



Readme File

Quad Gigabit Ethernet Forwarding Application

Contents

1.	Introduction.....	1
1.1	Getting Started.....	1
2.	IP Network Configuration.....	1
2.1	Default IP Network Configuration	1
2.2	Route Table.....	2
2.2.1	addRoute.....	3
2.2.2	addNextHop.....	3
2.2.3	addV4EthEntry	3
2.3	XML File Description.....	4
3.	Compilation	4
3.1	Compiling Microblocks	4
3.2	Compiling Core Components	5
3.2.1	Compiling on Linux	5
3.2.2	Compiling on VxWorks	5
4.	Running the Application	6
4.1	Running on Linux.....	6
4.2	Running on VxWorks.....	6

Revision History

Date	Revision	Description
November 2003	IXA SDK 3.5	New this release.

1. Introduction

This document describes the IPv4 Forwarding software application for Ethernet implemented on an Intel® IXP2400 Network Processor. The application is called quad_gbeth_2401. A detailed description of the application can be found in the *Intel® Internet Exchange Architecture (IXA) Software Building Blocks Applications Design Guide* distributed on the IXA SDK 3.5 Software Framework CD.

1.1 Getting Started

Detailed information on how to arrange the hardware and set up the operating system can be found in the *Intel® Internet Exchange Architecture Software Development Kit (IXA SDK) 3.5.0 Software Framework Installation Guide*.

2. IP Network Configuration

The IP network configuration of the quad_gbeth_2401 is defined in the following script files:

- `ix_sa_registry_data.xml` – This file contains an XML script. It is located in the `/quad_gbeth_2401_config` subdirectory in the quad_gbeth_2401 root directory. The purpose of this file is to define the application registry. The registry holds information about all ports and their network configuration. A recompilation of the application is required upon any modification of this file.
- `ethernet_rtm_config_linux.sh` – This is a Linux* shell script. It is located in the `./linux_scripts` directory of the quad_gbeth_2401 root directory. The purpose of this file is to set up the Route Table and L2 Table. The script adds routes, next hops and L2 entries for all defined ports. Changes in this file do not require recompilation of the application. The only required action is restarting the application with the modified script.
- `ethernet_rtm_config.scr` – This is a VxWorks* script. It is located in the root directory of the quad_gbeth_2401 application. The purpose of this file is to set up the Route Table and L2 Table. The script adds routes, next hops and L2 entries for all defined ports. Changes in this file do not require recompilation of the application. The only required action is restarting the application with the modified script.

2.1 Default IP Network Configuration

The quad_gbeth_2401 application has a default configuration, which allows it to be run without modifications, provided that the IP environment is properly set up to accommodate the IXP2401 network configuration. Figure 2-1 shows the default network configuration of the quad_gbeth_2401 application. The appropriate routes have been defined in the `rtm_config_linux.sh` file (for Linux) and the `ethernet_rtm_config.scr` file (for VxWorks).

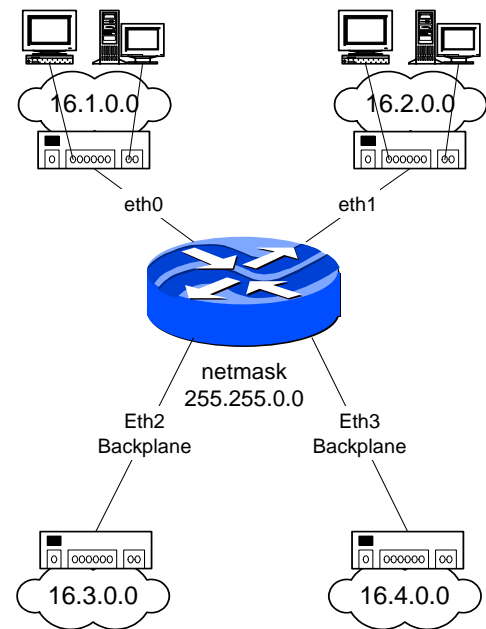


Figure 2-1: Network Configuration

The above default network configuration is sufficient for the supported hardware configurations listed in Table 2-1.

