RDM Troubleshooting

A White Paper

April 8, 2006

Notes:

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1. Preface

This White Paper explains how to resolve problems with IBM® Remote Deployment Manager (RDM) 4.11, 4.20, and later releases. It contains a list of problem symptoms that some users have experienced, plus suggested actions to correct them.

1.1 Who should read this White Paper

This paper is intended to help skilled RDM administrators to create deployment procedures and to understand the concepts involved. To effectively use this paper, you should already have an extensive knowledge of your Network environment, your RDM environment, and DOS batch files.

1.2 Further reference

In addition to this paper, there are various other sources of information that you can consult for RDM and for RDM Custom tasks.

1.2.1 Guides

The following product documentation is available for RDM:

- *Remote Deployment Manager 4.20 Users Guide* – The main reference manual for RDM

- *Remote Deployment Manager 4.20 Installation Guide* – Describes the complete installation process of RDM

- *Remote Deployment Manager 4.20 Compatibility and Configuration Guide* – Lists RDM-supported hardware and software

Check the IBM Web site at http://www-307.ibm.com/pc/support/site.wss/document.do?lndocid=MIGR-50575 to get the current versions of the above documents.

1.2.2 White Papers

The various RDM white papers are available on the IBM Web site at http://www-307.ibm.com/pc/support/site.wss/document.do?lndocid=MIGR-53487.

1.2.3 Online help

In general, every window has online help available (except for some message windows or other windows where no help is applicable), either using a **Help** menu or a **Help** button.

1.2.4 Links

The following links are available for further information:

- Support is available for supported systems (IBM and non-IBM) through e-mail or fee-based telephone support. Telephone support is not available in all countries. For more information about the fee-based telephone support, go to http://www.ibm.com/support or http://service.software.ibm.com/supportline.html. For more information about e-mail support, refer to the RDM home page.

Important: Before using RDM, check the compatibility test results and browse the rest of the RDM Web site for additional information and tips concerning the installation and use of RDM.

2. Problems

Each section below describes a particular problem (or class of problems). It contains a scenario by which the problem occurs, a detailed description of what the problem is, and a detailed description of how to resolve the problem.

2.1 T04 – Illegal TFTP operation

2.1.1 Scenario

Run Scan or any other RDM task.

2.1.2 Result

Basically, the systems start to boot to network, they get an IP address, and boot IP server messages all appear. Once TFTP tries to start, you see "TFTP." (with one dot), and after several seconds they get the T04 – Illegal TFTP operation. Boot continues to local. The RDM services are all started just fine. Director is up too.

RDM 3.2 running on the same server and network environment does not have this problem.

2.1.3 Resolution

There are 2 known causes for this error. Do whichever of the following is appropriate.

2.1.3.1 AT&T Network Client conflict

The AT&T Network Client is incompatible with the RDM 4.11 MTFTP Service. If you have the AT&T Network Client on your RDM Deployment Server, uninstall it.

2.1.3.2 Security policy conflict

You may have a security policy on your RDM Deployment Server that is preventing the RDM 4.11 MTFTP Service from accessing the files needed as part of the PXE process. We haven't yet determined the settings that cause this problem, but sharing the C:\Program Files\IBM\RDM\repository directory has circumvented this problem in at least one case.

2.2 Various TFTP errors

2.2.1 Scenario

Run any RDM task, especially on several systems concurrently.

2.2.2 Result

Intermittently, you may see a task fail because of a TFTP open time-out error, or because of a TFTP zero-divide error. If you rerun the task, the error often does not recur.

2.2.3 Resolution

These errors may be caused by having an insufficient number of ports available on the RDM D-Server. You can prevent these errors by changing the values of some configuration parameters. Do the following steps:

1. Open the *Deployment Server Management Options* window by selecting the **Tasks**, **Remote Deployment Manager**, **Options**, and **Change D-Server Options** menus.

2. Change the values of these settings:

    - MTFTP Server Port Range: Change from its default value of 50 to a much larger value, like 1000 or 2000.

    - MTFTP Timeouts Client Listen: Change from its default value of 2 to a larger value, like 5.

    - MTFTP Timeouts Client Delay: Change from its default value of 2 to a larger value, like 3.

3. Select the *OK* button.

4. Restart the IBM RDM D-Server service, either from the Services window or by running "net stop dserver" followed by "net start dserver" commands.

5. Open the *Deployment Server Management Options* window again, to make sure your new settings are there.
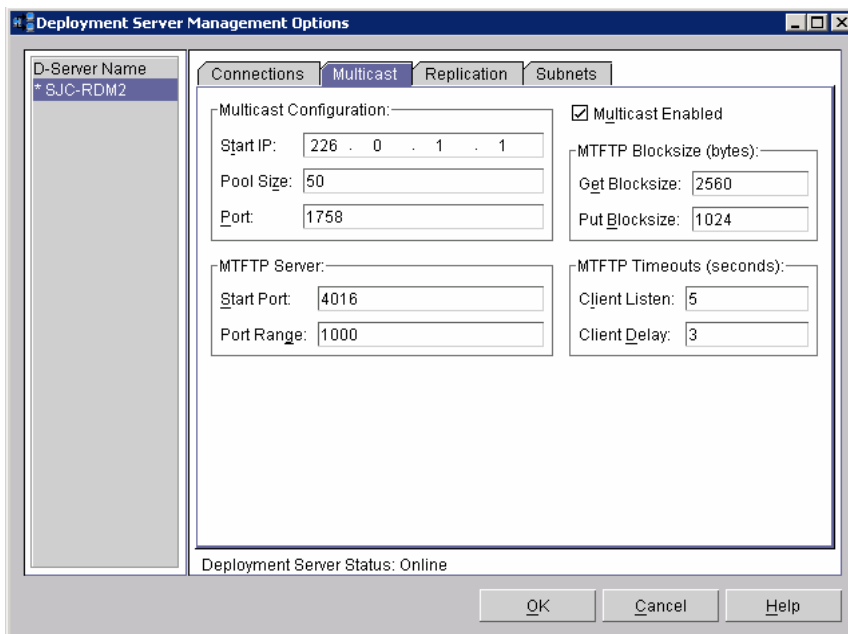
2.3 MKIMAGES.BAT or BPDISK.EXE invalid char in filename

2.3.1 Scenario

Run MKIMAGES.BAT to rebuild RDM's DOS System Environments.

2.3.2 Result

You get one or more error messages like "invalid char in filename" or "invalid char x in filename".

2.3.3 Resolution

There is probably a file in one of the directories that BPDISK.EXE is accessing whose name is not in the DOS 8.3 format. Remove all files with long names from those directories, and then rerun MKIMAGES.BAT.

2.4 Many *Command file not found* messages

2.4.1 Scenario

In a SBCS environment, run an RDM task for which you created or modified a batch file.

2.4.2 Result

The task starts normally, but when you get to the batch file that you created or modified, you see a string of "Command file not found" messages and eventually get to an a: prompt. If you press F8 after the "Starting PC DOS…" message and step through the task statement-by-statement, you may see the first statement in your batch file displayed with a blank space between every pair of characters.

2.4.3 Resolution

Edit your batch file, and save it as ASCII text (not Unicode).

2.5 Migration from RDM 3.2

2.5.1 Scenario

I am using RDM 3.2 and I want to replace it with RDM 4.20.

2.5.2 Result

The RDM 4.20 install program requires that I disable RDM 3.2. Further, I get unpredictable results when I later try to use RDM.

2.5.3 Resolution

There is no automated migration from RDM 3.2 to RDM 4.20. Here are some considerations for doing manual migration:

- RDM 4.20 and RDM 3.2 cannot coexist on the same subnet (due to PXE restrictions, only 1 PXE server can exist on a subnet). This means that you have to be careful when migrating. Before installing RDM 4.20 stop your RDM 3.2 PXE Service and MTFTP Service. Then, while migrating, make sure that you always stop these services on one RDM before starting them on the other.

- You can migrate the RDM systems manually. Just export the systems on RDM 3.2 (to a file). Then import that file into RDM 4.20.

- There is no way to migrate RDM 3.2 Profiles. You must manually create an RDM 4.20 task to replace each RDM 3.2 profile that you need.

- You can copy your old PowerQuest image files into RDM 4.20. Just use the RDM 4.20 *Image Management* window to create a *Windows Clone Install* image, and import the old file that way. Then create a Windows Clone Install task that uses that image.

- You must create new BIOS images in RDM 4.20. Just use the RDM 4.20 *Image Management* window to create a CMOS image, and import the old file that way.

- You will have to redo any RDM 3.2 profile customization manually when you create the corresponding RDM 4.20 task. Be aware that editing task properties and pressing the OK button will cause all task-generated files to be recreated. If you had modified those files before editing the task, your changes will be lost.

