Odin TeleSystems Inc.

Technical Description for Gimle-16-PCI-Plus and Gimle-16-PCIe

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1. Abstract

This document provides a technical description of Odin TeleSystems' Gimle-16-PCI-Plus and Gimle-16-PCIe adapter cards. This presentation is targeted to systems integrators and application developers who are developing telecommunications systems and/or software applications using the Gimle-16-PCI-Plus and Gimle-16-PCIe platform. The purpose of this document is to provide the needed information about the hardware to allow software developers to efficiently integrate Gimle-16-PCI-Plus and Gimle-16-PCIe into their overall system under design.

For information on how to develop host applications utilizing the OTX Hardware Device Driver Application Programming Interface (API), please refer to the "*Programmer's Guide for OTX Hardware API"* document (Odin TeleSystems Inc. document number 1411-1-SAA-1006-1). For help on how to install the Gimle-16-PCI-Plus and Gimle-16-PCIe cards and the OTX Device Driver Software, please refer to the *"Installation Guide for OTX PCI Adapters"* (Odin document number 1512-1-HCA-1001-1).

2. Table of Content

3. Introduction to Gimle-16-PCI-Plus and Gimle-16-PCIe

Gimle-16-PCI-Plus and Gimle-16-PCIe boards are T1/E1 monitoring adapters/probes. The Gimle-16-PCI-Plus and Gimle-16-PCIe card allows Personal Computers (PCs) and other systems with a PCI bus to monitor multiple T1/E1 links.

Gimle-16-PCI-Plus and Gimle-16-PCIe are members of the Odin Telecom frameworX (OTX) product family. Gimle-16-PCI-Plus and Gimle-16-PCIe are supported by the OTX device driver and by the OTX Hardware Application Programming Interface (API). Equipped with the appropriate OTX software modules, Gimle-16-PCI-Plus and Gimle-16-PCIe can be utilized in a variety of T1/E1, Integrated Services Digital Network (ISDN), Frame Relay, and Signaling System #7 (SS#7) applications.

The Gimle-16-PCI-Plus and Gimle-16-PCIe are equipped with 16 T1 or E1 receive interfaces at the speeds of 1.544 Mbps and 2.048 Mbps, respectively. Throughout the document the T1/E1 interfaces are referred to as Line Interfaces (LIs). The same board supports both T1 and E1 operation modes. The operation mode, as well as the line terminating impedance of 75 ohms or 100 ohms, are software switchable. The card also supports a high-impedance mode with switchable gain for monitoring   To monitor one link in both directions two LIs are used. Consequently, the Gimle-16-PCI-Plus and Gimle-16-PCIe cards can be used to monitor eight (8) bi-directional E1/T1 links.

The Gimle-16-PCI-Plus and Gimle-16-PCIe provide H.100 Computer Telephony Bus. The H.100 bus comprises of thirty-two (32) 2, 4, or 8 Mbit/s Time-Division Multiplexed (TDM) highways for board-to-board communication. H.100 highways are connected to a non-blocking time-space switch populated on the Gimle-16-PCI-Plus and Gimle-16-PCIe boards. The time-space switch allows 512 time-slots to be switched between H.100 highways and the local highways. 1024 time-slots can be switched locally between on-board devices. The H.100 bus is backwards compatible with the MVIP bus and the SCBus.

The Gimle-16-PCI-Plus and Gimle-16-PCIe boards also contains an OTX Application Specific Module (ASM) socket. The ASM interface can be used to add daughter boards providing additional resources. For example, Gimle-16-PCI-Plus and Gimle-16-PCIe can be augmented with Vidar-55x4-ASM providing 4 TI TMS320VC5510 Digital Signal Processors (DSPs). By loading and running different programs in these DSPs, the Gimle-16-PCI-Plus and Gimle-16-PCIe adapter can support a variety of different telecom functions, such as tone detection, HDLC decoding, voice decoding, etc.

4. Specifications

Gimle-16-PCI-Plus is a full-length PCI board Gimle-16-PCIe is a full-length PCIe board. The physical dimensions of Gimle-16-PCI-Plus and Gimle-16-PCIe are shown in Figure 1.

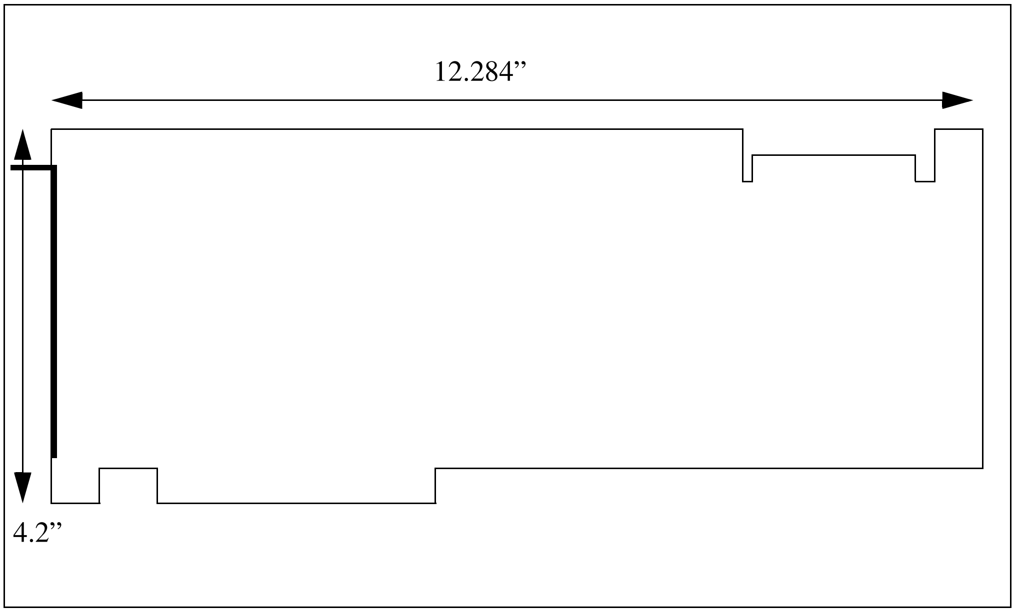

Figure 1. Gimle-16-PCI-Plus and Gimle-16-PCIe Physical Dimensions (inches).

