# Intel® Switch Module IXM5414E

## TFTP Server Setup Application Note

***Revision 1.0***

***April 2005***

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## Revision History

| Date | Revision | Description |
|---|---|---|
| January 2005 | 1.0 | Initial release |

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# 1.0 Executive Summary

The Intel® Switch Module IXM5414E is one of up to four switch modules that can be installed in the Intel® Blade Server Chassis SBCE. This high-performance IXM5414E switch module is ideally suited for networking environments that require superior microprocessor performance, efficient memory management, flexibility, and reliable data storage.

Each IXM5414E switch module has a total of 20 ports:

- Four external 1000Base-T ports for 10/100/1000 Mbps connections to backbone switches, end stations, or servers,
- 14 internal full-duplex gigabit ports, one for each blade servers, and
- Two internal full-duplex 100 Mbps ports connected to the management modules.

IXM5414E is designed to use the Trivial File Transfer Protocol (TFTP) protocol for upgrading its operating codes to the latest versions available. The same protocol is also used to move files (containing the error log, configuration details, and so on) from the switch module to a host connected to the network. This document introduces the concept of TFTP. After explaining the workings of the protocol and its usage, the procedures to configure the TFTP server software on various operating systems are described.

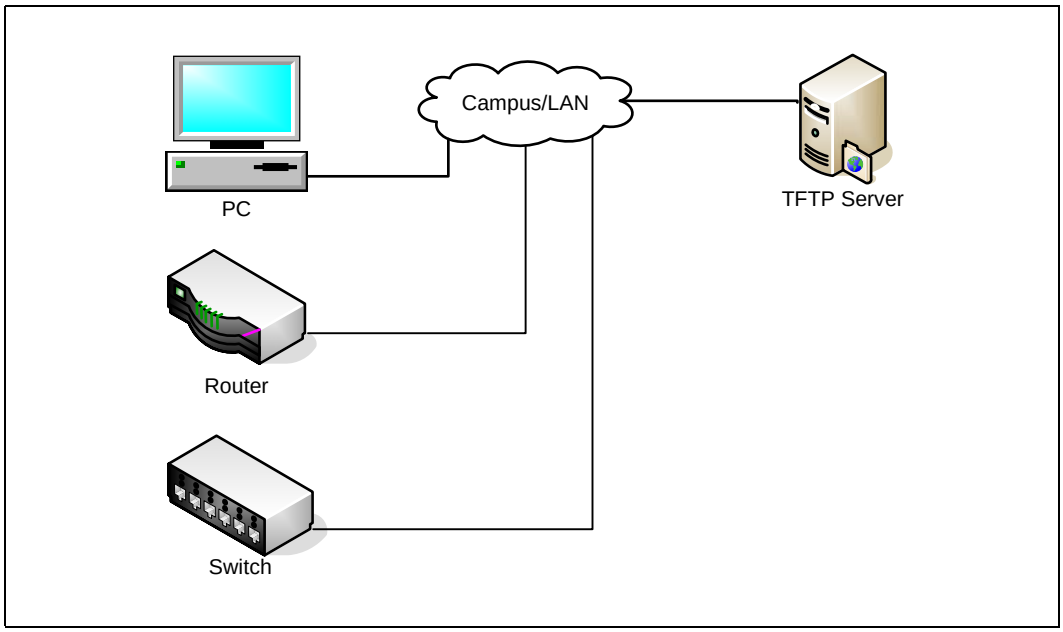
# 2.0 Introduction

Trivial File Transfer Protocol (TFTP) is an Internet standard protocol that is fully described in RFC 1350. It is a simple client-server protocol for transferring files from one host to another using User Datagram Protocol (UDP) packets. It is designed to be small and easy to implement. Therefore, it lacks most of the features of a regular FTP. The only thing it can do is read and write files from/to a remote TFTP server; it cannot list directories, and currently has no provisions for user authentication.

Because of its simple implementation and low overhead, TFTP is more suitable than HTTP or FTP for transferring firmware or operating codes to network devices such as routers and switches. Usually, the TFTP client is implemented in the operating codes of these network devices.

# 3.0 TFTP Overview

**Figure 1. Position of TFTP Server and Clients in a Typical Network**




The Trivial File Transfer Protocol works as a client-server protocol. It is implemented above the User Datagram Protocol. The TFTP client initially sends read/write requests via port 69; then, the server and the client determine the port that they will use during the remainder of the connection.

The TFTP client connects to the TFTP server and initiates a file transfer. Any transfer begins with a request to read or write a file. If the server grants the request, the connection is opened and the file is sent in blocks of 512 bytes (fixed length). The blocks of the file are numbered consecutively, starting at 1. Each data packet must be acknowledged by an acknowledgment packet before the next one can be sent. The transfer is terminated when a data packet of less than 512 bytes is sent. Almost all errors (except incorrect source port) will cause termination of the connection. If a packet gets lost in the network, a time-out will occur, after which the last packet (data or acknowledgment) will be retransmitted.