2.6 RDM Bootstrap Loader does not run, PXE-E55 error

2.6.1 Scenario

1. Power on a new system.
2. Press F12 to cause a network boot.

2.6.2 Result

The system gets an IP address from the DHCP server, but the RDM bootstrap loader program does not run. Eventually, you get a PXE-E55 error message.

2.6.3 Resolution

The RDM D-Server may be incorrectly configured. This could happen if you change the IP address of your RDM D-Server and don't reconfigure the D-Server. You should configure the D-Server in 2 places:

1. Open the D-Server Options window via the *Director Console's Tasks...Remote Deployment Manager...D-Server Options...* menu. On the *Connections* page, make sure that the D-Server IP Address and Subnet Mask are correct. On the *Subnets* page, make sure that the Subnet IP and Subnet Mask fields are correct. Then select the OK button to exit.

2. Run DSCONFIG.EXE via the *Start...Programs...Remote Deployment Manager...D-Server Config* menu. Make sure that the D-Server IP address is correct. Then select the OK button (which saves the configuration and restarts the IBM RDM D-Server service).

2.7 RDM Bootstrap Loader does not run, PXE-E74 error

2.7.1 Scenario

1. Power on a new system.
2. Press F12 to cause a network boot.

2.7.2 Result

The system gets an IP address from the DHCP server, and it also finds the Proxy DHCP server, but the RDM bootstrap loader program does not run. Eventually, you get a PXE-E74 (Bad or missing PXE menu and/or prompt information) error message.

2.7.3 Resolution

This is a known conflict with Broadcom network adapters and DHCP option 43, Vendor Specific Information. Check to see if you have option 43, Vendor Specific Information, configured.

You should remove option 43 and run a test to see if it resolves this problem. If it does resolve it, then you should determine why you have option 43 configured, and whether or not it is possible to remove that option permanently. If it is not possible to remove that option, then you will not be able to use RDM to manage or deploy systems with Broadcom network adapters on that subnet.

2.8 New system always boots local

2.8.1 Scenario

1. Power on a new system.

2. Press F12 to cause a network boot.

2.8.2 Result

Even though the system is unknown to RDM, the RDM bootstrap loader tells the system to boot local.

2.8.3 Resolution

There are several known causes for this error. Do whichever of the following is appropriate.

2.8.3.1 Non-unique UUID

On rare occasions, systems may accidentally ship with non-unique UUIDs (this is an error). Because RDM uses the UUID as a key, it cannot manage 2 systems with the same UUID. To RDM, they look like the same system. If RDM has no work scheduled for the 1st system, it will tell the 2nd system to boot local.

You can verify if this is the cause as follows:

1. Select all systems in the Director/RDM console, right click, and select **View Inventory** from the menu.

2. Right click on an entry in the UUID column, and select the **Sort** and **Ascending** menu items.

3. Boot the failing system and press the F1 key to view the BIOS settings. Navigate to the screen that shows the system's UUID (it might be labeled GUID).

4. If you also find that UUID in the *Inventory Query Browser* window, compare the entries in the *Product* and *Serial Number* columns with the comparable entries in the system's BIOS settings. If these are the same, it means that the system is already known to RDM and that there is no RDM work scheduled to run at this time (i.e., everything is working properly).

    Note: If you thought that the system was unknown to RDM because you deleted the system from the Director/RDM console, there may have been a second entry in the console for that system (i.e., the Native Managed Object from a Director Agent installed on the system or the Physical Platform Managed Object from an RDM discovery of the system) that you didn't delete.

If there are 2 systems with the same UUID, you can resolve this problem by changing the UUID on one of the systems.

1. Download the system's current BIOS diskette image from the IBM web site.

2. Run the file you downloaded, to create the BIOS diskette.

3. Modify the diskette's AUTOEXEC.BAT file so that the diskette boots to an A: prompt (instead of running the FLASH2.EXE program).

4. At the command prompt, run this command: "FLASH2 /u /e".

5. Shutdown the system, and then disconnect and reconnect electrical power (pull and reinsert a BladeCenter system, or disconnect and reconnect the power cords on another system.

This will change the system's UUID to a new, unique value.

2.8.3.2 Improper D-server configuration

Please see section 2.6.3 for resolution.

2.8.3.3 Improper DHCP server configuration

The subnet mask for the DHCP scope might be different than the subnet mask for the subnet on which the scope's IP addresses are located. When you create a DHCP scope, you must give a range of IP addresses and a subnet mask.

To determine if this is your problem, open the DHCP application and judge whether the IP address of the scope looks wrong. For example, if the IP address of your RDM D-server is 10.33.200.5, with subnet mask 255.255.255.0, and if the IP address of your scope is 10.0.0.0, it is probably because you did not enter the subnet mask when you created the scope. So the DHCP scope wizard used its default subnet mask of 255.0.0.0.

In this case, just delete the incorrectly configured scope, and create a new scope that is correctly configured.

2.9 Existing BladeCenter system sometimes boots local

2.9.1 Scenario

Use the RDM console to run an RDM task on a system.

2.9.2 Result

Although RDM wakes the system as expected, the RDM bootstrap loader tells the system to boot local (instead of booting to the network).

2.9.3 Resolution

Your BladeCenter Management Module firmware may be back-level.

1. Download the current Management Module firmware diskette image from the IBM web site.

2. Run the file you downloaded to create the firmware update diskette.

3. Use the web interface to the management module to update the firmware, using this diskette.

2.10 RAID error during system discovery

2.10.1 Scenario

Force an unknown-to-RDM system to do a PXE boot in order to add the system to the Director/RDM console:

1. Open the Director console. The system is not in the middle panel.

2. Power on the target system manually (e.g., with its white button).

3. When the target system's monitor displays a message (in the lower left corner) about pressing F12 to force a network boot (or to show a list of boot options), press the F12 key.

4. If you are presented with a list of options, select the one that will do a network boot.

2.10.2 Result

Although RDM runs the PXE boot as expected, it does not complete properly:

- The name of the new system that appears in the Director/RDM console is one of its MAC addresses (12 hexadecimal digits).

- If you observe the target system's monitor, you see an error involving RAID (one such example is "RDRAID070E Acu to SATA failed"). The system powers off immediately after this error, and it never runs SCAN.BAT.

- If you wait long enough, a red triangle icon appears next to the system in the console.

This usually means that either your RDM server is back-level, or your target system is not supported by RDM.

2.10.3 Resolution

The resolution is to upgrade your Director and RDM components to the latest releases. The upgrade procedure will vary, depending on how far back level your software is. The following procedure is an example (Director 4.12 and RDM 4.11.3):

1. **Important:** Back up your system, so that you can get back to the current state if something goes wrong.

2. Upgrade Director to version 4.20.

3. Upgrade RDM to version 4.20.

4. Upgrade Director to version 4.22.

5. Upgrade RDM to version 4.20.3

6. Upgrade Director to version 5.10 (optional).

Doing the upgrade the above way ensures that you are using a procedure that has been thoroughly tested. You could, instead, try the following abbreviated procedure, which was not part of our test suite:

1. **Important:** Back up your system, so that you can get back to the current state if something goes wrong.

2. Upgrade Director to version 5.10.

3. Upgrade RDM to version 4.20.

4. Upgrade RDM to version 4.20.3

2.11 RDM install does not take effect

2.11.1 Scenario

Do a typical install of RDM:

Install IBM Director (e.g., version 4.22).

Reboot

Install RDM (e.g., version 4.20).

Open the Director console on the RDM server.

2.11.2 Result

The RDM entries are missing from the Director console. There are no RDM entries in the Tasks panel or in the Tasks menu.

2.11.3 Resolution

You have probably installed RDM incorrectly. In particular, you probably installed RDM (step 3 above) without waiting for IBM Director to finish starting.

A complete install of IBM Director and RDM should contain the following steps:

Install IBM Director (e.g., version 4.22).

Reboot

IMPORTANT: Wait until the Director icon in the system tray changes to a green circle. (It will initially be a green triangle, and after a few minutes it will change to a green circle.)

Install RDM (e.g., version 4.20).

Wait until the Director icon in the system tray changes to a green circle.

Open the Director console on the RDM server. Verify that RDM is installed correctly.

Install the latest RDM update (e.g., version 4.20.2 or later).

Wait until the Director icon in the system tray changes to a green circle.

Open the Director console on the RDM server. Verify that RDM is installed correctly.

Waiting until IBM Director is completely started is the key to a successful RDM install.

2.12 PQIDPLYZ.EXE or PQIMGCTR.EXE exits immediately after it starts

2.12.1 Scenario

Run any task that uses PQIDPLYZ.EXE or PQIMGCTR.EXE (e.g., a *Get Donor* task or a *Windows Clone Install* task).