The Gimle-16-PCI-Plus and Gimle-16-PCIe operate with +3.3 and +5.0 V supply voltage. It is universally compatible with 3.3 volt of 5 volt signalling.

5. Supported Driver Devices

5.1 Physical Devices

The Gimle-16-PCI-Plus and Gimle-16-PCIe support the following physical API driver devices:

TABLE 1. OTX Physical Driver Devices supported by Gimle-16-PCI-Plus and Gimle-16-PCIe

Host Device	Device Type	Max #	Description
0	*OTX_DEVICE_GIMLE_16_PCI*	1	Board Device
OTX_DEVICE_GIMLE_16_PCI	*OTX_DEVICE_LI_T1E1*	8	T1/E1 Line Interface Devices
OTX_DEVICE_GIMLE_16_PCI	*OTX_DEVICE_TSS*	1	Time-Space Switch

TABLE 1. OTX Physical Driver Devices supported by Gimle-16-PCI-Plus and Gimle-16-PCIe

Host Device	Device Type	Max #	Description
OTX_DEVICE_GIMLE_16_PCI	*OTX_DEVICE_BURST*	1	32-bit DMA burst device for busting timeslot data to and from the host PC
OTX_DEVICE_GIMLE_16_PCI	*OTX_DEVICE_VIDAR_55x4_ASM*	1	Vidar-55x4-ASM Daughter Board (OPTIONAL)

5.2 Logical Devices

The Gimle-16-PCI-Plus and Gimle-16-PCIe supports the following logical API driver devices:

TABLE 2. OTX Logical Driver Devices supported by Gimle-16-PCI-Plus and Gimle-16-PCIe

Host Device	Device Type	Max #	Description
OTX_DEVICE_LI_T1E1	*OTX_LDEVICE_HDLC_RECEIVER*	1	Logical Device for receiving Hdlc framing. (3 per LI)
OTX_DEVICE_LI_T1E1	*OTX_LDEVICE_T1_ROB_BIT_ACCESS*	1	Logical Device for T1 Bit Rob Signalling for CAS
OTX_DEVICE_LI_T1E1	*OTX_LDEVICE_E1_S_BIT_ACCESS*	1	Logical Device for E1 Sa and Si bits access
OTX_DEVICE_LI_T1E1	*OTX_LDEVICE_E1_ABCD_BIT_ACCESS*	1	Logical Device for E1 ABCD bit access for CAS

In addition, DSPs on an ASM board can be loaded with various program packages to provide support for a variety of Logical Devices types. For example, the Signal Processing Package One (Otx55Spm2) for Vidar-55x4-ASM provides support for the following API logical devices:

- *OTX_LDEVICE_HDLC_RECEIVER*
- *OTX_LDEVICE_HDLC_SENDER*
- *OTX_LDEVICE_HDLC_RECEIVER*
- *OTX_LDEVICE_DATA_RAW_SENDER*
- *OTX_LDEVICE_DATA_RAW_RECEIVER*
- *OTX_LDEVICE_TONE_FSK_DETECTOR*
- *OTX_LDEVICE_TONE_DTMF_DETECTOR*
- *OTX_LDEVICE_TONE_MF_DETECTOR*
- *OTX_LDEVICE_TONE_DUAL_DETECTOR*

- *OTX_LDEVICE_TONE_SINGLE_DETECTOR*
- *OTX_LDEVICE_TONE_DTMF_GENERATOR*
- *OTX_LDEVICE_TONE_DTMF_DIALER*
- *OTX_LDEVICE_TONE_MF_DIALER*
- *OTX_LDEVICE_TONE_EFFECTS_GENERATOR*
- *OTX_LDEVICE_DATA_CONVERTER*
- *OTX_LDEVICE_TONE_CONST_VAL_GENERATOR*
- *OTX_LDEVICE_TONE_VAL_SAMPLER*
- *OTX_LDEVICE_TONE_SINEWAVE_GENERATOR*
- *OTX_LDEVICE_TONE_SILENCE_DETECTOR*

For mode information on the physical and logical driver devices, please refer to *"Programmer's Guide for OTX Hardware API"* (Odin document # 1412-1-SAA-1006-1).

6. System Architecture

The overall system architecture can be best described and understood through different architectural views or aspects. This document explores the systems architecture from the following angles:

1. **External Interface View:** The external interface view describes the external interfaces of the adapter board, and how they are connected to the various internal devices and modules.
2. **Data Architecture View:** The data architecture view illustrates how the Time - Division Multiplexed (TDM) serial data is connected and transferred through the board.
3. **Control Architecture View:** The control architecture view describes how the internal devices and modules can be controlled by the host processor.
4. **Clock Architecture View:** The clock architecture view specifies what clocking and synchronization options are available, how clocking is derived, and how it distributed to the various devices.
5. **Logical Subsystem View:** The logical subsystem view describes the logical design subsystems in the system. Each subsystem can comprise hardware, firmware and driver or on-board processor software.

It is important to note that one device within the board can be involved in several of these views, each view describing how one aspect of the device interfaces with other devices.

6.1 External Interfaces

The Gimle-16-PCI-Plus and Gimle-16-PCIe contain the following external interfaces:

- PCI Host Bus
- H.100 Computer Telephony Bus
- Centronics Network Interface with 16 T1/E1 receive Line Interfaces
- OTX ASM Socket
- JTAG Port for DSP Emulator/Debugging connection

The external interfaces of the Gimle-16-PCI-Plus and Gimle-16-PCIe cards are illustrated in Figure 2.

