLE-STRING\*
- TRAPVARIABLE-INTEGER
- TRAPVARIABLE-HEXADECIMAL\*
- TRAPVARIABLE-HEXNUMBER
- TRAPVARIABLE-DOUBLE

\* STRING and HEXADECIMAL are both strings; they can't be charted.

### ***Accessing Trap Variables by Position***

When accessing VarBind List entries, you can access them either by name or by position. Access by name is much easier to program and understand, but there have been instances where a vendor's traps contained VarBind List entries with the same name: in those cases you must get their values by position. Below are examples of accessing VarBind List entries by name and by position.

Given this trap, InterMapper creates the following Event Log entry:

```
03/23 11:37:34 TRAP IC3 Demo System:Video Stream ENC01 LIVEWAVE-
MIB::deviceFaulted (v2c)
  { LIVEWAVE-MIB::deviceUnitID : "5",
    LIVEWAVE-MIB::deviceName : "5 - Video Stream",
    LIVEWAVE-MIB::deviceStatus : "6" }
```

The trap contains these three values: deviceUnitID, deviceName, and deviceStatus. (InterMapper has already imported a LIVEWAVE MIB that defines these OIDs.)

The variables are declared in the variables section:

```
<snmp-device-variables>
  deviceUnitID, LIVEWAVE-MIB::deviceUnitID, TRAPVARIABLE, "Device
  Unit ID"
  deviceName, LIVEWAVE-MIB::deviceName, TRAPVARIABLE, "Device
  Name"
  deviceStatus, LIVEWAVE-MIB::deviceStatus, TRAPVARIABLE, "Device
  Status"
</snmp-device-variables>
```

When a trap is received, the probe variables above are set to the values of the trap variables from the VarBind list. One way you could use them is as follows:

```
<snmp-device-thresholds>
  critical: deviceStatus = 3 "Problem with $deviceUnitID
  $deviceName: Device status = $deviceStatus"
  okay: deviceStatus = 1 "$deviceUnitID $deviceName functioning
  normally."
</snmp-device-thresholds>
```

You can also access the variables by position in the VarBind list:

```
<snmp-device-variables>
  deviceUnitID, LIVEWAVE-MIB::$VarbindValue1, TRAPVARIABLE, "Device
  Unit ID"
  deviceName, LIVEWAVE-MIB::$VarbindValue2, TRAPVARIABLE, "Device
  Name"
  deviceStatus, LIVEWAVE-MIB::$VarbindValue3, TRAPVARIABLE, "Device
  Status"
</snmp-device-variables>
```

### The <snmp-device-display> Section for Traps

Use the <snmp-device-display> section to format the device's Status window exactly the same way as you do in an SNMP Probe. For more information, see the SNMP Probe's [<snmp-device-display> Section](#) topic.

### Trap Viewing and Logging

The contents of trap message are logged to the Event Log file at the time the trap is received. There are two forms: Short and Verbose. (The format is controlled by the **Verbose Trap Logging** checkbox in the **Server Settings > SNMP** preference pane.)

#### Short Trap Format

```
06/08 20:50:29 TRAP TestMap:192.168.2.1 1.3.6.1.4.1.6306 (333)
{ "321", "456" } (via 192.168.1.233)<p>
```

#### Verbose Trap Format:

```
06/08 20:50:05 TRAP TestMap:192.168.2.1 1.3.6.1.4.1.6306 (333)
{ 1.3.6.1.4.1.6306.99.1 : "321", 1.3.6.1.4.1.6306.99.2 : "456" }
(via 192.168.1.233)<p>
```

The fields of the trap entry in the log file are defined below, with examples in "[ ... ]":

- **Date and Time** - [ 06/08 20:50:05 TRAP ]  
The date and time followed by the word "TRAP"
- **Map Name and Device ID** - [ TestMap:192.168.2.1 ]  
The map name and device ID, separated by a colon (":")
- **Enterprise OID and Trap Field** - [ 1.3.6.1.4.1.6306 (333) ]  
The Enterprise OID, followed by the specific trap field in paren's
- **VarBind List** - The contents of the VarBind List, enclosed in curly braces, and separated by commas.  
Short format: { "321", "456" } shows only the values sent for each VarBind in quotes.  
or  
Verbose format: { 1.3.6.1.4.1.6306.99.1 : "321", 1.3.6.1.4.1.6306.99.2 : "456" }  
shows the OID, a colon (":"), and the OID's value in quotes.
- **Address** - [ (via 192.168.1.233) ] The address of the relaying computer, if present.

The verbose format shows all the information that was sent with the trap.

## Example - Trap Viewer Probe

The following example shows the handling of traps.

```

<!--
  SNMP Trap Viewer probe (com.dartware.snmp.trapdisplay.txt)
  Probe for InterMapper (http://www.intermapper.com)

  Copyright (c) 2007, Help/Systems, LLC.
  Feel free to use this as the basis for creating new probes.

  25 Apr 2005 Original version - reb
  4 May 2005 Changed to "custom-snmp-trap" -reb
               Modified for IM 4.4 header/display items.
  8 May 2007 Added special trap variables to the probe and display
-reb
  29 May 2007 Changed probe name to "Trap Display", updated
description -reb
  1 Jun 2007 Changed probe name to "Trap Viewer"; tweaked
description;
               left canonical name alone -reb
-->

<header>
  "type"           =      "custom-snmp-trap"
  "package"        =      "com.dartware"
  "probe name"     =      "snmp.trapdisplay"
  "human name"     =      "Trap Viewer"
  "version"        =      "2.2"
  "address type"   =      "IP,AT"
  "port number"    =      "161"
  "display_name"   =      "SNMP/Trap Viewer"
</header>

<description>
\GB\Trap Viewer Probe\P\

This probe listens for trap packets to arrive and displays the
contents of the
trap in the Status Window. It does not actively poll the device, nor
does it
take any action based on the trap contents.

You can view all the variables that have been parsed from the trap
packet in the
device's Status Window. You can also use this as a prototype for
making your own
trap probes.

\B\How the Trap Viewer Probe Works\p\

When a trap arrives, the probe parses the trap to get the values from
the trap's
header as well as the first ten items in its Varbind List. It assigns
all these
values to variables that can be used in the probe and displayed in
the Status
Window.

```



To see how this probe works, you can configure your equipment to send traps to InterMapper, or use the `net-snmp \b\snmptrap\p\` command. Either way, the Status Window will show the values present in any traps that arrive.

For more information on the `\b\snmptrap\p\` command, read the `net-snmp` documentation for the `\u2=http://www.net-snmp.org/tutorial/tutorial-4/commands/snmptrap.html\trap tutorial\p0\` and the `\u2=http://www.net-snmp.org/docs/man/snmpinform.html\snmptrap command\0p\`. The remainder of this note shows how to send a trap with variables from the Dartware MIB:

`\i\SNMPv1 Traps\p\`

- a) Add a device to a map with the IP address `\i\192.168.56.78\p\`
- b) Set it to use this probe
- c) Issue the `snmptrap` command below from the command line (it should all be on one line):

```
snmptrap -v 1 -c commString localhost
1.3.6.1.4.1.6306 192.168.56.78 6 123 4567890
1.3.6.1.4.1.6306.2.1.1.0 s "05/08 23:26:35"
1.3.6.1.4.1.6306.2.1.2.0 s Critical
1.3.6.1.4.1.6306.2.1.3.0 s "Big Router"
1.3.6.1.4.1.6306.2.1.4.0 s "Critical: High Traffic"
1.3.6.1.4.1.6306.2.1.5.0 s "127.0.0.1"
1.3.6.1.4.1.6306.2.1.6.0 s "SNMP Traffic Probe"
```

`\i\SNMPv2c Traps\p\`

- a) Add a device to the map with an IP address of `\i\localhost\p\`
- b) Set it to use this probe
- c) Issue the `snmptrap` command below from the command line (it should all be on one line)

```
snmptrap -v 2c -c commString localhost
4567890 1.3.6.1.4.1.6306
1.3.6.1.4.1.6306 192.168.56.78 6 123 4567890
1.3.6.1.4.1.6306.2.1.1.0 s "05/08 13:26:35"
1.3.6.1.4.1.6306.2.1.2.0 s Critical
1.3.6.1.4.1.6306.2.1.3.0 s "Big Router"
1.3.6.1.4.1.6306.2.1.4.0 s "Critical: High Traffic"
1.3.6.1.4.1.6306.2.1.5.0 s "127.0.0.1"
1.3.6.1.4.1.6306.2.1.6.0 s "SNMP Traffic Probe"
```

</description>

<!-- Copy/paste these lines into the terminal window for testing...

```
snmptrap -v 1 -c commString localhost 1.3.6.1.4.1.6306 192.168.56.78
6 123
4567890 1.3.6.1.4.1.6306.2.1.1.0 s "05/08 13:26:35"
1.3.6.1.4.1.6306.2.1.2.0 s
Critical 1.3.6.1.4.1.6306.2.1.3.0 s "Big Router"
```

```

1.3.6.1.4.1.6306.2.1.4.0 s
"Critical: High Traffic" 1.3.6.1.4.1.6306.2.1.5.0 s "127.0.0.1"
1.3.6.1.4.1.6306.2.1.6.0 s "SNMP Traffic Probe"

snmptrap -v 1 -c commString localhost 1.3.6.1.4.1.6306 192.168.56.78
6 123
4567890 1.3.6.1.4.1.6306.2.1.1.0 s "05/08 13:26:35"
1.3.6.1.4.1.6306.2.1.2.0 s
Critical 1.3.6.1.4.1.6306.2.1.3.0 s "Big Router"
1.3.6.1.4.1.6306.2.1.4.0 s
"Critical: High Traffic" 1.3.6.1.4.1.6306.2.1.5.0 s "127.0.0.1"
1.3.6.1.4.1.6306.2.1.6.0 s "SNMP Traffic Probe"
1.3.6.1.4.1.6306.2.1.7.0 s
"var7" 1.3.6.1.4.1.6306.2.1.8.0 s "var8" 1.3.6.1.4.1.6306.2.1.9.0 s
"var9"
1.3.6.1.4.1.6306.2.1.10.0 s "var10" 1.3.6.1.4.1.6306.2.1.11.0 s
"var11"
1.3.6.1.4.1.6306.2.1.12.0 s "var12"

snmptrap -v 2c -c commString localhost 4567890 1.3.6.1.4.1.6306
1.3.6.1.4.1.6306.2.1.1.0 s "05/08 13:26:35" 1.3.6.1.4.1.6306.2.1.2.0
s Critical
1.3.6.1.4.1.6306.2.1.3.0 s "Big Router" 1.3.6.1.4.1.6306.2.1.4.0 s
"Critical:
High Traffic" 1.3.6.1.4.1.6306.2.1.5.0 s "127.0.0.1"
1.3.6.1.4.1.6306.2.1.6.0 s
"SNMP Traffic Probe"
—>

— The parameters in this probe are unused, but could be used to
— set thresholds for various alarms.
<parameters>
    "MinValue" = "10"
    "MaxValue" = "50"
</parameters>

<snmp-device-variables>

    — TrapVariables are updated when a trap arrives.
    — This set of variables comes from the Dartware MIB
    — and would be sent in a trap from another copy of InterMapper.

    trapTimeStamp,      1.3.6.1.4.1.6306.2.1.1.0, TRAPVARIABLE,
    "Timestamp"
    DeviceStatus,      1.3.6.1.4.1.6306.2.1.2.0, TRAPVARIABLE,
    "Status"
    DeviceDNS,         1.3.6.1.4.1.6306.2.1.3.0, TRAPVARIABLE, "DNS
    Name of Device"
    DeviceCondition,   1.3.6.1.4.1.6306.2.1.4.0, TRAPVARIABLE,
    "Condition String"
    TrapSourceAdrs,    1.3.6.1.4.1.6306.2.1.5.0, TRAPVARIABLE, "Source
    of trap"
    ProbeType,         1.3.6.1.4.1.6306.2.1.6.0, TRAPVARIABLE, "Probe
    that generated trap"

    — Variables from the trap packet itself

    genericTrapVar,    $GenericTrap,      TRAPVARIABLE, "Generic

```

```

Trap"
  specificTrapVar,      $SpecificTrap,      TRAPVARIABLE, "Specific
Trap"
  timeStampVar,        $TimeStamp,        TRAPVARIABLE,
"Timestamp"
  enterpriseVar,       $Enterprise,       TRAPVARIABLE,
"Enterprise"
  commStringVar,       $CommunityString,   TRAPVARIABLE, "Community
String"
  trapOIDVar,          $TrapOID,          TRAPVARIABLE, "Trap OID"
  agentAdrsVar,        $AgentAddress,     TRAPVARIABLE, "Address"
  senderAdrsVar,       $SenderAddress,    TRAPVARIABLE, "Sender
Address"
  snmpVersionVar,      $SnmVersion,      TRAPVARIABLE, "SNMP
Version"
  varbindCountVar,     $VarbindCount,     TRAPVARIABLE, "Varbind
Count"

```

— Positional names of Varbind List items

```

vbVal1,      $VarbindValue1,    TRAPVARIABLE, "Value of Varbind1"
vbType1,     $VarbindType1,     TRAPVARIABLE, "Type of Varbind1"
vbOID1,      $VarbindOID1,     TRAPVARIABLE, "OID of Varbind1"
vbVal2,      $VarbindValue2,    TRAPVARIABLE, "Value of Varbind2"
vbType2,     $VarbindType2,     TRAPVARIABLE, "Type of Varbind2"
vbOID2,      $VarbindOID2,     TRAPVARIABLE, "OID of Varbind2"
vbVal3,      $VarbindValue3,    TRAPVARIABLE, "Value of Varbind3"
vbType3,     $VarbindType3,     TRAPVARIABLE, "Type of Varbind3"
vbOID3,      $VarbindOID3,     TRAPVARIABLE, "OID of Varbind3"
vbVal4,      $VarbindValue4,    TRAPVARIABLE, "Value of Varbind4"
vbType4,     $VarbindType4,     TRAPVARIABLE, "Type of Varbind4"
vbOID4,      $VarbindOID4,     TRAPVARIABLE, "OID of Varbind4"
vbVal5,      $VarbindValue5,    TRAPVARIABLE, "Value of Varbind5"
vbType5,     $VarbindType5,     TRAPVARIABLE, "Type of Varbind5"
vbOID5,      $VarbindOID5,     TRAPVARIABLE, "OID of Varbind5"
vbVal6,      $VarbindValue6,    TRAPVARIABLE, "Value of Varbind6"
vbType6,     $VarbindType6,     TRAPVARIABLE, "Type of Varbind6"
vbOID6,      $VarbindOID6,     TRAPVARIABLE, "OID of Varbind6"
vbVal7,      $VarbindValue7,    TRAPVARIABLE, "Value of Varbind7"
vbType7,     $VarbindType7,     TRAPVARIABLE, "Type of Varbind7"
vbOID7,      $VarbindOID7,     TRAPVARIABLE, "OID of Varbind7"
vbVal8,      $VarbindValue8,    TRAPVARIABLE, "Value of Varbind8"
vbType8,     $VarbindType8,     TRAPVARIABLE, "Type of Varbind8"
vbOID8,      $VarbindOID8,     TRAPVARIABLE, "OID of Varbind8"
vbVal9,      $VarbindValue9,    TRAPVARIABLE, "Value of Varbind9"
vbType9,     $VarbindType9,     TRAPVARIABLE, "Type of Varbind9"
vbOID9,      $VarbindOID9,     TRAPVARIABLE, "OID of Varbind9"
vbVal10,     $VarbindValue10,   TRAPVARIABLE, "Value of Varbind10"
vbType10,    $VarbindType10,    TRAPVARIABLE, "Type of Varbind10"
vbOID10,     $VarbindOID10,    TRAPVARIABLE, "OID of Varbind10"
</snmp-device-variables>

```

<snmp-device-display>

```

\B5\Information about the Trap\0P\
  \4\CommunityString:\0\ $commStringVar
  \4\   TimeStamp:\0\   $timeStampVar
  \4\   AgentAddress:\0\ $agentAdrsVar

```

```

\4\  SenderAddress:\0\  $senderAdrsVar
\4\  GenericTrap:\0\    $genericTrapVar \3IG\ (v1 only) \POM\
\4\  SpecificTrap:\0\   $specificTrapVar \3IG\ (v1 only) \POM\
\4\  Enterprise:\0\     $enterpriseVar \3IG\ (v1 only) \POM\
\4\  TrapOID:\0\        $trapOIDVar \3IG\ (v2c only) \POM\
\4\  SnmpVersion:\0\    $snmpVersionVar \3IG\ (0=SNMPv1; 1=SNMPv2c)
\POM\
\4\  VarbindCount:\0\   $varbindCountVar \3IG\ (total number of
Varbinds) \POM\

\B5\Varbind List Items parsed by OID\0P\
\4\  TimeStamp:\0\      $trapTimeStamp \3IG\ \POM\
\4\  Device Status:\0\   $deviceStatus \3IG\ \POM\
\4\  Device DNS:\0\      $deviceDNS \3IG\ \POM\
\4\ Condition String:\0\ $deviceCondition \3IG\ \POM\
\4\ Trap Source Adrs:\0\ $trapSourceAdrs \3IG\ \POM\
\4\  Probe Type:\0\      $probeType \3IG\ \POM\

\B5\Varbind List Items by Position\0P\ \3IG\ (Varbind Value / Varbind
Type / Varbind OID) \POM\
\4\ VarBindList #1:\0\   $vbVal1 / $vbType1 / $vbOID1
\4\ VarBindList #2:\0\   $vbVal2 / $vbType2 / $vbOID2
\4\ VarBindList #3:\0\   $vbVal3 / $vbType3 / $vbOID3
\4\ VarBindList #4:\0\   $vbVal4 / $vbType4 / $vbOID4
\4\ VarBindList #5:\0\   $vbVal5 / $vbType5 / $vbOID5
\4\ VarBindList #6:\0\   $vbVal6 / $vbType6 / $vbOID6
\4\ VarBindList #7:\0\   $vbVal7 / $vbType7 / $vbOID7
\4\ VarBindList #8:\0\   $vbVal8 / $vbType8 / $vbOID8
\4\ VarBindList #9:\0\   $vbVal9 / $vbType9 / $vbOID9
\4\ VarBindList #10:\0\  $vbVal10 / $vbType10 / $vbOID10
</snmp-device-display>

```

## The Dartware MIB

Help/Systems, LLC has registered the Enterprise 6306 for its own SNMP variables. The remainder of this page shows the Dartware MIB in ASN.1 notation.

```
-- *****
-- DARTWARE-MIB for InterMapper and other products
--
-- May 2007
--
-- Copyright (c) 2000-2007 by Help/Systems, LLC
-- All rights reserved.
-- *****

DARTWARE-MIB DEFINITIONS ::= BEGIN

    IMPORTS
        MODULE-IDENTITY, OBJECT-TYPE, NOTIFICATION-TYPE, enterprises
        FROM SNMPv2-SMI
        DisplayString
        FROM SNMPv2-TC;

    dartware MODULE-IDENTITY
        LAST-UPDATED "200507270000Z"
        ORGANIZATION "Dartware, LLC"
        CONTACT-INFO "Dartware, LLC
            Customer Service
            Postal: PO Box 130
            Hanover, NH 03755-0130
            USA
            Tel: +1 603 643-9600
            E-mail: support@dartware.com"

        DESCRIPTION
            "This MIB module defines objects for SNMP traps sent by
            InterMapper."

        REVISION      "200705300000Z"
        DESCRIPTION
            "Updated descriptions to show timestamp format, correct
            strings for intermapperMessage."

        REVISION      "200512150000Z"
        DESCRIPTION
            "Added intermapperDeviceAddress and
            intermapperProbeType."

        REVISION      "200507270000Z"
        DESCRIPTION
            "First version of MIB in SMIV2."

        ::= { enterprises 6306 }

    notify          OBJECT IDENTIFIER ::= { dartware 2 }
    intermapper     OBJECT IDENTIFIER ::= { notify 1 }
```

```

intermapperTimestamp OBJECT-TYPE
    SYNTAX      DisplayString (SIZE(0..255))
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "The current date and time, as a string, in the
format 'mm/dd hh:mm:ss'."
    ::= { intermapper 1 }

intermapperMessage OBJECT-TYPE
    SYNTAX      DisplayString (SIZE(0..255))
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "The type of event - Down, Up, Critical, Alarm,
Warning, OK, or Trap - as a string."
    ::= { intermapper 2 }

intermapperDeviceName OBJECT-TYPE
    SYNTAX      DisplayString (SIZE(0..255))
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "The (first line of the) label of the device as
shown on a map, as a
        string."
    ::= { intermapper 3 }

intermapperCondition OBJECT-TYPE
    SYNTAX      DisplayString (SIZE(0..255))
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "The condition of the device, as it would be
printed in the log file."
    ::= { intermapper 4 }

intermapperDeviceAddress OBJECT-TYPE
    SYNTAX      DisplayString (SIZE(0..255))
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "The device's network address, as a string."
    ::= { intermapper 5 }

intermapperProbeType OBJECT-TYPE
    SYNTAX      DisplayString (SIZE(0..255))
    MAX-ACCESS  read-only

```

```
        STATUS          current
        DESCRIPTION
            "The device's probe type, as a human-readable
string."
        ::= { intermapper 6 }

-- For SMIV2, map the TRAP-TYPE macro to the corresponding
NOTIFICATION-TYPE macro:
--
--
-- intermapperTrap TRAP-TYPE
--     ENTERPRISE      dartware
--     VARIABLES       { intermapperTimestamp,
intermapperMessage,
--                     intermapperDeviceName,
intermapperCondition }
--     DESCRIPTION
--         "The SNMP trap that is generated by InterMapper
as a notification option."
--     ::= 1

intermapperNotifications OBJECT IDENTIFIER ::= { intermapper 0 }

intermapperTrap NOTIFICATION-TYPE
    OBJECTS { intermapperTimestamp, intermapperMessage,
              intermapperDeviceName, intermapperCondition,
              intermapperDeviceAddress, intermapperProbeType }
    STATUS current
    DESCRIPTION
        "The SNMP trap that is generated by InterMapper as a
notification option."
    ::= { intermapperNotifications 1 }

END
```

# Chapter 5

---

## TCP Probes

```
type="tcp-script"
```

TCP Probes connect to the specified device and port, then execute a script that sends and receives data from the device. InterMapper examines the responses, and sets the device's status and condition based on the results.

