Chapter No. 2
"Using Graphs to Monitor Networks and Devices"
In this package, you will find:

A Biography of the author of the book

A preview chapter from the book, Chapter NO.2 "Using Graphs to Monitor Networks and Devices"

A synopsis of the book’s content

Information on where to buy this book

About the Author

**Thomas Urban** is the owner of Urban-Software.de, a software and consulting services company providing add-ons, plugins, and services for the Cacti and Zenoss Network Monitoring systems. He has been programming web applications for over 15 years, building reporting interfaces, network management software, asset management sites, and more.

I would like to thank the team at Packt Publishing—most of all for giving me this opportunity to write a book and also for taking care of schedules, providing support, guidance and feedback, and keeping me on track the whole way.

I would also like to thank all of the reviewers for taking the time to read, correct, and provide valuable feedback to the book throughout the writing process.

Lastly, I want to thank Despina—for making sure I never ran out of coffee on the countless evenings I spent sitting in front of the keyboard instead of with her and the children. I dedicate this book to her.

Generally speaking, network management refers to the tasks associated with running a network, along with the software, tools, and technology required to support these tasks. One major part of running a network is to monitor the devices on it in order to know what is happening.

One definition of network management from the ISO Telecommunications Management Network model and framework for network management is known as FCAPS. It divides network management into five disciplines: Fault, Configuration, Accounting, Performance, and Security. Most network management tools can be assigned to one of these disciplines and, out of the box, Cacti is generally more of a performance measurement tool than a management tool, but it can be enhanced to also perform additional tasks.

What is Cacti?

Cacti is an open source performance measurement and graphing application. The first version of Cacti was published on 23rd September, 2001, and provided a complete web-based frontend to RRDtool, the high performance data logging and graphing system created by Tobias Oetiker, two years earlier. Cacti stores all of the information required to gather this data and create the graphs in a MySQL database, all of which is completely configurable via its web interface.

For data gathering, Cacti uses external scripts and commands, as well as all 3 SNMP versions.

Even in its initial release, Cacti included much of the functionality needed for an enterprise class performance measurement tool:

- Complete web-based RRD and RRA management
- Complete RRD Graph configuration and generation
- With external Script/Command and SNMP support
- With easy configuration for SNMP interface data graphing
- With granular user rights management

System architecture of Cacti

From an architectural point of view, Cacti uses a cron/at-based poller to gather data from different sources, Round Robin Database (RRD) files to store the polled data, and a MySQL database to store the systems configuration. The primary user interface is a PHP web application that allows for easy management of all aspects of the system, as well as automatic display mechanisms for viewing the graphs.

Cacti is available for different operating systems such as Windows, Linux, and Solaris.

Cacti is more than performance measurement

Although the main area for which Cacti is used is performance measurement, it can be extended to do much more! With the introduction of the Plugin Architecture, Cacti can be extended to include tasks such as:

- Threshold alerting
- Real-time monitoring of specific data sources
- Creating and sending scheduled reports
- System logging and analysis
- Performing network configuration backups
- Integration of other network management software
- Tracking network hardware

Many of these extensions or plugins are actively maintained and supported by the Cacti Group itself, while others are maintained by the Cacti community and the developer of each extension.

What This Book Covers

Chapter 1, Installing Cacti, will take you through the installation and configuration of Cacti. You will also learn how to upgrade an existing installation. The final part of the chapter will get you familiar with the different features of Cacti.

Chapter 2, Using Graphs to Monitor Networks and Devices, will teach you how to create graphs using RRDtool. Cacti uses RRDtool to store the polled data. In addition to storing data, RRDtool is also used to create performance graphs. This chapter also shows you how to add new devices and performance measurement graphs to them. Then you'll learn how to group devices using the Cacti tree. Cacti provides a facility to create templates for data, graphs, and hosts.