2.12.2 Result

When the task tries to run PQIDPLYZ.EXE or PQIMGCTR.EXE, that program immediately exits. This either causes the task to fail or causes the system to keep rebooting forever (the task will eventually time out).

In some cases, you may find that the PowerQuest Unicast Image Server on the appropriate RDM Deployment Server is no longer running.

2.12.3 Resolution

Use the Windows Services application to restart the PowerQuest Unicast Image Server.

2.13 Get Donor task gets Error 21 after it is 4% complete

2.13.1 Scenario

Run the *Get Donor* task that uses PQIDPLYZ.EXE or PQIMGCTR.EXE. This program exits almost immediately, after it is about 4% complete, with Error 21: Illegal handle, or no handles available.

2.13.2 Result

PQIDPLYZ.EXE or PQIMGCTR.EXE exits almost immediately, after it is about 4% complete, with Error 21: Illegal handle, or no handles available.

2.13.3 Resolution

This error will occur whenever the donor system has dynamic disks. You must make sure that the donor system does not have dynamic disks in order to run *Get Donor*.

Note: It is possible to use a donor system that has basic disks to create a Windows Clone Install task whose target systems will have dynamic disks.

2.14 Local DHCP server does not issue IP addresses

2.14.1 Scenario

The DHCP server is installed on the same computer as the RDM D-Server, with option 60 properly configured. Run any (RDM or non-RDM) scenario where a DHCP client tries to get an IP address.

2.14.2 Result

The system does not get an IP address from the DHCP server.

2.14.3 Resolution

This is usually caused by an improper configuration of the RDM D-Server. The error occurs whenever the IBM RDM D-Server service starts before the DHCP service.

Change the line "LocalDhcpServer=no" to "LocalDhcpServer=yes" in the C:\Program Files\IBM\RDM\local\DSERVER.INI file. Then reboot your server (or restart the IBM RDM D-Server service, followed by restarting the DHCP service).

Note: This configuration error probably was caused by failing to select the *DHCP Server is Local* check box on the *D-Server Configuration* window when you installed the RDM D-Server.

2.15 Target system does not get a DHCP IP address, PXE-E53 error

2.15.1 Scenario

Run any RDM task.

2.15.2 Result

The system does not get an IP address from the DHCP server. The on-screen message displays 5 or 6 dots before an error message (e.g., PXE-E53) is displayed. The system will then try to boot from the next device in the startup sequence.

2.15.3 Resolution

This is usually caused by a network problem of some kind, such as:

- The network connection between the DHCP server and the target system may be physically disconnected.

  One example is when the BladeCenter Cisco IGESM is not configured properly for RDM use. What this problem turned out to be is that in the default configuration of the switch, the external ports are all set to trunk the VLANs out to an upstream CISCO switch. If you try to plug a network device directly into one of the external ports (e.g., an xSeries 346 configured as your RDM server), the port will automatically switch to an access port and put itself in VLAN 1. This doesn't sound like a problem until you realize that all of the blades are in VLAN 2 by default. In other words, the blades can't talk to your external device, and vice versa.

  The solution to this problem is to update the IGESM firmware to the latest level (e.g., version AY4 or later).

  The firmware is available at:

  > http://www-307.ibm.com/pc/support/site.wss/document.do?lndocid=MIGR-58132.

  The release notes are available at

  > http://www-307.ibm.com/pc/support/site.wss/document.do?lndocid=MIGR-58031.

- The network adapter may be timing out the PXE process before the transaction completes. See section 2.16 below for resolution.

- The system may be on a subnet that is unknown to RDM. Access the D-Server options window via the Director/RDM console's **Tasks**, **Remote Deployment Manager**, and **D-Server Options...** menus. Select the **Add Subnet...** button and configure the new subnet.
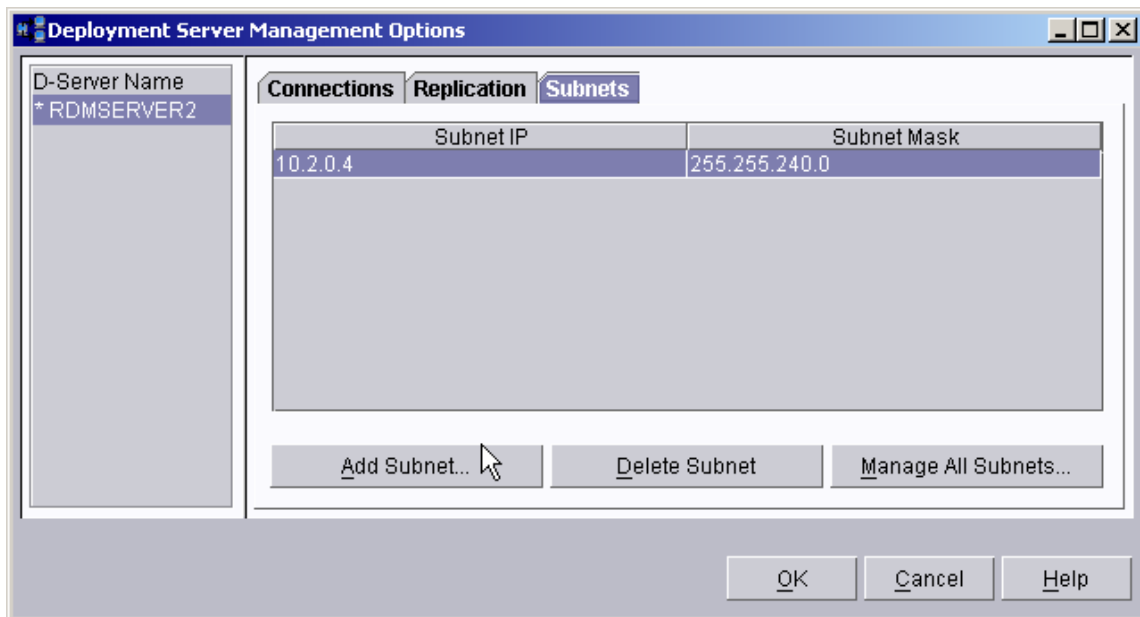
- There may be conflicting DHCP servers on the network. For example, if subnet A is served by a DHCP server that is on the RDM D-Server, and subnet B is served by another DHCP server, then systems on subnet B will never get a PXE IP address. To resolve the problem, remove one of the DHCP servers from the configuration and configure the other DHCP server to serve both subnets.

  Important: If you remove the DHCP server from the RDM D-Server, then you must also change the line "LocalDhcpServer=yes" to "LocalDhcpServer=no" in the C:\Program Files\IBM\RDM\local\DSERVER.INI file. Then reboot your server (or restart the IBM RDM D-Server service, followed by restarting the DHCP service).

- You may not have enabled BOOTP/DHCP forwarding properly on your network. For RDM to work properly, you must enable BOOTP/DHCP forwarding on the path from every RDM target system to **both** the DHCP server and the RDM Deployment Server. For example, if your target systems can get a DHCP IP address when they are running Windows or Linux, but they cannot get a DHCP IP address when they do a PXE network boot, it usually means that you have not configured BOOTP/DHCP forwarding to your RDM Deployment Server.

  Note: If you use Cisco switches, configuring BOOTP/DHCP forwarding is equivalent to configuring an IP helper address.

- You may have Spanning Tree Protocol enabled on switch ports to which target systems are cabled. You will see, intermittently, the following kinds of failures:

  - Network adapter times out before getting an IP address, message might be "no boot file found" (or something like that).

  - You may occasionally not time out and actually get an IP address (e.g., after seeing 5 or 6 dots on the target system message), but then a TFTP command times out.

  If you then turn Spanning Tree Protocol off (or for a Cisco switch, turn PortFast on) on the switch ports to which target systems are cabled, you'll get the IP address after only 2 or 3 dots appear on the message, and the TFTP will no longer time out.

2.16 RDM network performance is very slow

2.16.1 Scenario

Run any RDM task.

2.16.2 Result

Various RDM-related functions seem to perform very slowly. Examples include:

It takes a long time to get an IP address from the DHCP server. The on-screen message displays 5 or 6 dots before the transaction completes. Sometimes the network adapter may even time out before the PXE process completes.

It takes up to a minute for a DOS or Linux image to load.

"Contacting RDM D-Server (1)" messages are displayed for a noticeably long time (tens of seconds).

Multicast TFTP downloads are much slower than expected, in Windows Native Install or Linux Native Install tasks.

DeployCenter downloads are much slower than expected, in Windows Clone Install tasks.

2.16.3 Resolution

You may have your network configured in a less than optimal way. One or more of the following may be applicable:

- Please set all network components (i.e., switches and network adapters) to auto-negotiate their connection parameters. RDM is mostly a DOS-based product with no DOS extenders, and so always works in half-duplex mode. If the network components are left to take care of it, they usually do a great job of running the network at the best speed, especially if the network consists of components that are communicating in different modes at different times.

