



The ImageStream WAN Card Driver Suite For Linux

Compatible with all SBS Aries, WANic series cards
PPP, Cisco HDLC, Frame Relay, Raw IP, X.25
Includes SAND-compatible Linux Driver Version 3.00 or later release
Tuesday, March 06, 2001

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General Information

ImageStream Internet Solutions
7900 East 8th Road
Plymouth, IN 46563
(219) 935-8484

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All information in this manual is based on the latest product information available at the time of printing. ImageStream has carefully reviewed the accuracy of this manual, but cannot be held liable for omissions or errors that may appear. ImageStream reserves the right to revise this publication and to make changes in its contents without obligation of notifying any persons of such revision changes.

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ImageStream Internet Solutions, Inc. warrants that at the time of shipment the router product and its installed components shall be free from defect in material and workmanship. ImageStream Internet Solutions, Inc. warrants that the router will meet the product's standard specifications at the time of shipment. This warranty excludes damage resulting from mishandling, tampering, improper installation and misuse by the purchaser.

ImageStream Internet Solutions, Inc. warrants the router for a period of 1 year from the invoice date. For warranty claims, contact your place of purchase, or ImageStream Internet Solutions, Inc. immediately upon the discovery of such defect. If the Router or its installed components are found to be defective, ImageStream Internet Solutions, Inc. will repair or replace the router at ImageStream's option.

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SALES AND TECHNICAL SUPPORT

ImageStream's on-line resources provide the latest information on software driver upgrades, frequently asked questions and other issues. These services are available 24 hours a day, 7 days a week via FTP at <ftp:imagestream-is.com> and on the World Wide Web at <http://www.imagestream-is.com/>

The ImageStream Support Team is available Monday through Friday between the hours of 8:00 a.m. and 5:00 p.m. Eastern Time. For phone support please call 219-935-8484. The ImageStream fax number is 219-935-8488. For email support please send mail to support@imagestream-is.com.

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MS-DOS is a trademark of Microsoft Corporation.

UNIX is a registered trademark of AT&T Bell Labs.

Aries, Maxim, WANic and RISCom are registered trademarks of SBS Technologies, Inc.

FCC CLASS A LIMITS

Warning: Changes or modifications to this unit not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

Note: This equipment has been tested and found to comply with the limits for a Class A digital device pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of the equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

Shielded cables must be used with this unit to ensure compliance with FCC Class A limits.

CANADIAN DEPARTMENT OF COMMUNICATIONS CLASS A LIMITS

This digital apparatus does not exceed the Class A limits for radio noise emissions from digital apparatus set out in the Radio Interference Regulations of the Canadian Department of Communications.

Le present appareil numerique n'emet pas de bruits radioelectriques depassant les limites applicables aux appareils numeriques de la class A prescrites dans le Reglement sur le brouillage radioelectrique edicte par le ministere des Communications du Canada.

DS&G Registration Number - US Safety:

Canadian Use Registration Number:

CSA Registration Number - Canadian Safety:

FCC Registration Number

FCC PART 68 RULE DISCLOSURE

The following information is required by FCC Part 68 Rules which informs the user of his rights and obligations in connecting this equipment to the network and in ordering service.

This equipment complies with Part 68 of FCC Rules. Please note the following:

1. When you order service, the telephone company needs to know:

- a. The Facility Interface Code:
04DU-B (1.544 MB D4 framing format)
04DU9-C (1.544 MB ESF framing format)
- b. The Service Order Code: 6.0F

A signal power affidavit may be required to guarantee encoded analog content and billing protection unless this unit is used in combination with an XD type device or no encoded analog signals and billing information are transmitted.

- c. The USOC Jack Required: RJ48C

In addition, if requested, please inform the telephone company of the make, model and FCC Registration Number, which are on the label.

2. Your telephone company may make changes in its facilities, equipment, operations or procedures that could affect the proper functioning of your equipment. If they do, you will be notified in advance to give you an opportunity to maintain uninterrupted telephone service.

3. If your telephone equipment causes harm to the telephone network, the telephone company may discontinue your service temporarily. If possible, they will notify you in advance, but if advance notice is not practical, you will be notified as soon as possible. You will be informed of your right to file a complaint with the FCC.

4. If you experience trouble with the telephone equipment, please contact us for information on obtaining service or repairs. Only ImageStream or our authorized agents should perform repairs.

5. You are required to notify the telephone company when this unit is disconnected from the network.

I. Introduction And Preparing For Installation

Introduction

This section outlines the procedure for unpacking, configuring, installing and testing the WANic or RISCom/N2x for operation in a PC. It is assumed that the installer is familiar with the basic layout and operation of a PC Compatible computer.

Please read this entire manual before contacting ImageStream for technical assistance. Please report any errata or change recommendations to support@imagestream-is.com.

Unpacking The Card

Though a WAN card is shipped in a sturdy cardboard box with foam padding, it maybe damaged in shipping. We suggest that each box and its contents be examined for visual damage. If your shipment arrives damaged, incomplete, or incorrect, contact ImageStream Internet Solutions immediately.

Care must be taken in handling the card. It contains parts that may be damaged by Electric Static Discharge (ESD). It is suggested that the installer uses proper safety and grounding precautions prior to removing the card from the ESD protective bag.

The following items are typically shipped in a card box. However, the packing list should be reviewed to verify the completeness of the shipment:

Cards without integrated CSU/DSUs

- a. WAN card with RS232, EIA-530 or V.35 interface options
- b. RS232, RS449, EIA530 or V.35 Adapter Cable (if ordered)
- c. 3.5 Inch Diskette Software Drivers and Diagnostics (if ordered)

Cards with integrated CSU/DSUs

- a. WAN card with CSU and RS232, EIA-530 or V.35 interface options (if any)
- b. RS232, RS449, EIA530 or V.35 Adapter Cable (if ordered)
- c. 3.5 Inch Diskette Software Drivers and Diagnostics (if ordered)
- d. RJ48 Loop Back Plug (if ordered)

The Ethernet (100BaseTX/10BaseT), Token Ring, serial and console ports contain safety extra-low voltage (SELV) circuits. T1, 56 Kbps (DDS), BRI and PRI circuits are telephone-network voltage (TNV) circuits. Avoid connecting SELV circuits to TNV circuit equipment, such as the WANic and RISCom series cards with integrated CSU/DSUs, as this can cause damage to the equipment.