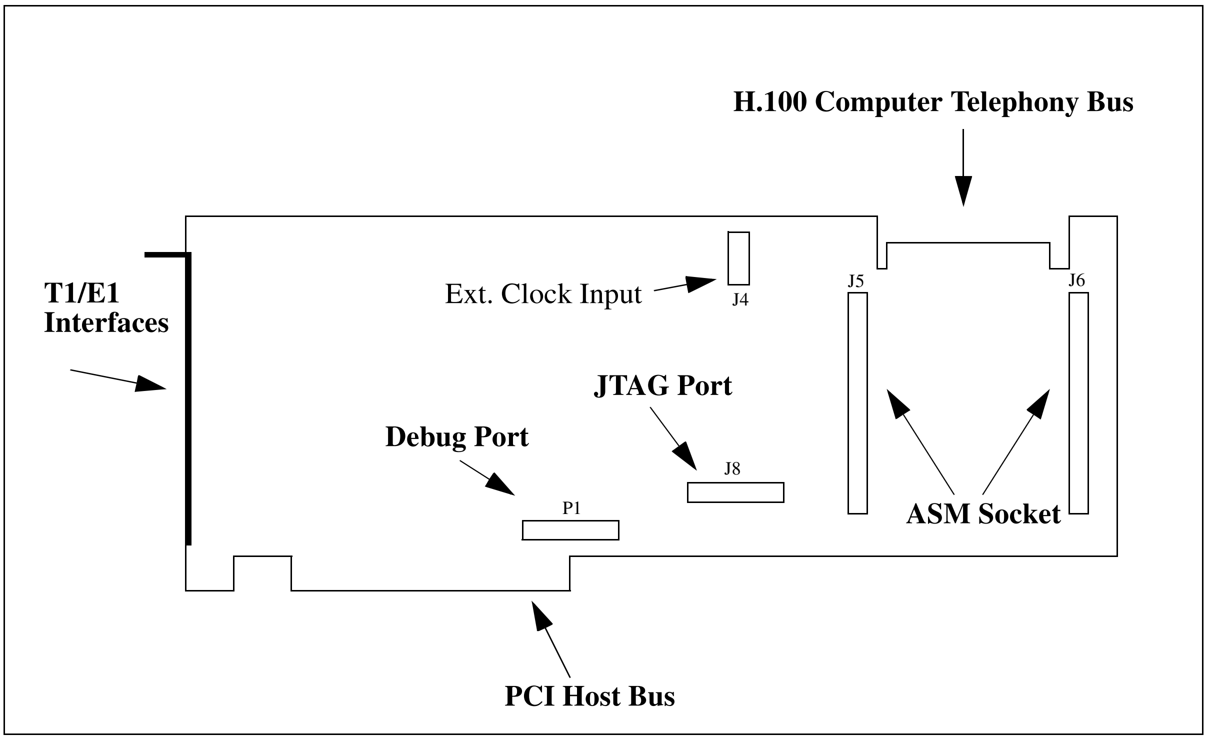

Figure 2. Gimle-16-PCI-Plus and Gimle-16-PCIe External Interfaces.

6.1.1 PCI Host Bus Interface

The interface between the Gimle-16-PCI-Plus and Gimle-16-PCIe boards and the Host Computer is the PCI (Peripheral Connection Interconnect) bus. The electrical characteristics comply to the PCI Standard, Revision 2.1. For more information on the PCI bus, please contact the PCI special interest group, PCI SIG, ***http://www.pcisig.com*** .

6.1.2 H.100 Computer Telephony Bus Interface

Gimle-16-PCI-Plus and Gimle-16-PCIe support the H.100 Computer Telephony Bus standard. The H.100 bus is a collection of time-division multiplexed (TDM) digital telephony highways designed to carry telephony traffic between extensions boards within one PC chassis. The H.100 bus supports 32 TDM highways. The highways can be operated at 2.048, 4.096, or 8.192 MBit/s carrying 32, 64, or 128 64 kbit/s time-slots, respectively. Up to 20 boards can be connected to one H.100 bus. The maximum distance between boards is 7 inches.

Within the PC chassis the data streams are passed from card to card using a 60 pin ribbon cable and AMP 1-557089-2 connectors. The H.100 connector is a 60-finger edge connector on the upper right-hand side (Figure 2) of the board. The pin-out of the H.100 connector is listed in Table 3.

TABLE 3. Gimle-16-PCI-Plus and Gimle-16-PCIe H.100 Pin Assignments

Pin	Signal	Pin	Signal
1	Reserved	2	Power to active devices (CT_+5Vdc)
3	TDM Highway 31 (CT_D31)	4	TDM Highway 30 (CT_D30)
5	TDM Highway 29 (CT_D29)	6	TDM Highway 28 (CT_D28)
7	GND	8	TDM Highway 27 (CT_D27)
9	TDM Highway 26 (CT_D26)	10	TDM Highway 25 (CT_D25)
11	TDM Highway 24 (CT_D24)	12	GND
13	TDM Highway 23 (CT_D23)	14	TDM Highway 22 (CT_D22)
15	TDM Highway 21 (CT_D21)	16	TDM Highway 20 (CT_D20)
17	GND	18	TDM Highway 19 (CT_D19)
19	TDM Highway 18 (CT_D18)	20	TDM Highway 17 (CT_D17)
21	TDM Highway 16 (CT_D16)	22	GND
23	TDM Highway 15 (CT_D15)	24	TDM Highway 14 (CT_D14)
25	TDM Highway 13 (CT_D13)	26	TDM Highway 12 (CT_D12)
27	GND	28	TDM Highway 11 (CT_D11)
29	TDM Highway 10 (CT_D10)	30	TDM Highway 9 (CT_D9)
31	TDM Highway 8 (CT_D8)	32	GND
33	TDM Highway 7 (CT_D7)	34	TDM Highway 6 (CT_D6)
35	TDM Highway 5 (CT_D5)	36	TDM Highway 4 (CT_D4)
37	GND	38	TDM Highway 3 (CT_D3)
39	TDM Highway 2 (CT_D2)	40	TDM Highway 1 (CT_D1)
41	TDM Highway 0 (CT_D0)	42	GND
43	Frame Sync from “A” Clock Master (/CT_FRAME_A)	44	GND

TABLE 3. Gimle-16-PCI-Plus and Gimle-16-PCIe H.100 Pin Assignments

Pin	Signal	Pin	Signal
45	Bit Clock from “A” Clock Master (CT_C8_A)	46	GND
47	Secondary Network Timing Reference (CT_NETREF)	48	GND
49	Redundant Frame Sync from “B” Clock Master (/CT_FRAME_B)	50	GND
51	Redundant Bit Clock from “B” Clock Master (CT_C8_B)	52	GND
53	Message Channel (CT_MC)	54	GND
55	Compatibility Frame Pulse (/FR_COMP)	56	GND
57	SCbus System Clock (SCLK)	58	GND
59	SCbus System Clock time two (SCLKx2)	60	GND
61	MVIP-90 bit clock (C2)	62	GND
63	MVIP-90 bit clock time two (/C4)	64	GND
65	H-MVIP 16 Mhz Clock (/C16+)	66	H-MVIP 16 Mhz Clock /C16-
67	GND	68	RESERVED

For more information on the H.100 bus, please contact the Enterprise Computer Telephony Forum, ECTF, ***http://www.ectf.org*** .