For example, the HTTP probe connects to the specified port, then issues the commands of an HTTP request to send data to the web server, and verifies the received data. If the response is not as expected, the probe sets the device into alarm or warning.

As another example, the [TCP Example \(Pg 137\)](#) shows another TCP-based probe that connects to a device. It then sends the specified string, waits several seconds and checks the response to determine the device state.

The Custom TCP probe is shown in full as an example, and can be used as the basis for making your own probes.

### Common Sections of TCP Probes

Each TCP probe follows the same general format as other probe files.

- The [<header>](#) (Pg 12) section of a command-line probe specifies the probe type, name, and a number of other properties fundamental to the operation of the probe.
- The [<description>](#) (Pg 17) section specifies the help text that appears in the Set Probe window. Format the description using IMML, [InterMapper's Markup language](#).
- The [<parameters>](#) (Pg 18) section defines the fields presented to the user in the Set Probe window.

### Sections Specific to TCP Probes

Each TCP probe also has:

- Use the [<script>](#) section of a TCP probe to define a sequence of commands the probe uses to interact with and query a device, and to interpret the responses from the device. The [<script>](#) section uses the [TCP Probe Scripting Language](#), a sequential language with a [rich set of commands](#).
- The [<script-output>](#) section of a TCP probe file formats the information retrieved from the device and sends it to the device's Status window. Format the script output using IMML, [InterMapper's Markup language](#).

InterMapper's TCP Probes establish a connection to a remote system, exchange commands and receive responses, and then set the status of the device based on those responses.



This note describes how probe writers can use *regular expressions* and *comparisons* to parse out information from the responses.

### The Overall Process

There is an annotated FTP probe in the [Developer Guide](#). This gives an overview of the script language and shows how it connects and logs into a FTP server, how a script can respond to error conditions, and how to set the device's status based on those conditions.

### Regular Expressions

The TCP Script Language uses the MTCH command to compare a response string to expected values. It can also use a regular expression to match on a part of a string. For example:

```
MTCH "A([BCD]+)E"r else goto @NOMATCH
STOR "testval" "${1}"
```

If the incoming line contains ABDE, then the "testval" variable will contain "BD".

In the MTCH regular expression, enclosing something in parentheses turns it into a capturing subgroup. The one or more Bs, Cs or Ds that it's matching will be stored in the \${1} variable. If you have several capturing groups, they get stored in \${2}, \${3}, etc.

For more information, see [the Regular Expressions examples](#) in Probe Calculations.

### Calculations in Scripts

To perform calculations within a TCP script, you should use [the EVAL command](#). Its argument is an expression (in quotes) that will be evaluated. It usually contains an assignment (with the ":=" operator), that sets a variable to the result of the expression. For example:

```
EVAL $celsius := (($fahrenheit - 32) * 5 / 9)
```

will set the variable \$celsius to the temperature that corresponds to the \$fahrenheit variable. The value of the \$celsius variable can be used in subsequent statements.

### Comparisons in Scripts

You can use the EVAL statement to make comparisons between either strings or numeric (either integer or floating point) values. To do this, write an EVAL statement that compares the two values and set the result in a new variable. If the comparison was true, then the resulting variable will be set to 1, otherwise it will be zero.

Here are examples of comparing numeric and string values:

#### Comparing Numeric Values

```
EVAL $x := ($val > 50.5)
NBNE #x #0 @greater
@less:
...
GOTO @ENDIF
@greater:
...
GOTO @ENDIF
@ENDIF:
```

#### Comparing String Values

```
EVAL $x := ("dog" > "cat")
NBNE #x #0 @dog
@cat:
...
GOTO @ENDIF
@dog:
...
GOTO @ENDIF
@ENDIF:
```

For more information, see The [Eval Macro section](#) of Built-in Custom Probe Variables.

### Simple Comparisons in Scripts

InterMapper TCP Scripts can compare two string or integer numeric values and branch based on the results. The commands below are no longer preferred as the EVAL statement described above is equally simple and more powerful.

The SBNE ("String Branch Not Equal") compares the two *string* values and branches if they are not equal. One or both of the arguments can be variables, expressed as `${variable-name}`.

The NBNE ("Numeric Branch Not Equal") and NBGT ("Numeric Branch Greater Than") compares two *numeric* values, branching on the result. The arguments to these commands are strings and are expected to be within quotes. To convert a string to a numeric value, place a number sign (#) before the parameter. For example:

```
STOR "val1" "100"
STOR "val2" "50"
NBGT #${val1} #${val2} @exit
```

In this example, the string `${val1}` will be converted to the numeric value 100, and `${val2}` will be converted to the numeric value 50, and the branch will be taken, because 100 is greater than 50.

**Note:** The NBGT, NBNE and other TCP probe commands expect integer arguments only (with an optional + or -). A script parses up to the first non-digit character. Thus, the value of "50.5" is 50; the remaining digits are ignored. If you wish to compare against a fraction or floating point value, use the EVAL statement described above.

These commands are described in detail in the [TCP Probe Command Reference](#) topic.

### The `<script>` Section

Use the `<script>` section of a TCP probe to define a sequence of commands the probe uses to interact with and query a device, and to interpret the responses from the device. The `<script>` section uses the TCP Probe Scripting Language, (described below) a sequential language with a [rich set of commands](#).

```
<script>
...
</script>
```

### TCP Probe Scripting Language

Use the InterMapper TCP Probe Scripting language to create custom probes. You can use script statements to send data to the device being tested, to examine responses from that device, and to return a status based on the response. To view a TCP Probe script example, see [Example TCP Probe File \(Pg 137\)](#).

- [Script Process Flow \(Pg 115\)](#)
- [Script Command Format \(Pg 115\)](#)
- [String Argument Format \(Pg 116\)](#)
- [String Matching \(Pg 117\)](#)
- [Numeric Argument Format \(Pg 118\)](#)
- [Using Labels for Program Control \(Pg 119\)](#)
- [Using Variables \(Pg 120\)](#)
- [Handling Script Failures \(Pg 121\)](#)
- [Adding Comments \(Pg 121\)](#)

### Script Process Flow

Each probe has a common process flow. It sends data (as a datagram or over a TCP connection) to the device to be tested, then examines any responses. Based on responses, the probe sets the device status (*UP*, *DOWN*, *CRITICAL*, *ALARM*, *WARN*, *OK*). It also sets a *condition string*, which contains a text description of the state.

### Script Command Format

All script command keywords have the following requirements:

- All commands are 4 letters long.
- All commands are case-sensitive.
- All commands MUST be in UPPER CASE.
- There must be white space between a command and each argument. You can include other text (e.g. comments) after the first argument, as long as it is separated by white space from the remaining arguments.

**Example:**

The **MITCH** command has the format

```
MITCH "string" #fail
```

The command statement

```
MITCH "blah" else goto #7
```

is treated exactly the same as

```
MITCH "blah" #7
```

When parsing the statement, InterMapper ignores the "else goto" part. This allows you to include comments to make the behavior of the script more obvious. This extraneous text does not have to be in uppercase.

**String Argument Format**

Some commands take string arguments.

- String arguments must be enclosed in double-quotes.

**Example:**

```
"This is a string"
```

### ***Special Characters***

The following special characters may be included by using a backslash escape code:

- \r** Carriage Return
- \n** Unix Linefeed
- \t** Horizontal Tab
- \f** Formfeed
- \b** Backspace
- \v** Vertical Tab
- \a** Alert (bell) Character
- \"** Double Quote
- \\** Backslash
- \ooo** Octal Number
- \xhh** Hexadecimal Number

### **Special Character Example:**

```
"\tThis sentence is preceded by a tab, and followed by a carriage  
return and linefeed.\r\n"
```

### **String Matching**

The MTCH and EXPT commands both specify a string to match. When specifying the string, you can use regular expressions. See Wildcard Matching, below.

### ***Controlling Case-Sensitivity***

- By default, string-matching is case-sensitive.
- Place an 'i' after the final quote if you want the matching to be case-insensitive.

### **Examples:**

"fred" matches only "fred".

"fred"i matches "fred", "FRED", or "FrEd".

### Wild-card Character Matching

In some cases, it is convenient to match a more general pattern. You can use simple regular expressions to match patterns and place them into variables.

To use regular expressions in MTCH and EXPT:

- Place an 'r' after the closing quote of the match string to indicate that the contents of the string is a regular expression.
- Place an 'i' after the closing quote of the match string to indicate that the match is case-insensitive.
- An expression inside round brackets (parentheses) creates a match group and places matched text within a numbered variable. The first variable is \${1}, the second is \${2}, and so on.
- A subsequent MTCH or EXPT command resets the variables, so you should make a copy of the contents into another variable after a match. See the example below.

#### Simple Example:

"red"r matches "fred", "Fred", "tred", "bred", etc. It does not match "freD" unless you include the "i" after the string.

#### More Complex Example:

Given the following returned data:

```
"var1=12 var2=1234.00 var3=45"
```

You match and store each data variable into an InterMapper variable:

```
MTCH m"var1=([0-9]+)"i else goto +1 (skip the next STOR line)
STOR "var1" "${1}"
MTCH m"var2=([0-9]+)"i else goto @BLAH
STOR "var2" "${1}"
MTCH m"var3=([0-9]+)"i else goto @BLAH
STOR "var3" "${1}"
```

Note: True Regex groups and the Alternate operator ( | ) are not supported.

### Numeric Argument Format

Some commands take numeric arguments.

- Numeric arguments are formed using a # sign followed by digits.

#### Example:

```
WAIT #30
```

### ***Using Numeric Arguments with the GOTO Command***

In many cases, numeric arguments are used to specify the script statement number to go to when a failure occurs. A special notation allows you to express these jumps as relative offsets.

- Include a sign ('+' or '-') after the # to express a relative offset from the current statement.

#### **Example:**

```
GOTO #+2
```

### ***Default Values and Script Termination***

- If a command takes a numeric argument, but you do not include it, the default value is 0.
- If you specify 0 as the statement to goto when the script fails, the script is terminated with a *DOWN* condition.

### **Using Labels for Program Control**

Use a label as script marker to which you can jump from elsewhere in the script.

Labels take the form:

```
@label_name
```

- Labels must be alone on a line.

#### **Example:**

```
@IDLE
```

### ***Jumping to a Label***

Use the *GOTO* command to jump to a label.

#### **Example:**

```
WAIT #30 seconds else goto @IDLE
```

**Using Relative Offsets to Transfer Control**

You can specify an offset for the *GOTO* command

Specify a offset (in statements) "#+n" or "#-n" to jump forward or backward *n* statements (respectively).

**Example:**

```
MITCH "${WARN Response}" else #+2
```

**Using Variables**

You can substitute variables in a script statement before the statement is processed.

- Variables names and their default values can be defined in the <parameter> section of the probe file, or by using the STOR, NADD, or TIME command.
- Variable names are preceded by a dollar sign (\$), and are enclosed by curly braces.
- Variable names are case-insensitive.
- See the the [Built-in Variable Reference \(Pg 36\)](#) topic for detailed information on variable usage.

**Example:**

\${Password} and \${password} are treated as the same variable

**Built-in Macros**

A macro is an expression that modifies an input string to produce another string. The built-in macros are:

|                                       |   |
|---------------------------------------|---|
| <b>\${_LINE:&lt;line&gt;}</b>         | The first <num> characters of the last line received.                             |
| <b>\${_BASE64:&lt;param&gt;}</b>      | The Base-64 encoding of the string that follows the ":".                          |
| <b>\${_CVSPASSWORD:&lt;param&gt;}</b> | The value of <param> encoded for use as a password over the CVS pserver protocol. |



### Handling Script Failures

Certain script commands may fail, either because they are malformed or because an unexpected situation occurs. For example, the script could jump to a non-existent command, it could fail to match a string it expects, or an unexpected disconnection could occur. In each case, the script immediately branches to a failure handler in the script. Each command that can fail takes the statement number of the failure statement as a numeric argument. If this number is omitted, the script will terminate with a "DOWN" status.

#### Example:

In the following example, the MTCH command succeeds if the incoming line of data contains "220". If the command fails, the script branches to statement 3.

```
MTCH "220" ELSE #3
```

**Note:** If the script is idle for too long, it may go to a special "idle" handler. See the [WAIT command \(Pg 133\)](#) for more details.

### Adding Comments to your Script

There are two ways to add comments to your script:

- Add text between or after arguments to a script command.
- Add a comment using the InterMapper probe file comment format.

#### *Adding text within a command line*

You can add text between arguments in a command line, as well as adding text after the line.

#### Examples:

The following statements all have exactly the same effect:

```
MTCH "331 " #14
MTCH "331 " else #14
MTCH "331 " else goto -1- #14 — Unexpected or unknown response to
USER command
```

***Adding text in Comment format***

Use the HTML comment syntax to add comments to a probe files. Place comments anywhere in a probe file. HTML comment syntax can be simplified by following this rule:

- Begin a comment with "<!--", end it with "-->", and do not use "--" within the comment.

**Example:**

```
<!-- This text is treated as a comment, and will be ignored -->
```

**The <script-output> Section**

The <script-output> section of a TCP probe file formats the information retrieved from the device and sends it to the device's Status window. Format the script output using IMML, [InterMapper's Markup language](#).

### TCP Probe Command Reference

This is a list of commands defined in the InterMapper TCP Probe Scripting Language. For an example of a custom probe script, see the [Annotated Example of the FTP \(Login\) Script \(Pg 134\)](#).

#### Device I/O Commands

The following commands operate on a device by sending data to the device or by reading one or more lines from the input (from the connection to the device being tested). Each command that reads a device compares its string to the *current line* - which is the most recently-read line from the connection. If there is no current line (for example, if a SEND command has been executed), these statements will read one or more lines to get the current line.

- [EXPT "string" #fail \(Pg 127\)](#) - Searches incoming lines for the specified *string*.
- [MTCH "string" #fail \(Pg 129\)](#) - Searches the next incoming line for the specified string.
- [SKIP "string" #fail \(Pg 132\)](#) - Ignore all incoming lines containing the specified *string*.
- [DISC #discfail \(Pg 126\)](#) - Jump to a specified line number if the probe is suddenly disconnected.
- [CONN #timeout \["TELNET"\] \["SECURE"\] \(Pg 126\)](#) - Specifies the connect timeout of the probe and whether to process Telnet options.
- [RCON \(Pg 131\)](#) - reconnects to the specified server and port.
- [PORT #port\\_num #connect\\_timeout \(Pg 130\)](#) - No longer required (the remote port number is now a separate parameter in the configuration dialog.)
- [LINE \[ON | OFF\] \(Pg 128\)](#) - Specifies whether the script should read incoming data as lines or as raw data.
- [NEXT \(Pg 130\)](#) - Clears the input buffer so that subsequent **MTCH** commands will operate on newly-received information.
- [SEND "string" \(Pg 131\)](#) - Sends the specified string to a remote device.
- [BRCV {BER sequence} \(Pg 125\)](#) - Receive TCP data and decode from BER format into a local format.
- [BSND {BER sequence} \(Pg 125\)](#) - Encode local data in BER format and send. (See LDAP probes for examples, syntax.)

#### Commands that control script flow

The following commands control the order of operations in the script.

- [CHCK "string" #fail \(Pg 125\)](#) - Determines whether "string" is non-empty.
- [DONE status \["message"\] \(Pg 126\)](#) - Terminates a script with a specified condition.
- [EXIT \(Pg 127\)](#) - Terminates a script with the condition specified previously by **STAT**.
- [FAIL \(Pg 128\)](#) - specifies the line # to jump to if a CONN command fails to connect.
- [GOTO #statement \(Pg 128\)](#) - Branches immediately to the specified statement number.
- [NBGT #arg1 #arg2 #line \(Pg 130\)](#) - (**N**umeric **B**ranch **G**reater **T**han) branches to #line if #arg1 is greater than #arg2.

- [NBNE #arg1 #arg2 #line \(Pg 130\)](#) - (**N**umeric **B**ranch **N**ot **E**qual) Compares two numeric arguments and branches to the indicated #line if they are not equal.
- [SBNE "arg1" "arg2" #line \(Pg 131\)](#) - (**S**tring **B**ranch **N**ot **E**qual) Compares two string arguments and branches to the indicated #line if they are not equal.
- [STAT status \["message"\] \(Pg 132\)](#) - Specifies the status condition of a script when it ends.
- [WAIT #secs #idlefail #discfail \(Pg 133\)](#) - Specifies the number of seconds the probe waits for a response.

### String processing commands

The following commands process and manipulate strings.

- [EVAL \\$result := expression \(Pg 127\)](#) - Assigns the evaluated value of `expression` to `${result}`
- [STOR "variable" "string" \(Pg 132\)](#) - Stores the string into the variable named "variable"
- [SCAT "variable1" "variable2" #fail \(Pg 131\)](#) - Concatenates variable1 and variable2, placing the resulting string in variable1.
- [NADD "variable" #number \(Pg 129\)](#) - (**N**umeric **A**dd) Adds a numeric value to a variable.

### Commands that measure time

- [STRT \(Pg 133\)](#) - Starts a millisecond timer that InterMapper can use to determine the elapsed time for some event.
- [TIME "variable" \(Pg 133\)](#) - Sets the named variable to the current number of milliseconds from the most recent STRT command.
- [WAIT #secs #idlefail #discfail \(Pg 133\)](#) - Specifies the number of seconds the probe waits for a response.