Figure 2 shows the order of the headers of a TFTP packet:.

**Figure 2. Order of TFTP Packet Headers**

| Local Medium | IP | UDP | TFTP | |
|---|---|---|---|---|

TFTP packets are of six types as shown in Table 1.

**Table 1. TFTP Packet Types**

| Opcode | Operation |
|---|---|
| 1 | Read Request (RRQ) |
| 2 | Write Request (WRQ) |
| 3 | Data (DATA) |

**Table 1. TFTP Packet Types**

| Opcode | Operation |
|---|---|
| 4 | Acknowledgment (ACK) |
| 5 | Error (ERROR) |
| 6 | Option Acknowledgment (OACK) |

Figure 3 shows the TFTP format for each type of packet.

**Figure 3. TFTP Packet Formats**

| RRQ.WRQ Packet | 2 bytes | string | 1 byte | string | 1 byte |
|---|---|---|---|---|---|
| | Opcode (1\|2) | Filename | 0 | Mode | 0 |

| DATA Packet | 2 bytes | 2 bytes | up to 512 bytes of data |
|---|---|---|---|
| | Opcode (3) | Block# | Data |

| ACK Packet | 2 bytes | 2 bytes |
|---|---|---|
| | Opcode (4) | Block# |

| ERROR Packet | 2 bytes | 2 bytes | string | 1 byte |
|---|---|---|---|---|
| | Opcode (5) | Block# | ErrMsg | 0 |

***Note:*** Refer to RFC 2347 for the format of OACK packets.

The mode of transfer is indicated in the Request for Read/Write packet (RRQ/WRQ). Two modes of transfer are currently defined in RFC 1350:

- **NetASCII**: US-ASCII with modifications specified in RFC 854 (Telnet Protocol Specification) and extended to use the high order bit; that is, an 8-bit character set.
- **Octet**: Raw 8-bit bytes, also called binary.

***Note:*** RFC 783 defined a **Mail** format, which allowed for sending mail to a user rather than transferring to a file. This mode was declared obsolete by RFC 1350.

The TFTP protocol defines the following error codes:

- 0: Not defined, see error message (if any)
- 1: File not found
- 2: Access violation
- 3: Disk full or allocation exceeded
- 4: Illegal TFTP operation
- 5: Unknown transfer ID
- 6 : File already exists
- 7: No such user

# 4.0 TFTP Usage Environment

Since TFTP does not have an authentication mechanism, the server must protect the host files. Most TFTP servers, by default, do not allow write access and only allow read access to public directories. Some server implementations also have a host access list or TCP/UDP wrapper to allow connections only from known sources.

TFTP is usually used within a LAN or campus environment. It does not work well on WANs (and on the Internet), due to delays and other errors. Another key factor against usage of TFTP on the Internet is that it is not a secure protocol. Hackers can exploit its vulnerabilities to get into the network. Also, as most routers and fire-walls on the Internet are configured to filter TFTP traffic through them, using a public TFTP server does not serve any purpose.

Many freeware TFTP servers (such as SolarWinds* and Pumpkin*) are available on the Internet. Several commercial TFTP server packages (such as, Winagents TFTP Service for Windows and WinTFTP Pro) are also available.

When selecting a package, it may be helpful to consider the following:

- **Security features**: Depending on the location of the TFTP server in the network, security features may be an important consideration.
- **Support for large transfers**: Some devices require images that are over 16 MB in size. Check the size of your image and verify that the TFTP server you are considering will support large transfers, if needed. For the Intel® Switch Module IXM5414E, this is not of major concern because the firmware file is approximately 5 – 6 MB in size and the MCU code about 10 KB.

In the case of IXM5414E, the operating code includes a TFTP client implementation. To upgrade the firmware or MCU code levels of the switch, end users may want to setup a TFTP server that is accessible from the switch module, on the local LAN or campus network.

# 5.0 Setting Up TFTP Servers

Microsoft* Windows* XP* and Windows 2003* do not contain native TFTP server services. Users would have to set up TFTP servers on these hosts to enable the TFTP server services. SolarWinds* and PumpKIN* are two examples of freeware TFTP servers that be downloaded from the Internet. Section 5.1 and Section 5.2 describe the procedure to set up these freeware TFTP servers on Windows.