Table 2-1: Hardware Configurations Supported by the Default Network Configuration

Backplane (Interface Supported)	DB1 (Interface Supported)	DB2 (Interface Supported)
2x1GE	MIC 2C 2x1GbE (copper only)	N/A
2x1GE	N/A	MIC 2F 2x1GbE (fiber only)
2x1GE	2x1GbE (fiber and copper)	

Table 2-2 lists all defined ports with corresponding IP and MAC addresses. The definition of the ports can be found in the `ix_sa_registry_data.xml` file.

Table 2-2: Network Addresses Assigned to Interfaces

Interface	IP Address	MAC Address	Next Hop
ETH0	16.1.0.1	02:01:02:03:00:01	16.1.0.10
ETH1	16.2.0.1	02:01:02:03:00:02	16.2.0.10
ETH2 Backplane	16.3.0.1	02:01:02:03:00:03	16.3.0.10
ETH3 Backplane	16.4.0.1	02:01:02:03:00:04	16.4.0.10

When considering a setup with multiple boards, one of the boards may use the default network configuration but the remaining boards must have the network configuration customized. The rest of this chapter briefly describes the configuration scripts.

2.2 Route Table

The Route Table configuration is set by the `rtm_config_linux_sh` Linux shell script. Actually the script contains a series of `rconfig` tool calls. The `rconfig` is a tool distributed with the `quad_gbeth_2401`

application. It adds IP routes, next hops and L2 entries to the Route Table Manager. The rconfig takes the following parameters:

- ```
rconfig < addRoute| addNextHop| addV4EthEntry> <parameter string>
```
- `addRoute` – adds a route to the RTM.
  - `addNextHop` – adds a Next Hop to the RTM.
  - `addV4EthEntry` – adds an L2 entry to the L2 table.
  - `parameter string` – the parameter string contains parameters for the action preceding the string. The parameter string holds a series of parameters divided with spaces. The parameters are dependent on the action executed by the rconfig tool.

In the VxWorks environment, the `ethernet_rtm_config.scr` file holds a series of calls similar to those used in Linux. The calls may be executed in the VxWorks shell accessible from the Tornado 2.2 development platform.

The following sections are valid for both VxWorks and Linux operating systems.

### 2.2.1 addRoute

This action adds an IPv4 route to the RTM. The parameter string takes the following parameters:

- ```
rconfig addRoute "<IP address> <IP mask> <NextHop Index>"
```
- `IP address` – the IP address of the subnet
 - `IP mask` – the mask of the subnet
 - `NextHop Index` – the index of the corresponding next hop

Note: The next hop entry must be added before the corresponding route, otherwise the `addRoute` operation will fail.

2.2.2 addNextHop

This action adds an IPv4 next hop to the RTM. The parameter string takes the following parameters:

- ```
rconfig addRoute "<NextHop Index> <Blade ID> <L2 index> <Port Index>
<mtu> <Flags> <Host IP> <L2 Index type>"
```
- `NextHop Index` – the index of the next hop entry
  - `Blade ID` – the identifier of the board
  - `L2 index` – the index of the corresponding L2 entry
  - `Port Index` – the port index as defined in the `ix_sa_registry_data.xml` file
  - `mtu` – Max Transfer Unit
  - `Flags` – various next hop flags. A detailed description on available flags can be found in the *Intel® Internet Exchange Architecture (IXA) Software Building Blocks Developer's Manual* in the "IPv4 Forwarding Microblock" chapter.
  - `Host IP` – IP address of the host attached to the port
  - `L2 Index type` – indicates the next hop type. For this application the value must be 0 (IPv4).

### 2.2.3 addV4EthEntry

This action adds a complete IPv4/Ethernet address to the L2 Table. The parameter string takes the following parameters:

- ```
rconfig addV4EthEntry "<L2 Index> <IP Address> <Dest MAC> <Source
MAC> [name]"
```
- `L2 Index` – Index into the L2 Table to be added, in Hex
 - `IP Address` – IP address in dotted-decimal form
 - `Dest MAC` – Destination MAC address (hex byte array). The Destination MAC address may be set to all zeros because the application is capable of learning the address from an ARP request.
 - `Source MAC` – Source MAC address (hex byte array)
 - `name` – Optional named table (or "DEFAULT" if left blank)