### Probe Command Details - Alphabetical

#### BRCV {BER Sequence}

Receive TCP data and decode from BER format into a local format, checking for expected tags and values as indicated. BER stands for "Basic Encoding Rules" for ASN.1. See LDAP probes for examples, syntax.

Documentation of BER format is beyond the scope of this manual.

**InterMapper-specific BER syntax** information you need is:

- { - starts a sequence (sequences may be nested)
- } - ends a sequence
- [ - starts a hexadecimal tag
- ] - ends a hexadecimal tag
- # - indicates a literal number follows
- " - begins and ends a literal string

Remember that `${}` is the variable format. Don't confuse these the sequence start and end characters `"{}"` with the variable delimiters.

#### Example:

```
BRCV { #1, [61]{ [0A]#ENUM, "", "" } } else @PARSE_
ERROR
```

#### BSND {BER sequence}

Encode local data in BER format and send. BER stands for "Basic Encoding Rules" for ASN.1. See LDAP probes for examples and syntax.

Documentation of BER format is beyond the scope of this manual. See [InterMapper-specific BER syntax \(Pg 125\)](#) above for the information you need to use BSND.

#### Example:

```
BSND { #1, [60]{ #3, "${Bind Name}", [80]"${Bind
Password*}" } }
```

#### CHCK "string" #fail

Use the **CHCK** command to determine whether "string" is non-empty. If the string is empty, the script jumps to the specified #fail line.

This command can be used to construct scripts whose control changes depending on whether an optional parameter is supplied.

**Possible failures:** None

***CONN #timeout ["TELNET"]["SECURE"]***

Use the **CONN** command to specify the connect timeout of the probe and whether to process Telnet options.

If you are going to use the **CONN** command, it *must be the first statement of the script*. When the script executes, the parameters of the **CONN** statement determine the options InterMapper uses to connect to the remote computer.

**#timeout:** The number of seconds to wait while trying to connect before giving up.

**"TELNET":** If the second parameter of the **CONN** command is "TELNET" (including the quotes), then the connection is created in a mode where the TCP stream automatically processes and negatively acknowledge any incoming Telnet options. This allows a Telnet probe to ignore the telnet options and work in simple line-by-line mode for the remainder of the script.

**SECURE** To create an SSL connection, place the word SECURE at the end of the line.

**SECURE:ADH** Use anonymous Diffie-Hellman key exchange.

**SECURE:NO\_TLS** TLSv1 is turned off when making a secure connection. The HTTPS (SSLv3) probe uses this option.

**Possible Failures:** None

***DISC #discfail***

Use the **DISC** command to cause the script to jump to a specified line number if the probe is suddenly disconnected. You can use this command to identify scripts that fail because of a TCP disconnection.

The script's disconnect line can also be set using the third parameter to the WAIT command.

***DONE status ["message"]***

Use the **DONE** command to terminate the script with the specified condition, which must be one of

```
[OKAY | WARN | ALRM | DOWN]
```

The optional "message" parameter lets you provide more detail about the condition. The status values for the **DONE** command must be in *UPPERCASE*.

**Example:**

```
DONE ALRM "[HTTP] 500 Response received."
```

This example sets the status of the device to *ALRM*. The condition of the device (which is displayed in the device's Status window and the Device List window) is

set to "[HTTP] 500 Response received." to give the user an indication of the reason for the alarm.

**Possible Failures:** None.

**Tip:** If the final statement of your script is not a **DONE** command, the script automatically terminates with a "DONE OKAY" status.

**EVAL *\$result* := *expression***

Assigns a value to the variable in `${result}` based on *expression*.

The expression can use any operators or functions defined in Probe Calculations, allowing you to perform variable assignments, arithmetic calculations, relational and logical comparisons, as well as use built-in functions to perform bitwise, rounding and mathematical operations. You can also perform operations on strings using regular expressions.

**Examples:**

```
-- Simple Assignment
EVAL $msgstring := $otherstring

--Simple subtraction of numeric values
EVAL $newopen := $fileopen - $prevfileopen

--Use of function and conditional logic
EVAL $prevtest := defined("test") == 1 ? $test : 0

--Use of regular expression
EVAL $msg_part := ($msg =~ "(.*)| *([^|]+)$")
```

Numerous examples that use the EVAL command can be found in the built-in TCP probes.

**Note:** The EVAL command used in TCP probes should not be confused with the [\*\*\*`\${eval}`\*\*\* macro \(Pg 42\)](#), available the output sections of command-line, SNMP, and TCP probes.

**EXIT**

Use the **EXIT** command to terminate the script, setting the status and condition string to whatever is specified by a previous **STAT** command.

**EXPT "*string*" #fail**

Use the **EXPT** command to "**EXPeCT**", or search for the specified *string* in any number of incoming lines.

- If the string is found, the script falls through to the next statement.
- If the string is not found, the script jumps to the statement specified in the *#fail* parameter.

**Notes:**

EXPT is identical to MTCH, except that:

- MTCH fails if the *\*next\** line or block does not match what is specified.
- EXPT keeps going until it finds a line or text block that matches what is

specified.

Both EXPT and MTCH can use regular expressions. For more information, see [String Matching \(Pg 117\)](#).

**Example:**

```
EXPT "220 " #14
```

**Possible Failures:**

The EXPT command can fail if the expected text is not received before the connection closes. In that event, the script jumps to the statement specified by *#fail*.

However, if the timeout specified by a previous WAIT command expires before the connection closes, the script jumps to the *#idlefail* line specified by the **WAIT** command instead.

**FAIL #**

Specify the line number to jump to if the probe fails to connect. The FAIL command must follow immediately after a CONN command line.

**Possible Failures:**

If the statement number is out of bounds, the script terminates with a **DONE** command and *DOWN* status.

**GOTO #statement**

Use the **GOTO** command to branch immediately to the specified statement number.

**Possible Failures:**

If the statement number is out of bounds, the script terminates with a **DONE** command and *DOWN* status.

**LINE [ON | OFF]**

Use the **LINE** command to specify whether the script should read incoming data as lines or as raw data.

**Notes:**

- By default, the script reads in **LINE ON** mode. That is, the incoming data is read until it is terminated by a CR-LF or just a plain LF, and then the line is processed.
- If you issue a **LINE OFF** command, data is read without regard for line delimiters.

Reading raw data is useful for scanning HTTP data since web pages are not necessarily broken into lines. InterMapper's TCP probe has a maximum line



buffer of 4096 characters, so if lines are longer than that, they may be treated as separate lines.

**Tip:** Once you've matched some data in **LINE ON** mode, you shouldn't match any more because your position in the buffer is not restored and you may miss something.

**Possible Failures:** None

### ***MTCH "string" #fail***

Use the **MTCH** command to "**MaTCH**", or search for the specified string in the next incoming line. If found, the script falls through to the next statement.

#### **Notes:**

MTCH is identical to EXPT, except that:

- MTCH fails if the \*next\* line or block does not match what is specified.
- EXPT keeps going until it finds a line or text block that matches what is specified.

Both EXPT and MTCH can use regular expressions. For more information, see [String Matching \(Pg 117\)](#)

#### **Example:**

```
MTCH "331" #16
```

#### **Possible Failures:**

If the next incoming line does not contain the desired string, or if the connection closes before the next line can be read, this script fails. In either case, the script jumps to the statement specified by **#fail**.

If the idle timeout expires instead, the script jumps to the **#idlefail** line specified by the previous **WAIT** command.

### ***NADD "variable" #number***

The **NADD** (**N**umeric **Add**) command adds a numeric value to a variable. The variable is looked up and converted to a numeric value. The number is added, and the result is converted back to a string and placed into the variable.

#### **Example:**

```
NADD "fred" #3
```

adds 3 to the value of the variable `fred`. If `fred` contains "3", the result will be "6". If `fred` contains "golf", the result will be "3" (because the conversion from a string to a number yields zero).

If the number is missing, the script adds zero to the value.

**Possible Failures:** None.

**NBGT #arg1 #arg2 #line**

Use the **NBGT** (**N**umeric **B**ranch **G**reater **T**han) command to branch to *#line* if *#arg1* is greater than *#arg2*.

**Example:**

```
NBGT ${arg1} ${arg2} @exit
branches to the label @exit if the numeric ${arg1} is greater than
${arg2}.
```

**Note:** Use the leading **#** to force InterMapper to treat the arguments as numeric values.

**Possible Failures:** None.

**NBNE #arg1 #arg2 #line**

Use the **NBNE** (**N**umeric **B**ranch **N**ot **E**qual) command compares the two numeric arguments, and branches to the indicated *#line* if the arguments are not equal.

**Example:**

```
NBNE ${arg1} ${arg2} @exit
```

branches to the label `@exit` if the numeric `${arg1}` is not equal to `${arg2}`.

**Possible Failures:** None.

**NEXT**

The **NEXT** command clears the input buffer (represented by the `${LINE}` variable) so that subsequent **MTCH** commands will operate on newly-received information.

**Notes:**

- The **SEND** command incorporates an implicit **NEXT** command.
- The **NEXT** command has no effect if input is not in **LINE** mode.

**Possible Failures:** None.

**PORT #port\_num #connect\_timeout**

*Deprecated* This command is no longer required in a script because the remote port number is now a separate parameter in the configuration dialog.

If present, this command must be in the first statement of the script. The first parameter specifies the default TCP port to connect to on the remote computer. The `#connect_timeout` parameter is the number of seconds to wait for the probe to connect.

**Possible Failures:** None

### ***RCON***

Takes no parameters.

See the Barracuda probes for examples and syntax.

**Possible Failures:** None

### ***SBNE "arg1" "arg2" #line***

The ***SBNE*** (**S**tring **B**ranch **N**ot **E**qual) command compares the two string arguments, and branches to the indicated #line if the arguments are not equal.

#### **Example:**

```
SBNE "${arg1}" "${arg2}" @exit  
branches to the label @exit if the string ${arg1} is not equal to  
${arg2}.
```

**Possible Failures:** None.

### ***SCAT "variable1" "variable2" #fail***

The ***SCAT*** (**S**tring **C**on**C**atenate) command concatenates variable1 and variable2 and places the resulting string in variable1.

#### **Example:**

```
STOR "name" "Fred"  
sets the variable ${name} to the string "Fred"  
  
SCAT "name" "Flintstone" @TOO_LONG  
sets the variable ${name} to the value "FredFlintstone"
```

**Possible Failures:** If the sum of the lengths of the strings exceeds 65,535 characters, the SCAT command will fail, and transfer to the @TOO\_LONG label.

### ***SEND "string"***

Use the ***SEND*** command to send the specified string to the remote device.

To send a line of data, you must explicitly specify the CR-LF using the quoting convention.

#### **Example:**

```
SEND "Greetings!\r\n"  
transmits the data "Greetings!" followed by a CR-LF.
```

**Possible Failures:** This command can't fail. If the data can't be sent because of a network failure or device failure, the failure shows up in a subsequent ***EXPT*** or ***MTCH*** command.

***SKIP "string" #fail***

Use the **SKIP** command to ignore all incoming lines containing the specified *string*. The script falls through to the next statement when an incoming line does *not* contain the *string*.

**Possible Failures:**

If the connection closes unexpectedly, the script jumps to *#fail*.

If the **WAIT** timeout (as defined by the **WAIT** command) expires, the script jumps to *#idlefail*.

***STAT status ["message"]***

Use the **STAT** command to specify the status of the device when the script ends. This command *does not* terminate the script. You can also specify a condition string as the second argument.

The status must be one of

[OKAY | WARN | ALRM | DOWN | CRIT]

**Example:**

```
STAT ALRM "[HTTP] 500 Response received."
```

**Note:** A subsequent **STAT** or **DONE** command overrides the value set by this command.

***STOR "variable" "string"***

The **STOR** command stores the string into the variable named *variable*. If you wish to set a variable to a numeric value, enclose the number in quotes ("). Subsequent parts of the script can refer to this variable as `${variable}`.

**Examples:**

```
STOR "fred" "foobar"
```

sets the variable `fred` to the text string `foobar`. Subsequent parts of the script can refer to this variable as `${fred}`.

```
STOR "fred" "3"
```

sets the variable `fred` to the string value `"3"`.

**Note:** String variables can be any length up to 65,535 characters.

**Possible Failures:** None.

### ***STRT***

The ***STRT*** command starts a millisecond timer that InterMapper can use to determine the elapsed time for some event. See the ***TIME*** command.

#### **Example:**

***STRT*** Starts the timer.

**Possible Failures:** None.

### ***TIME "variable"***

The ***TIME*** command sets the named variable to the current number of milliseconds from the most recent ***STRT*** command.

#### **Example:**

***TIME*** "connecttime"  
sets the variable `connecttime` to the number of milliseconds since the most recent ***STRT*** command. If there was no previous ***STRT*** command, the variable will be set to zero.

**Possible Failures:** None.

### ***WAIT #secs #idlefail #discfail***

Use the ***WAIT*** command to specify the number of seconds the probe waits for a response.

**Parameter 1 - #secs:** The number of seconds to wait for a response. If you do not include a ***WAIT*** command in your script, the default timeout 60 seconds is used.

**Parameter 2 - #idlefail:** If present, the script jumps to this line number if the probe is idle for the specified number of seconds. This idle handler supercedes the error line number specified by the ***EXPT***, ***SKIP***, or ***MTCH*** commands. If the `#idlefail` parameter is not included, the script branches to the failure handler of the current command. [\[link\]](#)

**Parameter 3 - #discfail:** If present, the script jumps to this line if the probe is unexpectedly disconnected. This allows you to identify scripts that fail because of a TCP disconnection.

**Possible Failures:** None

**Tip:** You should specify all three parameters in the ***WAIT*** command.

## Annotated Example of the FTP (Login) Script

```

01) PORT #21 (default tcp port)
02) WAIT #30 seconds
03) EXPT "220 " else goto -1- #14
04) SEND "USER ${User ID}\r\n"
05) MITCH "331" else goto -2- #16
06) SEND "PASS ${Password}\r\n"
07) MITCH "230" else goto -3- #20
08) SEND "NOOP\r\n"
09) MITCH "200" else goto -4- #24
10) SEND "QUIT\r\n"
11) EXPT "221" #+1 (i.e. can't fail)
12) DONE OKAY
13)
14) DONE DOWN "[FTP] Unexpected greeting from port ${_REMOTEPORT}.
    ${ LINE:50})" -1-
15)
16) MITCH "500" else goto #+2 -2-
17) DONE ALRM "[FTP] Port ${_REMOTEPORT} did not recognize the 'USER'
    command."
18) DONE ALRM "[FTP] Unexpected response to USER command. (${_
    LINE:50})"
19)
20) MITCH "530" else goto #+2 -3-
21) DONE WARN "[FTP] Incorrect login for \"${User ID}\"."
22) DONE ALRM "[FTP] Unexpected response to PASS command. (${_
    LINE:50})"
23)
24) DONE ALRM "[FTP] Unexpected response to NOOP command. (${_
    LINE:50})"

```

### Explanation of the Script

```

01) PORT #21 (default tcp port)
02) WAIT #30 seconds

```

**Line 1:** The PORT command at the beginning of the script specifies the default TCP port number for FTP, port 21.

**Line 2:** The WAIT command specifies that if the script doesn't hear responses back within 30 seconds, it fails.

```

03) EXPT "220 " else goto -1- #14

```

**Line 3:** FTP servers normally send one or more "220" lines to greet new FTP control connections. Our script scans the incoming lines for "220 ".

Note the space following the 220; we don't want to match an incoming "220-"; the incoming dash indicates there are still more 220 lines to be read -- we only want to match the final 220 line.

If the script fails to find "220 " before the connection closes or within 30 seconds, the script branches to statement 14. The "-1-" is an arbitrary label used to make the destination of the branch more easily visible.

The string "else goto -1-" has no function (except readability) in the script command text; this statement could have been written equally well as EXPT "220 " #14 . Note that statement #14 also has comment of "-1-" to show it is the destination.

```
04) SEND "USER ${User ID}\r\n"
```

**Line 4:** Send the FTP USER command. With this command, we send the user ID specified by the user, e.g. "anonymous". Note that you must include the carriage-return and line-feed at the end of the string sent, to denote the line ending.

```
05) MTCB "331" else goto -2- #16
```

**Line 5:** The script looks for the 331 response to the USER command.

If something else arrives, the script jumps to statement 16. Unlike the **EXPT** command, the **MTCB** command fails immediately if the next line doesn't contain the required text.

[...] (Skipping down to statement 16).

```
16) MTCB "500" else goto #+2 -2-
17) DONE ALRM "[FTP] Port ${_REMOTEPORT} did not recognize the
\"USER\" command."
18) DONE ALRM "[FTP] Unexpected response to USER command. (${_
LINE:50})"
```

**Line 16:** Statement 16 is executed only if statement 5 fails; that is, if an unexpected response to the USER command is received. The response is checked to see if it matches "500", which would indicate that the command isn't supported. This is possible if you accidentally try to pass the USER command to a TCP service other than FTP.

If the server's response matches "500", the script is terminated with the device in the *ALARM* status (in statement 17). The message reports that the server did not recognize the USER command.

If the server's response does not match "500", the script skips two lines to statement 18. This statement terminates the script with the *ALARM* status and uses the `${LINE}` macro to include the first 50 characters of the response line in the message.

## Measuring TCP Response Times

You can measure the response time of a device as it is being tested by a TCP probe. Times are measured in milliseconds.

With TCP Probes, InterMapper measures both the *time to establish the connection* and the *time for various portions of an interaction*. These times can be charted and logged.

### Time Measurement Probe Variables

TCP Timers are:

<b>Connection initiation interval</b>	<code>\${_connect}</code>	Records the time required to establish a connection.
<b>Connection duration interval</b>	<code>\${_active}</code>	Records the duration from the connection request until the end of the end of the script.

### TCP Script Commands

InterMapper supports two commands for measuring intervals during a script. These are:

<b>STRT</b>	Starts the probe's custom timer.
<b>TIME varname</b>	Sets the variable named <code>\${varname}</code> to the milliseconds elapsed since the customtimer was started.

### The <script-output> Section

Use the optional <script-output> section to display the results of custom TCP probes. The data in this section appears in a Status window when you click and hold on the device. The format of this section is the same as the <snmp-device-display>, described in [Customized Status Windows \(Pg 32\)](#).

Use the `${_connect}` and `${_active}` variables, as well as any variables set with the TIME *varname* command, in the <script-output> section of the Status window.

### A Note on Accuracy

InterMapper uses different techniques to measure the round-trip times of various probes.

- **Pings (ICMP and AppleTalk echoes)** - These are the most accurate timings. InterMapper detects the arrival of the Ping response at the moment it arrives. Thus, it can compute the response times with millisecond accuracy.
- **Other UDP-based and TCP-based probes** - These timings are computed by InterMapper as it does its normal polling. Thus, the measured time can be affected slightly by the such things as the number of devices probed and other various other tasks, as they may affect how long it takes InterMapper to execute a single round of polling.