Chapter 3, Creating and Using Templates, will teach you how to create data templates and apply them to devices. You will create a threshold-based graph template and change the appearance of the graph depending on the data value. This chapter will also teach you how to create a selection of SNMP-based graphs and data queries, and how to import a template from the template repository and export our own host template.

Chapter 4, User Management, teaches you how to create a user and apply basic settings to it. Then we discuss different kinds of permissions, user authentication, and how to import a list of users through the command line interface.

Chapter 5, Data Management, will teach you about retrieving data for graphing with Cacti, which is more than just pulling SNMP data. Cacti allows several different methods for data retrieval. This chapter teaches you how to create your own data input methods and create custom scripts to gather remote data. After you complete this chapter, you will be comfortably able to manage a Cacti system.

Chapter 6, Cacti Maintenance, shows you how to create backups of your Cacti installation and how to restore it, as well as providing information on how to keep your Cacti instance clean of dead hosts and files. This chapter is dedicated to Cacti management.

Chapter 7, Network and Server Monitoring, will teach you how to set up Cisco network devices and prepare Windows systems to be monitored using the WMI interface. You will be provided with several instructions to configure your network devices, windows servers, and VMware ESX servers. Each of the different systems requires different methods and configuration tasks in order to poll the performance data.

Chapter 8, *Plugin Architecture*, shows you how to extend the capabilities of your Cacti instance with the available Plugin Architecture. Plugins allow end-users to implement missing features or create specific enhancements needed for internal corporate usage. At the end of this chapter, you will be able to add new features and functionality to your Cacti instance using external plugins.

Chapter 9, *Plugins*, provides an overview of the general plugin design based on the ntop plugin. It describes commonly used plugins and also helps you create your first plugin.

Chapter 10, *Threshold Monitoring with Thold*, provides an overview of the Thold plugin. It describes the different threshold types available. It shows you how to create a threshold and also helps you to build a threshold template and assign it to a data source.

Chapter 11, *Enterprise Reporting*, shows you how to define reports with the free Nectar and the commercially supported CereusReporting plugins.

Chapter 12, *Cacti Automation for NOC*, provides an overview of Cacti automation. It describes the process of using the CLI to add permissions, devices, and trees. It also guides you through the process of installation and usage of Autom8.

Appendix A, *Mobile Access / Administration*, gives some further information on how to access your Cacti installation with mobile devices.

Appendix B, *Online Resources*, gives more information on the other online resources available.

Appendix C, *Further Information*, gives more information on RRDtool, SNMP, and Cacti forums.

Appendix D, *Pop Quiz Answers*, gives answers to the pop-quizzes which appear at the end of each chapter.
Using Graphs to Monitor Networks and Devices

After having installed and configured Cacti, you will now be able to add your first devices and graphs to the system. This chapter will show you how to add new devices and how to add some performance measurement graphs to them. You will also learn how to group devices using the Cacti tree.

This chapter is going to cover the following topics:

- Introduction to graph creation with RRDtool
- Adding devices to Cacti
- Adding graphs to a device
- Assigning host templates to a device
- Adding a device to the Cacti tree

So let's get started...

An introduction to Cacti graphs and the RRDtool

You can learn more about how RRDtool stores data in Appendix C. Now, you'll be looking into the actual graph creation process and what features Cacti supports.

Creating graphs with the RRDtool

Cacti uses the RRDtool to store the polled data. In addition to just storing the data, the RRDtool is also used to create the actual performance graphs.

If you now expect to see a fully-featured charting application, you will be disappointed. The RRDtool graph functionality offers only a very limited range of chart types. They can either be line charts, area charts, or a combination of both. There is no 3D option available, nor are there any other types of charts such as Pie or Scatter charts. This may be a disadvantage for some at first, but concentrating on only a few basic chart types makes it a fast specialized rendering engine for these. Being fast in displaying the raw RRD data is the main focus of the RRDtool graphing engine.