- If you force parts of the network to a specific setting, such as "100 Mb full duplex" or "1000 Mb full duplex", in an attempt to speed network operations, it will affect RDM performance adversely.

- Ensure that Spanning Tree Protocol is disabled on switch ports that are connected to computers (or, for Cisco switches, you could turn PortFast "on" for ports connected to computers, and "off" for ports connected to switches).

- Do not enable "Conflict Detection" or "Ping" in your DHCP Server configuration. If you must enable this, then set the number of attempts to 1.

  If you set the number of attempts higher, the time used by the pings may exceed the network adapter's built-in timeout value, thereby causing the PXE boot to fail.

2.17 Target system loses network connection

2.17.1 Scenario

Run any RDM task.

2.17.2 Result

Various symptoms occur that indicate that communications may be lost. These are intermittent, and they always seem to occur on the same systems. Other systems, even ones in the same subnet, don't have this problem. Examples include:

TFTP open timeout (any task), and the task immediately fails. When you look at the resulting <MACaddress>MTFTP.LOG file on the RDM server, it indicates a "file not found" error.

DeployCenter captures (Get Donor task) or restores (Windows Clone Install tasks) just stop, and the task eventually times out.

2.17.3 Resolution

You may have a rogue system in your network that is using a static IP that is in your DHCP scope. When the DHCP server issues that IP to an RDM task's target system, there is a conflict. Since it is impossible to have 2 systems using the same IP address, something must break.

An easy way to determine if this is your problem is to PING that IP address from another system. If the PING gets a response, it indicates that this error is possible (because RDM target systems cannot answer PING requests from their DOS system environments).

You can also use your switch's software to look at the port that is using that IP address. If it is not the port of the RDM target system, you have proven the error. You can also check the MAC address for that port to verify it is not the RDM target system.

Here is a possible sequence of events that can help explain what is happening:

1. The rogue system is running with the illegal static IP address.

2. The RDM task starts. The DHCP server issues that same IP address to the target system. This breaks the rogue system's network communications. Meanwhile, the target system is operating properly, with its network connection alive and well.

3. The rogue system reconnects to the network with that same IP address. This breaks the RDM target system's network communications, and the RDM task eventually fails. Meanwhile, the rogue system is operating properly, with its network connection alive and well.

You should fix this by disabling the switch port connected to the rogue system, until such time as its owner configures his network connections properly. It would usually be wrong to fix this by removing that IP from your DHCP scope, because that would encourage users to use IP addresses that they have not requested through proper channels.

2.18 Windows Clone Install task creates wrong IP address

2.18.1 Scenario

Set up a seemingly normal Windows Clone Install procedure:

Build a donor system with network adapter 1 using a DHCP IP address and network adapter 2 using a static IP address.

Run SYSPREP.EXE on the donor system.

Run the *Get Donor* task on the donor system.

Create a *Windows Clone Install* task using that image.

Deploy several systems with that task.

2.18.2 Result

Regardless of the way you configured TCP/IP in step 0 above (dynamic or static IP address), you get duplicate-IP-address error messages when the systems come on-line before the RDM task completes. Further investigation shows that network adapter 1 is configured as indicated in step 0 above, while network adapter 2 is configured with a static IP address that is identical to the IP address that the donor system had before you ran SYSPREP.EXE.

2.18.3 Resolution

This problem occurs because the *Windows Clone Install* task only configures the 1st network adapter. Apparently, SYSPREP.EXE does not remove the original configuration of the 2nd network adapter.

2.18.3.1 Circumventing the problem

The easiest way to avoid this problem is to configure your donor system to use dynamic IP addresses on both network adapters. Then the Windows Clone Install task will configure the 1st network adapter the way you define it in the task, and the 2nd network adapter, which the task does not configure, will use a dynamic IP address.

2.18.3.2 Modify RDM to configure both network adapters

A more elegant solution is to modify the *Windows Clone Install* task so that it can configure multiple network adapters. You do this by changing the ANSWER2.TXT file that is located in the task folder.

There are 2 options available: to identify each adapter by its MAC address or by its PCI ID and Location. The following example, which applies to the Broadcom network adapters in the HS20 model 8832 BladeCenter systems, uses PCI ID. The PCI info for these network adapters should always be:

> PCI ID: PCI\VEN_14E4&dev_16A8
> PCI Bus Num: 1
> PCI Dev Num: 0
> PCI Func. Num: 0 or 1 (0 for the primary adapter, and 1 for the secondary adapter)

The procedure is the following:

In the Windows Clone Install task, add the following user parameters, defined so you can configure their values via the System/Task Configuration window:

ComputerIp2 – the IP address of the 2nd network adapter.

SubnetMask2 – the subnet mask of the 2nd network adapter.

DefaultGateway2 – the IP address of the gateway for the 2nd network adapter.

Modify the ANSWER2.TXT file to configure both network adapters. The following example configures both adapters with static IP addresses:

```
[NetAdapters]
Adapter1=params.adapter1
Adapter2=params.adapter2

[params.adapter1]
INFID="PCI\VEN_14E4&dev_16A8"
PciBusNumber = 1
PciDeviceNumber = 0
PciFunctionNumber = 0

[params.adapter2]
INFID="PCI\VEN_14E4&dev_16A8"
PciBusNumber = 1
PciDeviceNumber = 0
PciFunctionNumber = 1

[NetProtocols]
MS_TCPIP=params.MS_TCPIP

[params.MS_TCPIP]
AdapterSections=params.mstcpip.adapter1,params.mstcpip.adapter2

[params.mstcpip.adapter1]
DNS=No
SubnetMask="%SubnetMask%"
DHCP=No
DefaultGateway="%DefaultGateway%"
WINS=No
SpecificTo=Adapter1
IPAddress="%ComputerIP%"
Gateway="%DefaultGateway%"

[params.mstcpip.adapter2]
DNS=No
SubnetMask="%SubnetMask2%"
DHCP=No
DefaultGateway="%DefaultGateway%"
WINS=No
SpecificTo=Adapter2
IPAddress="%ComputerIP2%"
Gateway="%DefaultGateway2%"
```

> **Important**: Whenever you edit a *Windows Clone Install* task, it rewrites the ANSWER2.TXT file. In particular, this action will overwrite some of your customizations.

When you want to run the modified task, select **Configure systems…** and enter values for all TCP/IP parameters, including the new user parameters.

2.19 Target systems do not power on (wake)

2.19.1 Scenario

Do an RDM console operation that should result in a previously powered off target system powering on, such as:

Drag an RDM task to some selected target systems and schedule the task to run immediately.

Run an RDM task via a command line.

Right click on some selected target systems, choose the RDM Wake Tool, and select the *Start Waking* button.

2.19.2 Result

One or more of the target systems does not power on.

2.19.3 Resolution

This problem occurs for one of these reasons:

The target system was powered off in a way that disables Wake on LAN (WoL).

There is a configuration error, somewhere.

2.19.3.1 Irregular shutdown

An "irregular" shut down, in one of these ways, can disable WoL:

- A momentary power-switch during Power On System Test (POST).
- A 4-second power-switch press at any time.

A "regular" shutdown, in one of these ways will not disable WoL:

- A momentary power-switch press from a non-ACPI operating system (DOS, Windows NT after shutdown processing).
- A momentary power-switch press to cause shutdown in an ACPI operating system (Windows 2000).
- An INT 15 power of from a real-mode operating system (as RDM does from DOS).
- A power off via the Shutdown command from the Start menu in an ACPI operating system (Windows 2000).

You can recover a system after an irregular shutdown by doing either of the following:

- Remove and restore AC power. The procedure is different, depending on whether the target system is an IBM BladeCenter system.
    - o Non-BladeCenter target system
        1. Disconnect the power cable.
        2. Wait about 5 seconds.
        3. Connect the power cable.
    - o BladeCenter target system
        1. Disconnect the blade from the chassis by sliding it out an inch or two.

2. Wait about 5 seconds.

3. Connect the blade into the chassis.

4. Wait until the blinking of the green light slows.

5. Power on the blade manually with its white button.

6. When the logo window appears and POST is complete (i.e., when you see the message about pressing F! to change the BIOS settings), power the blade off manually with its white button.

- Boot the system completely through POST and do a "regular shutdown".

2.19.3.2 Configuration error

There are many kinds of configuration errors that can cause WoL to fail. Many of these are subtle and easy to overlook (i.e., you "cannot see the forest because the trees are in the way"). So you'll need to do some careful debugging to figure it out.

- The target system may have WoL disabled in its BIOS settings. Since IBM systems typically ship with WoL enabled, an easy way to test for this problem is to set the BIOS settings to their default values. Press the F1 key after booting a system through POST (you'll see a message at the appropriate time) to run the BIOS configuration program.