2.3 XML File Description

The ix_sa_registry_data.xml file defines the registry used by the IXA SDK framework to set up several items, including the local ports. The following snippet shows a sample port section of the XML script.

```
<property name="PORT08" type="uint32" value="8">
  <property name="IP_VER" type="string" value="IPv4">
  <property name="IP_ADDR" type="string" value="16.9.0.1"/>
  <property name="IP_MASK" type="string" value="255.255.0.0"/>
  <property name="IP_BCAST" type="string" value="16.9.255.255"/>
  <property name="IP_GATE" type="string" value="16.9.0.254"/>
  </property>
  <property name="MTU" type="uint32" value="1500"/>
  <property name="LINK_SPEED" type="uint32" value="1000"/>
  <property name="MAC_ADDR" type="string" value="020102030009"/>
  <property name="MEDIA_TYPE" type="string"
value="1GB_ETHERNET"/>
</property>
```

The above section is for port 8, which is an Ethernet port running at 1 Gbps speed. Table 2-3 presents a brief description of the properties in the port section of the XML script.

Table 2-3: XML Script Properties for Local Ports

Property	Value	Description
PORTXX	X	Port index
IP_VER	IPv4	IP version 4
IP_VER/IP_ADDR	XXX.XXX.XXX.XXX	The host IP address of the port
IP_VER/IP_MASK	XXX.XXX.XXX.XXX	The IP mask of the ports subnet
IP_VER/IP_BCAST	XXX.XXX.XXX.XXX	The broadcast address of the port
IP_VER/IP_GATE	XXX.XXX.XXX.XXX	The default gateway in the ports subnet
MTU	X	Max Transfer Unit as available for the given media type
LINK_SPEED	155 or 622	The link speed is read from the baseboard driver automatically. This parameter is ignored.
MAC_ADDR	XXXXXXXXXXXX	The MAC address of the interface if the media type is Ethernet. For all other media types, this property is ignored.
MEDIA_TYPE	1GB_ETHERNET	The media type of the port

3. Compilation

The quad_gbeth_2401 application consists of two components:

- Microblocks
- Core Components which operate under either VxWorks or Linux

Each portion of the application is compiled separately in a different environment.

Note: All applications developed for the IXDP2401 platform must have the IX_PLATFORM_2401 flag defined in the project makefiles for both the Core Components and the Microblocks. An example of required flag definitions may be found in the makefiles of this application.

3.1 Compiling Microblocks

To compile microcode that will run on 2401 hardware for the quad_gbeth_2401 project you must do the following:

1. Open the project file named `quad_gbeth_2401.dwp` using the Workbench application (use File > Open project). The project file is located in this directory: `<IXA_SDK_directory>/src/applications/ipv4_forwarder/quad_gbeth_2401/wbench_project/`
2. Set appropriate preprocessor flags. For microcode that will be used with core components, you must set the flag `USE_IMPORT_VAR` instead of `SIMULATION`. To change flag settings, select Workbench Build > Settings and make changes in Preprocessor definitions.
3. Run the rebuild operation in Workbench by selecting Build > Rebuild

The compiled code will be placed in the same directory as the project file and will have a `uof` extension.

Note: `<IXA_SDK_directory>` indicates the directory in which the IXA SDK software was installed.

3.2 Compiling Core Components

The `quad_gbeth_2401` application can be compiled for both VxWorks and Linux operating systems.

3.2.1 Compiling on Linux

Framework and application compilation is done under Linux on a host machine. You must define the following three variables in the Linux environment:

- `IXA_SDK_DEV`
This variable must point to the `src` directory of IXA SDK, for instance
`IXA_SDK_DEV=/user/atumiali/views/ixa_linux2/vobs/ixa_sdk/ixa_sdk_3.0`
- `IXP2XXX_KERNEL_SOURCE_ROOT`
This variable must point to Linux sources. For example,
`IXP2XXX_KERNEL_SOURCE_ROOT=/user/atumiali/views/ixa_linux2/vobs/components/linux_kernel/ixp2000_kernel/linux`
- `IXA_SDK_DEV_TARGET`
This variable must point to the directory where all executables and loadable modules will be stored after build, for instance
`IXA_SDK_DEV_TARGET=/user/atumiali/ixa_cc_targets`

In addition, the host environment must be configured to have access to the cross-compiler for IXP platform, namely `xscale_be-gcc`.