There are several graphing features available for plotting the data. The most commonly used types are:

- **LINE**: The data is drawn as a line which can be formatted by width and type (for example, dashed line)
- **VRULE**: A fixed vertical line is drawn at a defined value
- **HRULE**: A fixed horizontal line is drawn at a predefined value (for example, threshold limits)
- **AREA**: A solid filled area chart is drawn. Several area charts can be stacked together

Each of these graph types can be combined together to build the final chart image.

Let us dive into the graph creation process here to get a better understanding of the RRDtool graphing capabilities.

You need to have the RRDtool in your path for the following commands to work.

### Basic RRDtool graph creation

Let’s begin with the RRD example which you can find in Appendix C and use that RRD file as the basis for our graphs.

---

**A note for Windows users**

The following examples also work for Windows. Simply replace the RRDtool command with the full path to the RRDtool binary, for example, use C:\rrdtool\rrdtool.exe instead of rrdtool.

You will also have to copy the DejaVu font from the RRDtool directory to your Windows fonts directory.

---

I have created a Perl script which will help in the creation of the RRD file and its automatic update with random data. In order to create the test RRD file, use the following command:

```bash
perl create_rrdfile_linux.pl test.rrd
```

If you have installed the RRDtool to C:\rrdtool you can use the following command for Windows:

```perl
curl create_rrdfile_windows.pl test.rrd
```

Having created the test data, you can now start to generate your first RRDtool-based graph. It is going to be a very simple graph displaying only the pure data.

Execute the following code at the command line interface (CLI):

```bash
rrdtool graph data_image.png \
--start 1282413600 \
--end 1282468500 \
DEF:intspeed=test.rrd:data:AVERAGE \
LINE2:intspeed#FF0000
```

This will create the following graph:

So what does this command actually do? Using the command, you defined a start and end time in the Unix time format and defined the RRD file and data set you wanted to plot. You also told RRDtool to draw a two-pixel line (LINE2) using this data set and stored the resulting graph as data_image.png. The RRDtool automatically creates the X- and Y-axis for you and also inserts the time and value description. This is the most basic way of creating an RRDtool-based graph.

**Advanced RRDtool graph creation**

Although this basic graph image already has a lot of information in it, it is still missing some important features. It neither describes what is being graphed, nor does it provide additional information such as threshold breaches or MAX/MIN values. So, let’s go back to this basic graph and look at how you can enhance it step-by-step using some of the advanced RRDtool features.
Adding a label and title to the graph

The first enhancement to our graph will be the addition of a label and a graph title. For this you can use the --vertical-label and --title parameters:

```
rrdtool graph data_image.png \
  --start 1282413600 \
  --end 1282468500 \
  --vertical-label bps \ 
  --title "Interface Speed" \ 
DEF:intspeed=test.rrd:data:AVERAGE \ 
LINE2:intspeed#FF0000
```

The resulting graph now has a title at the top and a description to the left as can be seen in the following image:

![Graph with title and label](image)

As you can see, the RRDtool command added a rotated description to the Y-axis and also added the title at the top of the graph. The graph is now bigger in dimensions than the first one. The RRDtool uses only the width and height information to set the actual chart size. Everything else must be added to the graph separately. You can see more about how this works in the following examples.

Adding a legend to the graph

Now that you have added some description to the graph, you can also add a legend to it. For this, you are going to use the LAST, AVERAGE, and MAX poller values. The function of the GPRINT item is to add additional graph information to the legend. You are also going to add a description field to the LINE2 item. Adding a description to the LINE or AREA items will automatically create a legend entry for you.

The LAST, AVERAGE, and MAX values are always calculated using the data limited by the start and end time. Therefore they directly relate to the chart being displayed.