- The target system's network adapter (NIC) may have WoL disabled. Use your NIC documentation to determine how to change the NIC configuration (you can press the Ctrl and s keys simultaneously to configure most IBM NICs).

- One of more routers between the RDM Deployment Server (D-Server) and the target system may not be forwarding subnet-directed broadcast messages to the target system's subnet. In a routed environment, RDM requires subnet-directed broadcast forwarding on all such routers.

  Important: This is not the same as broadcast forwarding. Do not enable broadcast forwarding on your routers. Instead, enable subnet-directed broadcast forwarding to the specific subnets you use.

- The IP address or subnet mask of your D-Server may be incorrectly configured in RDM.

  1. Open the *Deployment Server Management Options* window, via the **Tasks**, **Remote Deployment Manager**, **Options**, and **Change D-Server Options** menus. Inspect the IP and mask on the *Connections* page for correctness. Then look at the *Subnets* page, and make sure that the list of subnets is correct and that each subnet's IP and mask are correct.

  2. Open the **Start**, **Programs**, **Remote Deployment Manager**, and **D-Server Config** menus. Make sure that the *Master D-Server IP Address* and the *Remote D-Server IP Address* fields are correct.

  3. If you change anything in these steps, restart the *IBM RDM D-Server* service (via the Windows Services application).

- Your DHCP server's scope may be incorrect. Make sure that each scope has the correct subnet mask. If you change anything, restart the *DHCP Server* service.

- Your switches may be incorrectly configured. Make sure that your VLANs are properly defined, and make sure your switch IP and subnet mask are correct.

2.19.4 Example

This simple example will illustrate how a configuration error can cause WoL problems. It is a simple, isolated test network, with 1 BladeCenter chassis, a 10/100 Ethernet hub, an RDM server, and a FAStT storage server.

Device	IP address	Subnet mask
Management Module external Ethernet	10.2.0.90	255.255.255.0
Management Module internal Ethernet	10.2.0.91	255.255.255.0
Ethernet Switch Module	10.2.0.92	255.255.240.0
Fibre Switch Module	10.2.0.94	255.255.240.0
RDM server	10.2.0.7	255.255.240.0
DHCP scope	10.2.0.30 to 10.2.0.50	255.255.255.0

There are 5 network cables into the Ethernet hub:

- 2 FAStT

- Ethernet Switch Module

- Management Module

- RDM server

There is an obvious mismatch in the subnet masks. The rather surprising results were the following:

- HS20 model 8832 had no WoL problems, either via the RDM Wake Tool or when running an RDM task.

- HS20 model 8843 could not wake at all, either via the RDM Wake Tool or when running an RDM task.

- HS40 model 8839 could wake via the RDM Wake Tool, but it could not wake when running an RDM task.

Changing the RDM server's mask to 255.255.255.0 fixed all the problems. We also changed the 2 switch module's masks to 255.255.255.0.

2.20 RDM repository is out of space

2.20.1 Scenario

Do any RDM action that updates the repository. For example, create an RDM image using the *Image Management* tool, run an RDM *Get Donor* task, create a new RDM System Environment using the BPDISK.EXE program, etc.

2.20.2 Result

You get an error message indicating that there is not enough disk space.

The RDM repository is a directory in the path in which you installed RDM. So if you installed in the default path, your repository is C:\Program Files\IBM\RDM\repository. So if your C: disk is full, you get this kind of error.

2.20.3 Resolution

There are several ways to resolve this problem:

- Remove (non-RDM) files from your disk to make room for the files you need to add to the RDM repository.

- Use a tool like Symantec's PartitionMagic or ServerMagic to enlarge your disk.

- Uninstall RDM and reinstall it on another disk that has sufficient space.

- Map the repository directory to a path on another disk that has sufficient space.

We will discuss the latter 2 techniques here.

2.20.3.1 Reinstall RDM

If you elect to reinstall RDM to a different disk, you need to plan how to minimize the rework (i.e., having to redo work that you previously did on the original RDM installation). RDM has the ability to export and to import systems, tasks, and images. These represent a large part of the preparation work that you did on the original RDM installation that you won't have to redo. However, you will lose all of the system/task configurations (because there is no RDM export or import capability for this data).

First, you need to ensure that you have an up-to-date backup of your RDM server. You want to be able to recover, in case something goes wrong.

1. Run your standard backup procedure.

Use the following procedure to save important RDM data:

2. Export your systems.

3. Export your tasks. This will also automatically export the image that those tasks use.

4. Export any images that step 3 above did not automatically include.

5. Manually copy any other files that you changed (e.g., files used in DOS System Environments).

Then do your RDM installation:

6. Uninstall RDM.

7. Install RDM, selecting a different disk (i.e., one that has more space) as the new RDM install location.

Now import the important RDM data that you saved, above.

8. Import your systems, using the file created in step 2 above as input.

9. Import your tasks, using the directory created in step 3 above as input.

10. If necessary, import your images, using the directory created in step 4 above.

11. If necessary, manually copy the files that you created in step 5 above.

Finally, run some tests to validate your new RDM installation.

12. Perform the RDM operation that was previously failing due to lack of disk space.

At this point, your new RDM installation should behave exactly like your old one did with the following exceptions:

- You will no longer see the out-of-space errors.

- If you rerun any tasks that require configuration, you will have to configure those systems and tasks again.

2.20.3.2 Map the repository directory

The following procedure allows you to relocate the whole RDM repository into its own partition, without reinstalling RDM. As a matter of fact, you could relocate the whole RDM installation with this scheme, as long as the drive being used remains available to the operating system.

First, you need to ensure that you have an up-to-date backup of your RDM server. You want to be able to recover, in case something goes wrong.

1. Run your standard backup procedure.

Now do the following steps to map your RDM repository to another disk.

2. Make sure that your RDM server contains a disk with enough unallocated space to contain your repository. There should be sufficient free space to contain whatever files you will later add to your repository.

3. Rename your ...\RDM\repository directory to something like ...\RDM\oldrepository.

4. Create a new ...\RDM\repository folder, and make sure that it stays empty.

5. Right click on the *My Computer* icon on your desktop, and select *Manage* from the menu. Then select *Disk Management* in the left panel of the *Computer Management* window.
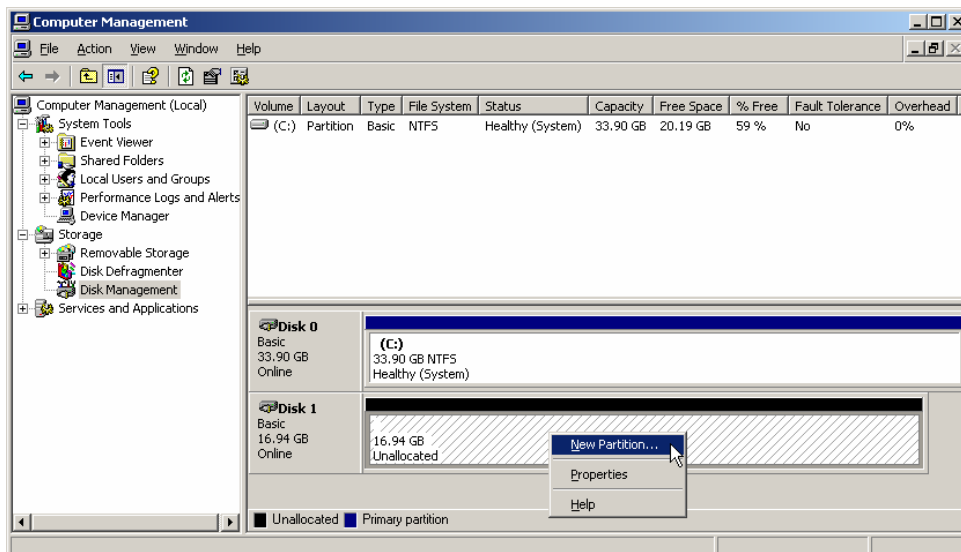
6. Right click on the free space or partition that you want to use as the repository, and select *New Partition...* from the menu. This displays the *New Partition Wizard*.