II. Hardware Configuration For The RISCom/N2x Series Card

Unlike the WANic series PCI WAN cards, the RISCom/N2x series cards require pre-configuration before installation. The hardware configuration for the RISCom/N2x card involves setting up the I/O Base Address and selecting the PC Interrupt Level.

Factory Default Settings

Each RISCom/N2x is factory configured and tested with the following configuration:

I/O Base Address (S1): 300H

IRQ Jumpers (J1): 5

Ceiling Current (J5): ON (N2CSU, N2DDS ONLY)

IRQ Jumpers

The N2x series of cards uses a hardware interrupt (IRQ). The jumper plug provided should be connected across the appropriate pins. The RISCom/N2x does not support sharing of interrupts, so an IRQ that does not conflict with other hardware in the system is required.

Available PC IRQ Selection: 3,4,5,7,10,11,12,15

I/O Base Address

The N2x card requires an I/O base address that does not conflict with other hardware in the system. The bank of dipswitches located on the edge of the card is labeled "S1". Use the table below to configure your card to use the proper I/O address. Switches 7 and 8 are not used and should be left in their factory default (ON) position.

Table 1-1
Switch S1 -- Base Address Configuration

I/O Address	6	5	4	3	2	1
220	OFF	ON	ON	ON	OFF	ON
240	OFF	ON	ON	OFF	ON	ON
250	OFF	ON	ON	OFF	ON	OFF
260	OFF	ON	ON	OFF	OFF	ON
2A0	OFF	ON	OFF	ON	OFF	ON
2B0	OFF	ON	OFF	ON	OFF	OFF
300	OFF	OFF	ON	ON	ON	ON
320	OFF	OFF	ON	ON	OFF	ON

III. Installing the ImageStream WAN Card Driver Suite For Linux

Pre-Installation Information		
Have the following information ready before you start		
Parameter	Where to find it	Description
I/O Base Address	Card dip switches	Check card jumpers.
IRQ	Card dip switches	Check card jumpers.
Local IP address	Line Provider	The local IP address will be the address for the specific link/port (“numbered link”) or primary Ethernet address (“unnumbered link”) of your router.
Remote IP address	Line Provider	The local IP address will be the address for the specific link/port (“numbered link”) or primary Ethernet address (“unnumbered link”) of the router on the other end of the link.
Clock Source	Line Provider	The clock source will either be internal (provided by the WAN card or integrated CSU) or external (provided by a CSU/DSU or by the line provider).
Line Encoding/Framing	Line Provider	If you have a card with an integrated CSU/DSU, you will need to know these values. The normal encoding values for will be B8ZS or AMI and normal framing values are Extended Super Frame (“ESF”) or Super Frame (“SF” or “D4”).
DLCI Number (Frame Relay Only)	Line Provider	Used to establish virtual circuit across frame relay network to remote router.

Getting Started

Please read this entire manual before contacting ImageStream for technical assistance. Please report any errata or change recommendations to support@imagestream-is.com.

The first step in the installation is to copy the file from your disk or saved download location to a convenient directory (i.e. "/usr/local/").

1. "unzip" and "untar" the driver archive file as follows.
 \$ cd /usr/local; tar xzpf <filename>; cd sand
 Note: if you do not have GNU tar and this command fails, try:
 \$ gunzip <filename>
 \$ tar xvf <filename>
 \$ cd wanic
2. You will notice that this not only "untarred" the file, but it also created a few directories and files. Among the directories and files created are a sample configuration directory, a documents directory containing this document, a source directory containing source code to the included statistics program and the ppp daemon as well as several scripts in the base directory:

CHANGES/README:

Outlines recent changes to the driver set, including bug fixes, new hardware drivers or protocols and other added features and provides a quick-start installation guide to operating the driver set.

LoadModules/UnloadModules:

Scripts used by the driver to load the protocol and WAN card hardware modules.

configmgr:

The controlling program for the WAN card drivers.

debug:

A script that toggles the output of debugging information to the terminal.

display_dlcis/hardware/ports/routes:

Diagnostic programs that display information about your system interfaces.

down:

A script that stops all ports and unloads the WAN card driver completely.

hw_debug/proto_debug:

A program used by the driver to control the output of debugging information.

make_devices:

Deletes old device files and creates new ones. Normally, configmgr will handle the creation of device files. If the "mknod" command is not in your path or if the block major number is being used by another device in your system, edit the script and change the path to "mknod" or the major number to reflect the new number. This script normally does NOT need to be executed manually.

ppp_routes/ppp_template:

Files used by configmgr to operate a port using the PPP protocol. These scripts should not be edited by hand.

pppd:

The ppp daemon, modified for use with synchronous WAN card devices.

reload:

A script that stops all ports, unloads and reloads the driver and restarts all ports.

stats:

The program used by the driver to display configuration and status information about the WAN ports in your system.

up:

The script that loads the driver and starts all ports.

wan.conf.default:

A default configuration file for your reference.

3. The default values in the "up" script should work for most systems. You can edit the "up" script to change the debugging level, the device names and the major number used by the drivers. Aside from changing the debugging level, you will not normally need to change anything in this script.
4. Change directories to the "example_configs" directory.

IV. Configuring the ImageStream WAN Card Driver Suite For Linux

Once you have unpacked and installed your driver suite, you are ready to configure your driver for the specific settings you want to run with your cards. ImageStream has provided pre-configured examples for you in the `example_configs` directory:

wan.conf.600:

A configuration file specifying a common setup for the WANic 600 series cards (WANic 604, 604, 654, or 658). The high-density WANic 600 series cards support additional parameters for automatically setting the type of interface.

wan.conf.crossover:

A configuration file specifying a common setup for a test setup using a crossover cable between two card ports or two routers.

wan.conf.csu:

A configuration file specifying a common setup for WAN cards with integrated CSU/DSUs on-board (RISCom/N2csu, RISCom/N2dds, WANic 550 series, WANic 560 series, WANic 650 series, WANic 850 series or WANic 1000 series).

wan.conf.frame:

A configuration file specifying a common setup for frame relay connections.

wan.conf.hdlc:

A configuration file specifying a common setup for Cisco HDLC connections.

wan.conf.ppp:

A configuration file specifying a common setup for point-to-point connections.

wan.conf.rawip:

A configuration file specifying a common setup for raw IP device connections.

wan.conf.x25:

A configuration file specifying a common setup for X.25 PVC connections.