Let’s look at the following command:

```
rrdtool graph data_image.png --start 1282413600 --end 1282468500 \
--vertical-label bps --title "Interface Speed" \
DEF:intspeed=test.rrd:data:AVERAGE \
LINE2:intspeed#FF0000:"Interface eth0" \
GPRINT:intspeed:LAST:"Current\:%8.0lf" \
GPRINT:intspeed:AVERAGE:"Average\:%8.0lf" \
GPRINT:intspeed:MAX:"Maximum\:%8.0lf\n"
```

The resulting image now also contains a small legend at the bottom:

![Graph Image]

As you can see, the legend was added to the bottom of the graph, expanding its height. By adding a description to the LINE2 line (*Interface eth0*) the description was automatically placed at the bottom along with the color being used to draw that line. The GPRINT text and values have then been added right after the description. If you want to add some more text to the next line, you need to make sure that the last GPRINT value contains a \n (newline) string at the end.

In this example, you can also see that the RRDtool did not increase the width of the graph to fit the legend in it. The Maximum value has been silently dropped. GPRINT statements do not automatically increase the graph width, so you will need to increase the width yourself. This can be done by using the \-width parameter.

---

Adding a threshold line to the graph

Now let’s also set a threshold and display a line on the graph marking the threshold. This can be achieved by using the HRULE item. You are going to set a threshold at 50 and use a light grey color to display it on the graph. The following command creates this line and also adds an additional entry to the legend. In addition, you are also going to change the LINE2 item to an AREA item, so the data being displayed is shown as a filled area:

```
rrdtool graph data_image.png --start 1282413600 --end 1282468500 --vertical-label bps --title "Interface Speed" DEF:intspeed=test.rrd:data:AVERAGE HRULE:50#C0C0C0FF:"Threshold ( 50 )\n" AREA:intspeed#FF0000:"Interface eth0" GPRINT:intspeed:LAST:"Current:\%8.0lf" GPRINT:intspeed:AVERAGE:"Average:\%8.0lf" GPRINT:intspeed:MAX:"Maximum:\%8.0lf\n"
```

You can see the light gray line being printed horizontally in the image, providing a good overview of when the data exceeds the threshold:

![Graph with threshold line](data_image.png)

Note the usage of the newline string `\n` in the description string for the HRULE item. As you can see in the graph, the following text items are added to the next line.

Adding threshold breaches to the graph

You have now seen how you can add a threshold line to the graph, but you probably also want to change the color of the data every time the threshold is breached. Let us assume that you want to have the color go red at or above the threshold and go green once it is below. This can be achieved by using a Computed DEFINition (CDEF) and the LIMIT statement.

You define a CDEF named `isGreen` which returns a number as long as the value of `intspeed` is between 0 and 50, otherwise no value is returned. You are going to use this CDEF to change the color of the displayed area.

Instead of using the `intspeed` value you assign this new `CDEF isGreen` to the `AREA` item and change the color of the `AREA` to green (RGB: 00FF00). You also create a new `AREA` entry, to which you now assign the `intspeed` value, set the color to red, and give it a description `Over Threshold\n`. For this to work correctly, you need to place this new `AREA` above the old `AREA` statement.

Why are there two `AREA` statements? In fact, changing the color of one `AREA` as it is displayed is not possible, so you need to do a little trick here. The first `AREA` statement will graph all values in red, also the ones which are below the threshold, as you have seen in the preceding example. With the second `AREA` statement a green area will be drawn at all data values which are below the threshold. As the color is not transparent, the red area will disappear. You can see the total red area when you remove the second `AREA` statement.

The complete code now looks like the following:

```
rrdtool graph data_image.png --start 1282413600 --end 1282468500 \
--vertical-label bps --title "Interface Speed" \
DEF:intspeed=test.rrd:data:AVERAGE \ 
CDEF:isGreen=intspeed,0,50,LIMIT \ 
HRULE:50#C0C0C0FF:"Threshold ( 50 )\n" \ 
AREA:intspeed#FF0000:"Over Threshold\n" \ 
AREA:isGreen#00FF00:"Interface eth0" \ 
GPRINT:intspeed:LAST:"Current:\%8.0lf" \ 
GPRINT:intspeed:AVERAGE:"Average:\%8.0lf" \ 
GPRINT:intspeed:MAX:"Maximum:\%8.0lf\n"
```

Run this code from the command line and you will see the resulting graph:

![Graph of Interface Speed](data_image.png)

Using Graphs to Monitor Networks and Devices

All of the graphs you have just created can be created in Cacti using the Cacti web interface. This section provides a small and very limited overview of the capabilities of the RRDTool graphing functions, but should give you enough ideas to start playing around with it to create your own graphs.