## Example TCP Probe File

The following is the Help/Systems-provided probe for the Custom TCP script.

```
<!--
Custom TCP (com.dartware.tcp.custom)
Copyright © 2000-2003 Help/Systems, LLC.
Please feel free to use this as the basis for new probes.
-->

<header>
  type = "tcp-script"
  package = "com.dartware"
  probe_name = "tcp.custom"
  human_name = "Custom TCP" version = "1.2"
  address_type = "IP"
  port_number = "23"
</header>

<description>
\GB\Custom TCP Probe\P\
This probe lets you send your own string over the TCP connection and
set the
status of the device depending on the response received. There are
six
parameters which control the operation of this probe:
\i\String to send\p\ is the initial string sent over the TCP
connection. This
could be a command which indicates what to test, or a combination of
a command
and a password. The string is sent on its own line, terminated by a
CR-LF.

\i\Seconds to wait\p\ is the number of seconds to wait for a
response. If no
response is received within the specified number of seconds, the
device's status
is set to DOWN.

\i\OK Response\p\ is the substring which should match the device's
"ok
response". If it matches the first line received, the device is
reported to have
a status of OK.

\i\WARN Response\p\ is the substring which should match the device's
warning
response.

\i\ALRM Response\p\ is the substring which should match the device's
alarm
response.

\i\DOWN Response\p\ is the substring which should match the device's
down
response.

If InterMapper cannot connect to the specified TCP port, the device's
status is
set to DOWN.
```

```

</description>

<parameters>
  "String to send" = ""
  "Seconds to wait" = "30"
  "OK Response" = ""
  "WARN Response" = ""
  "ALRM Response" = ""
  "DOWN Response" = ""
</parameters>

<script>
  CONN #60 (connect timeout in secs)
  SEND "${String to send}\r\n"
  WAIT #${Seconds to wait} else goto @IDLE
  EXPT ".r" else goto @DISCONNECT
  MITCH "${OK Response}" else #+2
  DONE OKAY "[Custom] Response was \"${_LINE:50}\"."
  MITCH "${WARN Response}" else #+2
  DONE WARN "[Custom] Response was \"${_LINE:50}\"."
  MITCH "${ALRM Response}" else #+2
  DONE ALRM "[Custom] Response was \"${_LINE:50}\"."
  MITCH "${DOWN Response}" else #+2
  DONE DOWN "[Custom] Response was \"${_LINE:50}\"."

  @IDLE:
    DONE DOWN "[Custom] Did not receive a line of data within
  ${Seconds to wait}
    seconds. [Line ${_IDLELINE}]"

  @DISCONNECT:
    DONE DOWN "[Custom] Connection disconnected before a full line
  was received."
</script>

<script-output>
  \B5\Custom TCP Information\0P\
  \4\Time to establish connection:\0\ ${_connect} msec
  \4\Time spent connected to host:\0\ ${_active} msec
</script-output>

```

# Chapter 6

---

## Command Line Probes

```
type="cmd-line"
```

InterMapper provides the ability to run a *command-line* probe, a script or program (written in perl, C, C++, or your favorite language.) Your program's return value becomes the device's status on the InterMapper map.

### Common Sections of a Command-Line Probe

Each command-line probe follows the same general format as other probe files, sharing these common sections:

- The [<header>](#) (Pg 12) section of a command-line probe specifies the probe type, name, and a number of other properties fundamental to the operation of the probe.
- The [<description>](#) (Pg 17) section specifies the help text that appears in the Set Probe window. Format the description using IMML, [InterMapper's Markup language](#).
- The [<parameters>](#) (Pg 18) section defines the fields presented to the user in the Probe Configuration window.

### Sections Specific to Command-line Probes

Each command-line probe also has:

- The [<command-line>](#) (Pg 142) section - defines the command-line, specifying the path to the executable, the command to execute, and any arguments to the command.
- The [<command-exit>](#) (Pg 143) section - controls how the device's state is set, based on the results of the command.
- The [<command-display>](#) (Pg 143) section - controls what appears in the device's Status window.

InterMapper uses the information in the probe's `<command-line>` section to invoke the program or script and pass arguments to it. InterMapper sets the device's status based on the return code from the program or script. In addition, any data written to the script's standard output file is used as the device's reason string, and appears in the status window. The total amount of data that can be returned by the program, including return code, reason string, and additional values, is 64k.

InterMapper's command-line probes are similar to [Nagios® plugins](#). You can see the [standard set of Nagios plugins](#). Many vendors and individuals have created their own Nagios plugins. You will have to download the Nagios plugins and build/compile them yourself.

If you wish to develop your own command-line probes, we recommend you follow the [developer guidelines for Nagios](#). This will result in probes/plugins that work for both InterMapper and Nagios.

For more information about InterMapper and Nagios Plugins, see the [Nagios Plugins page \(Pg 152\)](#).

See [Command Line Probe Example \(Pg 149\)](#) for a sample shell script and corresponding probe.

### The <tool> section - embedding a companion script

You can also embed script code directly in a probe. This provides an easy way to deliver a command-line probe and a script that it runs in a single probe file, ensuring that the version of the script matches the version of the probe. WMI probes provide a number of good examples of companion scripts. For more information, see [The <tool> Section \(Pg 144\)](#).

### Command Line Script API

When InterMapper invokes a command line program or script, it passes parameters on the command line. Use the `path`, `cmd`, and `arg` properties of the `<command-line>` section to specify the script or other executable to invoke, and any arguments to the command. As the script developer, you are responsible for parsing the arguments.

The script can return three kinds of information to InterMapper:

1. The operating system return code, or *exit code*, is used to indicate the success/failure/severity. This will be handled by the `<command-exit>` section of the probe file.
2. The script can optionally return *additional values*, such as measurements, discovered during execution. It does this by writing to the script's `stdout`. You return these values as a comma-separated list enclosed in "{ ... }" characters. These values can then be handled as variables in the probe's `<command-display>` section. The values themselves are *name-value* pairs in the form:

```
<name> := <value>
```

3. The script can also return a **reason string** that will be used to explain the device's condition. You specify the reason string by writing to the script's `stdout`. This text should follow the closing "}" of any additional values.

**Example:** The following output from a script sets two values to the probe:

`$rtt` and `$hop`, and sets the device's reason string to *"Round-trip time is very high"*.

```
\{ $rtt := 5, $hop := 2 } Round-trip time is very high
```

You can do a significant amount when writing to `stdout`, using the `${^stdout}` variable. For more information, see [The \\${^stdout} variable and the Reason string \(Pg 44\)](#).

## Installing a Command-line Probe

Once you have created your probe, you need to install it before you can test it.

### To install and use a command-line probe:

1. If you are using an external script or other executable, create the program, and make it runnable. If it's a Perl, Python, or other script, set the permissions so that it can run from the command line. If it's written in C, C++, or other non-interpreted language, compile the source and then place the resulting binary in an appropriate directory. (See the [path \(Pg 139\)](#) discussion below.)  
**Note:** If you embed a script in the `<tool>` section of the probe, permissions are set by InterMapper when it writes the script to the Tools directory (when you import or reload the probe.)
2. Create a Command-line probe that references the executable program or contains the script in the `<tool>` section.
3. Import or reload the probe (from the Set Probe window) to make it available.

See [Command Line Probe Example \(Pg 149\)](#) for a sample shell script and corresponding probe.

### Passing parameters to a command-line probe

Pass arguments to the command line into the probe by accessing the parameter variables with `${parametername}`. The named arguments can be added to the command line.

For example, use `${Timeout}` for an parameter as follows:

```
<parameters>
  Timeout = "7"
</parameters>
```

The `arg` variable could be set as follows:

```
arg = "-H ${Timeout}"
```

**Note:** Depending on the nature of the parameters you are passing, you may want to pass the parameters through STDIN, as described below.

### Sending Data to STDIN

Using the `ps` command on Unix systems, or using the Task Manager or other utility programs on Windows systems, it is possible to see the command line arguments. This represents a security vulnerability. Use the `input` property of the `<command-line>` section to pass sensitive data to STDIN, removing this vulnerability. See [Sending Data to STDIN \(Pg 143\)](#) in *The <command-line> Section* for a detailed example.

### The `<command-line>` Section

The `<command-line>` section allows you to specify the information needed to execute the commands for the probe. There are three variables:

- **path** - specify the path to the executable script/command.
- **cmd** - specify the actual script/command.
- **arg** - specify the arguments to be passed to the script/command.
- **input** - specify information to pass to STDIN to the script/command.

### The Properties of the `<command-line>` Section

- Use the `path` property to specify the directories in which InterMapper should look for the executable to run as a probe. This is the only path InterMapper will use; the `PATH` environment variable is not used. The `path` property follows the conventions for the `PATH` environment variable on the system hosting InterMapper. The example below is for Unix or Mac OS X. A path for Windows would use "\" instead of "/" and ";" instead of ":".

#### Notes:

- If no path is specified, *InterMapper Settings/Tools* is used as the path.
- On Unix systems, it might be possible to see the command line arguments in the 'ps' listing. This represents a security vulnerability. Use the `input` variable to pass values to stdin, removing this vulnerability. For more information, see [Sending Data to STDIN \(Pg 143\)](#), below.
- Use the `cmd` property to specify the executable you wish to run. In the example below, this is "check\_ping". Note that you need to specify the exact name, including any extensions such as .exe or .cmd. You may also specify arguments as part of the `cmd` property if you'd like.
- Use the `arg` property to specify arguments to the executable. This may be instead of or in addition to specifying them in the `cmd` property. We could have just as easily written our sample `cmd` property as a command and argument, like this:

```
<command-line>
  path = ""
  cmd = "check_ping"
  arg = "-H ${ADDRESS} -w 100,10% -c 1000,90%"
</command-line>
```

- Use the `input` property to pass information to STDIN. See [Sending Data to STDIN](#), below.

Note the use of the "\${ADDRESS}" macro. This is replaced with the address given when the device was created. You can also use the "\${PORT}" macro to indicate the port given when the device was created.

## Sending Data to STDIN

Using the `ps` command on Unix systems, or using the Task Manager or other utility programs on Windows systems, it is possible to see the command line arguments. This represents a security vulnerability. Use the `input` variable to pass sensitive data to `stdin`, removing this vulnerability.

This mechanism provides a less visible channel for sensitive communication to a probe script. Usernames, passwords, and SSL pass-phrases are likely candidates for this technique.

### Example:

```
<command-line>
  cmd = "executable"
  input = "${User} ${Password}"
</command-line>
```

## The <command-exit> Section

### The <command-exit> Section

The <command-exit> section allows you to specify which results from the command indicate the five InterMapper device states. The states are:

- down
- critical
- alarm
- warning
- okay

For each state, you need to indicate what item InterMapper should examine and what its value should be to result in that state being set. At the moment, the only thing InterMapper can look at is the exit code, which is indicated with `${EXIT_CODE}`. So, in the example below, the line:

```
down: ${EXIT_CODE} = 2
```

means, "To determine if the device is down, examine the exit code from the command; if it is 2, the device is down." If none of the criteria for the states you have defined are true, then the device is set to "unknown".

## The <command-display> Section

The <command-display> section displays variables in the device's Status window using the same form as the output section of other probe types. If the plugin returns a non-integer value, you should use the `${chartable:...}` macro to display digits to the right of the decimal point. As with other probe types, you format the appearance of the output using IMML, [InterMapper's markup language](#).

See [Command Line Probe Example \(Pg 149\)](#) for a sample shell script and corresponding probe.

## The <tool> Section

Use the <tool> section of a command-line probe to embed a script's code directly into a command-line probe. The <tool> section provides a convenient way to maintain the probe and the script in a single file.

```
<tool:scriptname>  
  [script code]  
</tool:scriptname>
```

Replace ***scriptname*** with the executable you want to use for the script.

Replace ***[script code]*** with the code of the script.

### What happens when you load a probe with a <tool> section?

When the InterMapper server starts or when you import or reload a probe, if a tool section appears for a probe, InterMapper creates a subdirectory of Tools with the canonical name of the probe and writes the script to that subdirectory, using `scriptname` as a file name.

If a subdirectory of that name already exists, all non-hidden files are deleted before the script is written out. For this reason, you should not edit scripts directly in the subdirectories of the Tools directory, since they are overwritten when probes are reloaded.

For example, given the trivial example of a command-line probe where the canonical name is `com.dartware.cmdline.test`, where the `cmd` clause in the <command-line> section is:

```
cmd="python test.py"
```

or, using the `${PYTHON}` macro:

```
cmd="${PYTHON} test.py"
```

and the tool section is:

```
<tool:test.py>  
  # Trivial example  
  print "okay"  
  raise SystemExit, 0  
</tool:test.py>
```

When InterMapper starts or reloads probes, a subdirectory of Tools named `com.dartware.cmdline.test` is created if it doesn't exist, and (in this case) a file named "test.py" is written into it, containing the text between <tool:test.py> and </tool:test.py>.

The WMI probes provide a number of good examples of this feature.



## Calling external scripts and other executables

While using the <tool> section is recommended, it is optional. You can call an external script or other executable by providing the correct path to it in the `cmd` property of the <command-line> section of the probe. If you provide a paths to multiple directories in the `path` parameter, InterMapper looks in the specified directories for the executable. The <tool> section is appropriate only for scripts, not for compiled programs.

### Python Example

```
<!--
check connect
(com.dartware.commandline.check_connect.txt)
Copyright (c) 2009 Help/Systems, LLC. All rights reserved.
-->

<header>
  type = "cmd-line"
  package = "com.dartware"
  probe_name = "commandline.check_connect"
  human_name = "Check Connect"
  version = "1.1"
  address_type = "IP"
  display_name = "Miscellaneous/Test/Check Connect"
</header>

<description>
  \GB\Check for connect\p\

  This probe checks to see if you can connect to the given address
  and port.
</description>

<parameters>
  "CHECK_PORT" = "80"
</parameters>

<command-line>
  cmd=${PYTHON}
  arg="check_connect.py ${ADDRESS} ${CHECK_PORT}"
</command-line>

<command-data>
  -- Currently unused.
</command-data>

<command-exit>
  -- These are the exit codes used by Nagios plugins
  down: ${EXIT_CODE}=4
  critical: ${EXIT_CODE}=3
  alarm: ${EXIT_CODE}=2
  warn: ${EXIT_CODE}=1
  okay: ${EXIT_CODE}=0
</command-exit>

<command-display>
```

</command-display>

<tool:check\_connect.py>

```
import sys
import socket

# constant return codes for InterMapper
OKAY = 0
WARNING = 1
ALARM = 2
CRITICAL = 3
DOWN = 4

retcode = OKAY
output = ""

try:
    host = sys.argv[1] # The remote host
    port = long(sys.argv[2]) # The port
except:
    print "Usage: check_connect HOST PORT"
    sys.exit(DOWN)

try:
    s = socket.socket(socket.AF_INET, socket.SOCK_STREAM)
    s.connect((host, port))
    s.close()
except IOError, e:
    retcode = DOWN
    if hasattr(e, 'reason'):
        reason = 'Reason: ' + e.reason
    elif hasattr(e, 'code'):
        reason = str(e.code)
    else:
        reason = "unknown"

    output = "Error (" + reason + ") connecting to " + str(host) + ":"
    + str(port)

    print output
    sys.exit(retcode)
</tool:check_connect.py>
```

**Cscript Example**

```

<!--
Check Web
Copyright (c) 2009 Help/Systems, LLC. All rights reserved.
-->

<header>
  type = "cmd-line"
  package = "com.dartware"
  probe_name = "commandline.check_web"
  human_name = "Check Web"
  version = "1.1"
  address_type = "IP"
  display_name = "Miscellaneous/Test/Check Web"
  visible_in = "Windows"
</header>

<description>
  \GB\Check Web\p\

  Given an address or hostname, attempts to connect to a web server.
</description>

<parameters>
</parameters>

<command-line>
  -- Empty path forces the InterMapper Settings:Tools directory
  path=
  cmd="{CSCRIPT} check_web.vbs"
  arg="{address}"
  timeout = ${Timeout (sec)}
</command-line>

<command-data>
  -- Currently unused.
</command-data>

<command-exit>
  down:${EXIT CODE}=4
  critical:${EXIT CODE}=3
  alarm:${EXIT CODE}=2
  warning: ${EXIT CODE} = 1
  okay:${EXIT CODE}=0
</command-exit>

<command-display>
  ${^stdout}
</command-display>

<tool:check_web.vbs>
  Dim web
  Set web = Nothing
  Set web = CreateObject("WinHttp.WinHttpRequest.5.1")

  numargs = wscript.arguments.count
  If (numargs < 1) Then

```

```
wscript.Echo "Usage: check_web hostname"
wscript.quit(4)
End If

URL = "http://" + wscript.arguments(0)

on error resume next
web.Open "GET", URL, False
on error resume next
web.Send
If err.Number <> 0 Then
    returncode = 4
Else
    If err.Number = 0 and web.Status = "200" Then
        returncode = 0
    Else
        returncode = 4
    End If
End If

If returncode <> 0 Then
    wscript.Echo "Error connecting to " + URL + "."
Else
    wscript.Echo ""
End If
wscript.quit(returncode)
</tool:check_web.vbs>
```

## Command Line Probe Example

The following shell script is called from the command-line probe:

```
#!/bin/sh
# Expects an address passed in. Passes out the address and a pretend
# result.
# Note that we use "\$" instead of just "$" because "$" has special
# meaning
# in a shell script.
echo "\{ \$addr := \"\$1\", \$result :=1.2345 } Note that everything
after the brace is used as the reason."
```

```
<!--
Simple Command Line Example (com.dartware.cmd.simple)
Copyright (c) 2007 Help/Systems, LLC. All rights reserved.
-->

<header>
  type = "cmd-line"
  package = "com.dartware"
  probe_name = "cmd.simple"
  human_name = "Simple Command Line Output Example"
  version = "1.0"
  address_type = "IP"
</header>

<description>
This probe shows how to use the specially-formatted output from the
simple shell script listed above for display in the command-display
section, rather than being set to the reason as is usual for
command-line probes.
</description>

<parameters>
</parameters>

<command-line>
  path = ""
  cmd = "simple.sh ${ADDRESS}"
</command-line>

<command-exit>
  down: ${EXIT CODE} = 2
  alarm: ${EXIT CODE} = 1
  okay: ${EXIT CODE} = 0
</command-exit>

<command-display>
  \B5\Simple Probe Information\0P\
  Output from $addr is $result (${chartable: #.#### : $result})
</command-display>
```

For more information about Nagios, visit the web site at <http://www.nagios.org>. Nagios® and the Nagios logo are registered trademarks of Ethan Galstad.

## InterMapper Python Plugins

InterMapper DataCenter ships with an embedded Python interpreter. You may use this interpreter to write command-line probe scripts and command-line notifiers. This Python interpreter is a good way to give maximum compatibility across systems. In InterMapper DataCenter 5.7, the version of Python we ship is 2.6, with optimized system libraries.

An extensive introductory tutorial on Python is available at <http://docs.python.org/tut>

As shipped, this Python interpreter requires the use of optimized and stripped mode (-OO), so the interpreter must be invoked as:

<b>MacOSX/ Linux/ Unix:</b>	<code>/usr/local/imdc/core/python/bin/imdc -OO [script_name]</code>
<b>Windows:</b>	<code>c:\Program Files\InterMapper\dwf\core\python\imdc.exe -OO [script_name]</code>

### Notes:

- Use the `${PYTHON}` macro as shown below; it automatically determines the platform and expands to the proper path to the interpreter with the `-OO` argument.
- Use the [The <tool> Section \(Pg 144\)](#) (`<tools:sample.py>` in the example below) to incorporate the Python script directly into the probe file itself.