6.1.3 Centronics Network Interfaces

The back panel of Gimle-16-PCI-Plus and Gimle-16-PCIe contains a Centronics connector with 50 contacts. The Centronics connector provides 16 T1/E1 receive Line Interfaces. The pin-out of the Centronics connector is documented in Figure 3 and in Table 4.

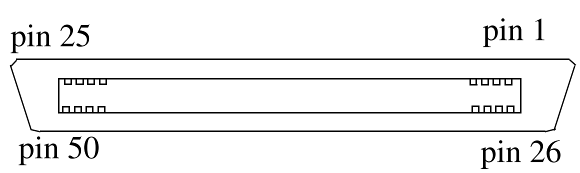

Figure 3. Gimle-16-PCI-Plus and Gimle-16-PCIe Centronics Connector.

TABLE 4. Gimle-16-PCI-Plus and Gimle-16-PCIe Centronics Connector Pin Assignments

Pin	Signal	Pin	Signal
1	Unused	26	Unused
2	Unused	27	Unused
3	Unused	28	Unused
4	Unused	29	Unused
5	Unused	30	Unused
6	Unused	31	Unused
7	Unused	32	Unused
8	Unused	33	Unused
9	Unused	34	Unused
10	Line Interface 0, Receive Line (tip)	35	Line Interface 0, Receive Line (ring)
11	Line Interface 1, Receive Line (tip)	36	Line Interface 1, Receive Line (ring)
12	Line Interface 2, Receive Line (tip)	37	Line Interface 2, Receive Line (ring)
13	Line Interface 3, Receive Line (tip)	38	Line Interface 3, Receive Line (ring)
14	Line Interface 4, Receive Line (tip)	39	Line Interface 4, Receive Line (ring)
15	Line Interface 5, Receive Line (tip)	40	Line Interface 5, Receive Line (ring)
16	Line Interface 6, Receive Line (tip)	41	Line Interface 6, Receive Line (ring)
17	Line Interface 7, Receive Line (tip)	42	Line Interface 7, Receive Line (ring)
18	Line Interface 8, Receive Line (tip)	43	Line Interface 8, Receive Line (ring)
19	Line Interface 9, Receive Line (tip)	44	Line Interface 9, Receive Line (ring)
20	Line Interface 10, Receive Line (tip)	45	Line Interface 10, Receive Line (ring)
21	Line Interface 11, Receive Line (tip)	46	Line Interface 11, Receive Line (ring)
22	Line Interface 12, Receive Line (tip)	47	Line Interface 12, Receive Line (ring)
23	Line Interface 13, Receive Line (tip)	48	Line Interface 13, Receive Line (ring)
24	Line Interface 14, Receive Line (tip)	49	Line Interface 14, Receive Line (ring)
25	Line Interface 15, Receive Line (tip)	50	Line Interface 15, Receive Line (ring)

Gimle-16-PCI-Plus and Gimle-16-PCIe is delivered with a telco-type connector cable (SCSI Cable) and a Harmonica module which converts from Centronics connector to 8 RJ-45 connectors. The Harmonica module allows the connection of T1/E1 lines to Gimle-16-PCI-Plus and Gimle-16-PCIe using RJ-45 connectors (See Figure 4).

Although Gimle-16-PCI-Plus and Gimle-16-PCIe is delivered with the RJ-45 Harmonica module, the modular structure of Gimle-16-PCI-Plus and Gimle-16-PCIe allows it to be adapted for other types of connectors such as 19” rack-mountable connection harnesses. Odin offers two types of optional rack-mountable “harmonicas”; one with BNC connectors (1U height, supports one Gimle-1-6-PCI-Plus board) and one with RJ-45 connectors (1U height, supports two Gimle-16-PCI-Plus and Gimle-16-PCIe boards).

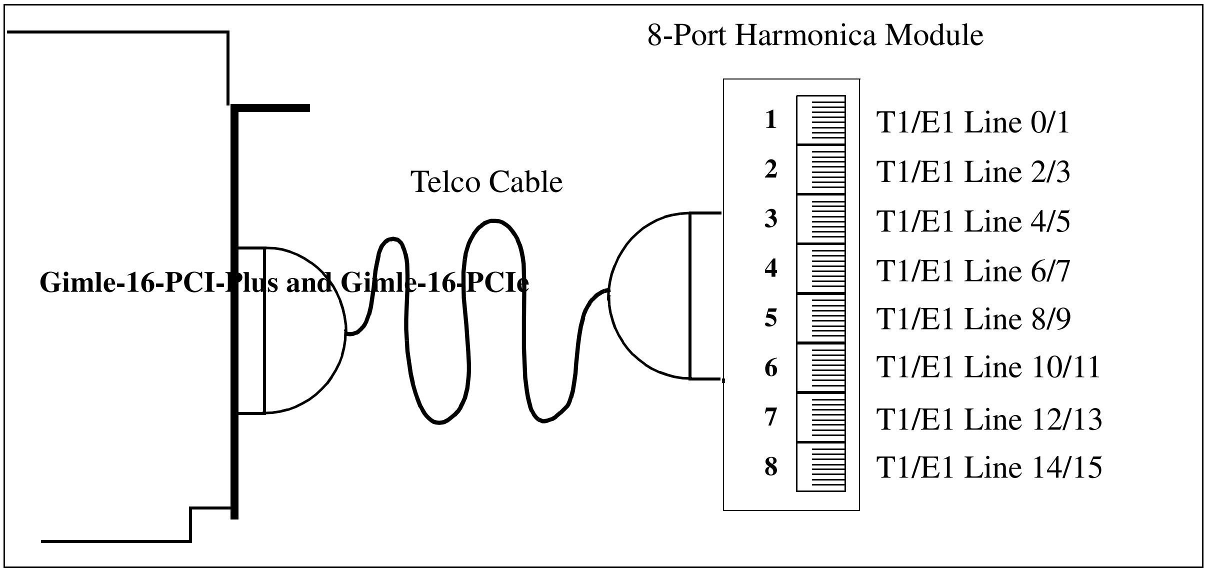

Figure 4. Gimle-16-PCI-Plus and Gimle-16-PCIe Harmonica Module

The RJ-45 pin-outs in the Harmonica module for the 4-wire T1/E1 line interfaces are shown in Figure 5.