7. Select the *Next* button on the first wizard window. Then select the appropriate partition type, and then the *Next* button on the *Select Partition Type* window.
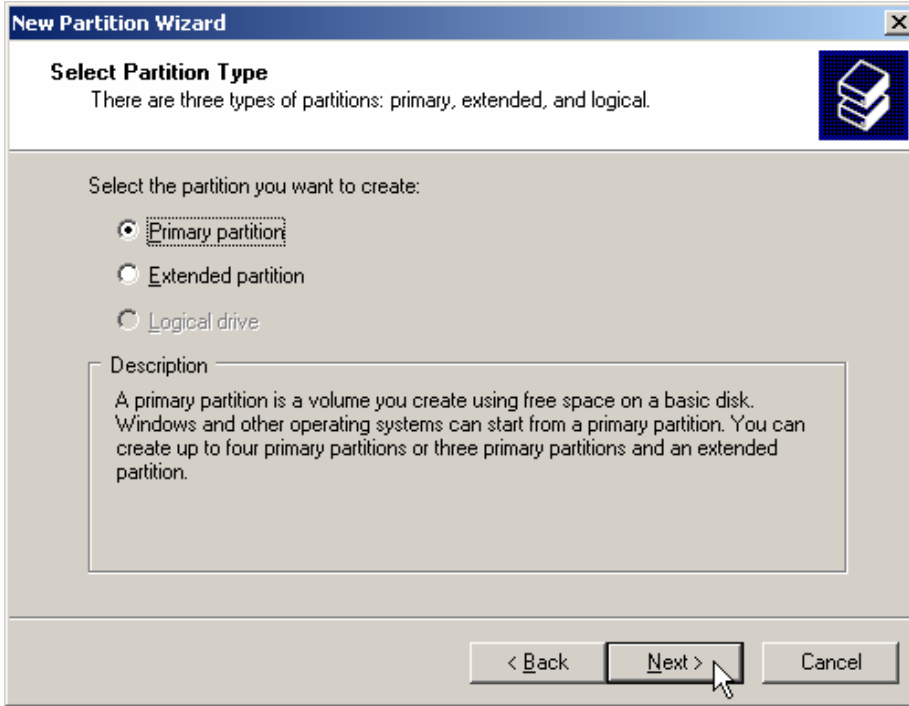

8. On the *Specify Partition Size* window, enter the appropriate partition size, and then select the *Next* button.
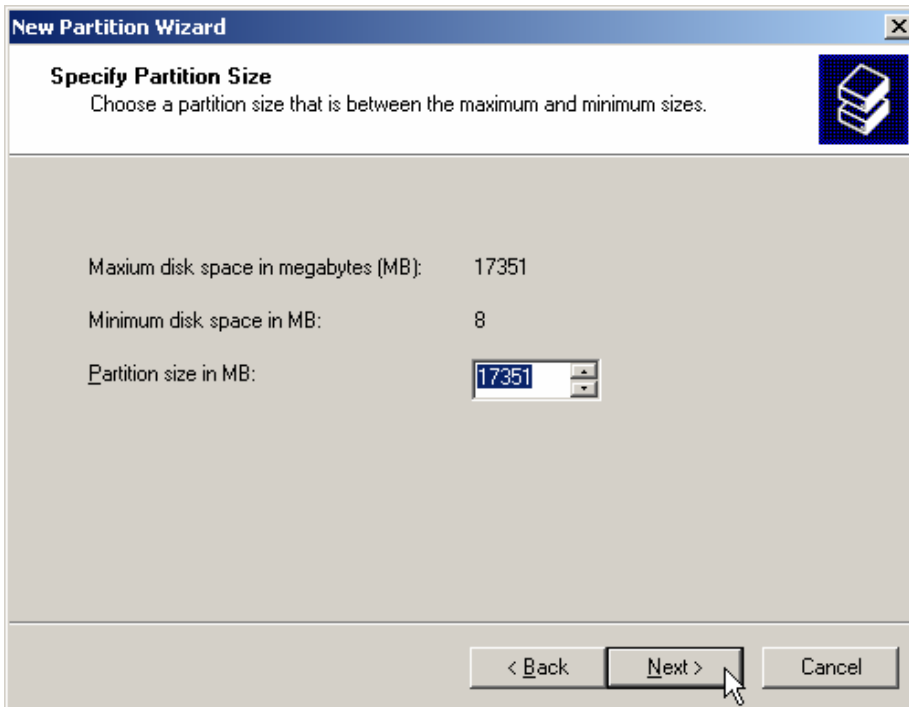
9. On the Assign Drive Letter or Path window, select the *Mount in the following NTFS folder* radio button. Enter the full path of the empty repository that you created in step 4 above (or use the *Browse...* button to do this), and then select *Next* button.
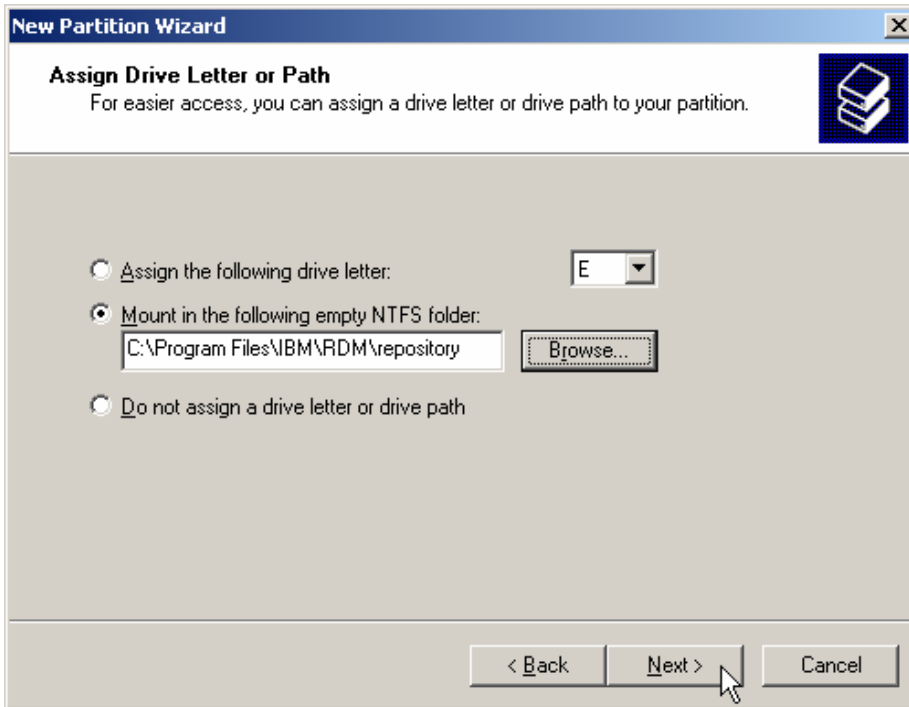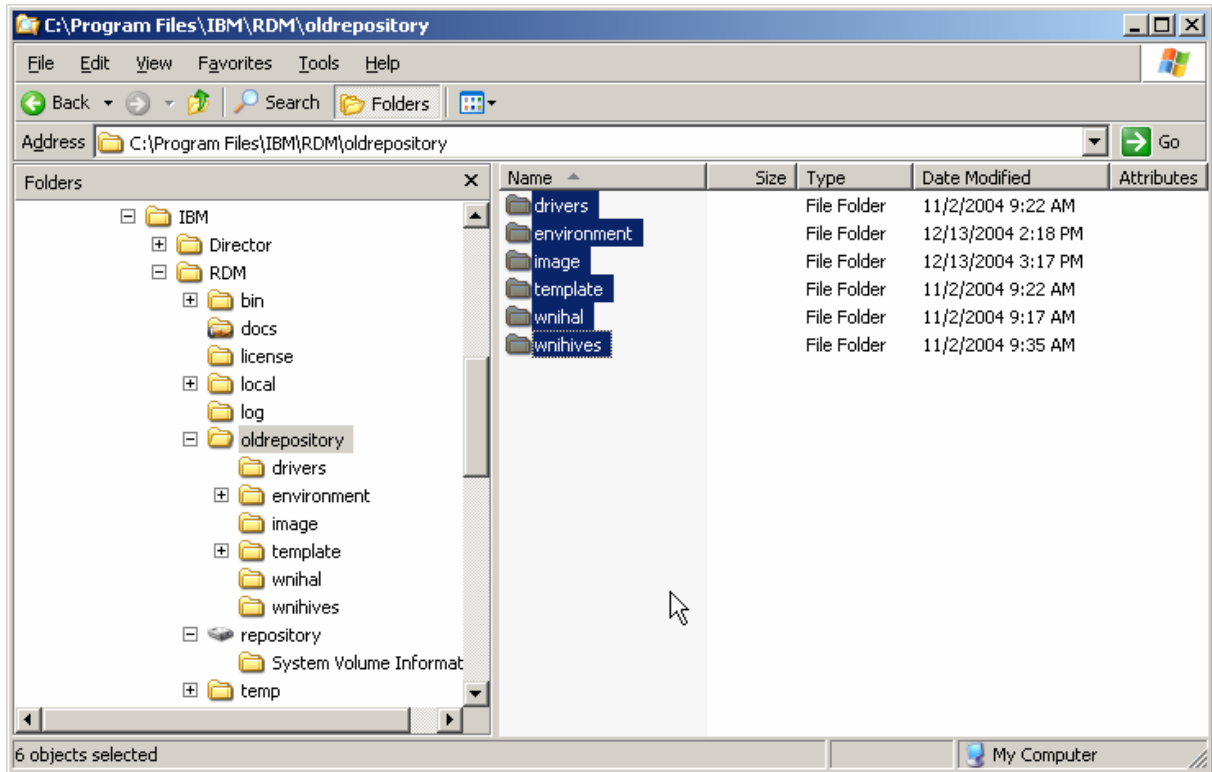