### Simple example

A simple sample probe that includes a Python script might look like this. The script automatically gets saved in the InterMapper Settings/Tools directory.

```
<!--
Command Line Python Sample (com.dartware.python.sample.txt)
Custom Probe for InterMapper (http://www.intermapper.com)
Please feel free to use it as a base for further development.
Original version 31 Mar 2004 by Christopher L. Sweeney,
Help/Systems, LLC.
Updated 13 Jun 2007 by Stephen P. Ryan, Help/Systems, LLC, for
Python
Updated 28 Dec 2007 to update text descriptions and
include display name header line -reb
Updated 3 Jan 2010 to include ${PYTHON} macro -reb
-->

<header>
  type="cmd-line"
  package="com.dartware"
  probe_name="python.sample"
  human_name="Python Sample"
  version="1.1"
  address_type="IP"
```

```

    display_name = "Miscellaneous/Test/Python Sample"
</header>

<description>
\GB\Python Sample Command-Line Probe\p\

A sample command line probe which executes a Python script.

The Python script generates and returns a random number which sets
the device status to one of four values Down/Alarm/Warning/OK.

</description>

<parameters>
</parameters>

<command-line>
    path=""
    cmd="{PYTHON} sample.py ${ADDRESS}"
    arg=""
</command-line>

<command-exit>
    down:${EXIT CODE}=3
    alarm:${EXIT CODE}=2
    warning:${EXIT CODE}=1
    okay:${EXIT CODE}=0
</command-exit>

<command-display>
</command-display>

<tool:sample.py>
#!/usr/local/imdc/core/python/bin/imdc -OO
# Sample Python script uses InterMapper's Python interpreter

import sys

if (len(sys.argv) < 2):
    print "Usage: %s _address_" % sys.argv[0]
    sys.exit(0)
addr = sys.argv[1]

# Code to get status from device at address addr
import random
result = random.randrange(4)

print "Pretending we got result %d from device at address %s" %
(result, addr)
sys.exit(result)

</tool:sample.py>

```

### Nagios Plugins

InterMapper's command-line probes are similar to **Nagios® plugins** (<http://www.nagios.org>). You can see the [standard set of Nagios plugins](#). Many vendors and individuals have created their own Nagios plugins, many of which are available in the [development section](#). You will have to download the Nagios plugins and build/compile them yourself.

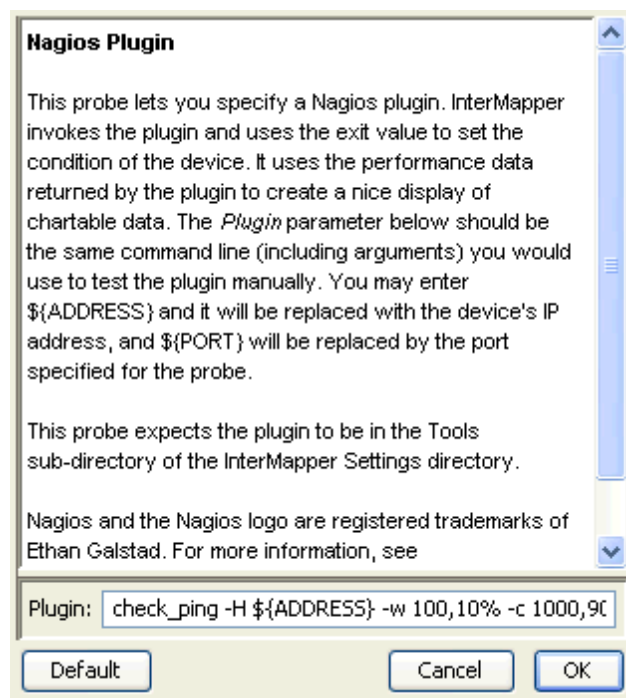
The Nagios Plugin probe lets you specify a Nagios plugin to run, along with any associated parameters. You can use the `${ADDRESS}` and `${PORT}` macros in the command line--InterMapper substitutes the device's IP address and the specified port. InterMapper will invoke the plugin and use the exit value to set the condition of the device to UP/Okay, UP/Alarm, UP/Critical, or DOWN.

InterMapper also interprets the information written by the plugin to stdout and puts it in the InterMapper status window, nicely displaying and making chartable the performance data returned by the probe, and displaying the reason/condition provided.

The Nagios Plugin probe expects the Nagios plugin to be in the Tools sub-directory of the InterMapper Settings directory. Nagios and the Nagios logo are registered trademarks of Ethan Galstad. For more information, see <http://www.nagios.org/>.

#### To install and use a Nagios plugin:

1. Download the plugin. Make it executable by following the instructions from the creator.
2. Move the executable file (or a link/alias/shortcut to it) to the *Tools* sub-directory of the *InterMapper Settings* directory.
3. Add a device to the map and set its Probe Type to **Nagios Plugin**.
4. Enter in the plugin file's name and arguments in the Plugin field of the configuration window.
5. You can use the `${ADDRESS}` and `${PORT}` macros in the command line. InterMapper will substitute the device's IP address and the specified port.





### Creating Nagios Probes

If you wish to develop your own Nagios plugins, you should follow the developer guidelines for Nagios (found at <http://nagiosplug.sourceforge.net/developer-guidelines.html>). This will result in probes/plugins that work for both InterMapper and Nagios.

As described in the Nagios Guidelines, a Nagios plugin returns:

- **a POSIX return code** as described in [section 2.4](#) of the Guidelines. InterMapper uses this to determine the device's state.
  - 0 = OK;
  - 1 = Warning (yellow);
  - 2 = Critical (red);
  - 3 = Down.
- **A single output line on STDOUT** with the following format.

```
<description of the device status>|Perfdata
```

where:

- <description of the device status> is a short text string. This becomes the InterMapper Condition string, and is described in [section 2.1](#) of the Guidelines. The output string should have the format:

```
SERVICE STATUS: information text
```

- | is the "pipe" character to separate the description from the "Perfdata"
- Perfdata (Performance Data) is a series of name/value pairs. These are described in [section 2.6](#) of the Guidelines, but are generally a space-separated list with this form:

```
'label'=value[UOM];[warn];[crit];[min];[max]
```

### Example Return String

The Nagios check\_load string returns three values: the load average over 1, 5 and 15 minutes. When the plugin is invoked, it returns a response like this:

```
% ./check_load -w 15,10,5 -c 30,25,20
OK - load average: 0.95, 0.72, 0.64|load1=0.954;15.000;30.000;0;
load5=0.718;10.000;25.000;0; load15=0.635;5.000;20.000;0;
```

InterMapper parses the plugin's response line and uses the `${nagios_output}` macro to produce a status window as shown in the image below.

```
localhost.  
Device Status  
  Name: localhost.  
  DNS Name: localhost.  
  Address: 127.0.0.1  
  Status: UP  
  Probe: Nagios Plugin  
  Up Time: n/a  
  Availability: 100 % (of 2 days, 3 hours, 6 minutes)  
  Packet Loss: 0.0 % (of 0 total attempts)  
  Short-term Packet Loss: 0.0 % (of 0 last attempts) [Reset]  
  Recent Loss: None  
  Response time: 40 msec  
  
  Retention Policy: 24 Hours (-3), Exportable  
  
NAGIOS Probe Performance Data: check_load -w 15,10,5 -c 30,25,20  
load1 : 0.954  
load5 : 0.718  
load15: 0.635  
  
Recent Outages: [Reset]  
08/09 22:18:46: DOWN for 0 seconds  
07/15 03:03:25: DOWN for 20 seconds  
07/10 07:46:07: DOWN for 29 seconds  
Last updated Aug 27, 01:59:02; interval: 30 seconds  
Reason: OK - load average: 0.95, 0.72, 0.63
```

For more information about Nagios, visit the web site at <http://www.nagios.org>. Nagios® and the Nagios logo are registered trademarks of Ethan Galstad.

### **Changes for InterMapper 5.0**

For those familiar with the older Nagios Template probe, the new Nagios Plugin probe contains the following changes in behavior:

- The Nagios Template probe mapped plugin exit code 2 as down. The Nagios Plugin probe maps plugin exit code 2 as critical, and plugin exit code of 3 as down.
- The Nagios Template probe took anything written to stdout as the "condition" or "reason" for the status. The Nagios Plugin probe detects the presence of performance data ('PERFDATA') ([section 2.6](#) of the Guidelines) in the output, and makes a formatted and chartable display of the data.
- We have not changed the canonical name of the Nagios probe; any device which used the old Nagios Template probe will now automatically use the Nagios Plugin probe. An InterMapper probe will automatically handle a Nagios plugin if it has the following:
  - "flags" = "NAGIOS3" in the <header> section of the probe. See [Probe File Header](#).
  - \${nagios\_output} in the <command-display> section of the probe. See [Built-in Variables](#)

## Nagios Plugin Example

```

<!--
Command Line Nagios Plug-in Example (com.dartware.nagiosx.template)
Copyright (c) 2008 Help/Systems, LLC. All rights reserved.
-->

<header>
  type           = "cmd-line"
  package        = "com.dartware"
  probe_name     = "nagios.template"
  human_name     = "Nagios Plugin"
  version        = "1.6"
  address_type   = "IP"
  display_name   = "Miscellaneous/Nagios/Nagios Plugin"
  flags          = "NAGIOS3"
</header>

<description>
\GB\Nagios Plugin\p\
This probe lets you specify a Nagios plugin. InterMapper invokes the
plugin and uses the exit value to set the condition of the device. It
uses performance data returned by the plugin to create a nice display
of chartable data. The \i\Plugin\p\ parameter below should be the
same command line (including arguments) used to test the plugin
manually. \${ADDRESS} is replaced with the device's IP address, and
\${PORT} is replaced by the port specified for the probe.

This probe looks in the Tools sub-directory of the InterMapper
Settings directory for the plugin.

Nagios and the Nagios logo are registered trademarks of Ethan
Galstad. For more information, see \U2\http://www.nagios.org\PO\
</description>

<parameters>
  Plugin = "check_ping -H \${ADDRESS} -w 100,10% -c 1000,90%"
</parameters>

<command-line>
-- Empty path forces the InterMapper Settings:Tools directory
  path = ""
  cmd  = \${Plugin}
</command-line>

<command-exit>
-- These are the exit codes used by Nagios plugins
  down: \${EXIT_CODE}=3
  critical: \${EXIT_CODE}=2
  alarm:    \${EXIT_CODE}=1
  okay:     \${EXIT_CODE}=0
</command-exit>

<command-display>
\B5\NAGIOS Probe Performance Data: \${Plugin}\PO\
\${nagios output}
</command-display>

```

## NOAA Weather Probe Example

It is now easier than ever to build command-line probes. Here is a fun example that retrieves temperature data from the [US NOAA weather feed](#) in a particular city.

How does this probe work?

1. Right-click a device and choose **Select Probe...**
2. Select the **Weather Service-Temp** probe from the Miscellaneous/Test category.
3. Enter the city code for the closest weather station (KLEB is at Lebanon Municipal Airport, about a half mile to the south of us.) The Status window shows the name of the weather station, with a chartable value for the temperature reading.

Under the covers, InterMapper launches a Python program to contact the weather service, retrieve the meteorological conditions for the indicated city, and parses out the XML response to retrieve the temperature. (There's lots more information in the Weather Service feed - the program could easily be extended to display more information.) Here are some of the features of this probe:

- The `${PYTHON}` macro gives the path to the built-in python interpreter of InterMapper DataCenter no matter what platform you're using. For example, the probe can now use

```
cmd = "${PYTHON} program.py"
```

and InterMapper substitutes the proper path to invoke Python, whether on Windows, OSX, or Linux/Unix.

**Note:** To use this macro, the InterMapper DataCenter (IMDC) must be installed. IMDC will be installed automatically with InterMapper 5.2 on Windows and OSX; Linux and Unix systems require a separate install for IMDC.

- You can include the script directly in the text of the probe file. This makes it much easier to write scripts and keep the probe file in sync. To do this, use the `<tool:program-name>` section in your probe file. The example below contains a program named `noaa-weather.py`. When InterMapper loads the probe, it parses out this section and saves it in a folder within the Tools directory of InterMapper Settings. Programs in the `<tools>` section may also save private files in that directory.
- The example probe file uses a couple interesting Python libraries. First is `urllib2` that makes it easy to make queries from web services. It's a few straightforward calls to build a url, issue it, and retrieve the results.
- The probe also uses the `xml.dom.minidom` library to parse out XML data returned from the NOAA web service. This library is particularly well-explained in Chapter 9 of *Dive into Python*.

## The NOAA Temperature Probe

To use this probe, copy the text below, paste it to a text editor, save it to a text file, then use File->Import->Probe... in InterMapper.

```
<!--
Weather Service Temperature - Retrieve the temperature from the NOAA
weather XML (com.dartware.tool.noaa.txt)
Copyright (c) 2009 Help/Systems, LLC.
Please feel free to use this as a base for further development.
-->

<header>
  type      = "cmd-line"
  package   = "com.dartware"
  probe_name = "tool.noaa"
  human_name = "Weather Service-Temperature"
  version   = "1.2"
  address_type = "IP"
  display_name = "Miscellaneous/Test/Weather Service-Temp"
</header>

<description>
\GB\Retrieve the current temperature\p\

This probe retrieves the current temperature from the NOAA weather
feed. To see the proper city code, visit:

\u4=http://www.weather.gov/xml/current
obs/\http://www.weather.gov/xml/current_obs/\p0\
</description>

<parameters>
  "Weather Station" = "KLEB"
</parameters>

<command-line>
  path=""
  cmd="{PYTHON} noaa-weather.py"
  arg="{Weather Station}"
</command-line>

<command-exit>
-- These are the exit codes used by Nagios plugins
  down:  ${EXIT_CODE}=4
  critical:  ${EXIT_CODE}=3
  alarm:  ${EXIT_CODE}=2
  warn:  ${EXIT_CODE}=1
  okay:  ${EXIT_CODE}=0
</command-exit>

<command-display>
\b5\ Temperature for $loc\p0\
```

```
Temperature: $temp \3g\degrees F\p0\  
</command-display>  
  
<tool:noaa-weather.py>  
  
# noaa-weather.py  
# Scan the XML results from NOAA's XML feeds  
# e.g., http://www.weather.gov/xml/current_obs/KLEB.xml  
# for relevant weather-related information.  
# 25 Mar 2009 -reb  
import os  
import re  
import sys  
import getopt  
import urllib  
import urllib2  
import httplib  
from xml.dom import minidom  
  
# httplib.HTTPConnection.debuglevel = 1 # force debugging....  
  
# options are: station  
  
try:  
    opts, args = getopt.getopt(sys.argv[1:], "")  
except getopt.GetoptError, err:  
    searchString = "getopt error %d" % (err)  
  
station = args[0]  
userAgent = "Mozilla/5.0 (Macintosh; U; Intel Mac OS X 10_5_5; en-us)  
AppleWebKit/525.18 (KHTML, like Gecko) Version/3.1.2 Safari/525.20.1"  
noaaString = "http://www.weather.gov/xml/current_obs/%s.xml"  
noaaString = noaaString % (urllib.quote_plus(station))  
  
# print noaaString;  
retcode = 4;  
try:  
    request = urllib2.Request(noaaString)  
    opener = urllib2.build_opener()  
    request.add_header('User-Agent', userAgent)  
    usock= opener.open(request)  
#    print buf  
except IOError, e:  
    if hasattr(e, 'reason'):  
        resp = 'We failed to reach a server. '  
        reason = 'Reason: ' + 'Wrong host name?' # e.reason[1]  
    elif hasattr(e, 'code'):  
        resp = 'The server couldn\'t fulfill the request. '  
        reason = 'Error code: ' + str(e.code)  
    print "{ $temp := '%s', $loc := 'Unknown' } %s" % (0, resp +  
reason)  
    sys.exit(retcode) # make it look down  
  
retcode = 0 # looks like it'll succeed  
xmldoc = minidom.parse(usock)  
tempList = xmldoc.getElementsByTagName('temp_f')  
tempElem = tempList[0]  
tempval = tempElem.firstChild.data
```

```
loclist = xmldoc.getElementsByTagName('location')
locval = loclist[0].firstChild.data
print "\{ $temp := '%s', $loc := '%s' }%s" % (tempval, locval,
tempval + ' degrees at ' + locval)
sys.exit(retcode)
</tool:noaa-weather.py>
```

**See also**

[\\${PYTHON} macro \(Pg 36\)](#) - the full path the to the Python interpreter.

[The <tool> Section \(Pg 144\)](#) - Include a script directly into the probe file.

**Python Documentation:**

urllib2 - <http://docs.python.org/library/urllib2.html>

xml.dom.minidom - <http://docs.python.org/library/xml.dom.minidom.html>

**Dive into Python:** A very readable chapter on XML processing in Python  
[http://diveintopython.org/xml\\_processing/](http://diveintopython.org/xml_processing/)

# Chapter 7

---

## Working With Probe Files

### Installing and Reloading Probes

Use custom probes to enhance InterMapper's capabilities. These are probes created for special purposes or for certain devices.

#### To install a custom probe:

1. Download the probe, and uncompress the file if necessary.
2. From the File menu, choose **Import > Probe** command  
or

Click the **Plus** icon (shown at right) in the Set Probe window. A file dialog appears. Choose the probe file you want to import, and click **Open**. The probe is installed copied to the InterMapper Settings/Probes directory, and becomes available from the Set Probe window.



#### To test a custom probe after importing it:

1. Open an InterMapper map.
2. Add a new device with the DNS name or IP address of the device you want to test.
3. Right-click the device and choose **Set Probe...** The Select Probe window appears.
4. Select the new probe from the Select Probe window.
5. Configure the probe by filling in the fields as required.
6. When finished, click **OK**. InterMapper begins using the new probe to test the device.

### Reloading a Probe

If you make changes to a probe, you need to do one of two things before the changes become active:

- Re-import the probe as described above. You can do this regardless of the probe file's location.
- Manually reload probes. If you make a change to the probe file located in the InterMapper Settings/Probes directory, you must click the **Reload Probes** button (shown at right) to activate your changes.





### Modifying Built-in Probes

Built-in probes are stored in a ZIP archive named `BuiltinProbes.zip`, located in the `Intermapper Settings/Probes` directory.

To view or modify a built-in probe, you'll need to unzip the archive.

#### How InterMapper resolves filename conflicts

InterMapper scans the archive as well as the unzipped contents of the folder.

If a built-in probe's filename matches an unzipped version, InterMapper locates the most recent version of the probe with:

- the probe's **version number**
- then
- the probe's **last-modified date**

If you are developing or modifying a built-in probe, be sure to advance the version number to be sure that InterMapper uses the modified version.

### Sharing Probes

InterMapper has an enthusiastic user-base that has contributed literally hundreds of probes, many of which have been adopted as built-in probes. Users are encouraged to check out the library of user-contributed probes, and to contribute useful probes themselves.

#### Sharing Your Own Probes

If you create a probe you find useful, please contribute your new probe so others can use it as well. Send us an e-mail at [support@intermapper.com](mailto:support@intermapper.com) and we'll post it to the Contributions page mentioned above.

#### Using Contributed Probes

You can use any of the probes that Help/Systems has created, or use probes contributed by our other customers. These probes are available from:

<http://intermapper.com/go.php?to=probes.contrib>

## Chapter 8

---

### Troubleshooting Probes

There are a number of different ways to troubleshoot your custom probes.

The most basic troubleshooting is done through the error messages that appear in the device's Status window. Use the [comprehensive list of Error Messages](#) to help you track down errors.

For SNMP probes, you can use [SNMPWalk](#) to view the MIB variables returned from an SNMP device. Use [SNMPWalk with the -O option](#) to redirect the output from the Debug log to an SQLite database.

You can also gain a lot of information by [measuring response times](#) of a device as it is being tested. A number of different timers are available for viewing and charting.

### Errors with Custom Probes

When working with custom probes, you may see results that you don't expect. Here are some common problems.

#### Error: "Undefined variable" in Debug log

When processing a probe, InterMapper will not evaluate an expression if it detects a variable that is not defined. A variable will be undefined if it is not in the symbol table. This could happen because:

- there is a typo in the variable name
- the value for the variable was not returned in a SNMP response
- the value was not set earlier in the probe processing

In this case, InterMapper will emit the following message in the Debug log file:

```
Calculation error in rule (probe: com.dartware.example, expression:
"($oid 0)": Undefined variable: '$oid'
```

To guard against these error messages (where it may be a legitimate case that a particular variable is undefined) you may use the "defined()" function in the expression:

```
warning: defined("oid") && ($oid > 0) "Warning condition string"
```

#### Error: A device shows a "Reason: No SNMP Response." at the bottom of the status window.

There are several reasons that InterMapper might not be able to retrieve SNMP information from a device. The two most common are

- The device doesn't speak SNMP
- You haven't entered the proper SNMP read-only community string.