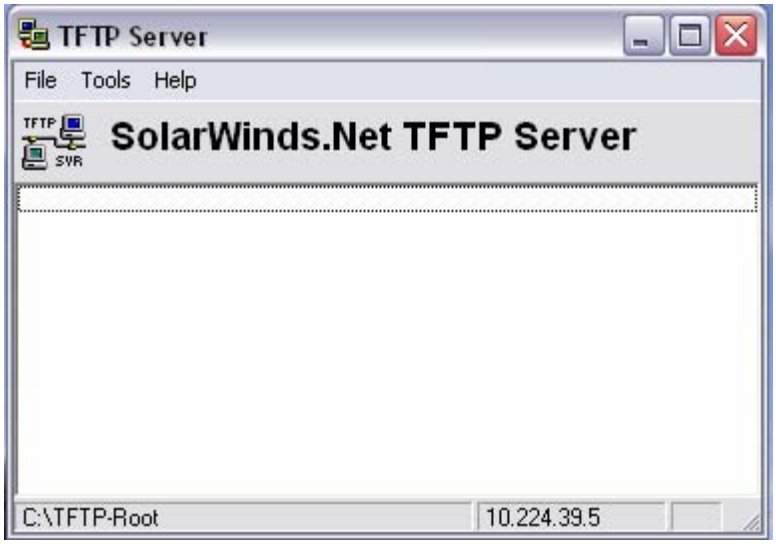
Section 5.3 describes the procedure to set up TFTP server services on Linux* servers.

Section 5.4 describes the procedure to enable TFTP server services on Sun Solaris* servers.

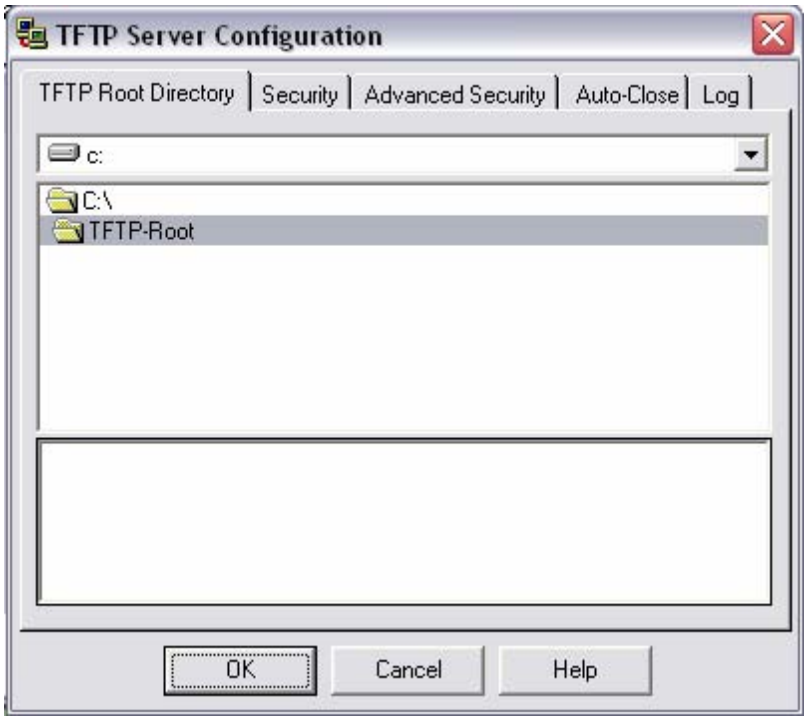
## 5.1 Installing SolarWinds on Windows

The SolarWinds TFTP server is available at http://support.solarwinds.net/updates/SelectProgramFree.cfm#.

After downloading and installing the server, run the application. The following window is displayed:




Select the **Configure** option from the **File** menu. The following window is displayed.



Select the directory that contains the software to be downloaded to IXM5414E.

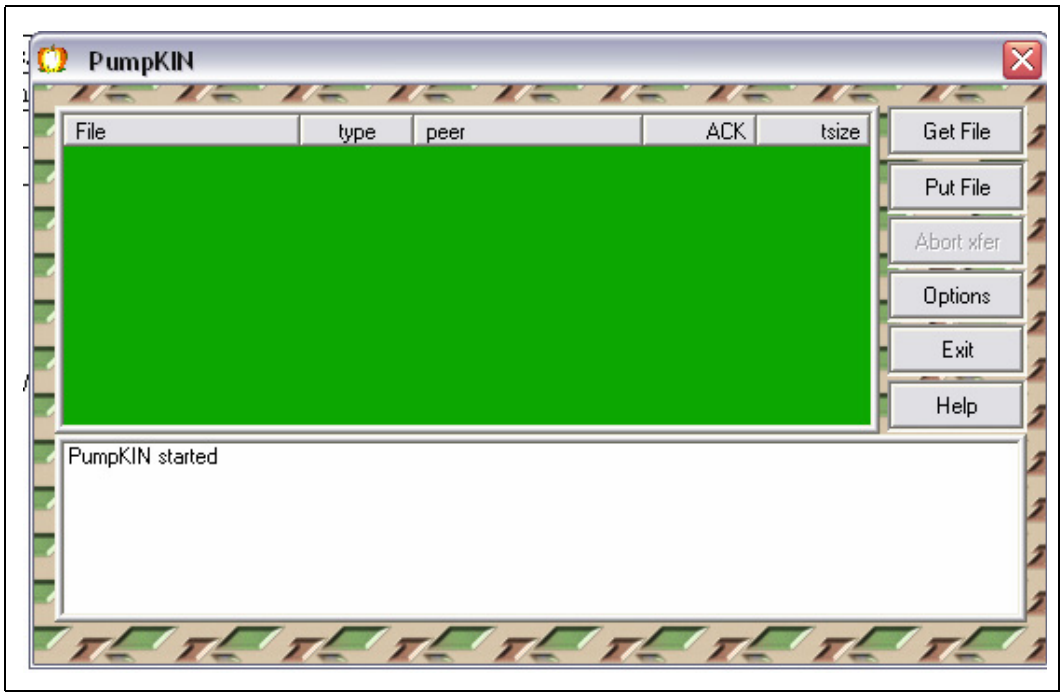
***Note:*** The same directory will be used for saving files transferred from IXM5414E to the TFTP server.