To compile, perform the following:

1. Change directory to `ixa_sdk/ixa_sdk_3.5/src/applications/ipv4_forwarder/quad_gbeth_2401`
2. Issue this command: `make -f Makefile.linux_kernel`
3. All executables and loadable modules appear in the `IXA_SDK_DEV_TARGET` directory.

3.2.2 Compiling on VxWorks

Framework and application compilation is done under the Windows operating system on a host machine. Before you begin compiling, you must:

- Set the `IXA_SDK_DEV` environment variable to the directory of IXA SDK, for instance
`C:\ixa_sdk_3.5`
- The Monta Vista Tornado 2.2 tools must be installed on the host machine.

To compile the application, perform the following steps:

1. Using the Windows XP Explorer go to the directory
`<IXA_SDK_DEV>/src/applications/ipv4_forwarder/quad_gbeth_2401`
2. Double-click the `quad_gbeth_2401.wpj` file icon. This should start the Tornado 2.2 application with the appropriate workspace opened.
3. From the Tornado menu, choose the Build > Build option. This should start the compilation process in a Tornado workspace window. The resulting `quad_gbeth_2401.out` file should appear in the following directory:

```
<IXA_SDK_DEV>\src\applications\ipv4_forwarder\  
quad_gbeth_2401\XSCALEgnube_Debug
```

4. Running the Application

The quad_gbeth_2401 application can be executed in both VxWorks and Linux environments.

4.1 Running on Linux

This description applies to a configuration where the board boots from TFTP server.

1. Prepare an ixa directory in root directory in TFTP directory tree.
2. Prepare a subdirectory in the ixa directory (for instance quad/).
3. Copy the quad_gbeth_2401.uof file to the quad/ directory.
4. Copy the files listed below to the quad/ directory:
 - a. Copy l2config, rconfig, sa from IXA_SDK_DEV_TARGET directory
 - b. Copy ethernet_media_driver.o from IXA_SDK_DEV_TARGET/linux_kernel/xscale_be/ixp2400
 - c. Copy everything from directory IXA_SDK_DEV_TARGET/linux_kernel/xscale_be/ixp2400/debug
 - d. Copy halMeDrv.o, halMev2_lib.o from IXA_SDK_DEV/me_tools/bin_linux_kernel_be
 - e. Copy make_linux_kernel_devices.sh, quad_gbeth_2401_run.sh, ethernet_rtm_config_linux.sh from directory IXA_SDK_DEV/src/applications/ipv4_forwarder/quad_gbeth_2401/linux_scripts
5. Boot the board. Note you must have the correct Linux kernel image that is appropriate for your version of the IXA SDK.
6. Login as root and change to the /ixa/quad directory.
7. Change mode for all files: `chmod 777 *.sh l2config rconfig sa`
8. Run `make_linux_kernel_devices.sh`
9. Run `quad_gbeth_2401_run.sh`
10. Run `ethernet_rtm_config_linux.sh`

Now your system is prepared to forward traffic between the front and backplane Ethernet ports.

4.2 Running on VxWorks

To run the quad_gbeth_2401 application on VxWorks, you must perform the following:

1. Prepare a /target/config/ixdp2401_be/ directory in the root directory of the TFTP directory tree.
2. Copy the quad_gbeth_2401.uof file to the ixdp2401_be directory.
3. Boot the board using the appropriate VxWorks version.
4. Start Tornado 2.2 on the Windows host machine.
5. From the Tornado menu, select Tools > Target Server > Configure...
 - a. Set "Target Server Name", for example "ixdp2401"
 - b. Set "Target Name/IP Address" to the IP address of the blade as set in VxWorks.
 - c. From Combo Box "Target Server Properties" select "Core File Symbols"
 - d. Choose option "File" and set the full path to the VxWorks binary file.
 - e. Launch the Target Server

6. From the Tornado menu, select Tools > Shell... This will open the "Launch Shell" dialog. Choose the appropriate target server in the combo box "Targets" and press OK. This should start a VxWorks shell.
7. Select the appropriate target server from the list located on the tool bar.
8. From the Tornado menu, choose Project > Download... An Open File dialog box should appear. Locate the quad_gbeth_2401.out file and press OK. The file is downloaded. If a Download Error with the following text is shown, you can ignore this error message and press Close:

Errors while downloading C:/IXA_SDK_3.1/src/applications/ipv4_forwarder/
quad_gbeth_2401/XSCALEgnube_Debug/A_quad_gbeth_2401.out: netPoolShow
9. In the VxWorks shell, type `ix_sa_create(1)`. This will start the application.
10. Open the `ethernet_rtm_config.scr` file in any text editor and copy the contents into the clipboard, then paste it into the VxWorks Console. This will configure the route and L2 tables.