*About SNMP*, located in the Troubleshooting section of the [User Guide](#), lists many other reasons.

#### Error: When I build a custom probe, the status window shows "[N/A]" for certain values.

This probably means that there is an error with the OID for one of the device variables.

Open the Debug window, and look for entries in this format:

```
12:57:00 router.example.net.: SNMP error status [[query = 28]]
noSuchName (2), index = 3
1) 1.3.6.1.2.1.1.3: NULL
2) 1.3.6.1.2.1.1.1: NULL
3) 1.3.6.1.7.1.1.4: NULL
4) 1.3.6.1.2.1.1.6: NULL
```

Note that the first line above shows a "noSuchName" error for index 3. Look at the subsequent lines to find item 3, and check that OID very carefully. In this example, the proper OID should have a "2" in place of the "7" that's there.

**Error: When I build a custom probe, the status window shows "[noSuchName]" for certain values.**

This probably means that there is an error with the OID for one of the device variables.

Open the Debug window, and look for entries in this format.

```
13:17:59 OID Error: GetNextRequest from 192.168.1.1 expected  
1.3.6.1.2.1.2.2.1.2.10; got 1.3.6.1.2.1.2.2.1.3.1
```

In this case, the desired value is from a non-existent table row. (The OID 1.3.6.1.2.1.2.2.1.2 is the ifDescr for an interface on a device. The index (.10) indicates which row to retrieve. But when InterMapper requested that row, it learned it was not present.) Consequently, InterMapper displays the "noSuchName" value.

## Debugging with the SNMPWalk Command

InterMapper provides a simple SNMPWalk command, available from the Monitor menu, that allows you to perform an SNMPWalk on a specified OID. In some cases this may not be sufficient. You can also execute SNMPWalk as a server command, and include specific arguments as described below.

The InterMapper server implements a simple snmpwalk facility in its debug mode.

```
snmpwalk -v [1|2c|3] -c community -o filename [-e] [-n num-OIDs] -p  
161 -r 3 -t 10 IP-address startOID
```

where:

- *-v [1|2c|3]* is the version of SNMP to use: SNMPv1, SNMPv2c, or SNMPv3
- *-c community* indicates the SNMP read-only community string (see note for SNMPv3)
- *-e* if present, means to proceed to the end of the MIB
- *-n num-OIDs* if present, indicates the number of OIDs to display (*-e* and *-n* are mutually exclusive)
- *-o filename* is the name of a SQLite-format file saved in the InterMapper Settings/Temporary directory. For more information see [Using the SNMPWALK -O Option](#).
- *-p* destination port (default is 161)
- *-r* number of retries that InterMapper will attempt if a response doesn't return (default is 3)
- *-t* timeout in seconds that InterMapper waits for a response (default is 10 seconds)
- *IP-address* is the IP address of the device to query
- *startOID* if present as the final argument, indicates the first OID to request

The command will start an SNMP walk on device with the specified IP-Address, starting from the given startOID. The walk will end when the specified number of OIDs has been received. The walk will also end if the OID received from the device does not have the specified start OID as its prefix unless *-e* is specified. If *-e* is specified, the walk will continue until the end of the MIB or the specified maximum OIDs have been received.

*Note:* For SNMPv3, *community* should be in the following format:

```
username: [md5 | sha | none] :authpassword: [des | none] :privpassword
```

## Examples

**Example:** SNMP walk of the ifTable of a device with IP address 192.168.1.1 using SNMPv2c with community string public:

```
snmpwalk -v 2c -c public 192.168.1.1 1.3.6.1.2.1.2.2
```

**Example:** SNMP walk of the ifXTable of a device with IP address 10.10.2.20 using SNMPv3 with user name 'user', authentication protocol MD5, authentication password 'auth', privacy protocol DES and privacy password 'priv':

```
snmpwalk -v 3 -c user:md5:auth:des:priv 10.10.2.20 1.3.6.1.2.1.31.1.1
```

**Example:** SNMP walk of the ifTable of a device with IP address 192.168.1.2 using SNMPv3 with user name 'test', authentication protocol MD5, authentication password 'pass', and no privacy protocol:

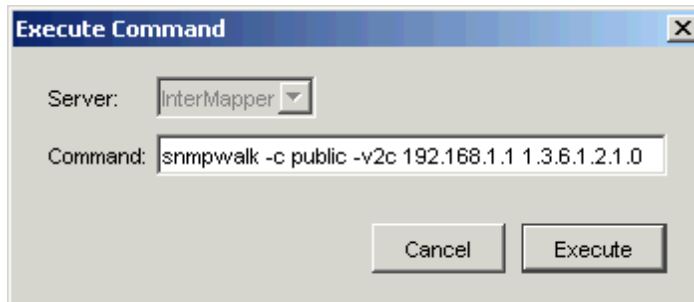
```
snmpwalk -v 3 -c test:md5:pass:none: 192.168.1.2 1.3.6.1.2.1.2.2
```

**Example:** Walk starting from the ifTable until the end of the device is reached or until 10,000 OIDs have been received:

```
snmpwalk -v 1 -c public -e -n10000 192.168.1.1 1.3.6.1.2.1.2.2
```

**Invoking the snmpwalk command**

You execute the **snmpwalk** command as a "Server command..." (available from the Help menu's Diagnostics menu) To use this command:



1. Select **Help > Diagnostics > Server Command...**

The Server command window appears as shown above.

2. Enter the snmpwalk command, and click Send.
3. The output of the SNMPwalk is written to the **Debug** file, which is at this path: InterMapper Settings : InterMapper Logs : Debugyyyyymmddhhmm.txt

Note: You can use snmpwalk's -o option to direct the output of snmpwalk to an SQLite database. For more information, see [Using the SNMPWALK -o Option \(Pg 168\)](#).

4. The output of the SNMPwalk will also appear in the Debug window, as shown below:

```
SNMPWalk 192.168.1.1: prefix 1.3 (maximum number of OIDs: 2000)
— 9/16/2005 13:04:56
SNMPWalk on 192.168.1.1 started
SNMPWalk 192.168.1.1: 1.3.6.1.2.1.1.1.0 = OctetString: ExampleOS
SNMPWalk 192.168.1.1: 1.3.6.1.2.1.1.2.0 = OID: 1.3.6.1.4.1.9.1
SNMPWalk 192.168.1.1: 1.3.6.1.2.1.1.3.0 = TimeTicks: 11058776
SNMPWalk 192.168.1.1: 1.3.6.1.2.1.1.4.0 = OctetString:
support@example.com
SNMPWalk 192.168.1.1: 1.3.6.1.2.1.1.5.0 = OctetString: Example.com
Router
SNMPWalk 192.168.1.1: 1.3.6.1.2.1.1.6.0 = OctetString:
http://www.example.com
SNMPWalk 192.168.1.1: 1.3.6.1.2.1.1.7.0 = Integer: 72
SNMPWalk 192.168.1.1: 1.3.6.1.2.1.1.8.0 = TimeTicks: 413
SNMPWalk 192.168.1.1: 1.3.6.1.2.1.1.9.1.2.1 = OID: 1.3.6.1.2.1.1.9.1
SNMPWalk 192.168.1.1: 1.3.6.1.2.1.1.9.1.3.1 = OctetString: See
RFC2580
SNMPWalk 192.168.1.1: 1.3.6.1.2.1.1.9.1.4.1 = TimeTicks: 413
SNMPWalk 192.168.1.1: 1.3.6.1.2.1.2.1.0 = Integer: 2
SNMPWalk 192.168.1.1: 1.3.6.1.2.1.2.2.1.1.1 = Integer: 1
SNMPWalk 192.168.1.1: 1.3.6.1.2.1.2.2.1.1.2 = Integer: 2
...
SNMPWalk 192.168.1.1: Finished (end of MIB reached) — 9/16/2005
13:09:48
```

### snmpwalk stopall command

To stop all SNMPwalks for a particular server, you can enter this command in the Server command... window.

```
snmpwalk stopall
```

#### Error Conditions

InterMapper detects the following error conditions:

- When InterMapper walks to the end of the MIB, it displays a "Finished (end of MIB reached)" message
- When InterMapper fails to receive a response after the specified number of retries, it displays a "Finished (No response received)" message
- The snmpwalk expects that the OIDs received are increasing. When InterMapper receives an OID that is out of order, it would terminate the walk with an error message that indicates that a loop is detected in the walk.

#### Help from the telnet command line

There is also documentation in the InterMapper's telnet help. Typing 'help snmpwalk' in the telnet window will display a summary of the command.

### Using the SNMPWALK -o Option

Instead of writing the voluminous results of the SNMPWalk to the Debug log, InterMapper can write the results to an SQLite file. To use this feature, you use the **-o** option.

When you use the **-o** option, snmpwalk stores its output into an SQLite database. To use this feature, you specify the name of the database file following the **-o** option.

#### Example:

To create an SQLite3 database named "foo" and store the snmpwalk results there, use the following "server command":

```
snmpwalk -v1 -c public -o foo switch 1.3
```

This writes the output to an SQLite database file named "foo", located in InterMapper Settings/Temporary directory. The database file named "foo" may contain multiple snmpwalk's. The file is created if it doesn't exist.



When the -o option is used, only these four lines are written to the Debug log:

```
SNMPWalk command received: 'snmpwalk -v1 -c public -o foo -n 10
switch 1.3'
SNMPWalk 192.168.1.36 3: prefix 1.3 (version SNMPv1 ...
SNMPWalk on switch started
SNMPWalk 192.168.1.36 3: Finished (10 OIDs ...
```

### The SNMPWALK Schema

Here is the schema used for the snmpwalk database:

```
CREATE TABLE walks (
  id          INTEGER PRIMARY KEY,
  address     TEXT,
  port        INTEGER,
  startOid    TEXT,
  snmpVersion INTEGER,
  pktTimeout  INTEGER,
  pktRetries  INTEGER,
  maxOids     INTEGER,
  toEnd       INTEGER,
  timeStarted INTEGER,
  timeFinished INTEGER,
  oidCount    INTEGER,
  stopReason  TEXT
);

CREATE TABLE results (
  walk_id    INTEGER,
  name       TEXT,
  oid        TEXT,
  type       INTEGER,
  value      BLOB
);
```

**Table: walks**

The walks table stores one row for each snmpwalk command. Each walk will receive a unique id that is used to identify it (id). The other columns are:

**address**

the address of the snmpwalk target device

**port**

the udp port number of the snmpwalk target device

**startOid**

the starting OID specified in the snmpwalk command

**snmpVersion**

the SNMP version specified

**pktTimeout**

the packet timeout specified

**pktRetries**

the packet retry count specified

**maxOids**

the maximum number of OID's specified

**toEnd**

a boolean flag indicating that the walk should proceed to the end (i.e. don't limit by startOid).

**timeStarted**

the UTC timestamp when the walk was started

**timeFinished**

the UTC timestamp when the walk was completed

**oidCount**

the number of OID rows walked

**stopReason**

text indicating the reason the walk stopped where it did

**Table: results**

The results table stores a row for each entry of one snmpwalk, as specified by id in the walks table.

**walk\_id**

the id of the walk (references walks.id)

**oid**

the text of the OID naming the SNMP variable

**type**

the ASN.1 type integer for the SNMP variable

**value**

the actual, uninterpreted binary value returned by the SNMP agent

### Accessing the SQLite Data

On Mac OS X 10.4, you can use the built-in `sqlite3` command to access the data in the SQLite database file:

```
$ sqlite3 foo

sqlite> .mode csv
sqlite> select * from walks;

1,"192.168.1.1",161,1.0,0,10000,3,2000,0,1178801645,1178801685,0,"No
answer received"

2,"192.168.1.2",161,1.3,0,10000,3,2000,0,1178801708,1178801895,2000,"-
Finished (2000 OIDs found)"
sqlite> select count(*) from results where walk_id = 1;
0
sqlite> select count(*) from results where walk_id = 2;
2000
sqlite> select * from results where walk_id = 2 order by oid limit
5;
2,"1.3.6.1.2.1.1.1.0",4,"HP J4813A ProCurve Switch 2524..."
2,"1.3.6.1.2.1.1.2.0",6,"+\006\001\004\001\013\002\003\007\013\023"
2,"1.3.6.1.2.1.1.3.0",67,"\035\330J\375"
2,"1.3.6.1.2.1.1.4.0",4,"Bill Fisher"
2,"1.3.6.1.2.1.1.5.0",4,"HP ProCurve Switch 2524"
```

There is a Firefox add-on called "SQLite Manager" that opens and displays SQLite database files. This makes it a cross-platform tool, requiring only Firefox 3.5 or greater, plus a small download.

#### To install SQLite Manager:

1. Start Firefox 3.5 or newer - Tools -> Add-ons - Click Get Add-ons
2. Enter "SQLite" into the Search field and press Return.
3. Double-click the "SQLite Manager" item to install it. Restart Firefox when instructed.

#### To use SQLite Manager:

1. Tools -> SQLite Manager to open it.
2. Use the Database -> Connect Database (within the window) to open a saved SQLite database
3. Click the results table to view it.

# Chapter 9

---

## InterMapper HTTP API

InterMapper provides an HTTP API for retrieving data from, and sending data to the InterMapper server ("exporting" and "importing", respectively). The API allows an external program to use standard HTTP commands (GET, POST) and a straightforward URL syntax to make these requests.

These are the major features of the HTTP API:

- **File Import/Export** gives access to files of the InterMapper Settings folder.
- **Table Import/Export** gives access to the tables in the same formats that are currently available through the RemoteAccess Import and Export commands.
- **Acknowledgements** - send Basic Acknowledgements to an InterMapper server using HTTP. This allows you to acknowledge down devices from phones, browsers, or scripts.

Through these API interfaces you can accomplish a number of scripting tasks. Two scripts are provided, allowing you to "clone" the InterMapper Settings directory through a script.

The features of the HTTP API are described in these topics:

[Importing & Exporting Files \(Pg 173\)](#) - How to access the InterMapper Settings directory's file system.

[Importing & Exporting Tables \(Pg 176\)](#) - How to import or export map data directly.

[Acknowledging Devices \(Pg 178\)](#) - How to acknowledge down devices or interfaces using the HTTP API.

[Scripting Examples \(Pg 179\)](#) - Examples of the "clone" scripts and much more.

### Importing & Exporting Files

Most of the files in the InterMapper Settings folder can be accessed through the HTTP API. These include:

- Custom Icons
- Fonts
- Maps
- MIB Files
- Probes
- Sounds
- Web Pages

These folder contents may be exported, but not imported:

- Extensions
- Certificates folder
- Tools

The contents of the following folders are not currently available:

- Chart Data folder
- InterMapper Logs folder
- Deleted and Disabled Maps folders

All other files are served up as binary files with a MIME type of application/octet-stream. Each file has a corresponding URL to retrieve its contents; each folder in InterMapper Settings also has a URL to retrieve the list of URLs for the files in that folder.

All URLs given below are relative to a URL composed of the InterMapper Server address and the webport, as defined in the server settings. For example, in the following discussion a URL of `/~files` would imply the full URL (either http: or https:):

```
http://imserver_address:webport/~files
```

**Example:** The URL above produces a text listing the URLs for the folders in the InterMapper Settings that can be accessed over HTTP; this is provided for the convenience of scripts that might want to access all files.

A request for following URLs provides a text listing of the URLs for the files within the corresponding folder in the InterMapper Settings folder.

<b>InterMapper Settings folder</b>	<b>Corresponding URL</b>
Custom Icons	/~files/icons
Extensions	/~files/extensions
Fonts	/~files/fonts
Maps	/~files/maps
MIB Files	/~files/mibs
Probes	/~files/probes
Sounds	/~files/sounds
Tools	/~files/tools
Web Pages	/~files/webpages

### *HTTP file imports*

To import these files over HTTP, issue a POST request to the appropriate URL with the file contents as a payload; the MIME type should be application/octet-stream.

### **Icons**

You can import icons via HTTP as described above. The URL should take the following form:

```
http://imserver:port/~files/icons/Folder/Filename.type
```

If the file type is a valid image file (jpeg or png), it will be available to use immediately.

Sample curl commands (command-line) to use this facility might look like this (should be all on one line):

```
HTTP: curl --data-binary "@sample.png"  
http://localhost:8080/~files/icons/Default/sample.png  
HTTPS: curl -k --data-binary "@sample.png"  
https://localhost/~files/icons/Default/sample.png
```

**Note:** the `-k` option for HTTPS ignores an unsigned certificate.

### **Maps**

You can import maps or map data using the HTTP API.

A sample curl command line to import a map file should take this form:

```
$ curl --user admin:Pa55w0rd --data-binary @/path/to/local/map_file  
http://imserver:port/~files/maps/map_file
```

## Importing & Exporting Tables

### Table-based Import/Export

The table-based functions of the InterMapper HTTP API match the capabilities of the Import -> Data file... and Export -> Data file... commands of InterMapper RemoteAccess (available from the File menu). These import and export a number of "tables" of information about the devices being monitored. These tables include:

- Devices
- Interfaces
- Vertices
- Maps
- Notifiers
- Users
- Schema

These tables have detailed descriptions in the *Advanced Data Import/Export* section of the [InterMapper User Guide](#). The URLs for importing and exporting have the following format:

```
http://imserver:port/~export/tablename.format? (options)
```

Supported formats are:

- .tab - save as a tab-delimited text file
- .csv - save as a comma-delimited text file
- .xml - save as an XML format file
- .html- display as HTML directly in the browser

The primary option is "fields=...." The list of valid fields are listed in the "schema" export. For example, this query:

```
http://imserver:port/~export/schema.html
```

provides a list of the supported tables and the fields for each table in an HTML format that you can view right in the browser. Other examples include:

```
http://imserver:port/~export/devices.tab
```

provides a list of all devices on active maps as a tab-delimited file. This URL:

```
http://imserver:port/~export/devices.tab?fields=id,name,macadress,address
```

provides a list of all devices on active maps, but only includes the ID, Name, MACAddress and Address fields.



### ***Importing Table-based Data***

An external program can also import table information with an HTTP POST operation by including the table data as the payload.

```
http://imserver:port/~import/filename
```

The *filename* in this URL is written to the log file, but is otherwise ignored. It is not used to determine the data to import, nor is it used to specify where the data goes. InterMapper examines the directive line of the attached file to determine what information is imported from the file. It follows the same logic that is used when importing data using the Import->Data File... command available from InterMapper RemoteAccess's File menu.

A sample curl command line to import map data should take this form:

```
$ curl --user admin:Pa55w0rd --data-binary @/path/to/import/file  
http://imserver:port/~import/file
```

## Acknowledging with HTTP

You can perform a Basic Acknowledgement of a device by issuing a POST to a URL of this format:

```
http://inserver:port/mapid/device/deviceIMID/*acknowledge.cgi?message=
=URL+encoded+string
```

where:

- *mapid* = the mapid of the corresponding map.
- *deviceIMID* = the IMID of the device you wish to acknowledge.
- *message*: requires a URL-encoded text string

There are several ways of finding these values:

- Look in the web interface at the status window for a device, remove the trailing "!device.html" at the end, and replace that with "\*acknowledge.cgi?message=....".
- Review the device table (you can view it using the HTTP API) and get the MapId and IMID.