Below, you will find basic instructions on each configuration file command. You should also refer to the attached "*SAND Driver Command Reference*" for a complete list of supported commands and their descriptions.

Understanding the “wan.conf” configuration file

Regardless of the protocol that you choose to run with your WAN cards, you will need to configure each serial port and (optionally) ethernet port in your system using the wan.conf file. A standard wan.conf file is as follows:

```
version 2.00
!
interface Ethernet0
  description Ethernet 0
  ip address 172.16.0.1 255.255.0.0
  ip address 172.17.0.1 255.255.0.0 secondary
!
interface Serial0
  description Internet Gateway
  encapsulation hdlc
  ip address 192.168.10.1 255.255.255.252
!
interface Serial1
  description Main Street Office
  encapsulation ppp
  ip address 192.168.10.5 255.255.255.252
!
interface Serial2
  shutdown
  description Port2
  encapsulation ppp
!
interface Serial3
  description Sprint frame connection
  encapsulation frame-relay ietf
  frame-relay lmi-type ansi
!
interface Serial3.1
  description 256k to Anytown office
  bandwidth 256000
  encapsulation frame-relay ietf
  frame-relay interface-dlci 16
  ip address 172.16.100.2 255.255.255.252
!
ip route 0.0.0.0 0.0.0.0 Serial0
ip route 205.159.243.0 255.255.255.0 Serial1
ip route 162.142.242.0 255.255.255.0 Serial3.1
!
end
```

version 2.00:

Denotes the version number of the configuration file and driver set. This value is set by ImageStream and should not be changed or modified.

interface Ethernet0:

Denotes the start of the configuration section for the first ethernet device in your system. Inclusion of this section is optional. You may configure your ethernet devices and addresses in your system configuration files.

description Internet Gateway:

Allows you to supply a description for each serial port to assist in identifying each port's function. The description will appear in the statistics output for each port.

ip address 192.168.10.1 255.255.255.252:

Specifies the ip address and netmask for the ethernet or serial port.

!, end:

Signifies the end of a configuration section or the end of the wan.conf file. *You must include a "!" to delimit each section of the configuration file and an "end" statement at the end of the file, or the WAN drivers will exit with errors.*

encapsulation hdlc:

Specifies the protocol to be used for each port. Valid entries consist of:

hdlc (Cisco HDLC supported by Cisco routers)
ppp (Point-to-point protocol supported by most routers)
frame-relay ietf (IETF-standard frame relay)
rawip (raw network device transfers supported by Linux WAN card drivers)
x25 (X.25 protocol with PVC support)
none (raw character device transfers for use with standalone applications)

ip route 0.0.0.0 0.0.0.0 Serial0:

Specifies the default route for the system. "Serial0" can also be replaced with an IP address. In the example above, the address would be 192.168.10.1

shutdown:

Instructs configmgr not to start this port when the WAN card driver is started or reloaded.

Understanding Frame Relay Configurations

- I. ImageStream's frame relay protocol module for SAND allows you to configure not only main frame relay circuits, but individual permanent virtual circuits (PVCs) as well. Each PVC should be configured with its own individual subinterface. Each subinterface can be manipulated like any other interface, including firewalling rules, quality of service routing, and bandwidth management. The frame relay protocol module maintains full statistical and status reports for each subinterface.
- II. In the example in this manual, our frame relay connection will have one PVC: a 256Kbps connection using DLCI 16 and ANSI LMI.

III.

```
!
interface Serial3
description Sprint frame connection
encapsulation frame-relay ietf
frame-relay lmi-type ansi
!
interface Serial3.1
description 256k to Anytown office
bandwidth 256000
encapsulation frame-relay ietf
frame-relay interface-dlci 16
ip address 172.16.100.2 255.255.255.252
```

IV. !

encapsulation frame-relay ietf

- V. ImageStream supports the open IETF standard for frame relay encapsulation. The encapsulation command is required in both the main interface and any subinterfaces (PVCs) that you configure.
- VI.
- VII. Please note that the Cisco IOS used by Cisco routers defaults to a proprietary implementation of frame relay. The Cisco IOS also supports IETF frame relay encapsulation by entering the same "encapsulation frame-relay ietf" command you see above at the Cisco router's interface configuration level.

VIII.

frame-relay lmi-type ansi

The circuit above is configured to use ANSI LMI. ANSI (Annex-D) is an open standard and will be compatible with any standards-based router hardware. Other LMI types are available. See the attached "*SAND Driver Command Reference*" for a complete list of supported LMI types and their descriptions.

interface Serial3.1

This interface command denotes a subinterface. For each PVC, you will configure a subinterface. Although not required, we recommend numbering these interfaces consecutively. In our example, a second PVC would have a section entitled interface Serial3.2. A third PVC would use Serial3.3, etc.

bandwidth 256000

Since our example PVC has a 256Kbps maximum, we have used the “bandwidth” command to scale the output of the stats program. Using this command only affects the output of the stats program and does not limit bandwidth to 256Kbps.

frame-relay interface-dlci 16

This command assigns the DLCI number to your subinterface. Check with your frame relay provider to verify that you have the correct DLCI for your end of the PVC.

ip address 172.16.100.2 255.255.255.252

Specifies the ip address and netmask for the PVC. Typically, your frame relay service provider will assign a specific address and network for use with their network.

Understanding the ImageStream “stats” program

ImageStream’s router distribution includes Linux’s standard “ifconfig” interface program. However, ifconfig was not designed to display status and statistical information for specialized LAN and WAN devices. ImageStream’s SAND distribution includes a program called “stats” that allows you track the status of all of LAN and WAN devices and view specific information on each interface and sub-interface.

To execute the stats program, return to the Main Menu of your router and choose “Show interface status”. This will display a screen with one-line summaries of each interface and sub-interface in your system.