Further reading

The RRDtool webpage provides some very good documentation on the RRDtool and the graphing functions. The features you have seen here are only a small set of what is possible with the RRDtool. Unfortunately, providing information on all of the features is beyond the scope of this book, but it is recommended that you especially look at the gallery at http://oss.oetiker.ch/rrdtool/ for some further ideas on the graphs.

Please remember that, although Cacti does provide many of the functions of the RRDtool, there are some which may not yet be available.

Have a go hero – creating a yellow warning area

Let’s assume green and red areas are not granular enough, and you also want to have a yellow area where you can immediately see that the threshold is about to be breached. This yellow warning area should be displayed between the values of 45 and 50.

Have a look at the following image:

What would you need to change in the above RRDtool command line to get this image?

Solution: You need to add one additional CDEF and another AREA for this to work. You also need to change the isGreen CDEF. The following command line will create and display the yellow warning area and the appropriate legend:

```
rrdtool graph data_image.png --start 1282413600 --end 1282468500 \
--vertical-label bps --title "Interface Speed" \
DEF:intspeed=test.rrd:data:AVERAGE \
CDEF:yellow=INTSPEED<45 IOR INTSPEED>50 \nAREA:yellow=yellow#FFA500 \n```

CDEF:isGreen=intspeed,0,44,LIMIT \
CDEF:isYellow=intspeed,45,50,LIMIT \
HRULE:50#C0C0C0FF:"Threshold ( 50 )
" \
AREA:intspeed#FF0000:"Over Threshold" \
AREA:isYellow#FFFF00:"Warning" \
AREA:isGreen#00FF00:"Good"
\ 
COMMENT:"Interface eth0"
\ 
GPRINT:intspeed:LAST:"Current: %.0lf"
\ 
GPRINT:intspeed:AVERAGE:"Average: %.0lf"
\ 
GPRINT:intspeed:MAX:"Maximum: %.0lf"

Note that we use a `COMMENT` item to add the `Interface eth0` text at the beginning of the graph legend.

### Adding devices to Cacti

A device in Cacti can be anything which can be monitored remotely or locally. This can include storage devices, Windows or UNIX servers, and of course network devices. For Cacti to be able to monitor a device, it needs to be reachable by ping or SNMP, but the actual data retrieval can also be done using scripts and commands, or a set of SNMP queries.

### Creating a device

Creating a device in Cacti can be achieved by using the Cacti web interface. You are going to add your first device here. While looking at the different steps it takes to add a device, you are not going too much into the details of every field, as most of the user interface is self-explanatory and provides a detailed description of each field.

**Before you start: Create a naming standard**

If you have not already done so, you should now think about a naming standard for your devices. Creating and keeping to a naming standard is the first step to automation. Later in this book you will go through some device and graph creation automation, where it is assumed that you have in place a naming standard for your devices.
Time for action – creating a new device in Cacti

1. Login as an admin user to your new Cacti installation.

2. Click on the Devices link under the Management menu. This will open a table with all devices added so far. For a new installation there should only be the localhost device showing its status as Up.

3. On the top right of the new page click on Add. This is the default position for this Add link.

4. You will now be presented with the Devices [new] screen. Have a look at this screen and make yourself comfortable with the different fields.

5. Enter a Description and Hostname (or IP address).

6. If you add an SNMP-enabled device, select SNMP as the Downed Device Detection method. Otherwise select Ping. When selecting Ping you can choose the protocol type and port to use.

7. Enter the SNMP community and select the correct version (some additional fields will show up when you choose SNMP Version 3). If the device is not SNMP compatible, you can select Not used.

8. You can also add some notes. Click on the Create button once you are finished.

What just happened?

You just created your first device within Cacti by providing some basic information such as an IP address and SNMP management options. With this information Cacti is now able to poll the device. However, it still does not have any graphs associated with it.

Selecting host templates for the device