Example: This curl command sends the POST with the proper string to acknowledge the device:

```
curl --user admin:Pa55w0rd
http://inserver:port/mapid/device/deviceIMID/*acknowledge.cgi?message=
=URL+encoded+text+string -d "dummy post data"
```

Example: This curl command retrieves the full list of devices and each device's address, MapID and IMID

```
curl --user admin:Pa55w0rd
http://inserver:port/~export/devices.tab?fields=MapId,IMID,address,na-
me
```

Example: You can also use this expression in Python to create the URL to POST:

```
"http://inserver:port/%s/device/%s/*acknowledge.cgi?message=%s" %
(mapId, IMID,urllib.urlencode([('message', messageStr)]))
```

## HTTP API Scripting Examples

Two command line script examples are included here; these scripts provide good examples of the use of the InterMapper HTTP API:

- **Unix shell script** - for Unix/Linux platforms
- **Windows vbscript** - for Windows platforms

### Notes:

- These scripts are not installed on your InterMapper server.
- If you copy the scripts, *make sure you are copying from the online version* of this guide, available at <http://download.intermapper.com/docs/DevGuide/>. Copying from the PDF version may result in unreliable results, caused by unwanted line breaks.
- Both scripts make a copy of the InterMapper Settings directory.
- Both scripts assume they are invoked *from the destination directory* rather than trying to look it up - this is intended to make testing easier. Help/Systems recommends that you create a dummy InterMapper Settings folder someplace and try the synchronization to that (the destination directory doesn't even require that InterMapper is installed, only the script). The remote server does not need to be the same platform as the destination machine.
- The destination directory should **not** have an active InterMapper running in it, as the script assumes that it can replace files at will.

The following URLs are used to access the folders:

InterMapper Settings folder	Corresponding URL
Custom Icons	/~files/icons
Extensions	/~files/extensions
Fonts	/~files/fonts
Maps	/~files/maps
MIB Files	/~files/mibs
Probes	/~files/probes
Sounds	/~files/sounds
Tools	/~files/tools
Web Pages	/~files/webpages

### **Unix shell script**

**File location:** The Unix shell script assumes that the current working directory is the "Temporary" folder inside the destination InterMapper Settings.

The script requires bash, curl, tr, grep, sed and awk. to be installed.

**Unix script options**

```
clone im.sh [options]
-r [remote_host_name]
-t [remote_port]
-u [remote_user]
-p [remote_password]

Defaults:
remote_host_name = "localhost"
remote_port = 8080 (this is the InterMapper web access port)
remote_user = "admin"
remote_password = "admin"

Example:
clone_im.sh -r nitro.dartware.com -t 8080 -u IMuser -p UsErpaSS
```

**Windows vbscript**

**File location:** The Windows vbscript assumes that the current working directory is the destination machine's InterMapper Settings folder.

**Windows script options**

```
clone im.vbs
/host:[remote_hostname]
/port:[remote_port]
/user:[remote_user]
/password:[remote_password]

Defaults:
remote_host_name (none, must be specified)
remote_port = 80
user (none, uses auto-login unless specified)
password (none, uses auto-login unless specified)
secure = false

Example:
clone_im.vbs /host:nitro.dartware.com /port:8080 /user:IMuser
/password:UsErpaSS /secure:true
```

**Known bugs**

- The Unix version does not yet support a "secure" switch.
- The Unix version should not have default username and password, to use the auto-login if that's available.
- The Unix version should require the current directory to be the top-level of the destination InterMapper Settings directory, not the "Temporary" subdirectory.

***clone\_im.sh***

```
#!/bin/bash

# Synchronize InterMapper Settings folder from a remote host with
InterMapper SDK
#
# Requires curl and gnu awk

remote=localhost
port=8080
user=admin
password=admin
auth=
while getopts 'r:t:u:p:' OPTION ; do
    case $OPTION in
        r) remote="$OPTARG" ;;
        t) port="$OPTARG" ;;
        u) user="$OPTARG" ;;
        p) password="$OPTARG" ;;
        ?) printf "Usage: %s -r remotehost\n" $(basename $0) >&2
            exit 2;;
    esac
done

if [ "$user" ] ; then
    auth="--user $user:$password"
fi

# This script requires InterMapper to be stopped before running.
#/etc/init.d/intermapperd stop

# Get list of top-level file directories from InterMapper
topdirs=$(curl $auth -s http://$remote:$port/~files | tr '\r' '\n')

for dir in $topdirs ; do
    # Get list of files in this directory
    filelist=$(curl $auth -s $dir | tr '\r' '\n')

    webdir=$(basename $dir)
    echo "Processing $webdir..."
    localdir=""

    echo $filelist | grep "does not exist" >& /dev/null
    if [ $? != 0 ] ; then

        # Convert the web path into the corresponding Setting folder path
        case $webdir in
            icons) localdir="Custom Icons" ;;
            sounds) localdir="Sounds" ;;
            mibs) localdir="MIB Files" ;;
            probes) localdir="Probes" ;;
            tools) localdir="Tools" ;;
            webpages) localdir="Web Pages" ;;
            fonts) localdir="Fonts" ;;
            extensions) localdir="Extensions" ;;
```

```

        maps) localdir="Maps" ;;
    esac

    for file in $filelist ; do
        # Get this file and move it into the proper location
        curl $auth -s -O $file
        filename=$(basename $file)

        # Decode the URL to find the real filename
        # Modified from http://do.homeunix.org/UrlDecoding.html to work
        with gnu awk
            local filename=$(echo $filename | \
                sed 's/+//g' | \
                sed 's/\%0[dD]//g' | \
                awk '/%/{while(match($0,/\%[0-9a-fA-F][0-9a-fA-F]/))
        {$0=substr($0,1,RSTART-1)sprintf("%c",strtonum("0x"substr
        ($0,RSTART+1,2)))substr($0,RSTART+3);}}{print}')

            # This version works with BSD awk
            # local filename=$(echo $filename | \
            #     sed 's/+//g' | \
            #     sed 's/\%0[dD]//g' | \
            #     awk '/%/{while(match($0,/\%[0-9a-fA-F][0-9a-fA-F]/))
            {$0=substr($0,1,RSTART-1)sprintf("%c",0+("0x"substr($0,RSTART+1,2)))
            substr($0,RSTART+3);}}{print}')

            # Make sure the destination directory exists
            local_dirname=$(dirname "$local_filename")
            mkdir -p "$localdir/$local_dirname"

            echo "  " $(basename "$local_filename")
            mv $(basename $file) "$localdir/$local_filename"
        done
    fi
done

# Preferences file is separate, since it's stored in the top level of
the InterMapper Settings directory
curl $auth -s -O http://$remote:$port/~files/Preferences
mv Preferences ../

# restart InterMapper
#/etc/init.d/intermapperd start

```

***clone\_im.vbs***

```
Rem Synchronize with a remote InterMapper server

Option Explicit

Dim remoteAddr, remotePort, remoteUser, remotePassword,
secureConnection
Dim urlBase, topLevelDirs, dir, fileList, file, fileName, fileData
Dim webDir, localDir, localFileName

'*****_
'*****
' Parse command line arguments

If WScript.Arguments.Named.Exists("host") Then
    remoteAddr = WScript.Arguments.Named.Item("host")
Else
    WScript.Echo "Must specify a remote InterMapper host to synchronize with"
    WScript.Quit
End If

If WScript.Arguments.Named.Exists("port") Then
    remotePort = WScript.Arguments.Named.Item("port")
Else
    remotePort = 80
End If

If WScript.Arguments.Named.Exists("user") Then
    remoteUser = WScript.Arguments.Named.Item("user")
End If

If WScript.Arguments.Named.Exists("password") Then
    remotePassword = WScript.Arguments.Named.Item("password")
End If

if (WScript.Arguments.UnNamed.Count > 0) Then
    secureConnection = (WScript.Arguments.UnNamed.Item(0) = "secure")
End If

'*****_
'*****
' Get list of supported folders
urlBase = MakeURLBase(remoteUser, remotePassword, remoteAddr,
remotePort, secureConnection)

topLevelDirs = Split(FetchURL(urlBase, remoteUser,
remotePassword,true), VbCrLf, -1, vbBinaryCompare)
```

```

For Each dir In topLevelDirs
    if dir <> "" Then

        ' Convert the top-level name in the URL to the local folder name
        webDir = Right(dir, Len(dir) - Len(urlBase) - 1)
        Select Case webDir
            Case "icons"
                localDir = "Custom Icons"
            Case "sounds"
                localDir = "Sounds"
            Case "mibs"
                localDir = "MIB Files"
            Case "probes"
                localDir = "Probes"
            Case "tools"
                localDir = "Tools"
            Case "webpages"
                localDir = "Web Pages"
            Case "fonts"
                localDir = "Fonts"
            Case "extensions"
                localDir = "Extensions"
            Case "maps"
                localDir = "Maps"
        End Select

        ' Get the files in this folder
        fileList = Split(FetchURL(dir, remoteUser, remotePassword, true),
        vbCrLf, -1, vbBinaryCompare)
        For Each file In fileList
            If (Len(file) > len(dir)) Then
                localFileName = Right(file, len(file) - len(dir) - 1)

                fileName = localDir & "\" & URLDecode(localFileName)
                fileData = FetchURL(file, remoteUser, remotePassword, false)
                MakeFolderFor fileName
                SaveBinaryData fileData, fileName
            End If
        Next
    End If
Next

' Preferences file is not contained in a folder on the server.
fileData = FetchURL(urlBase & "/Preferences", remoteUser,
remotePassword, false)
SaveBinaryData fileData, "Preferences"

'*****
*****

'*****
*****

'*****
*****

Function URLDecode(str)

```



```
URLDecode = Replace(Unescape(Replace(str, "+", " ")), "%2F", "\\")
End Function
```

```
Function FetchURL(url, user, password, textonly)
    Dim http, result

    Set http = CreateObject("WinHttp.WinHttpRequest.5.1")
    http.Open "GET", url

    If user <> "" Then
        http.SetCredentials user, password, 0
    End If

    http.Send

    if http.Status = 200 then
        if textonly Then
            result = http.ResponseText
        Else
            result = http.ResponseBody
        End If
    Else
        result = ""
    End If

    Set http = Nothing
    FetchURL = result
End Function
```

```
Sub MakeFolderFor(filename)
    'Recursively make folders
    Dim fso, i
    Redim dirstack(0)

    Set fso=CreateObject("Scripting.FileSystemObject")
    dirstack(0) = fso.GetParentFolderName(filename)

    While (dirstack(ubound(dirstack)) <> "" )
        Redim preserve dirstack(ubound(dirstack) + 1)

        dirstack(ubound(dirstack)) = fso.GetParentFolderName(dirstack
(ubound(dirstack) - 1))
    WEnd

    For i = ubound(dirstack)-1 To 0 step -1
        If Not fso.FolderExists(dirstack(i)) Then
            fso.CreateFolder(dirstack(i))
        End If
    Next

    Set fso=Nothing
End Sub
```

```
Function MakeURLBase(user, password, host, port, secure)
    Dim protocol, fullhost
    If secure Then
```

```
    protocol = "https://"
Else
    protocol = "http://"
End If

If (port <> "") Then
    fullhost = host & ":" & port
Else
    fullhost = host
End If

MakeURLBase = protocol & fullhost & "/~files"
End Function

Function SaveBinaryData(arrByteArray, strFileName)
    Dim objBinaryStream
    Set objBinaryStream = CreateObject("ADODB.Stream")
    objBinaryStream.Type = 1
    objBinaryStream.Open()
    objBinaryStream.Write(arrByteArray)
    objBinaryStream.SaveToFile strFileName, 2
End Function
```

# Chapter 10

---

## Retrieving Collected Data

InterMapper Reports Server is a PostgreSQL database that retrieves data from an InterMapper server and saves it for use by external programs.

Although the InterMapper Reports UI is the easiest way to get data from the database, you can connect to the InterMapper Reports Server database using your own techniques. Several short example reports in Crystal Reports and OpenRPT are available, as well as several example perl scripts. The perl scripts require DBI and DBD::pg.

These scripts have been packaged and zipped and placed on our downloads server, and are available at:

[http://download.intermapper.com/sql/sql\\_examples.tar.gz](http://download.intermapper.com/sql/sql_examples.tar.gz)

Please feel free to share your own, as well.

If you want to create your own queries to retrieve data, see [Creating SQL Queries \(Pg 188\)](#).

## InterMapper Database Schemas

The most up-to-date schema for the InterMapper Database is available at:

[https://\[Your InterMapper Database Server URL\]:8182/~imdatabase/schemaddl.html](https://[Your InterMapper Database Server URL]:8182/~imdatabase/schemaddl.html)

It is also available at:

<http://download.intermapper.com/schema/imdatabaseschema.sql>

## Creating SQL Queries

You can create your own SQL queries to retrieve data from InterMapper Database. The `datasample` tables contain the 5-minute, hourly and daily samples derived from the original data values. The recommended approach for retrieving data is to get it from these tables. For more information, see [InterMapper Database Schemas \(Pg 187\)](#).

You can also query individual data values, but this is much slower than querying the `datasample` tables. In InterMapper 5.4 and earlier, individual data values were stored in the `datapoints` table. They are now stored in the `datastore` table. Existing queries on the `datapoints` table must be rewritten to use the `datastore` table instead. *This applies only if you have written queries in this or a related construct:*

```
SELECT FROM datapoint WHERE dataset_id = 5 AND data_time BETWEEN a
AND b
```

To retrieve data from the `datastore` table, use the `load_data()` function, described below.

### Using the `load_data()` function

Use this function *only* if you have an existing query on the `datapoint` table, or if you actually need the individual raw values. In the overwhelming majority of cases you should query the `datasample` tables as described above, since they're faster and easier to access.

The syntax for the `load_data()` function is as follows:

```
load_data([dataset id],[datetime start],[datetime end])
```

For example, to retrieve data for `dataset_id = 5` between `data_times a` and `b`, use this recommended syntax:

```
SELECT data_time, data_value FROM load_data(5, a, b)
```

The explicit column list is not required, but it is recommended. If you use `SELECT *` rather than an explicit column list, the function returns a single column of the built-in *composite-value* type, containing both values. You can still reference the values from this composite data type, but you won't be able to treat it as you would a regular Postgres column.

The `load_data()` function acts as a table source, and accepts the built-in Postgres `infinity` and `-infinity` timestamps.:

```
SELECT data_time, data_value
FROM load_data(1, '2011-11-09 00:00:00', 'infinity')
ORDER BY data_time
```

You can also use `UNION` to combine sources:

```
SELECT 5 as dataset_id, data_time, data_value
FROM load_data(5, '2011-11-09 00:00:00', 'infinity')
UNION SELECT 6 as dataset_id, data_time, data_value
FROM load_data(6, '2011-11-09 00:00:00', 'infinity')
UNION SELECT 14 as dataset_id, data_time, data_value
FROM load_data(14, '2011-11-09 00:00:00', 'infinity')
ORDER BY dataset_id, data_time
```

# Chapter 11

---

## Customizing Web Pages

InterMapper comes with a set of default web page layouts, and uses them to generate web pages. Use this section to learn how to customize those pages by modifying the files that InterMapper uses to create the pages delivered by its web server.

InterMapper's built-in web server generates pages based on files in its Web Pages directory. When a web request is received, InterMapper finds a corresponding file (called a *target file*) to use as the response. The target file is then formatted according to information specified in a *template file*. The resulting file is returned to the user's web browser.

InterMapper uses the following elements to control the appearance of the web pages returned from its web server:

- [Target files](#) (Pg 191) - Contain the main text of the various pages sent by the server
- [Template files](#) (Pg 193) - Control the overall format of the web pages
- [Directives](#) (Pg 194) - Commands within files to control the formatting of the web pages
- [Quoted links](#) (Pg 197) - Make it easy to create links to other pages.
- [Macros](#) (Pg 198) - Elements you can insert in your templates and target files to show blocks of useful InterMapper information.
- [Web Pages Folder](#) (Pg 205) - Controls which web pages are available to Administrators and Guests.
- [Mime Types](#) (Pg 207) - Associates templates or target files with specific MIME types.

**Tip:** The target and template files are simply text files. You may edit them with any text editor. On certain platforms, you must have the correct permissions to edit them.

## Reloading Changed Web Page Files

The changes you make to these files do not take effect until InterMapper reloads them.

### To force InterMapper to reload the Web Page files:

1. From the Edit menu, choose **Server Settings...**
2. From the Server Configuration category, choose **Web Server**. The Web Server settings panel appears.
3. Stop and then restart the Web Server. The changed web pages are reloaded.

### Target Files

When InterMapper receives a request for a web page, the requested URL is parsed to determine the target of the request. This *target file* contains the text content of the desired page. The target file may contain HTML markup if desired.

In addition to the page's text, the target file can contain these other elements:

- [Directives \(Pg 194\)](#) - Commands that describe or modify the way a page should be displayed.
- [Quoted Links \(Pg 197\)](#) - Provide a quick way to create a link to another page using its name, rather than specifying its full URL. If a string is placed in double-quotes (") and the text matches the title of another InterMapper web page, a link is created.
- [Macros \(Pg 198\)](#) - InterMapper variables that are replaced with text or formatted HTML in the final web page. The macro may be replaced with a static string, a device's name or network address, the contents of another file, or other information. Macros are composed of keywords and optional parameters, and are enclosed in "\${...}".

#### Target File Example:

```
#title "This is a test page"
This is some text to be displayed in a
web page. The page's title is "This is a test page", while the
remaining
text is displayed in the "body" of the page. The text may also
contain
plain text, HTML tagged text such as <b>bold</b> and <i>italic</i>,
and macros, such as the ${date} macro, which displays today's date.
```

- The first line is a directive that sets the title of the page to be displayed.
- The text between double-quotes is placed in <title>...</title> tags in the resulting web page.
- The remainder of this example is placed in the <body>...</body> section of the resulting page. The macro \${date} will be replaced by the current date when the page is displayed.

#### Quoted Links

Note that the text "This is a test page" will be displayed as a link to its own page, since it is a string in quotes that matches the #title of a web page (its own). Note, too, that the text "body" could be a link to a page with a title of "body". It is not an error if no such page exists: in that case, InterMapper displays the quoted string in place. For more information see [Quoted Links \(Pg 197\)](#).

## What Happens When a Target File Is Read?

As the target file is read, InterMapper processes the directives, then the expands the macros and creates the <A

HREF= . . . > tags for any quoted links it encounters. The web server does not insert any white space or paragraph marks (such as <P>) when it encounters carriage returns, etc.

## Built-in Target Files

InterMapper provides a number of built-in target files. These file names all begin with "!", and are required because InterMapper refers to them explicitly. Here are some of the built-in files:

- **!index.html** - Displays the default page, when none is specified in the URL.
- **!document.html** - Displays a graphical image of the specified map.
- **!network.html** - Displays detailed information about the specified network.
- **!device.html** - Displays detailed information about the specified device.
- **!link.html** - Displays detailed information about the specified link.
- **!chart.html** - Displays the specified strip chart.

**Note:** The !network.html, !device.html, !link.html, and !chart.html files are targets intended to display information about a specific network, device, link or chart. The macros that display lists of maps, networks, devices, or charts create links to these targets. The easiest way to create custom versions of these targets is to edit them directly.



## Template Files

To allow all the web pages to have the same look, InterMapper uses *template files* to control the formatting of pages. A template file is composed of HTML commands that provide the skeleton for a web page. In addition, template files often contain macros and quoted links that are replaced by appropriate text when the page is generated.

### Template File Example

Here is a simple template file that could be used with InterMapper:

```
<!DOCTYPE HTML PUBLIC "-//IETF//DTD HTML 3.2//EN">
<HTML>
<HEAD>
  <TITLE>${pagetitle}</TITLE>
</HEAD>
<BODY BGCOLOR="#FFFFFF">
  ${imageref:logo.gif}
  ${bodytext}
  ${include:footer.incl}
</BODY>
</HTML>
```

This sample contains several important macros:

- **\${pagetitle}** - Replaced with the text of the #title directive of the target file.
- **\${bodytext}** - Replaced with the body text of the target file, that is, everything from the target file that is not a directive.
- **\${imageref:logo.gif}** - Replaced with an `<img ... >` tag that refers to the logo.gif file in the ~GuestImages folder on the InterMapper server.
- **\${include:footer.incl}** - Replaced with the contents of the file named 'footer.incl'.