The summary screen

```
6:28:38 AM  ISis-Router      Interface Summary
#  Port      Description              Encaps      BW          HW  Proto  In  Out
0  Ether0    100 Mb Ethernet          none        100.00 Mbps up   up     92% 10%
1  Serial0   WANic 800 Port 0        none        0.00 bps   down down never up
2  Serial1   Sprint Frame Relay T1 Frame Relay 256.00 Kbps up   up     1%  4%
3   Serial1.1 ISis Plymouth 256K      256.00 Kbps up   up     1%  4%
4   Serial1.2 ISis San Pierre 256K    256.00 Kbps up   up     0%  0%
5  Serial2   WANic 555 Port 2        PPP         1.54 Mbps up   down 15:31:52
6  Serial3   WANic 850 Port 0        none        0.00 Mbps down shut
-----
d - Detail  s - Sleep interval  q - Quit
```

#

Indicates the number in the summary listed. When selecting the detail option, you will be prompted for this interface number.

Port

- IX. This column shows the name of the corresponding device configured in the wan.conf file.

Encaps

Displays the configured encapsulation for the device. Ethernet devices will not show a value in this column. Devices that have not been configured or that are administratively shut down will display “none”

BW

Indicates the bandwidth value or channel group configured in wan.conf or learned from the integrated CSU/DSU on the port. Devices that have not been configured or that are administratively shut down will display “0.00 Mbps”

HW

Indicates whether or not the interface hardware connection to the telephone company network or external CSU/DSU is active. If carrier is detected on the line, this column will display “up”. If carrier is not detected on the line, or if the interface has not been configured or administratively shut down, the column will display “down”.

Proto

Indicates whether the software processes that handle the device’s protocol consider the line usable (that is, whether keepalives are successful) or if it has been taken down by an administrator. If a usable connection has been established, this column will display “up”. If a connection has not been established or the device is not configured, the column will display “down”. If the device is administratively shut down, the column will display “shut”.

In/Out

Displays the amount of traffic currently on the interface. The percentage displayed is calculated using the sleep interval and bandwidth value on the interface. If the device is not configured, the columns will display “never up”. If the device is administratively shut down, the columns will not display any values. If the hardware or protocol is down on the device, the length of time since the device’s status changed to down will be displayed in the columns.

The detail screen

Selecting “d” and choosing an interface number on the summary screen will display the detail screen for that particular device.

```
6:06:48 PM                               Interface Serial0 Detail
-----
Serial0 is up, protocol is up
  Description: UUNet Chicago T1

  Encapsulation: Frame Relay
  IP address: 127.0.0.1 255.255.255.255
  Broadcast address: 127.255.255.255

  Line has been up since Mon May 22 21:14:17 2000 ( 3d20h )
  Last input: 00:00:00  Last output: 00:00:00

  Bandwidth: 1.54 Mbps  Load in: 2%  Load out: 29%
  10 second average input rate: 29.94 Kb/s, 38 packets/s
  10 second average output rate: 421.00 Kb/s, 61 packets/s
  Rx Packets: 31,334,319 874,515,604 bytes
  Tx Packets: 43,412,174 1,796,695,211 bytes
  Rx Errors: 0 (0 CRC 0 frame 0 fifo 0 dropped)
  Tx Errors: 0 (0 fifo 0 dropped)
  Carrier transitions: 1
  DCD= up DSR= n/a DTR= n/a RTS= n/a CTS= n/a

-----
y - Summary  s - Sleep interval  p - Previous  n - Next  q - Quit
```

The table below shows the significant fields in the example display above.

Detail Screen Field Descriptions

Field	Description
Serial... ip {up down}	Indicates whether the interface hardware is currently active (whether carrier detect is present).
protocol is {up down administratively down}	Indicates whether the software processes that handle the line protocol consider the line usable (that is, whether keepalives are successful) or if it has been taken down by an administrator.
Description	Indicates the value of the description parameter specified in the wan.conf file
MTU	Maximum transmission unit of the interface
Encapsulation	Encapsulation method assigned to interface
IP address	Specifies the Internet address and subnet mask configured on the interface
Broadcast address	Specifies the broadcast address configured on the interface
Line has been up since...	Number of hours, minutes, and seconds

Last input	since the interface was last reset. When the number of hours in any of the "last" fields exceeds 24 hours, the number of days and hours is printed. Interfaces that have never been up will specify Number of hours, minutes, and seconds since the last packet was successfully received by an interface.
Last output	Number of hours, minutes, and seconds since the last packet was successfully transmitted by an interface.
Bandwidth	Indicates the value of the bandwidth parameter that has been configured for the interface. If the interface is attached to a serial line with a line speed that does not match the default, use the bandwidth command to specify the correct line speed for this serial line.
Load in	Inbound load on the interface as a fraction of the bandwidth, calculated as an average of the specified sleep interval
Load out	Outbound load on the interface as a fraction of the bandwidth, calculated as an average of the specified sleep interval
...second average input rate	Actual inbound data rate load on the interface, calculated as an average of the specified sleep interval
...second average output rate	Actual outbound data rate load on the interface, calculated as an average of the specified sleep interval
Rx/Tx Packets	Total number of error-free packets received/sent by the system and total number of bytes, including data and MAC encapsulation in the error-free packets received/sent by the system
Rx/Tx Errors	Total number of no buffer (fifo), CRCs, frame, overrun, ignored, and abort counts recorded on the interface
CRC	Cyclic redundancy checksum generated by the originating station or far-end device does not match the checksum calculated from the data received. On a serial link, CRCs usually indicate noise, gain hits, or other transmission problems on the data link
frame	Number of packets received incorrectly

	having a CRC error and a noninteger number of octets. On a serial line, this is usually the result of noise or other transmission problems
fifo	Number of received packets discarded because there was no buffer space in the main system
Dropped	Number of received packets ignored by the interface because the interface hardware ran low on internal buffers
Carrier transitions	Number of times the carrier detect signal of a serial interface has changed state. For example, if data carrier detect (DCD) goes down and comes up, the carrier transition counter will increment two times. Indicates line problems if the carrier detect line is changing state often
DCD/DSR/DTR/RTS/CTS	Status of signals tracked by the serial card or integrated CSU/DSU. If a signal is not tracked by the interface, the signal will display "N/A"

Using ImageStream's bonder for link aggregation/load balancing

ImageStream's router distribution includes special link aggregation/load balancing capabilities, allowing you to aggregate traffic on any router interfaces that share endpoints. This link aggregation/load balancing software is compatible with most similar tools on other manufacturer's routers. *To use the bonder, all of the serial devices that you want to aggregate must have the same endpoint.*

Configuration for the bonder is handled through the wan.conf file.