You may have noticed the Host Templates field, but what is a host template? A host template is a predefined package of graphs or data queries which can be assigned to a device. Using a template for complex devices reduces the administrative task for adding devices. Here you are going to assign a template to the device. Host templates can also be selected once the device has been created. Cacti comes with some very basic host templates such as Cisco Router Windows 2000/XP Host or Generic SNMP-enabled Host. All of these contain predefined graphs or data queries for these hosts.

Time for action – adding a host template to the device

1. Go back to the device overview page by clicking on the Devices link under the Management menu.
2. Click on the device (the description) you have just created.
3. In the Host Template drop-down box, select a template that fits your device best.
4. Click on the Save button.
5. Note the additional entries in the **Associated Graph Templates** and **Associated Data Queries** fields.
What just happened?
By selecting a host template for the device, you have added a predefined package of graph templates and data queries to the host. This is a convenient way of reducing the administrative tasks of adding these manually through the provided drop-down lists. You will come back to templates later in the book, so you do not have to fully understand these right now.

Adding graphs to the device
Cacti displays performance data as graphs, therefore we are now going to add some basic graphs to the device which we have just added. The first graph which you are going to add is a simple ping graph. Let’s go ahead and add the ping template to the host and later add the associated graph to the device.

Time for action – adding graphs to the device

1. Go back to the device overview page by clicking on the Devices link under the Management menu.
2. Click on the device you have just created.
3. In the Associated Graph Templates section select the Unix - Ping Latency from the drop-down list and click on the Add button.

4. Click on the Save button at the bottom of the page.

5. Go to the top of the page and click on, **Create Graphs for this Host.**

6. Select **Create: Unix - Ping Latency.**

7. Click on the **Create** button.

8. A new screen will appear, where you can choose a legend color and text, but for now, just click on **Create.**

9. You will be redirected back to the graphs selection screen with the entry we selected being greyed out.

Using Graphs to Monitor Networks and Devices

What just happened?
You just added your first graph to a Cacti device by adding a graph template to the device and selecting it during the graph creation screen. Cacti will now start to poll the data for this graph and generate the associated RRD file for it.

The Unix templates
Except for the Ping Latency template, all other Unix templates are for the localhost only and will not provide any information for remote systems.

Adding interface graphs to a device
Adding interface graphs is a little different from adding a generic one such as the ping graph. Normal network devices have several network interfaces, all of which can be polled for performance data. Cacti provides a nice interface for selecting the different network interfaces using the web interface. In the following section you are going to look into this kind of graph selection.

Time for action – adding interface graphs to a device

1. Go back to the device overview page by clicking on the Devices link under the Management menu.

2. Click on the device you have just created or create any other SNMP capable device having network interfaces.

3. Configure the device to use SNMP and click on the Save or Create button.

4. Make sure that the following information appears at the top of the page. This will show that the device is SNMP capable.

![Localhost (127.0.0.1)
SNMP Information](image)

5. In the **Associated Data Queries** section select the **SNMP – Interface Statistics** from the drop-down list and click on the **Add** button. If it is already there, then skip this step.

![Associated Data Queries](image)

6. Click on the **Save** button at the bottom of the page.

7. Go to the top of the page and click on **Create Graphs for this Host**.

8. On the new page which appears, select the interfaces you want to monitor and select a **Graph type** from the drop-down list.

9. Click on the Create button.

What just happened?
You added the SNMP – Interface data query to the device and selected some interfaces from the interfaces list.

The SNMP – Interface data query is a special package, containing the graph definitions and a kind of blue-print for Cacti to poll information for the interfaces of a device.

Adding devices to the Cacti tree