10. On the *Format Partition* window, select the appropriate values, and then select the *Next* button.
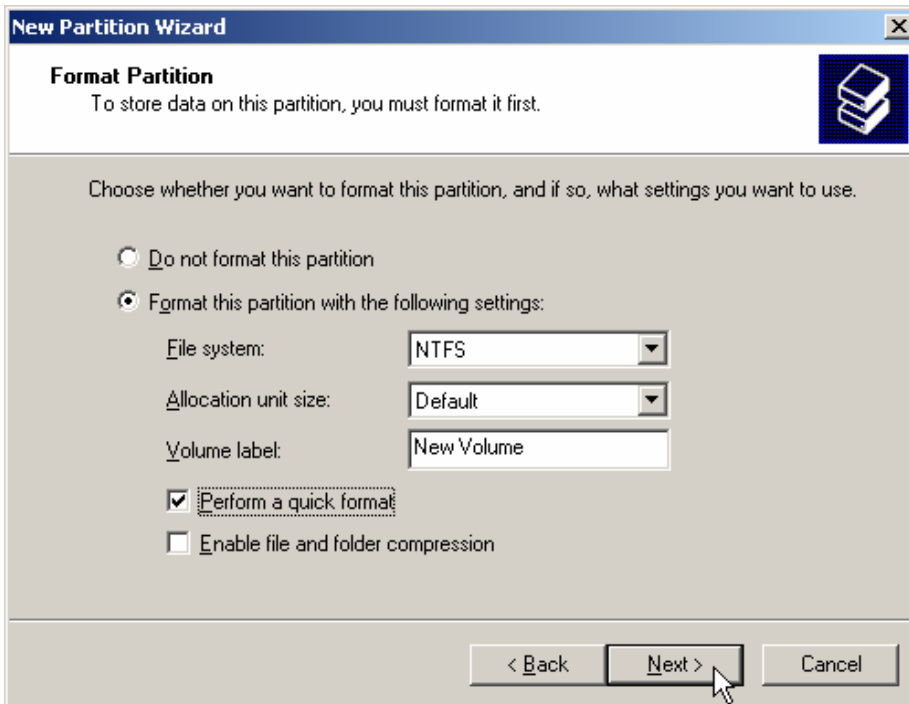
11. On the final wizard window, select the *Finish* button.

12. Use Windows Explorer to copy the contents of the repository from ...\RDM\oldrepository into the new folder ...\RDM\repository (it now appears as a drive icon under the ...\RDM directory).

Finally, run some tests to validate your modified RDM installation.

13. Perform the RDM operation that was previously failing due to lack of disk space.

14. Delete the ...\rdm\oldrepository directory.

At this point, your modified RDM installation should behave exactly like your old one did with the following exceptions:

- You will no longer see the out-of-space errors.

2.21 Windows Clone Install task only copies 1 partition

2.21.1 Scenario

Run a typical Windows Clone Install scenario. The donor system contains C: and D: partitions.

Capture an image of the donor system using the *Get Donor* task.

Create a *Windows Clone Install* task that uses that image.

Deploy a system with that *Windows Clone Install* task.

2.21.2 Result

The target system boots correctly. It gets the C: disk properly, but it contains no D: disk.

This occurs because RDM's built-in (Symantec) DeployCenter tool is a light version that can copy only a single partition.

2.21.3 Resolution

RDM requires that you upgrade the DeployCenter tool in order to get the ability to clone multiple-partition systems. Instructions on how to do this are contained in the *Using DeployCenter 5.6 with RDM 4.20* white paper, which you can download from the Web (see URL in section 1.2.2 above).

2.22   PQIMGCTR.EXE Causeway 09 error

2.22.1 Scenario

Run a typical *Windows Clone Install* scenario.

2.22.2 Result

The task fails after PQIMGCTR.EXE has completed a large percentage of the download. You will see messages like this in the task's execution log:

```
12/20/2005 10:21:19 AM   Starting PQImgCtr for Image Deployment - RAID Support Enabled
12/20/2005 10:50:13 AM   Exit Deploy.bat
12/20/2005 10:50:15 AM   RDAgent returns: RDBATC000I Command processed successfully.
12/20/2005 10:50:15 AM   Processing command: custimg\setUser.bat
12/20/2005 11:52:30 AM   Task Cancelled.
12/20/2005 11:52:30 AM   IBM 884341U KQAVD7X client job status changed to "Error".
```

If you are observing the target system when the error occurs, you will see a message like this:

```
CauseWay error 09: Unrecoverable exception. Program terminated.
```

This occurs because of an anomaly in the (Symantec) DeployCenter service or client.

We have seen it on a type 8843 BladeCenter system, with a multiple-file DeployCenter image, when the donor system and the target system have identical disk configurations

2.22.3 Resolution

There are 2 known occurrences of a Causeway 09 error:

1. First, make sure that your RDM is at version 4.20.3 or higher. That is, you must install RDM Update 3. (Installing the RDM Update Module for ServeRAID, after installing RDM Update 3, is optional.)

    RDM Update 3 modified some of the RDM batch files to correct a Causeway 09 error.

    If this does not fix the problem, then go to step 2.

2. You may be able to circumvent this problem by adding a command to the DeployCenter script. Do the following:

    a. Edit the C:\Program Files\IBM\RDM\local\env\71c\deploy\restore.txt file (e.g., with Notepad or your favorite text editor).

    b. Add a line "RESIZE IMAGE NO" to this file.

        SELECT DRIVE 1
        SELECT FREESPACE FIRST
        SELECT IMAGE ALL
        RESIZE IMAGE NO
        RESTORE

    c. Run the C:\Program Files\IBM\RDM\local\env\MKIMAGES.BAT program. This rebuilds RDM's DOS System Environments so that the DOS71C environment will contain the modified RESTORE.TXT file.

    The default, when you don't include a RESIZE statement in the DeployCenter script, is RESIZE IMAGE PROPORTIONAL. In some cases, changing to RESIZE IMAGE NO will eliminate the Causeway 09 error.

Important: If you are using RDM remote D-Servers, you must make the above change on all remote D-Servers.

2.23 PQIDPLYZ.EXE or PQIMGCTR.EXE fail with error 1832

2.23.1 Scenario

Run a typical *Get Donor* or *Windows Clone Install* scenario.

2.23.2 Result

The task fails right after PQIDPLYZ.EXE or PQIMGCTR.EXE starts. You will see an error message like this in the task's execution log:

6/16/2005 11:35:59 AM   RDAgent returns: RDMPWR252E ImageCenter Error 1832 Error: Image file name not specified.

This occurs because the (Symantec) DeployCenter service is not started.

2.23.3 Resolution

Just restart the service, and the problem should disappear. In the Windows Services window, its name is one of the following:

- PowerQuest Unicast Image Server

- Symantec Unicast Image Server

2.24 PQIDPLYZ.EXE fails with error 1810

2.24.1 Scenario

Run this *Windows Clone Install* scenario:

Import an image of a donor system using the *Image Management* window. That is, you had created the DeployCenter image outside of RDM.

Create a *Windows Clone Install* task that uses that image.

Deploy a system with that *Windows Clone Install* task.

2.24.2 Result

The task fails right after PQIDPLYZ.EXE starts. You will see an error message like this in the task's execution log:

9/16/2005 11:35:59 AM   RDAgent returns: RDMPWR252E ImageCenter Error 1810 Error: Could not open image file.

This can occur because the (Symantec) DeployCenter version that was used to create the image is incompatible with the light DeployCenter version that is in RDM.

2.24.3 Resolution

You need to upgrade RDM's DeployCenter to version 5.6. Just follow the procedure in the latest version of the *Using DeployCenter 5.6 with RDM 4.20* white paper (see section 1.2.2 above for the location of the RDM white papers).

2.25 How to change the IP address of the RDM server

2.25.1 Scenario

You change the IP address of the RDM server.

2.25.2 Result

The remote D-Servers stay off-line, and you cannot run any RDM tasks on subnets served by your remote D-Servers.

2.25.3 Resolution

Here is the procedure for changing your RDM server's IP address:

1. Change the IP address on the RDM server in the usual way, using the Windows network-adapter properties window.

2. Update the settings for the RDM server via the *Deployment Server Management Options* window:

    a. Open the *Deployment Server Management Options* window using the menus: *Tasks* ➔ *Remote Deployment Manager tools* ➔ *Options* ➔ *Change D-server Options...*

    b. Change the IP address and subnet mask on the *Connections* page.

    c. Press the *OK* button, to save the changes. Press the *Yes* button on the message window that appears.