In the first example below, we will bond 2 frame relay PVCs:

```
interface Serial0.14
description T1 to Anytown
encapsulation frame-relay ietf
frame-relay interface-dlci 29
ip address 192.168.10.1 255.255.255.255
!
interface Serial0.15
description Second T1 to Anytown
encapsulation frame-relay ietf
frame-relay interface-dlci 30
ip address 192.168.10.1 255.255.255.255
!
interface Bonder0
description Pair of T1s to Anytown
bond Serial0.14
bond Serial0.15
ip address 192.168.10.1 255.255.255.252
!
```

You can add bonder interface definitions anywhere in the wan.conf file. The router treats the bonder interface as a regular serial interface, meaning you can make modifications to the bonder configuration without taking down other interfaces. You can use firewalling, bandwidth limiting, rule-based routing and other advanced features of the router with any bonder device you create. Like regular serial interfaces, the bonder device is also available via SNMP for monitoring purposes.

The IP addresses on the individual T1s can be set to any valid IP address, and do not necessarily need to be identical. In the example above, both Serial interfaces use the same IP address. If you choose to use the same IP address on all of the bonded interfaces, you must use a host netmask (/32 or 255.255.255.255) on the individual serial devices. On the main Bonder device, as you see above, we have used a /30 (255.255.255.252) netmask so that pinging 192.168.10.2 will send traffic to the bonder device, and not the individual T1 lines.

Below is another example configuration for bonded links:

```
interface Bonder0
  description Chicopee POP
  bond Serial16
  bond Serial17
  ip address 216.20.6.13 255.255.255.252
!
```

In this example, we've chosen to leave the individual serial device configurations with their own netblocks.

```
interface Serial16
  encapsulation hdlc
  description Chicopee CC T1-1
  ip address 216.20.6.6 255.255.255.252
!
interface Serial17
  encapsulation hdlc
  description Chicopee CC T1-2
  ip address 216.20.6.10 255.255.255.252
!
```

Bonder can be used with any type of serial device, regardless of the interface speeds attached to it. The bonder software will automatically balance traffic to favor any higher speed links in the list of bonded devices. Bonder distributes the load evenly based on each interface's bandwidth and the number of packets currently queued to that particular device. For example, a DS-3 link bonded with a T1 line will send more traffic to the DS-3 and will efficiently use the available bandwidth on both interfaces. Bonder automatically calculates bandwidth based on the active (hardware and protocol are both "up") bonded interfaces and will not attempt to use any interface which has hardware or protocol down.

V. Troubleshooting

Here are some of the more commonly encountered problems with ImageStream routers and Linux driver Installation:

Q: I have verified my configurations in wan.conf, but hardware and protocol are still showing “down” in the stats output. How can I find out if the card is sending data, or receiving protocol data from the network?

A: Each serial interface in wan.conf supports “debug” statements with varying levels of verbosity. To receive hardware-related messages, use “debug hardware X” where X is the debug level you choose. To receive protocol-related messages, use “debug software X” where X is the debug level you choose. The messages will appear on the router console, in the router debug log option from the router menu, and in the output of the kernel messaging file (available by typing “dmesg” at the command line).

Valid debug levels:

- 1 Module information only.
- 2 Adds hardware details.
- 3 Adds port state changes.
- 4 Adds port error details.
- 5 Adds advanced hardware details.
- 6 Adds tx & rx packet counts.
- 7 Adds lock debugging.
- 8 Adds function entry/exit debugging.
- 9 Turns on everything possible.

Q: I can see that the module has been inserted into the kernel, but the ifconfig command isn't showing the interface. What did I do wrong?

A: Ensure that the parameters set your wan.conf file are valid. If you have not set an encapsulation in the wan.conf file, the interface may not appear in ifconfig. Ensure that you have removed any “shutdown” statements from serial ports you want to use.

If you are using PPP, make sure that the line that you are connecting to has successfully negotiated a connection. Unlike Cisco HDLC, Raw IP, and Frame Relay, PPP will not show a device in ifconfig until a link has been negotiated. Check the stats program (available by running “stats” from the command line or from the menu system) to ensure that your hardware is connected properly.

Q: I'm using frame relay encapsulation and am connecting to a Cisco router on the other side of the link. My configuration appears to be correct, there are no problems with my telephone company circuit, but stats reports that the protocol down.

A: Cisco routers do not support the open IETF frame relay standard by default. In the Cisco IOS, you must specifically use “encapsulation frame-relay ietf”. Check the configuration on the remote Cisco router. The telephone company will often report that the LMI types appear to be mismatched when the Cisco router is configured for Cisco’s proprietary implementation of frame relay.

Q: When I run “up”, I get an error about a kernel version mismatch.

A: Your Linux kernel is configured to require kernel module versions to match the version of the kernel you are currently running. This option is unnecessary, since very few packages (PCMCIA for example) require kernel module versions. Recompile your kernel and answer no to the question about setting kernel module versions.

Q: I'm trying to make one card talk to another card back-to-back and nothing is happening.

A: When connecting two WAN cards back to back, one card has to be set for internal clocking, and the other has to be set for external clocking.

Q: I have configured PPP correctly, the stats program shows that the hardware is up, but the protocol stays down. I've verified that the line is functioning.

A: Try specifying the destination router's IP address using the *pointopoint* command. If you line passes through a multiplexer or a Cascade switch or is connected to an older router, your router may not receive the destination router's IP address.

Q: I can't get my Linux driver to work and the documentation does not address the problem I'm seeing.

A: Please send email to support@imagestream-is.com. We will investigate your problem as soon as possible.

This driver, release notes and related documentation are constantly evolving, so check the FTP site periodically for the latest revisions. Your input and suggestions to improve this document are appreciated.