The Cacti tree lists sub-trees, hosts, and graphs in a tree-like interface. It is the main user interface for the Graphs tab. There can be more than one tree which allows for a granular definition of the tree structure.

Before creating the Cacti tree, think about a good structure for it. Changing the tree later is going to involve quite some manual work, so it is better to have this set up correctly beforehand, so it is better to have this set up correctly beforehand.

Creating a tree
Cacti already has a default tree defined which holds the localhost. You are going to leave this default tree empty and create your very own tree.

Time for action – creating a Cacti tree
1. Click on Graph Trees under the Management menu.
2. You will see the Default Tree. Click on the Add link to the top right of that table.

3. Enter a name, for example, Customer A.
4. Click on the Create button.

![Save Successful]

What just happened?
You created a new Cacti Tree called Customer A which you can now use to add all Customer A-specific entries. Using separate trees for customers or business units will enable you to better allow or deny access to these for specific users. You are going to see the interaction between a tree and the users later in the book.

Sub-tree items
A sub-tree item enables the creation of sub-entries to the Cacti tree. These can be entries such as "Country", "Site", or a "Business Unit". Creating sub-tree items allows end users to easily find their devices on the Cacti Tree.

Time for action – adding a sub-tree

1. Click on Add at the top right of the Tree Items table.
2. Select Header as the Tree Item Type.
3. Enter Country A as the title.
4. Click on the Create button.
5. Click on the (Add) link next to the new Country A entry.

Using Graphs to Monitor Networks and Devices

6. Keep the Parent Item to Country A and the Tree Item Type to Header.
7. Enter Site A as the title.
8. Click on the Create button.

What just happened?
You created your first site for Customer A. You can now use this tree to fit all countries, sites, and buildings into a nice manageable tree structure. Your end users will immediately recognize the structure and will be able to quickly find the necessary information.

Adding a device to the tree
Now that you have created a tree and its sub-tree items, you can move on and add a device to the tree.

Time for action – adding a device to the Cacti tree
1. Click on the (Add) link next to the Site A entry.
2. Select Host as Tree Item Type.
3. From the Host drop-down list, select the host which you created earlier. There should also be a Localhost listed. This is the Cacti server.
4. Leave all the others to their defaults.

5. Click on the **Create** button.

**What just happened?**

You just added your first device to your newly created Cacti tree. You can also add single graphs to the tree by changing the **Tree Item** type.

**Before we continue**

You now have a basic knowledge of the RRDtool graph functionality and have also added your first device to Cacti.

**Pop quiz – a few questions about Chapter 2**

1. If you want to add an additional threshold line, what do you need to add?
   a. A **LINE2** item
   b. A **THRESHOLD** item
   c. An **HRULE** item

2. What information will be displayed when you create an SNMP-enabled device?
   a. The hardware configuration of the device
   b. A message of the day
   c. The contact information and hostname of the device

3. Where do you add the "Cisco - CPU Usage" graph?
   a. At the Cacti tree
   b. At the RRDtool command prompt
   c. At the Device screen

---

Using Graphs to Monitor Networks and Devices

Summary

In this chapter you have learned quite a bit about the RRDtool graph generation features. Specifically you have covered the following:

- Creating some basic graphs using the RRDtool
- Adding advanced features such as threshold line and color changes based on the threshold
- Adding a device to Cacti
- Assigning graphs and interface graphs to a device
- Creating a new Cacti tree containing sub-tree items and devices

You now have a running Cacti server, which is capable of polling and graphing at least one device.

In the next chapter, you are going to learn more on creating and using graph and device templates.
Where to buy this book

You can buy Cacti 0.8 Beginner's Guide from the Packt Publishing website:

Free shipping to the US, UK, Europe and selected Asian countries. For more information, please read our shipping policy.

Alternatively, you can buy the book from Amazon, BN.com, Computer Manuals and most internet book retailers.