## Directives

A *directive* is a special command interpreted by the web server to control the way a page is formatted.

- Directives must start with a "#" in the first column.

### Summary of Directives

InterMapper has several directives that can change the way pages are formatted. They are defined below:

<b>#template</b>	<pre>#template "othertemplate.html"</pre> <p>A target file may specify a template file with the <code>#template</code> directive. The <code>#template</code> directive is optional; if none is present, InterMapper uses the file named <code>!template.html</code> as the page's template.</p>
<b>#title</b>	<pre>#title "This is a Test Page"</pre> <p>The text in quotes becomes the title of the page - it enclosed in <code>&lt;title&gt;...&lt;/title&gt;</code> tags in the generated page. The <code>#title</code> directive also provides a destination for quoted links on other pages.</p> <p>Every target file must have a <code>#title</code> directive to give it a name.</p> <p>You may include a macro within the quoted text of this directive. This is useful for inserting the device name or other information into the title of the web page.</p>
<b>#alt_title</b>	<pre>#alt_title "Test Page"</pre> <p>The optional <code>#alt_title</code> directive provides a way to give a page an alternate name that can be used with a quoted link.</p>
<b>#filename</b>	<pre>#filename "otherpage.html"</pre> <p>The optional <code>#filename</code> directive causes InterMapper to treat the file as if named with the quoted string.</p> <p>For example, a target file named "xindex.html" could have a directive of <code>#filename "!index.html"</code>. This causes the target file to be used in place of the file named <code>"!index.html"</code> <i>if its version number is higher</i>. This can be useful for debugging, or for creating alternate versions of pages.</p>

### #version

```
#version "2.1"
```

The optional `#version` directive determines which file is used when there are two or more instances of the same filename (as a result of using `#filename` directives.)

The optional `#version` directive is used to break "ties" between several files having the same name to determine which should be used. This comes into play in several cases:

- InterMapper has its own internal copy of the web template files, which it uses to create the original set on disk.
- If you edit one of the default web template files, you could change its `#version` to make it take precedence over InterMapper's built-in copy.
- If you edit the file without changing the `#version`, its date-last-modified value is later, causing it to take precedence over InterMapper's built-in copy.
- If you install a new version of InterMapper with updated web files, the `#version` value is incremented, causing the built-in copy to take precedence over the user-edited files,

**Note:** The user files are not overwritten.

- Through the use of the `#filename` directive, it is possible to have two files on-disk that have "essentially" the same name. One could be named "foo.html", and the other (named something else) can use the `#filename` directive to set its "virtual filename" to "foo.html". In such a case, the `#version` is used to determine which file takes precedence.

Version numbers must be in a 'digit.digit' format. InterMapper uses the file with the highest version number. This is useful for debugging as well as experimenting with alternate pages.

If `#version` directive is not present in the file, the default version, "1.0" is used.

### #redirect

```
#redirect "otherpage.html"
```

The `#redirect` directive causes the InterMapper to find `otherpage.html` and use that in place of the original target file.

This can be used to force a well-known page (such as !index.html) to display a user-selected page.

**Note:** This directive creates a static redirection that works only for web pages that exist on the disk when the web server is started. To redirect to web pages that are generated dynamically by InterMapper (such as map web pages), use the HTML refresh meta tag instead.

### **#target**

```
#target "window_name"
```

The `#target` directive forces a page to be opened in a new window named "window\_name".

When generating the web page, InterMapper generates an HREF link with a `...target = "window_name" ...` reference. This causes the detailed information to appear in a separate window when the user clicks a map's device or link.

### Quoted Links

You can create a link to another page by entering the page's title in double-quotes. For example, the text "Test Page" creates a link to a page with a `#title` or `#alt_title` directive that contains the text "Test Page".

**Note:** Two target files may have the same `#title` or `#alt_title`. When this happens, InterMapper chooses one of the target files, but you cannot predict which one is chosen.

### Preventing a Quoted String From Becoming a Link

If you place a string in quotes, and the string that does not match another page's `#title` or `#alt_title`, InterMapper displays the quoted string as-is.

You may want text to appear in quotes, even when the text matches another page's `#title` or `#alt_title`. (Remember, you can create quoted links only to pages which have `#title` or `#alt_title` directives, and only quoted text that matches one of those directives results in a link.)

**To prevent a string in quotes from being interpreted as a quoted link:**

- Place backslashes ("`\`") in front of *both* the first and second quote character.

## Macro Reference

A macro is a text string with the format `${macroname:other-information}`. The *macroname* is required, and some macros use or require *other-information* which follows the ":". The entire macro is replaced by the appropriate text when the page is generated.

Macros fall into these general categories:

- [The Include Macro \(Pg 198\)](#)
- [Macros that generate "content" on an InterMapper web page \(Pg 198\)](#)
- [Macros that describe InterMapper and its environment \(Pg 199\)](#)
- [Macros to place images onto a page \(Pg 200\)](#)
- [Macros that control the interval between page refreshes \(Pg 202\)](#)
- [Macros related to links and URLs \(Pg 202\)](#)

### The Include Macro

Your template files and target files may include other files.

**`${include:file-to-be-included.html}`** The named file is inserted into the web page. The file must be in the same folder.

### Macros that generate the "content" of an InterMapper web page

InterMapper often uses these macros either as the `${bodytext}` of the page, or as a major part of a page's contents. All the macros below work on the map named in the request URL. If the URL is for a page in the `~admin` directory, InterMapper displays information about all items in all maps.

**`${fullstatus}`** shows a list of all the devices and links for the map named in the URL.

**`${errorstatus}`** Shows only the devices and links which are in warning or alarm states, or down for the named map.

**`${errorstatus_orig}`** Output the original "errors" status report. Differences from `${errorstatus}`:

- `${errorstatus_orig}` doesn't show device alarms.
- `${errorstatus}` first outputs interfaces in error, then interfaces with high utilization. `${errorstatus}` lists interfaces in random order.

**`${currentoutages}`** Shows the list of current outages -- devices or links that are currently in warning, alarm, or are down in the named map.

**`${currentlinkoutages}`** Output a table of current interface outages. The table's column names are ***Date***, ***Time***, ***Interface*** and ***Duration***.

**`${previousoutages}`** Shows the list of devices that had been listed as

outages but have since returned to normal.

**`${previousoutages:hours=-xx}`** Shows the list of previous outages within the last xx hours.

**`${previousoutages:maxrows=x}`** Shows a list of the last x previous outages.

**`${maplist}`** Shows an HTML unnumbered list (`<UL>`) of the maps available.

**`${chartlist}`** Outputs a sorted list of charts from the current context, one per line with each line preceded by a `<LI>` tag. You are required to supply your own `<UL>` or `<OL>` tags. Each chart title is a hyperlink to the related chart web page.

Within an administrator context, **`${chartlist}`** generates a list of all charts. In a "per-map" context, **`${chartlist}`** generates a list of charts from the current map.

**`${chartname}`** Outputs the title of the chart related to the current web page. If you are not on a chart-related page, the output is "".

**Note:** Similar to `${mapname}`

**`${maplistwithcharts}`** Shows an HTML unnumbered list of the maps available, with sub-lists of the charts for each map.

**`${include:file-to-be-included.html}`** Inserts the specified file into the web page.

### **Miscellaneous macros that describe InterMapper and its environment**

**`${abouthtml}`** Shows the "About" page with the current version of InterMapper.

**`${statshtml}`** Shows InterMapper's statistics: uptime, memory usage, etc.

**`${httpuserid}`** The name the user typed when asked for authentication.

**`${httplocaladdress}`** Output the IP address of the web server's side of the connection. If the InterMapper server is multi-homed, this will be the local side IP address of the current TCP connection.

**Note:** Use caution with this address; URL's produced using this address may break in NAT situations.

**`${httpremoteaddress}`** The IP address of the remote browser.

**`${intermapperaddress}`** The IP address of this InterMapper server.

**`${version}`** The version of this copy of InterMapper.

**`${date}`** The current date.

<b><code>\${time}</code></b>	The current time.
<b><code>\${imagesuffix}</code></b>	Set to ".png" if the web client can display PNG images, or ".jpeg" otherwise.
<b><code>\${telnetserverurl}</code></b>	The <code>telnet:</code> URL that connects to this InterMapper Telnet server.
<b><code>\${webserverurl}</code></b>	The <code>http:</code> URL that connects to this InterMapper server.
<b><code>\${mapname}</code></b>	The current map's name.
<b><code>\${deviceaddress}</code></b>	The IP or AppleTalk address of the particular device. For anything that isn't a device, an empty string is returned.
<b><code>\${deviceid}</code></b>	Outputs the device ID of the device related to the current page, in the form: "gMMMM-rNN". If the current page is not device-related, output "".
<b><code>\${devicelist}</code></b>	Outputs a table showing the device list for the current context. The table's columns are <b><i>Status</i></b> , <b><i>Name</i></b> , <b><i>Condition</i></b> , <b><i>Date</i></b> , <b><i>Time</i></b> , <b><i>Probe</i></b> , and <b><i>Port</i></b> .  Within an administrator context, <b><code>\${devicelist}</code></b> generates a list of all devices. In a "per-map" context, <b><code>\${devicelist}</code></b> generates a list of devices from the current map.
<b><code>\${devicelist_kml}</code></b>	Generates a device list in <a href="#">KML format</a> for use by Google Earth.
<b><code>\${devicename}</code></b>	The DNS name or AppleTalk NBP name of the particular device. It is an empty string for anything that isn't a device.
<b><code>\${ifadmin: ADMIN : NONADMIN }</code></b>	Outputs ADMIN if the user has admin privileges. Otherwise outputs NONADMIN.
<b><code>\${pagetitle}</code></b>	Displays the value set by the <code>#title</code> directive
<b><code>\${SetNameFieldWidth:x-x}</code></b>	Set the width of the name field. InterMapper pads the name up to xx characters wide. Use -1 to set the width of the field to the width of its contents. The default width is 20 chars.

### Macros to place images onto a page

<b><code>\${imageref:IMAGEFILE [,tags]}</code></b>	Creates an <code>&lt;img ... &gt;</code> tag to place an image on the page.
--	---

Example:

```
${imageref: photo, class='grade4'}
```

outputs

```
<IMG SRC="/images/photo.gif"
class='grade4'>
```



**Notes:**

Unlike every other macro, this one uses a comma-delimiter in the parameter section instead of a colon.

This macro searches the images folder alphabetically for the first file whose name matches the IMAGEFILE parameter. If you have two files, "photo.gif" and "photo.png", photo.gif is found first.

**`${imagesuffix}`** Set to ".png" if the web client can display PNG images, or ".jpeg" otherwise.

**`${intermapperlogo}`** Creates an `<img... >` tag that includes the "Made with InterMapper" logo image.

**`*chart`** Displays a strip chart, generally has a suffix of `${chart}.${imagesuffix}` to send the desired format for the client's browser. Takes parameters of width (for the chart, in pixels) and the other parameters of the URL.

Usage:

```
<IMG
SRC="*chart.${imagesuffix}?${clientwidth}
&${httpparams}">
or
<IMG
SRC="*chart.${imagesuffix}?width=300&${httpparams}">
```

**`*popuptext.html`** Displays the contents of the current device, network, or interface Status Window (these were formerly called "pop-up windows") as HTML.

Usage:

`${include: *popuptext.html}`, generally enclosed in `<pre> ...</pre>` tags.

**`*map`** Displays an image of the devices, networks, and links (the "foreground") of the selected map against a transparent background. The objects in this image match with the `*imagemap.html`, below. Takes an option of a timestamp, to provide for auto-refresh.

Usage:

```

```

**`*mapbg`** Displays the background image of the selected map. This provides the customer-selected background to the map as an image. It takes an

option of a timestamp to provide for auto-refresh.

Usage:

```

```

**\*imagemap.html** Displays an HTML imagemap that corresponds to the map image; clicking in the image, follows the links in the (automatically-generated) image map.

Usage:

```
${include:/${httpdocument}
/document/main/*imagemap.html}
```

**Note:** The web pages combine `*map` with the `*mapbg` and `*imagemap` to create a `<div>` that superimposes all three items into a single visual unit. See `InterMapper Settings/Web Pages/PerMapHTML/map.html` for an example.

### Macros that control the interval between page refreshes

InterMapper's web server can automatically refresh a particular web page at a desired interval. Include these tags on your page to take advantage of this facility.

**\${htmlrefreshmetatag}** Either an empty string or the previous refresh choice from the web client. (Inserts a `<meta http-equiv="refresh"...>` tag on the resulting page.)

**\${htmlrefreshmetaoptions}** The option list that a web client can choose from. The current `${htmlrefreshmetatag}` value is selected. Note that your HTML template should supply the `<form><select>...</select></form>` surrounding this `${htmlrefreshmetaoptions}` macro.

**\${jsrefreshoptions}** The option list that a web client can choose from, generated with JavaScript. The current `${htmlrefreshmetatag}` value is selected. Note that your HTML template should supply the `<form><select>...</select></form>`

### Macros related to links and URLs

These macros all return a fully-escaped string, that is, a space character (" ") will be replaced with a `%20`; a "?" with `%3F`; etc.

Here is a sample URL. The result of using this URL is shown in parentheses after each macro:

```
http://localhost/Map1/device/192.168.0.1%3ASNMP/!device.html
```

**\${webpageurl}** The full URL of the requested web page. (e.g., the full URL as shown above).

**\${httppath}** The full path to the file requested (e.g., `"/Map1/device/192.168.0.1%3ASNMP/!device.html"`).

- `${httpdocument}`** The top level directory of the page requested. Also an alias for `${mapname}` (e.g., "Map1").
- `${httpclass}`** The second level directory of the page requested (device, chart, link, document, network) (e.g., "device").
- `${httpinstance}`** The third level directory of the page requested (e.g., "192.168.0.1%3ASNMP").
- `${httpmethod}`** The fourth-level part of the page requested (e.g., "!device.html").
- `${httpinstancepath}`** A concatenation of `${httpdocument}`, `${httpclass}`, `${httpinstance}` separated by "/" (e.g., "/Map1/device/192.168.0.1%3ASNMP").
- `${httpparam: NAME}`** Outputs the value of the HTTP parameter specified by NAME. An HTTP parameter is one passed with the originating GET request, affixed to the URL following a question mark. If there is no HTTP parameter by the given name, outputs "".
- Example, given the following URL:
- ```
http://www.example.com/TestMap/?color=red&style=bold
```
- `${httpparam: color}` outputs "red"  
`${httpparam: style}` outputs "bold"  
`${httpparam: font}` outputs "" (because the parameter doesn't exist)
- `${httpparams}`** Outputs all the HTTP parameters from the originating GET request in their original format. If there were no parameters attached to the original request, output "".
- Example, given the following URL:
- ```
http://www.example.com/TestMap/?color=red&style=bold
```
- `${httpparams}` outputs "color=red&style=bold".
- `${httpparams_endchart}`** `${httpparams_endchart}` - Replaces the value of the "endtime" parameter with the chart's last time. (For scrolling to the end of the chart).
- `${httpparams_nextchart}`** `${httpparams_nextchart}` - Replaces the value of the "endtime" parameter with a new time value that effectively scrolls the chart one page into the future.
- `${httpparams_prevchart}`** `${httpparams_prevchart}` - Replaces the value of the "endtime" parameter with a new time value that effectively scrolls the chart one page into the past.

`${httpparams_startchart}` - Replaces the value of the "endtime" parameter with the chart's starting time. (For scrolling to the beginning of the chart).

`${httpparams_timescale: VALUE}` - Replaces the value of the "timescale" parameter with the specified value.

**Note:** These five macros are nearly identical to `${httpparams}`. They implement support for chart scrolling and scaling in the web interface. They generate output *only* within a web page associated with a chart.

**`${anchor: value}`** Sets the current "anchor" value.

**`${attr}`** Outputs the current "anchor" parameter value as set using `${anchor: value}`. If no "anchor" value has been set, output is "".

**Note:** These two macros are closely related.

`${anchor}` sets the value; `${attr}` retrieves it.

Example:

```
${anchor:class="header"}
  <A HREF="maplist.html" ${attr}>Map
List</A>
  <A HREF="${TelnetServerURL}" ${attr}
>Telnet</A>
  <A HREF="${WebServerURL}"${attr}>Home</A>
${anchor:}
```

In this example, the anchor is set to 'class="header"'. Then the `${attr}` macro is used to place the attribute string in each link. Afterward, `${anchor:}` sets the anchor to an empty string.

### Folder Structure

Web target files and template files are in the *Web Pages* folder within the *InterMapper Settings* folder. Except for the folders described below, the InterMapper web server serves out only those files located in the top level of the *Web Pages* folder.

InterMapper ships with four folders stored in the *Web Pages* folder:

#### **~AdminHTML**

This folder contains HTML templates for pages that show the overall status of the InterMapper program. People who have access to these pages may also view all the separate map pages. You can access these files from the default web URL, or by using a URL in this form:

```
http://intermapper.domainname.com/~admin/filename.html
```

#### **~GuestHTML**

This folder contains HTML templates for reporting errors such as missing or invalid file names, and for responding to web clients who are not authorized for the web server. These files bypass the usual access list mechanism; you can access them using this URL form:

```
http://intermapper.domainname.com/~error/filename.html
```

#### **~GuestImages**

This folder contains images used by the InterMapper web server. These images may be placed in a target or template file using the `${imageref: ... }` macro.

#### **PerMapHTML**

This folder contains HTML templates that are used when displaying a map's information. To view a specific document's information, use this URL form:

```
http://intermapper.domainname.com/docname
```

## How the Web Page Files are Used

### Main Web Page

The main web page is the `~admin/!index.html` target file. When an unqualified URL request arrives (that is, a request for `/`, without any additional path of file information), InterMapper sends out the file specified by `~admin/!index.html`.

### Main Template file

By default, all target files use the same template, `!template.html` (note the exclamation point at the beginning of the filename). A target file may specify a different template file by using the `#template` directive.

### Default HTML page

For both the `"~AdminHTML"` and `"PerMapHTML"` folders, the default HTML page is `!index.html`. A request for `http://intermapper.domain.com/` is treated like a request for

```
http://intermapper.domain.com/~admin/!index.html.
```

Similarly, a request for

```
http://intermapper.domain.com/docname
```

will be treated like a request for

```
http://intermapper.domain.com/docname/document/main/!index.html.
```

## MIME Types

You can associate a template or target file's suffix with MIME-type information you want to send with the file. You create this association by placing a file named "mimetypes" at the top level of the *Web Pages* folder.

Below is a sample mimetypes file:

```
# Sample MIMETypes file
# Format is: <file-suffix> <whitespace> <MIME-descriptor>
wml      text/vnd.wap.wml
wmls     text/vnd.wap.wmlscript
wbmp     image/vnd.wap.wbmp
wbxml    application/vnd.wap.wbxml
wmlc     application/vnd.wap.wmlc
wmlsc    application/vnd.wap.wmlscriptc
```

## Tip for Calling Charts

When calling charts through the web server, you can control the height and width of the chart by passing parameters with the URL. You can also control the time scale.

### To control the height and width of the chart:

- Enter height & width tags for charts as

```
http://.../!chart.html?height=xxx&width=yyy
```

- Tip: To enter different time scale,

```
http://.../!chart.html?time=XXXXXX
```

## Chapter 12

---

### Command-line Options for InterMapper

You can call InterMapper and InterMapper RemoteAccess from a command line, and control a significant number of functions. This can be useful for automating the updating of maps, or for various testing purposes.

For detailed information on the use of the command-line for scripting InterMapper and InterMapper RemoteAccess, see *Command-line Options for InterMapper* and *Command-line Options for InterMapper RemoteAccess* in the User Guide's *Reference* section as well as [InterMapper HTTP API](#) in this manual.



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