Technical Support

Anonymous FTP:

FTP.IMAGESTREAM-IS.COM
login: anonymous
/pub/SDL

World Wide Web:

<http://www.imagestream-is.com/>

Electronic Mail: support@imagestream-is.com
Telephone: (219) 935-8484
Fax: (219) 935-8488

VI. Appendix A – Product Return Procedures

Equipment returns to ImageStream fall under the category of Factory Repair or Service Replacement. These categories and guidelines are explained in the following sections.

Factory Repair

Customers who return equipment to ImageStream for factory repair should contact ImageStream for return authorization and instructions. When you call ImageStream, you will be given a Return Material Authorization (RMA) control number. Mark this number clearly on the shipping container for ease of identification and service. The RMA control number is simply a shipment-control procedure and does not affect the provisions of a sales or lease agreement. ImageStream will also request that you provide the following information for each piece of equipment you wish to return:

- Name of Product and Description
- Serial Number
- Customer Order Number
- Failure Symptoms

You will be provided a shipping address to return any defective equipment or parts.

Re-packing Guidelines for Equipment Return

Equipment or parts that are being returned to ImageStream for any reason must be properly packaged to prevent damage in shipment and handling. If the original packing material and shipping container are available, reuse these items to return equipment. If these items are not available, package the equipment for shipment as follows:

Secure movable and exposed parts before shipping so will not become loose in shipment and cause damage or be damaged. Abrasive or dusty materials should not be used for cushioning. Customers should attempt to ship equipment weighing more than 20 pounds in sturdy or double-wall containers.

When returning more than one item in the same shipping container, wrap each unit individually in air-cell or similar material, prevent possibility of movement of individual units during shipment. Place each printed circuit (PC) card in an individual conductive bag, wrap the card in a double layer air-cell or similar material if possible. Ship in a sturdy container that prevents movement of individually wrapped cards.

Specific Packing Guidelines

In returning equipment to ImageStream, the alternative packaging guidelines are listed with the exception of procedures authorized by ImageStream.

Most Desirable

Return the equipment in its original packing material and shipping container.

Acceptable

Wrap the equipment in sufficient air-cell (bubble pack) or similar material providing cushioning, ship in a double-wall container if possible.

VII. Appendix B – Netmask Conversion Table

Bitmask (Bits)	Dotted Decimal Netmask	Hexadecimal Netmask	Binary Netmask
/0	0.0.0.0	0x00000000	00000000 00000000 00000000 00000000
/1	128.0.0.0	0x80000000	10000000 00000000 00000000 00000000
/2	192.0.0.0	0xc0000000	11000000 00000000 00000000 00000000
/3	224.0.0.0	0xe0000000	11100000 00000000 00000000 00000000
/4	240.0.0.0	0xf0000000	11110000 00000000 00000000 00000000
/5	248.0.0.0	0xf8000000	11111000 00000000 00000000 00000000
/6	252.0.0.0	0xfc000000	11111100 00000000 00000000 00000000
/7	254.0.0.0	0xfe000000	11111110 00000000 00000000 00000000
/8	255.0.0.0	0xff000000	11111111 00000000 00000000 00000000
/9	255.128.0.0	0xff800000	11111111 10000000 00000000 00000000
/10	255.192.0.0	0xffc00000	11111111 11000000 00000000 00000000
/11	255.224.0.0	0xffe00000	11111111 11100000 00000000 00000000
/12	255.240.0.0	0xffff0000	11111111 11110000 00000000 00000000
/13	255.248.0.0	0xffff8000	11111111 11111000 00000000 00000000
/14	255.252.0.0	0xffffc000	11111111 11111100 00000000 00000000
/15	255.254.0.0	0xffffe000	11111111 11111110 00000000 00000000
/16	255.255.0.0	0xfffff000	11111111 11111111 00000000 00000000
/17	255.255.128.0	0xfffff800	11111111 11111111 10000000 00000000
/18	255.255.192.0	0xfffffc00	11111111 11111111 11000000 00000000
/19	255.255.224.0	0xfffffe00	11111111 11111111 11100000 00000000
/20	255.255.240.0	0xfffff000	11111111 11111111 11110000 00000000
/21	255.255.248.0	0xfffff800	11111111 11111111 11111000 00000000
/22	255.255.252.0	0xfffffc00	11111111 11111111 11111100 00000000
/23	255.255.254.0	0xfffffe00	11111111 11111111 11111110 00000000
/24	255.255.255.0	0xfffff000	11111111 11111111 11111111 00000000
/25	255.255.255.128	0xfffff800	11111111 11111111 11111111 10000000
/26	255.255.255.192	0xfffffc00	11111111 11111111 11111111 11000000
/27	255.255.255.224	0xfffffe00	11111111 11111111 11111111 11100000
/28	255.255.255.240	0xfffff000	11111111 11111111 11111111 11110000
/29	255.255.255.248	0xfffff800	11111111 11111111 11111111 11111000
/30	255.255.255.252	0xffffffc0	11111111 11111111 11111111 11111100
/31	255.255.255.254	0xffffffe0	11111111 11111111 11111111 11111110
/32	255.255.255.255	0xfffffff0	11111111 11111111 11111111 11111111

VIII. Appendix C – Cables And Adapters

Several adapter cables currently available for all WAN cards are illustrated in this section. As additional physical interfaces are added, the necessary adapter cables will be added to this section.

RS-232 Adapter Cable

The adapter cable required for output to the standard RS232, DB25 connector standard is illustrated in Figure C-1.

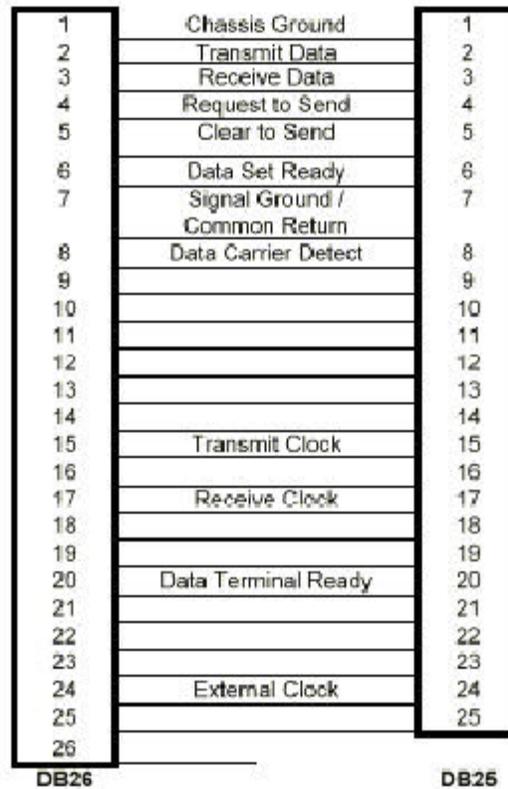


Figure C-1 DB26P To DB25P RS232 Adapter Cable
Part # 400005

V.35 Adapter Cable

The cable required for adapting the WAN/c DB26S connector to a DCE such as a CSU/DSU with a V.35 (Winchester) connector is illustrated in Figure C-2.