3. Look at the C:\Program Files\IBM\RDM\local\DSERVER.INI file on the RDM server. If it does not contain the new IP address in the 2 places below, then change them yourself (with an editor, like Notepad):

    a. Change the value of the MasterDServerIpAddress statement to contain the new IP address.

    b. Change the value of the IpAddress statement to contain the new IP address.

    c. Save the changes.

4. If you changed DSERVER.INI (in step 3 above) or if the *IBM RDM D-Server* service on the RDM server is not started, then restart the service. Do this via the Windows Services window.

5. Update the settings for each RDM D-Server via the *RDM D-Server Configuration* window:

    a. Open the window using the menus: *Start* ➔ *Programs* ➔ *Remote Deployment Manager* ➔ *D-Server Config.*

    b. Change the value of the *Master D-Server IP address*.

    c. Press the *OK* button, to save the changes.

6. Wait a few minutes (perhaps, up to 5 minutes) for the remote D-Servers to show as on-line (in the *Deployment Server Management Options* window).

2.26 How to change the IP address of an RDM remote D-server

2.26.1 Scenario

You change the IP address of the RDM D-Server.

2.26.2 Result

The remote D-Server stays off-line, and you cannot run any RDM tasks on subnets served by your remote D-Server.

2.26.3 Resolution

Here is the procedure for changing your RDM remote D-Server's IP address:

1. Change the IP address on the RDM remote D-Server in the usual way, using the Windows network-adapter properties window.

2. Update the settings for each RDM D-Server via the *RDM D-Server Configuration* window.

   a. Open the window using the menus: *Start ➔ Programs ➔ Remote Deployment Manager ➔ D-Server Config.*

   b. Change the value of the *D-Server IP address* (by selecting it from the drop-down list).

   c. Press the *OK* button, to save the changes.

2.27 Windows Clone Install task stops with message box displayed

2.27.1 Scenario

Run a typical Windows Clone Install scenario.

Capture an image of the donor system using the *Get Donor* task.

Create a *Windows Clone Install* task that uses that image.

Deploy a system with that *Windows Clone Install* task.

2.27.2 Result

The task stops with a message box displayed. The message box refers to the need for activating the Windows product with Microsoft. There are 2 forms of the message, depending on whether the 60-day period has expired or is nearly expired.

This occurs because you have run SYSPREP.EXE on the donor system more than 3 times. SYSPREP.EXE resets the activation timer a maximum of 3 times. After 3 resets, it no longer resets it. You can read the Microsoft documentation at: http://www.microsoft.com/resources/documentation/Windows/XP/all/reskit/en-us/prbc_cai_ztee.asp.

For example, your scenario was something like this:

1. Create the donor system, the image, and the task that uses it.

   a. Install Windows (e.g., via an RDM *Windows Native Install* task, or with a ServerGuide CD) on your donor system.

   b. Add applications and modify the configuration, as necessary. Then run SYSPREP.EXE.

   c. Capture an image of the donor system using the *Get Donor* task.

   d. Create a *Windows Clone Install* task that uses that image.

2. Modify the donor system (e.g., because your requirements for the image have changed), the image, and the task that uses it.

   a. Redeploy the donor system with that *Windows Clone Install* task.

   b. Add applications and modify the configuration, as necessary. Then run SYSPREP.EXE.

   c. Capture an image of the donor system using the *Get Donor* task.

   d. Create a *Windows Clone Install* task that uses that image.

3. Modify the donor system (e.g., because your requirements for the image have changed), the image, and the task that uses it.

   a. Redeploy the donor system with that *Windows Clone Install* task.

   b. Add applications and modify the configuration, as necessary. Then run SYSPREP.EXE.

   c. Capture an image of the donor system using the *Get Donor* task.

   d. Create a *Windows Clone Install* task that uses that image.

4. Modify the donor system (e.g., because your requirements for the image have changed), the image, and the task that uses it.

   a. Redeploy the donor system with that *Windows Clone Install* task.

b. Add applications and modify the configuration, as necessary. Then run SYSPREP.EXE.

c. Capture an image of the donor system using the *Get Donor* task.

d. Create a *Windows Clone Install* task that uses that image.

The *Windows Clone Install* task from steps 1, 2, and 3 will not stop with the product activation message. However, the *Windows Clone Install* task from step 4 will stop, because you have now run SYSPREP.EXE 4 times (step 4b) on that same operating system.

2.27.3 Workaround

You can process the message box manually on each target system. That is, you can select the *Yes* button and register Windows with Microsoft. Or if the 60-day period has not expired, you can select the *No* button (and register Windows later).

2.27.4 Resolution

There are 2 ways to prevent the task from stopping.

2.27.4.1 Use a CD that does not require product activation

If your Windows CD does not require product activation, then this problem will not occur.

2.27.4.2 Do not recreate your donor system using a *Windows Clone Install* task

If your Windows CD does require product activation, then you cannot do step 4a in the above scenario via a *Windows Clone Install* task. You will instead have to do it as you did step 1a.

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4. Glossary

BAT file. A file that contains a batch program (that is, a set of commands).

bind. Associating one or more systems to a task. This causes all information to be verified (by one of the STC modules) and a resulting job to be scheduled to run.

console, or RDM Console. The group of programs that make up the user interface to RDM. RDM is client/server in nature so that the Console might run on any computer and not necessarily be running on the same computer as the RDM server or other RDM components. The RDM Console is actually an IBM Director Console on which the RDM Console component is installed.

image. An image is the software stored on a deployment server that is downloaded to a system during an operation. Images vary in size and in the type of software they provide to the system. The purpose and content of each image depends on the task to be accomplished, as well as the method used to download the image from the deployment server to the system. A *native* image is built off a product installation CD. A *clone* image is copied from a donor system.

job. An object managed by the scheduler and created by STC. A job is a binding of one task and one or more systems. A job can be scheduled to run once or to recur. Sometimes a job is called by a different name (Scheduled Task, Running Task), to emphasize some aspect of the job.

managed system. The IBM Director term for its system. Mentioned here only for clarity; the term *system* is preferred when referring to an RDM system.

preboot DOS agent. The preboot DOS agent is a DOS operating system with a communications stack that is booted from the network by the bootstrap agent. The preboot DOS agent performs actions on a system as directed by the RDM server.

Preboot Execution Environment (PXE). PXE is an industry standard client/server interface that allows networked computers that are not yet loaded with an operating system to be configured and booted remotely. PXE is based on Dynamic Host Configuration Protocol (DHCP). Using the PXE protocol, clients can request configuration parameter values and startable images from the server.

The PXE process consists of the system initiating the protocol by broadcasting a DHCPREQUEST containing an extension that identifies the request as coming from a client that uses PXE. The server sends the client a list of boot servers that contain the operating systems available. The client then selects and discovers a boot server and receives the name of the executable file on the chosen boot server. The client downloads the file using Trivial File Transfer Protocol (TFTP) and executes it, which loads the operating system.

Redundant Array of Independent Disks (RAID). RAID is way of storing the same data in different places (thus, redundantly) on multiple hard disks. By placing data on multiple disks, I/O operations can overlap in a balanced way, improving performance. Multiple disks increase the mean time between failure (MTBF) and storing data redundantly increases fault-tolerance.

system. An individual, target system being deployed or managed by RDM. In IBM Director terminology, an RDM system is always a platform managed object. These can represent any of the supported-by-RDM systems. They cannot represent an IBM Director object that RDM does not process, such as a chassis or an SNMP object.

task. An already defined and configured unit of work that is available to be applied to a system or a group (of systems). You create a task by clicking on the applicable task template from the RDM main console. RDM is installed with predefined tasks, such as data disposal and scan.

task template. A prototype of a specific kind of RDM task. This is a term used to describe the different kinds of tasks shown on the task pane in the main window of the RDM console. Each task template has its own characteristics and attributes. RDM comes with a set of task templates.

Wake on LAN. Technology developed by IBM that allows LAN administrators to remotely power up systems. The following components are essential for the Wake on LAN setup:

- Wake on LAN-enabled network interface card (NIC).

- Power supply that is Wake on LAN-enabled.

- Cable which connects NIC and power supply.

- Software that can send a magic packet to the system.

If the system has the first three of the previous components, the system is called a Wake on LAN-enabled system. Even though a system might be powered off, the NIC keeps receiving power from the system power supply to keep it alive. A network administrator sends a magic packet to the system through some software, for example, RDM or Netfinity IBM Director. The NIC on the system detects the magic packet and sends a signal to the power supply to turn it on. This process is also called *waking up the system*. Using RDM, this process can be scheduled for individual systems. The Wake on LAN feature and RDM together make it very easy for you to deploy software on individual systems on a scheduled basis.