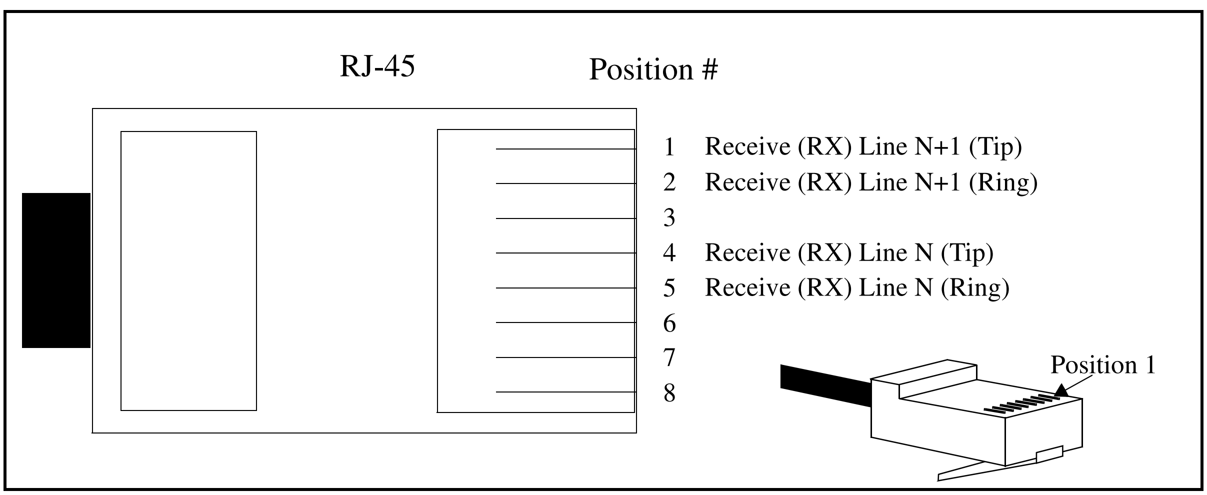

Figure 5. RJ-45 Connector for the T1 or E1 Interface.

TABLE 5. Gimle 8-port Harmonica Module Pin Connections

Line Interface	RJ-45 Port	Pins
Li0	1	4.5
Li1	1	1,2
Li2	2	4.5
Li3	2	1,2
Li4	3	4.5
Li5	3	1,2
Li6	4	4.5
Li7	4	1,2
Li8	5	4.5
Li9	5	1,2
L10	6	4.5
Li11	6	1,2
Li12	7	4.5
Li13	7	1,2
Li14	8	4.5
Li15	8	1,2

Table 5 shows that each port of the Gimle Harmonica Module has connections for two Line Interfaces. Typically, the Gimle-16-PCI-Plus and Gimle-16-PCIe boards are used to monitor both directions of multiple T1/E1 spans. Therefore, by having connectivity to two T1/E1 spans in each RJ45 port of the Harmonica facilitates easy connectivity of up to 8 bidirectional T1/E1 spans to be monitored.

6.1.4 OTX ASM Interface

The Gimle-16-PCI-Plus and Gimle-16-PCIe boards contain an OTX ASM (Application Specific Module) Interface (Reference Designators J5 and J6). The ASM Interface can be used to attach a daughter board modules to the Gimle-16-PCI-Plus and Gimle-16-PCIe boards. The ASM daughter boards can add functionality, such as DSP or HDLC resources.

6.1.5 External Clock Connector

The Gimle-16-PCI-Plus and Gimle-16-PCIe boards can be clocked by supplying a external 8kHz clock signal to the J4 connector. The clock signal can be a 3.3V or 5V signal. The location of the J4 connector is show in Figure 2. The pinout of the J4 connector is shown in Figure 6.

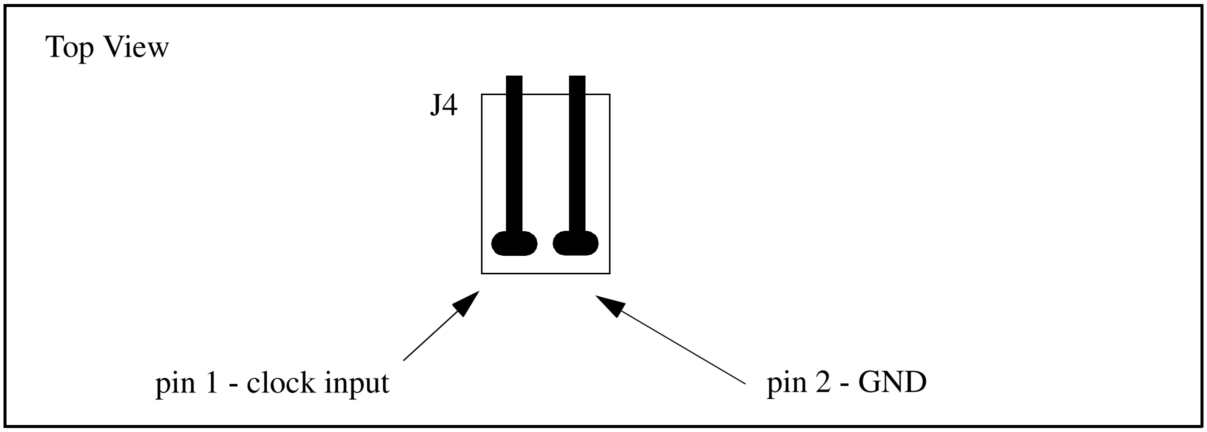

Figure 6. External Clock Connector.

6.1.6 JTAG Interface

The JTAG port (reference designator J8) are used for:

- Board Testing
- Programming of Complex Programmable Logical Devices (CPLDs)
- Connecting the DSP emulator board for DSP Software Development.

For more information on how to use the JTAG port and the DSP emulator, please refer to *"Programmer's Guide for OTX C54x DSP Software Development Kit"* Odin Document # 1412-1-SAA-1007-1, and *"Programmer's Guide for OTX C55x DSP Software Development Kit"* Odin Document # 1412-1-SAA-1012-1.

6.2 Data Architecture

Internally, Gimle-16-PCI-Plus and Gimle-16-PCIe utilize serial TDM (Time-Division Multiplexed) data streams for transfer of data or voice. The internal serial TDM data streams are called "Highways." External interfaces are called spans.