***Note:*** It is important to disable the TFTP server services on the host immediately after the intended transfer is completed. To do this, close SolarWinds.

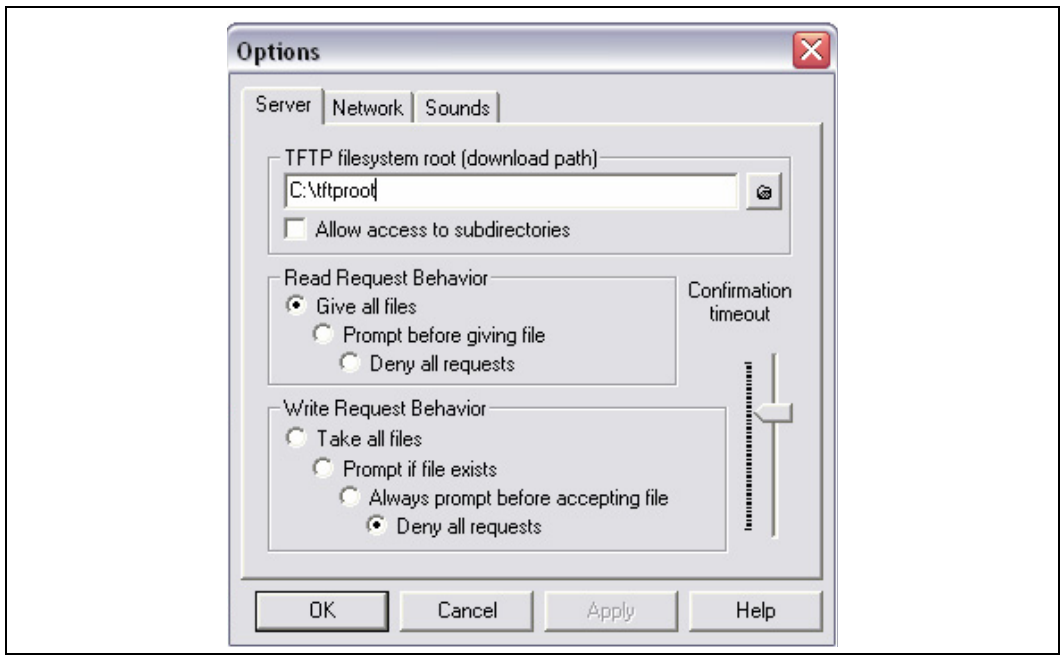
## 5.2 Installing PumpKIN on Windows

The PumpKIN TFTP server is available at http://kin.klever.net/pumpkin/binaries.

After downloading and installing the server, run the application. The following window is displayed:




Click on the **Options** button. The following window is displayed:




Set the **TFTP filesystem root** field to the directory that contains the software to be downloaded. The same directory will be used for saving files transferred from IXM5414E to the TFTP server.

***Note:*** If the TFTP server is also to be used for transferring files from IXM5414E to the server, set the **Write Request Behavior** fields as appropriate.

***Note:*** It is important to disable the TFTP server services on the host immediately after the intended transfer is completed. To do this, close PumpKIN.

## 5.3 Installing the TFTP Server on Linux

The installation can be downloaded from any site that allows downloading package managers (RPMs), such as: http://rpm.sh-linux.org/rpm-index-2004/sh4/tftp-server-0.33-3.sh4.html.

1. Install the TFTP server from the RPM package using the following command:

   ```
   # rpm -ihv tftp-server-*.rpm
   ```

2. Create a directory that will contain the software to be downloaded or in which files will be written when they are transferred from IXM5414E to the TFTP server, using the following command:

   ```
   # mkdir /tftpboot
   ```

3. Change the ownership of the **/tftpboot** directory to the user, **nobody**, using the following command.

   ```
   # chown nobody:nobody /tftpboot
   ```

***Note:*** **nobody** is the default user ID set up by the TFTP daemon to access the files in the **/tftpboot** directory.