Now your system is prepared to forward traffic between the front and backplane Ethernet ports.

Legal Notices

INFORMATION IN THIS DOCUMENT IS PROVIDED IN CONNECTION WITH INTEL® PRODUCTS. NO LICENSE, EXPRESS OR IMPLIED, BY ESTOPPEL OR OTHERWISE, TO ANY INTELLECTUAL PROPERTY RIGHTS IS GRANTED BY THIS DOCUMENT. EXCEPT AS PROVIDED IN INTEL'S TERMS AND CONDITIONS OF SALE FOR SUCH PRODUCTS, INTEL ASSUMES NO LIABILITY WHATSOEVER, AND INTEL DISCLAIMS ANY EXPRESS OR IMPLIED WARRANTY, RELATING TO SALE AND/OR USE OF INTEL PRODUCTS INCLUDING LIABILITY OR WARRANTIES RELATING TO FITNESS FOR A PARTICULAR PURPOSE, MERCHANTABILITY, OR INFRINGEMENT OF ANY PATENT, COPYRIGHT OR OTHER INTELLECTUAL PROPERTY RIGHT. Intel products are not intended for use in medical, life saving, life sustaining applications.

Intel may make changes to specifications and product descriptions at any time, without notice.

Designers must not rely on the absence or characteristics of any features or instructions marked "reserved" or "undefined." Intel reserves these for future definition and shall have no responsibility whatsoever for conflicts or incompatibilities arising from future changes to them.

The IXA SDK may contain design defects or errors known as errata which may cause the product to deviate from published specifications. Current characterized errata are available on request.

MPEG is an international standard for video compression/decompression promoted by ISO. Implementations of MPEG CODECs, or MPEG enabled platforms may require licenses from various entities, including Intel Corporation.

This Developer's Manual as well as the software described in it is furnished under license and may only be used or copied in accordance with the terms of the license. The information in this manual is furnished for informational use only, is subject to change without notice, and should not be construed as a commitment by Intel Corporation. Intel Corporation assumes no responsibility or liability for any errors or inaccuracies that may appear in this document or any software that may be provided in association with this document.

Except as permitted by such license, no part of this document may be reproduced, stored in a retrieval system, or transmitted in any form or by any means without the express written consent of Intel Corporation.

Contact your local Intel sales office or your distributor to obtain the latest specifications and before placing your product order.

AnyPoint, AppChoice, BoardWatch, BunnyPeople, CablePort, Celeron, Chips, CT Media, Dialogic, DM3, EtherExpress, ETOX, FlashFile, i386, i486, i960, iCOMP, InstantIP, Intel, Intel Centrino, Intel logo, Intel386, Intel486, Intel740, IntelDX2, IntelDX4, IntelSX2, Intel Create & Share, Intel GigaBlade, Intel InBusiness, Intel Inside, Intel Inside logo, Intel NetBurst, Intel NetMerge, Intel NetStructure, Intel Play, Intel Play logo, Intel SingleDriver, Intel SpeedStep, Intel StrataFlash, Intel TeamStation, Intel Xeon, Intel XScale, IPLink, Itanium, MCS, MMX, MMX logo, Optimizer logo, OverDrive, Paragon, PC Dads, PC Parents, PDCharm, Pentium, Pentium II Xeon, Pentium III Xeon, Performance at Your Command, RemoteExpress, SmartDie, Solutions960, Sound Mark, StorageExpress, The Computer Inside., The Journey Inside, TokenExpress, VoiceBrick, VTune, and Xircom are trademarks or registered trademarks of Intel Corporation or its subsidiaries in the United States and other countries.

*Other names and brands may be claimed as the property of others.

Copyright © 2003, Intel Corporation