The serial highways provide data paths between physical devices as shown in Figure 7. If the physical device connects to more than one highway, the device specific highway port number is also shown in Figure 7.

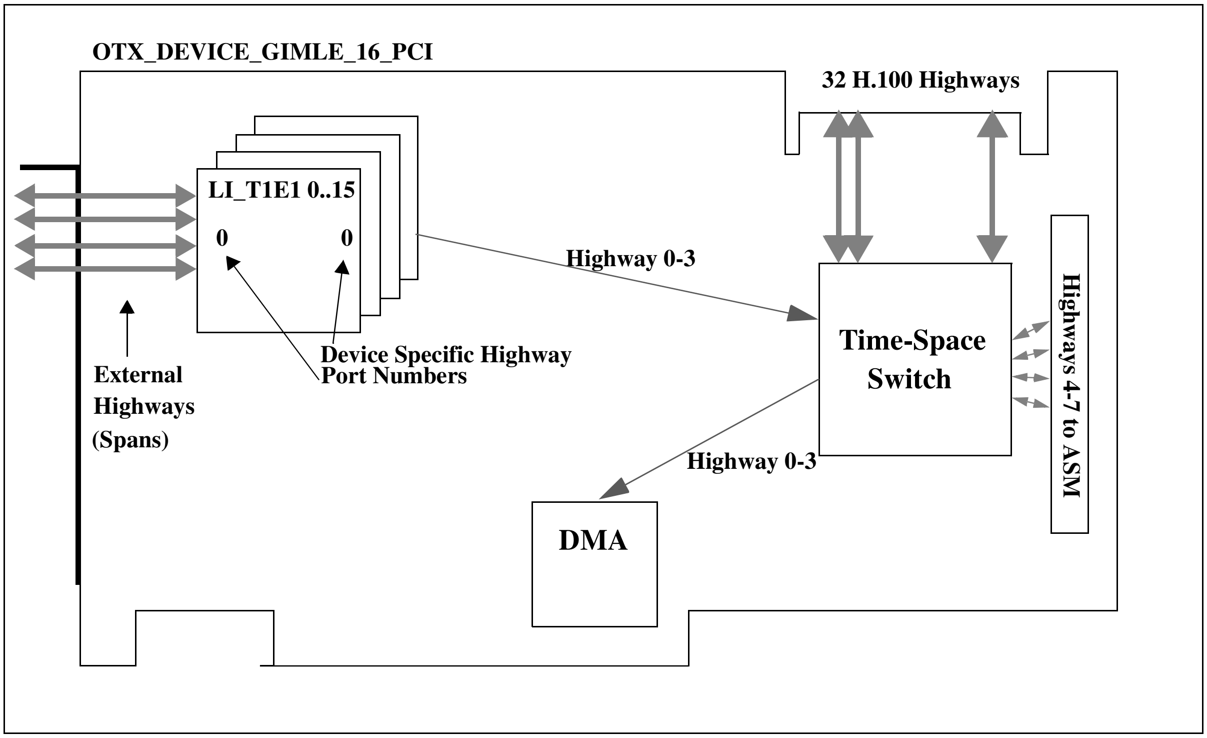

Figure 7. Gimle-16-PCI-Plus and Gimle-16-PCIe Highway Connections.

The Gimle-16-PCI-Plus and Gimle-16-PCIe internal highways are configured to operate at 8.196 Mbit/s, each containing 128 8-bit time-slots, respectively The data rate of one time-slot is 64 kbit/s. Table 6 lists the internal highways used on Gimle-16-PCI-Plus and Gimle-16-PCIe boards.

TABLE 6. Gimle-16-PCI-Plus and Gimle-16-PCIe Highway Connections

Highway #	Connecting Time-Space Switch to
0	8.196 Mbits/s Highway connecting from LI#0, LI#1, LI#2, and LI#3 and to the DMA system.
1	8.196 Mbits/s Highway connecting from LI#4, LI#5, LI#6, and LI#7 and to the DMA system.
2	8.196 Mbits/s Highway connecting from LI#8, LI#9, LI#10, and LI#11 and to the DMA system.
3	8.196 Mbits/s Highway connecting from LI#12, LI#13, LI#14, and LI#15 and to the DMA system.
4-7	8.196 Mbits/s Highway connecting from the ASM Daughter Board

The time-space switch in non-blocking and allows any internal time-slot on any internal highway to be switched to any other highway/time-slot. The cross-connections are software programmable and automatically taken care of by the OTX driver.

In addition, the Gimle-16-PCI-Plus and Gimle-16-PCIe contain 32 H.100 Highways.

The Gimle-16-PCI-Plus and Gimle-16-PCIe time-space-switch also provides support for multicasting and messaging. In multicasting mode any input channel can be cross-connected to multiple output channels. For example, an incoming Li time slot can be both switched to an outgoing H.100 Highway and it can also be switched to the ASM board.

In the messaging mode, the time-space switch can be instructed to send a constant byte on any time slot. Once activated, every byte on the specified time slot will contain the same value. The generation of constant byte does not consume any processing capacity. The constant byte feature is useful in, for example, verification of a through connection .

6.3 Control Architecture

The host PC can control the physical devices on the Gimle-16-PCI-Plus and Gimle-16-PCIe boards through the PCI bus. The Gimle-16-PCI-Plus and Gimle-16-PCIe control architecture is illustrated in Figure 8.