4. Edit the **/etc/xinetd.d/tftp** file to include the following changes:

   — Set the **disable** parameter to **no** (to enable the service)

— Introduce the server argument **-c**. Normally, the TFTP server is in read-only mode. Addition of the **-c** argument allows creation of files, which is necessary to save boot or disk images.

The edited file would be:

```
service tftp
{
socket_type= dgram
protocol= udp
wait= yes
user= root
server= /usr/sbin/in.tftpd
server_args= -c -s /tftpboot
disable= no
per_source= 11
cps= 100 2
}
```

5. Reload **xinetd** using the following command:

   ```
   /etc/rc.d/init.d/xinetd reload
   ```

***Note:*** It is important to disable the TFTP server services on the host immediately after the intended transfer is completed. To do this, set the **disable** parameter in the **/etc/xinetd.d/tftp** file to **yes** and then perform step-5.

## 5.4 Installing the TFTP Server on Sun Solaris

The installation is available with the operating system.

1. Log in as root.
2. Add the following line in the **/etc/inetd.conf** file. If this line already exists in the file, ensure that it is not commented.

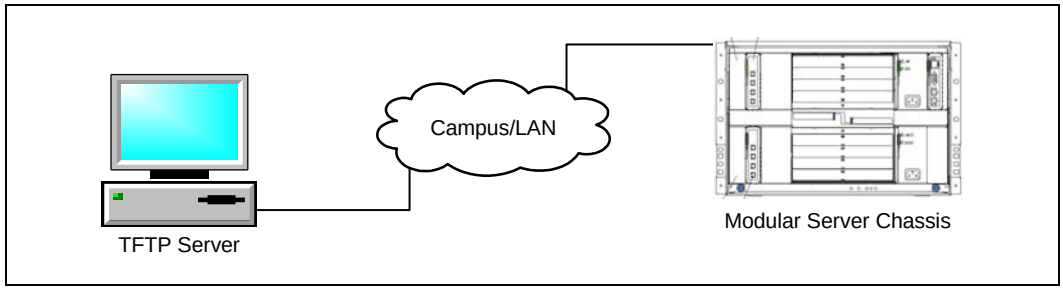
   ```
   tftp dgram udp wait root /usr/sbin/in.tftpd in.tftpd
   ```

3. Specify the TFTP directory. By default, the directory is **/tftpboot**, unless **-s <directory>** was appended in step-2. View the **in.tftpd** man page for more information.
4. Use the following commands to find the **inetd** process and send the SIGHUP signal to force it to reread the **inetd.conf** file:

   ```
   /bin/ps -ef | grep inetd
   kill -1 <inetd_process_ID>
   ```

***Note:*** It is important to disable the TFTP server services on the host immediately after the intended transfer is completed. To do this, comment the line referred in step-2 and then perform step-4.

# 6.0 Downloading Operating Codes from the TFTP Server




IXM5414E has two operating codes:

- Micro-Controller Unit (MCU) code
- Firmware image

The latest versions of these operating codes are available at http://downloadfinder.intel.com. After downloading the operating codes, place the files in the appropriate folder on the TFTP server. The operating codes can be upgraded using either the Command Line Interface (CLI) or the Web-based Graphical User Interface (GUI) of the switch. The procedures for both methods are described in Section 6.1.

## 6.1 Upgrading the Firmware Image

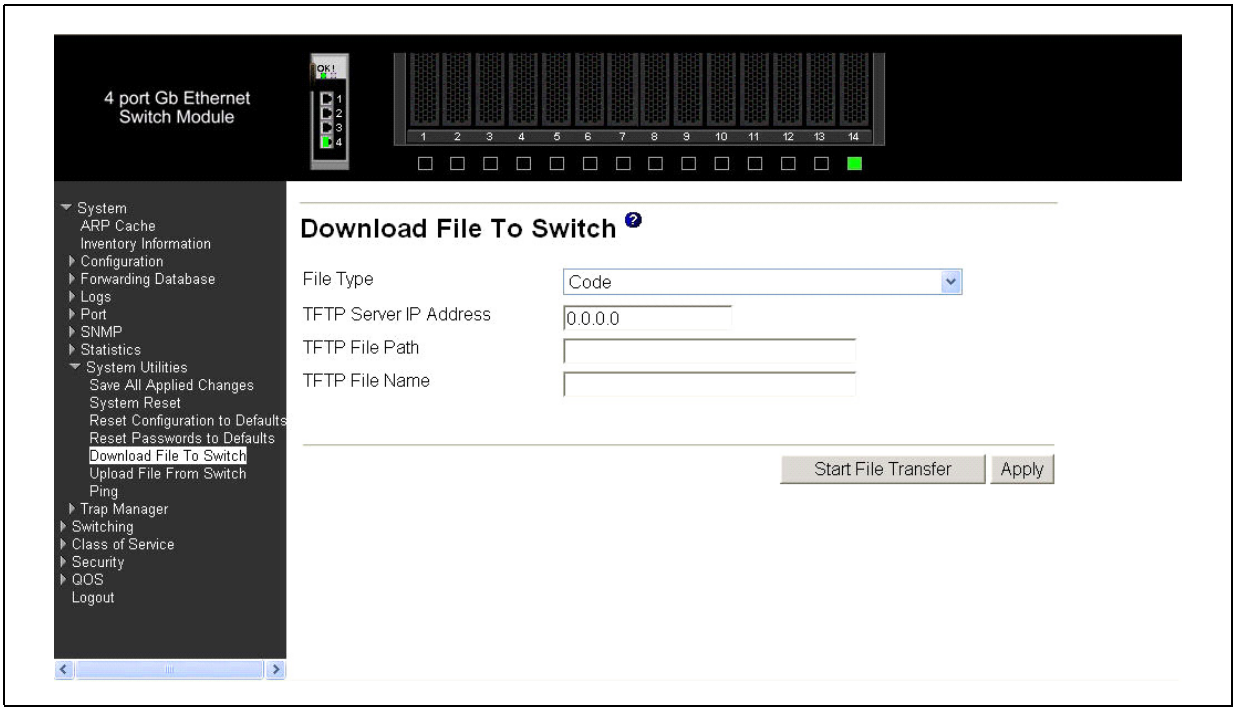
**To upgrade the firmware using the CLI**, complete the following steps:

1. Start a Telnet session to IXM5414E and login.
2. Type **transfer download** and press the **Enter** key.
3. Type **serverip ipaddress**, where **ipaddress** is the IP address of the TFTP server, and press **Enter**.
4. Type **datatype Code** and press **Enter**
5. Type **filename <name>**, where **<name>** is the firmware file that you downloaded from http://downloadfinder.intel.com, and press **Enter**.
6. Type **start** and press **Enter** to begin the firmware upgrade process.
7. Review the information displayed on the screen. If it is correct, type **y** at the **Are you sure you want to start? (y/n)** prompt. If you need to change any information, type **n**, and start from step -2.
8. After successful completion of the TFTP transfer, type **reset** to restart IXM5414E with the new firmware.

**To upgrade the firmware using the Web-based interface**, complete the following steps:

1. Log on to the Web-based interface of the management module of the SBCE chassis.
2. From the **I/O Module Tasks** menu, click **Management -> Advanced Management**.
3. Click **Start Web Session**.

4. Log on to IXM5414E.
5. From the **System Utilities** menu, select the **Download File to Switch** option. The **Download File to Switch** window is displayed.




6. Enter the following information in the **Download File to Switch** window.
   - Select **Code** from the **File type** drop-down list.
   - In the **TFTP Server IP Address** field, type the IP address of the TFTP server.
   - In the **TFTP File Name** field, type **<file_name>**, where **<file_name>** is the firmware file that you downloaded from http://downloadfinder.intel.com, and press **Enter**.

   Click on the **Start File Transfer** button to download the new firmware.
7. After successful completion of the TFTP transfer, click on the **System Reset** option to restart IXM5414E with the new firmware.

## 6.2 Upgrading the MCU Code

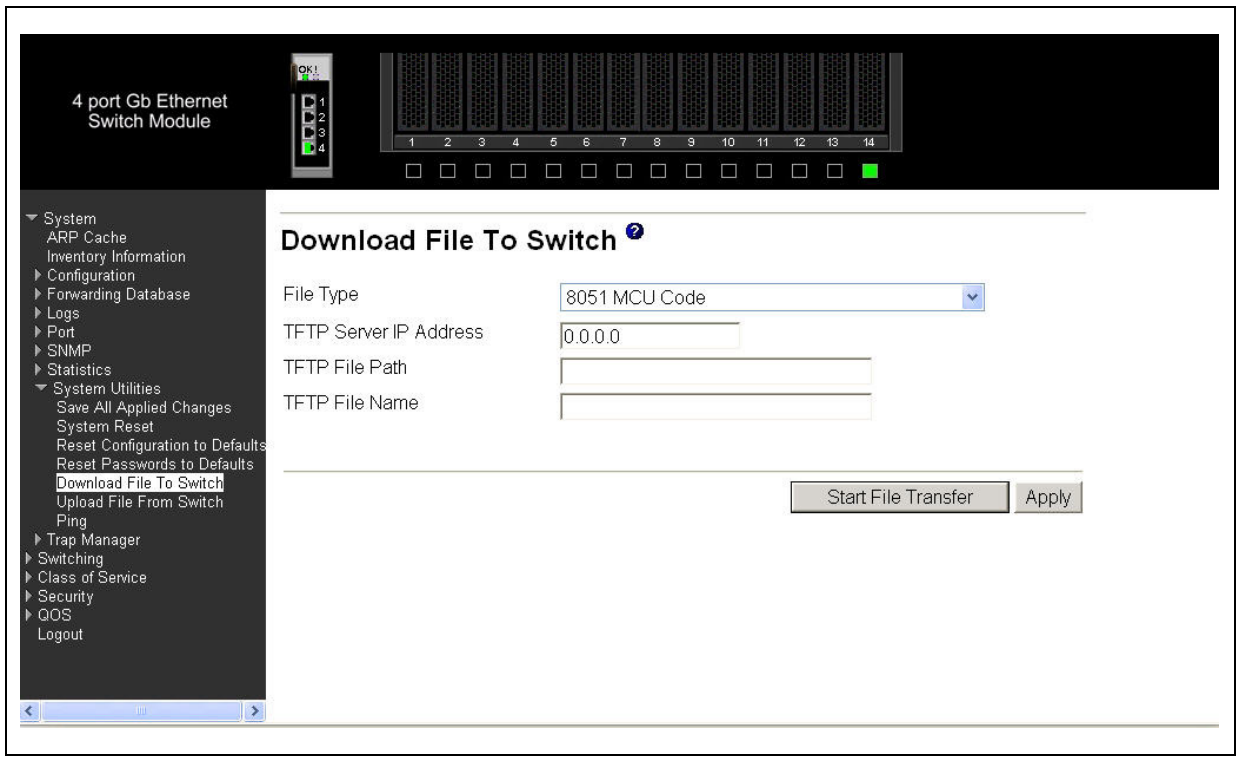
**To upgrade the MCU code of IXM5414E using the CLI**, complete the following steps:

1. Start a Telnet session to IXM5414E and login.
2. Type **transfer download** and press the **Enter** key.
3. Type **serverip ipaddress**, where **ipaddress** is the IP address of the TFTP server, and press **Enter**.
4. Type **datatype 8051-mcu-code** and press **Enter**.
5. Type **filename <name>**, where **<name>** is the MCU code file that you downloaded from http://downloadfinder.intel.com, and press **Enter**.

6. Type **start** and press **Enter** to begin the MCU code upgrade process.
7. Review the information on the screen. If it is correct, type **y** at the **Are you sure you want to start? (y/n)** prompt. On confirmation, the MCU code is transferred to IXM5414E from the TFTP server. After a successful upgrade, IXM5414E is automatically powered off.
8. To activate the new MCU code, turn on IXM5414E through the management-module interface.

**To upgrade the MCU code of IXM5414E using the Web-based GUI**, complete the following steps:

1. Log on to the Web-based interface of the management module of the SBCE chassis.
2. From the **I/O Module Tasks** menu, click **Management -> Advanced Management**.
3. Click **Start Web Session**.
4. Log on to IXM5414E.
5. From the **System Utilities** menu, select the **Download File to Switch** option. The **Download File to Switch** window is displayed.




6. Enter the following information in the **Download File to Switch** window.
   - Select **8051-MCU-Code** from the **File type** drop-down list.
   - In the **TFTP Server IP Address** field, type the IP address of the TFTP server.
   - In the **TFTP File Name** field, type **<file_name>**, where **<file_name>** is the MCU code file that you downloaded from http://downloadfinder.intel.com, and press **Enter**.
   - Click on the **Start File Transfer** button to download the new MCU code. The MCU code is transferred to the switch from the TFTP server.

After a successful upgrade of the MCU code, IXM5414E is automatically powered off.

7. To activate the new MCU code, turn on IXM5414E through the management-module interface.

For more information about the CLI commands and GUI options of IXM5414E, refer to the *Intel Blade Server Ethernet Switch Module IXM5414E Installation and User's Guide*.

***Note:*** MCU code can be upgraded only for IXM5414E with hardware part number: C56082-010. IXM5414E with hardware part number: C56082-003 does not support the MCU upgrade feature.

# 7.0 Transferring Information to the TFTP Server

Section 6.0 provided information about downloading operating codes from the TFTP server to IXM5414E for upgrading the operating codes on the switch. Occasionally, information may have to be transferred from IXM5414E to the TFTP server. The intention of such transfers could be to archive or edit these files and to generate periodic reports based on these files. This section describes the procedure for transferring information from IXM5414E to the TFTP server.

Three types of files can be transferred from IXM5414E to the TFTP server:

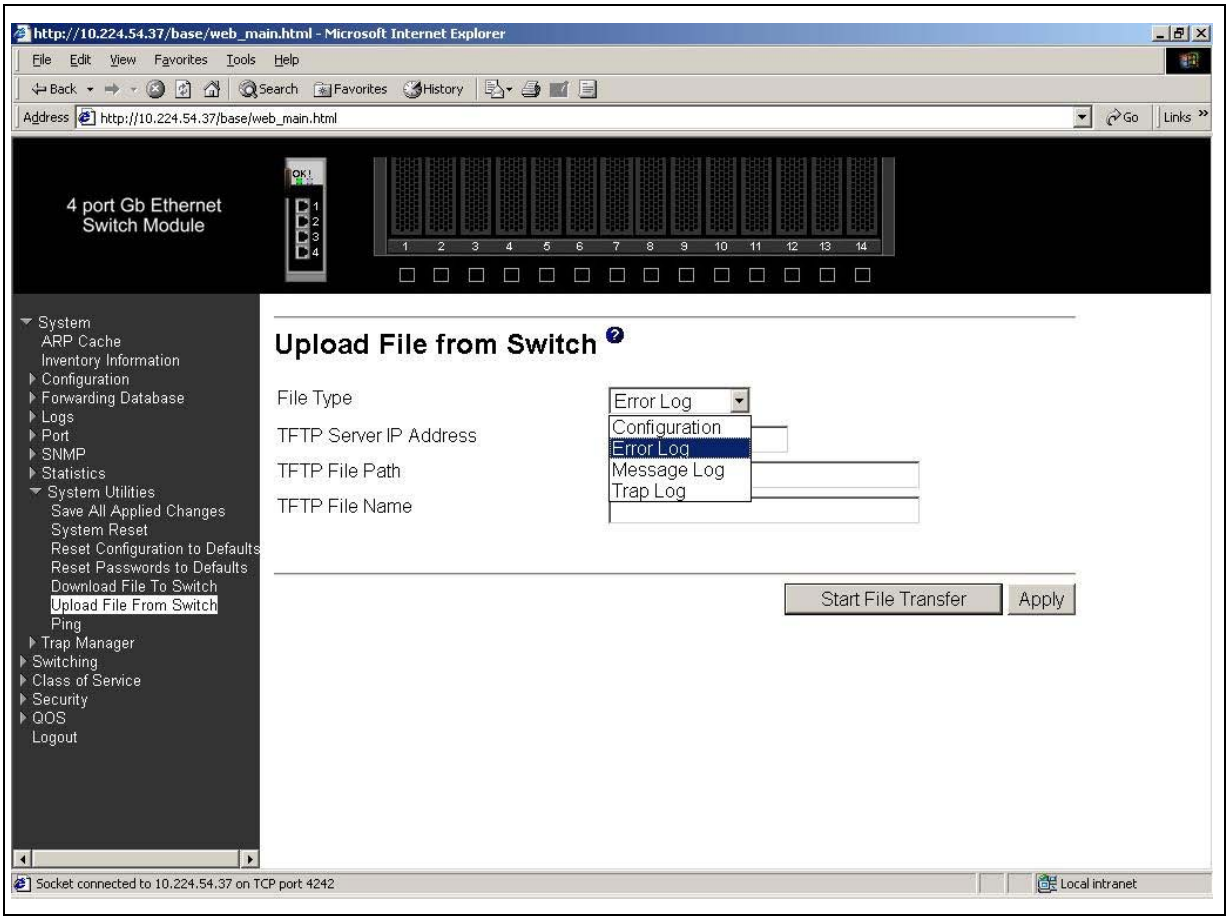
- **config**: Configuration file of the switch module
- **errorlog**: Error log on the switch module
- **msglog**: Message log on the switch module
- **traplog**: Trap log on the switch module

**To upload any of the above files using the switch CLI**, complete the following steps:

1. Start a Telnet session to IXM5414E and login.
2. Type **transfer upload** and press the **Enter** key.
3. Type **serverip ipaddress**, where **ipaddress** is the IP address of the TFTP server, and press **Enter**.
4. Type **datatype <config | errorlog | msglog | traplog>**, depending on the file that you want to upload and press **Enter**.
5. Type **filename <xxx>**, where **xxx** is the name of the file that will be saved on the TFTP server and press **Enter**.
6. Type **start** and press **Enter** to start the transfer.
7. Review the information on the screen. If it is correct, type **y** at the **Are you sure you want to start? (y/n)** prompt.

**To upload a file using the Web-based GUI**, complete the following steps:

1. Log on to the Web-based interface of the management module of the SBCE chassis.
2. From the **I/O Module Tasks** menu, click **Management -> Advanced Management**.
3. Click **Start Web Session**.
4. Log on to IXM5414E.
5. From the **System Utilities** menu, select the **Upload File to Switch** option. The **Upload File to Switch** window is displayed.




6. Enter the following information in the **Upload File to Switch** window.
   - Select the appropriate file type from the **File type** drop-down list.
   - In the **TFTP Server IP Address** field, type the IP address of the TFTP server.
   - In the **TFTP File Name** field, type **<file_name>**, where **<file_name>** is the name of the file to be saved on the TFTP server.
7. Click **Start File Transfer** to transfer the file.

For more information about the CLI commands and GUI options of IXM5414E, refer to the *Intel Blade Server Ethernet Switch Module IXM5414E Installation and User's Guide*.

# 8.0 References


- *RFC 1350*
- *RFC 2347*
- *IBM Redbook on TCP/IP*
- *Internetworking with TCP/IP (vol. I), Douglas E. Comer*
- *Intel Blade Server Ethernet Switch Module IXM5414E Installation and User's Guide*