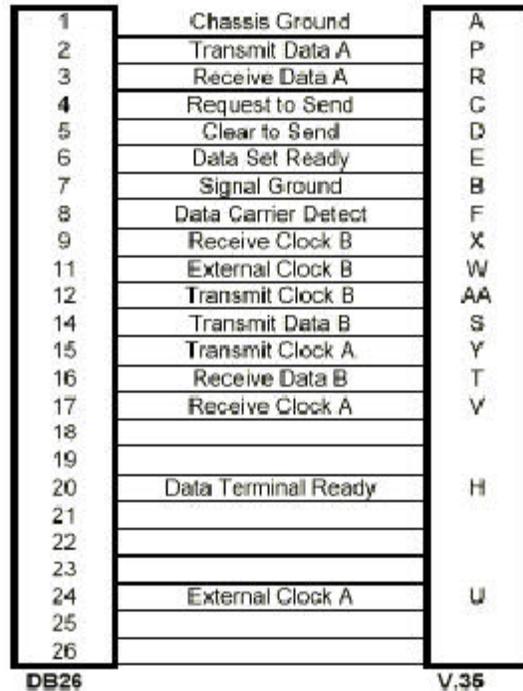


Figure C-2, DB26P to V.35 Adapter Cable
Part # 400006

RS-422 Adapter Cable

This adapter cable is required for output to a standard RS-422. The DB25 connector on the cable is identical to one on the RS-232 described previously. Figure C-3 describes the RS-422 signaling. The cable required for adapting the WANic DB26S connector to the RS422 (DB25 connector) standard is illustrated in Figure C-3.

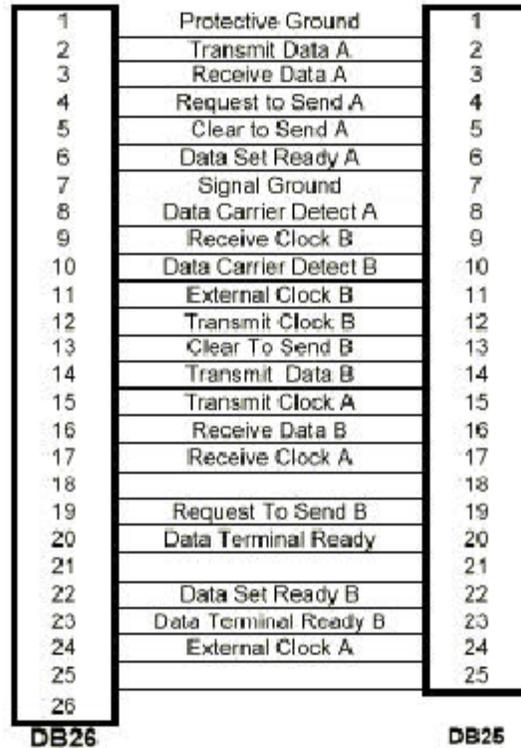


Figure C-3, DB26P to DB25 (RS422) Adapter Cable
Part # 400020

RS-449 Adapter Cable

The cable required for adapting the WAN/c DB26S connector to the RS449 (DB37 connector) standard is illustrated in Figure C-4.

1	Chassis Ground	1
2	Transmit Data A	4
3	Receive Data A	6
4	Request to Send	7
5	Clear to Send A	9
6	Clear to Send B	27
7	Signal Ground	19
8		15
9	Receive Clock B	26
11	External Clock B	35
12	Transmit Clock B	23
14	Transmit Data B	22
15	Transmit Clock A	5
16	Receive Data B	24
17	Receive Clock A	8
19		25
24	External Clock A	17

DB26 DB37

Figure C-4, DB26P to DB37 (RS449) Adapter Cable
Part # 400020

X.21 Adapter Cable

The cable is required for adapting the WAN/c DB26S connector to the X.21 (DB15 connector) standard is illustrated in Figure C-5.

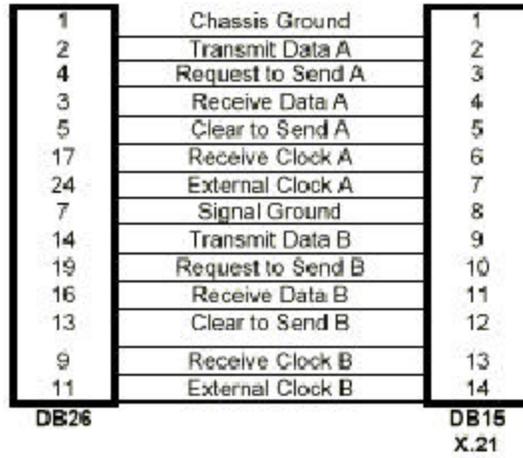
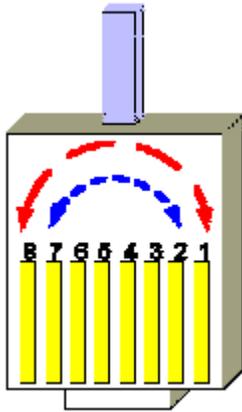


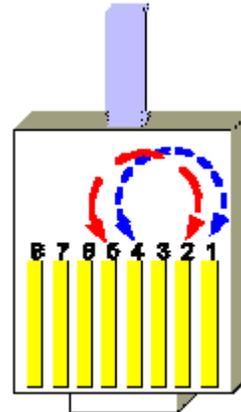
Figure C-5, DB26P to DB15 (X.21) Adapter Cable
Part # 400060

RJ48 Loop Back Plug

The loop back plug is shipped with every card with an integrated CSU/DSU and is used to test the board upon initial installation under DOS.