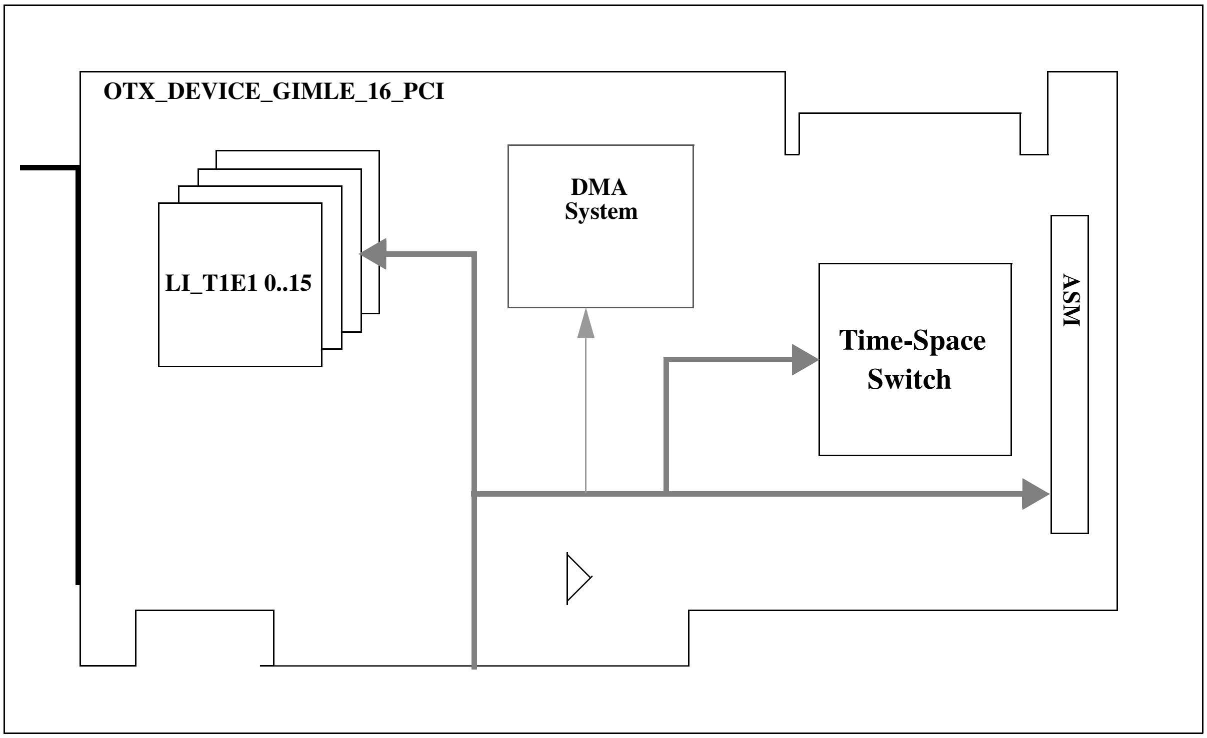

Figure 8. Gimle-16-PCI-Plus and Gimle-16-PCIe Control Architecture.

6.4 Front End Options

Each T1/E1 interface has four line termination impedance options, two external gain settings, and a monitor mode option used for resistively attenuated signals. When not using Monitor Mode, the Threshold for determining a pulse is present is selectable. The four line termination impedance options are made up by enabling two load resistors. The four possible combinations of resistors produce 75 ohms, 110 ohms (used for both 100 and 120 ohm termination), 230 ohms, and high impedance. Monitor mode is used when the Gimle T1/E1 interface is connected to a resistivly attenuated monitoring port. The Front-end Amplifyer may be enabled to help with receiving weak signals. See Figure 9.

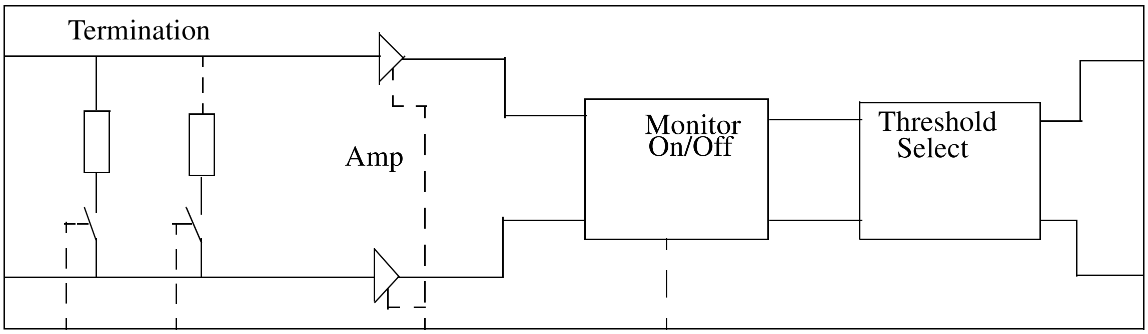

Figure 9. Gimle Front-End Interface Architecture.

6.5 Clock Architecture

On the Gimle-16-PCI-Plus and Gimle-16-PCIe boards all the internal TDM data highways and the all the devices processing TDM data are synchronized to one clock reference. The clock reference can be derived from multiple sources and then switched to all the devices. The clocking sources supported by Gimle-16-PCI-Plus and Gimle-16-PCIe are illustrated in Figure 10 and listed in Table 7.

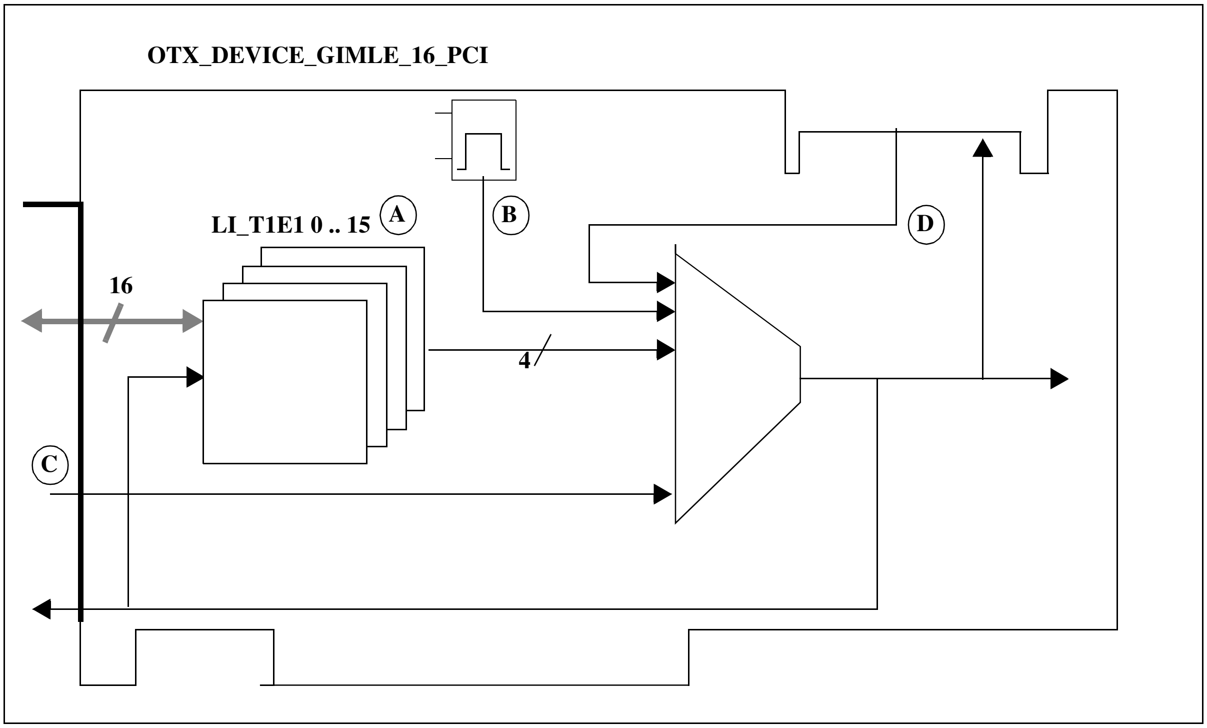

Figure 10. Gimle-16-PCI-Plus and Gimle-16-PCIe Clock Architecture Overview.

TABLE 7. Gimle-16-PCI-Plus and Gimle-16-PCIe Clocking Sources.

Clock Source	Description
A	8 kHz frame clock extracted from one of the incoming T1/E1 spans (0-15). OTX_CLOCK_SOURCE_LOCAL_0 through OTX_CLOCK_SOURCE_LOCAL_15
B	On-board free running oscillator. OTX_CLOCK_SOURCE_INTERNAL
C	External 8 kHz framing clock. OTX_CLOCK_SOURCE_EXTERNAL
D	H.100 Reference Clock. OTX_CLOCK_SOURCE_A_CLOCKS, OTX_CLOCK_SOURCE_A_CLOCKS_ETCF, OTX_CLOCK_SOURCE_B_CLOCKS, or OTX_CLOCK_SOURCE_B_CLOCKS_ETCF

In the event that the clocking source is lost, Gimle-16-PCI-Plus and Gimle-16-PCIe will automatically switch to a backup clocking source. For example, If one span loses signal, then Gimle-16 will switch to free-running mode and the clocking will be derived from the on-board oscillator. If the H.100 clocks or the external clocks are used as the clocking source and the clocking is lost, Gimle-16-PCI-Plus and Gimle-16-PCIe will switch into free-running mode and use the on-board oscillator.

It is important to understand that the difference between the clocks on the external T1/E1 spans and the internal clocks. When the Gimle-16-PCI-Plus and Gimle-16-PCIe clocking is derived from one incoming T1/E1 span, the external T1/E1 span and the internal highways on-board are completely synchronized. In that case, the other T1/E1 span is not necessarily in synchronization with the internal highways. To compensate for that, Gimle-16-PCI-Plus and Gimle-16-PCIe implement an elastic receive buffer with a size of 64x8 bits.The elastic store is used to adapt the clock rates between the T1/E1 clock and the Gimle-16-PCI-Plus and Gimle-16-PCIe system clock, to compensate for input wonder and jitter, and to align the received frame with the internal highway frame. However, the elastic buffer may eventually over- or underflow and a slip condition may occur. When a positive or negative slip occurs, Gimle-16-PCI-Plus and Gimle-16-PCIe will discard one received layer-1 frame to free space in the elastic receive buffer and to continue forwarding the data from incoming T1/E1 span to the internal highway. The slip condition will cause a one 8-bit data sample to be discarded on all of the time-slots.

The occurrence of slips is normal in telephone network. A loss of data sample in a voice data is insignificant cannot be detected by human ear. Loss of one data byte in a data transmission is typically detected with Cyclic Redundancy Checks (CRC). A loss of a data byte due to a slip is typically corrected by the data link protocol requesting a retransmission of the corrupted packet.

6.6 Logical Subsystems

The logical subsystem view describes the logical design subsystems within the Gimle-16-PCI-Plus and Gimle-16-PCIe adapters. Each subsystem can comprise hardware, firmware, and driver or on-board processor software. The Gimle-16-PCI-Plus and Gimle-16-PCIe consist of three subsystems:

1. Line Interface Subsystem
2. Switching Subsystem
3. DMA Subsystem

6.6.1 Line Interface Subsystem

The Line Interface subsystem is responsible for interfacing the Gimle-16-PCI-Plus and Gimle-16-PCIe card with the external T1/E1 links. The subsystem provides the connectors, terminating resistors, transformers, and overvoltage protection.

6.6.1.1 Line Configurations

The Gimle-16-PCI-Plus and Gimle-16-PCIe line interfaces support several different line codes:

- HDB3 - High Density Bipolar 3
- B8ZS - Bipolar 8 Zero Substitution

- AMI - Alternate Mark Inversion
- AMI with NZC

For the T1 operation mode, the following framing formats can be used:

- F4 - 4-frame multiframe
- F12 - 12 frame multiframe
- ESF - Extended Superframe
- F72 - 72 frame multiframe

For the E1 operation mode, Gimle-16-PCI-Plus and Gimle-16-PCIe support the following framing formats:

- Doubleframe
- CRC multiframe

6.6.1.2 Fault Monitoring

The line interface subsystem supports fault and performance monitoring. The transceiver subsystem detects and reports the following alarms in the receive streams:

- Framing errors
- Cyclic Redundancy Check (CRC) errors
- Code violations
- Loss of frame alignment
- Loss of Signal (LOS)
- Alarm Indication Signal (AIS)
- E bit errors (E1 only)
- Slip
- Remote Alarm Indication (RAI, Yellow Alarm)

6.6.2 Switching Subsystem

The switching subsystem provides a time-space switch for the switching of any incoming time/slot to any outgoing time slot. This subsystem is also responsible for delivering and switching of the on-board clock signals. The switching subsystem has already been covered in Chapter 6.2: "Data Architecture" and Chapter 6.5: "Clock Architecture".

6.6.3 DMA Subsystem

The Gimle-16-PCI-Plus and Gimle-16-PCIe board contains a Direct Memory Access (DMA) system allowing the user to send Four 8 MHz highways of data directly into the host PC's memory. This greatly reduces the host CPU time required for data transfer to the host. The time-space switch can be used to cross-connect the DMA system into any incoming time-slot in the Line Interface, ASM, or H.100 Highways.

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