DDS (56Kbps) Circuits



T1/Fractional T1 Circuits

Figure C-6, RJ48 Loop Back Plugs

RJ48C to RJ48C Crossover (Loopback) Cable

The Crossover (Loopback) Cable is a RJ48C to RJ48C cable, optionally supplied. The crossover cable is used to connect two CSU/DSUs together.

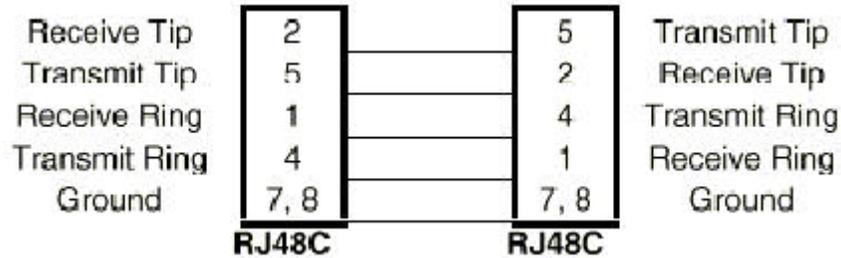


Figure C-8a, RJ48C to RJ48C DDS Crossover (Loopback) Adapter Cable
T1 and Fractional T1 Circuits Only

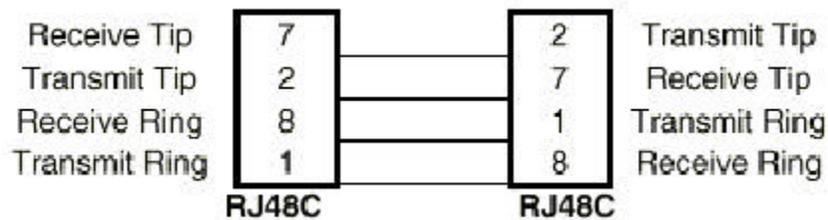


Figure C-8b, RJ48C to RJ48C DDS Crossover (Loopback) Adapter Cable
DDS (56Kbps) Circuits Only

DB26 to DB26 Crossover (Loopback) Cable

The Crossover (Loopback) Cable is a DB26 to DB26 cable, optionally supplied. The crossover cable is used to connect two non-integrated CSU/DSU cards together. Figure C-9 displays the pin connections for the Crossover (Loopback) Cable.

GND	1	1	GND
TDA	2	3	RDA
TDB	14	16	RDB
RDA	3	2	TDA
RDB	16	14	TDB
RTS	4	5	CTS
CTS	5	4	RTS
DSR	6		
DCD	8	20	DTR
DTR	20	8	DCD
		6	DSR
ETB	11	9	RCB
		12	TCB
RCB	9	11	ETB
TCB	12		
		15	TCA
ETA	24	17	RCA
TCA	15	24	ETA
RCA	17		
GND	7	7	GND

Figure C-7, DB26 to DB26 Crossover (Loopback) Cable
Part # 400018

IX. Appendix D – T1 Basics

What Is A T1 Line?

A T1 line is a digital transmission line capable of 1.544 Million bits per second (Mbps). T1 normally carries 24 voice or data channels. Each channel has a sample rate of 8kHz with a resolution of 8 bits of data per sample. Every 192 bits of the transmission a framing bit is added.

24 Voice/Data Channels
8 kHz Sample Rate
8 Bits per Sample
1 Framing Bit per 192 Data bits

24 Channels x 8 Data Bits + 1 Framing Bit = 193 Bits per Frame
193 Bits per Frame x 8,000 Frames per Second = 1,544,000 Total Bits per Second

How Can A T1 Be Used?

T1s can be used to connect two distant PBX's together to form a single functioning PBX's. T1s are also used to form a bridge between two Local Area Networks (LAN's). In this way one single Wide Area Network (WAN) is formed. A single T1 line can be used for both PBX's and digital data at the same time by dedicating channels to each task. Other variations of service include fractional T1. Fractional T1 is a reduced number of channels leased from the service provider. The transmission rates vary from 56Kbps to 1.544Mbps.

What is a CSU/DSU?

A Channel Service Unit (CSU) also called a Data Service Unit (DSU) is a device used to terminate a digital service on the customers end. The CSU/DSU maintains records on different types of line errors and provides functions for line conditioning, line equalization, and loopback modes. These functions can be accessed from the main office of the service provider to maintain line quality.

CSU/DSU Alarms

A CSU/DSU reports different types of alarms to indicate the status of the T1 line. These alarms allow the user to know if line problems are occurring. Some of these alarms are described below:

Loss of Signal – activated when insufficient signal pulses are being received.

Loss of Frame Sync – activated when frame pulses have not been detected for 2 seconds.

Loopback Mode – activated when the CSU has responded to either a network or user loopback request.

Yellow Alarm – received from the remote CSU, when it has lost frame sync.

What needs to be configured for a CSU to Work?

The T1 service provider will inform the customer what settings should be set for their specific service. The service provider will specify the line build out (LBO= 0, -7.5, -15 dB), framing type (D4 or ESF) network line code (B8ZS or AMI), pulse density enforcing (AMI only), and the signaling mode (ATT54016 or ANSI T1.403) that the customer's CSU should be configured for. For a fractional T1, the service provider must also specify the active channels (DS0s).

AMI versus B8ZS Line Coding

When using AMI (alternate mark inversion) mode with non-inverted data, a problem arises when a series of zeros is sent across the transmission line. These zeros prevent the receiver, who relies on clock edges for sync, from establishing a proper sync. There are two ways to correct this problem.

1. AMI Mode with Inverted HDLC Data

If the network (external CSU, carrier, etc.) can AMI mode with inverted HDLC data, the N2csu can be placed in INVERT HDLC DATA mode. With data inversion enabled, proper ones density will be maintained on the line.

2. B8ZS Mode (If Available)

B8ZS (bipolar with 8-zero substitution) mode was designed to correct for AMI's pulse density problem. B8ZS inserts BPVs at specific points in the data to allow the receiver to maintain sync. At the receiving end, any B8ZS BPV patterns are recognized and the correct data patterns are re-constructed.