Odin TeleSystems Inc.

Alvis-ASM
Technical Description

Doc. No. 1111-1-HCA-1018-1

Rev. 1.0

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1 Abstract

This document provides a technical description of Odin TeleSystems' Alvis-ASM adapter cards. This presentation is targeted to systems integrators and application developers who are developing telecommunications systems and/or software applications utilizing the Alvis-ASM modules together with Odin Telecom frameworX (OTX) Network Interface Cards (NICs). The purpose of this document is to provide the needed information about the hardware to allow software developers to efficiently integrate Alvis-ASM 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 information on how to develop custom DSP applications, please refer to "Programmer's Guide for OTX C64x+ DSP Software Development Kit" (Odin document number 1412-1-SAA-1014-1). And finally, for help on how to install the Alvis-ASM card and the OTX Device Driver Software, please refer to the Installation Guide for OTX PCI and PCIe Adapters (Odin TeleSystems Inc. document number 1512-1-HCA-1001-1).

2 Alvis-ASM Overview

The Alvis-ASM is a member of the Odin Telecom frameworX (OTX) product family. It is supported by the OTX device driver (Window and Linux) and accessed through the OTX Hardware Application Programming Interface (API).

Alvis-ASM is an Application Specific Module (ASM) which is designed to be attached to an OTX Network Interface Card (such as Thor-2-PCI-Plus Rev 2.0, Thor-8-PCI-Plus Rev 2.0). Alvis-ASM provides Digital Media Processing resources for the Network Interface Card.

Alvis-ASM is available in 3 different options:

- Alvis-1-ASM: 1 TMS320DM6443 System On Chip (SOC) processor
- Alvis-2-ASM: 2 TMS320DM6443 System On Chip (SOC) processors
- Alvis-4-ASM: 4 TMS320DM6443 System On Chip (SOC) processors

Each DM6443 device contains two cores. One core is a C64x+ DSP code rated at 4752 MIPS. The other core is an ARM9 core clocked at 297 MHz. Both cores share the same memory map and can very efficiently process Digital Media, such as voice and video encoding and decoding.

TDM data can be routed to and from the processors on the Alvis-ASM board via the time-space switch (TSS) device on the OTX NIC board. After the data has been encoded or decoded by the DSP core of an Alvis processor it can easily be packaged by the ARM9 core (running MontaVista Linux or Windows CE) and transferred to and from the

Ethernet port. Ethernet packages are switched locally on the Alvis board and can leave the Alvis board via a 10/100/1000 Ethernet port provided by the OTX NIC board.

The DSP core on the Alvis daughter board can also be used to run Odin provided standard DSP applications or they can be used to run customized user applications. Alvis-ASM is delivered with a number of Odin's Standard Program Modules (SPM) that provide supports for many common telecom applications; such as audio and video encoding and decoding, tone detection and generation, and HDLC sending and receiving.

For custom DSP application development, Alvis-ASM supports the Texas Instruments development tools, such as Code Composer Studio. These tools can be purchased directly from Texas Instruments or from any of their distributors.

For more information on custom DSP application development, please refer to the "Programmer's Guide for OTX C64x+ DSP Software Development Kit" (Odin document number 1412-1-SAA-1014-1).

Equipped with the appropriate OTX software modules, Alvis-ASM can be utilized in a variety of Voice over IP (VoIP), TVoIP, Soft-switch, Trans-coding and Signaling System #7 (SS#7) applications.

3 Installation

The Alvis-ASM board has been packaged in a sealed anti-static bag for protection during shipping and handling. Follow precautions regarding handling of electrical equipment while attaching Alvis-ASM into an OTX Network Interface Card (NIC). Be aware of the possibility of damage to the sensitive electrical devices on the Alvis-ASM board from static electricity discharge. Please wear anti-static protection devices such as a ground strap connected to a grounded equipment frame while handling the board.

To attach the Alvis-ASM board to an OTX NIC board, remove it from the anti-static bag and place it together with the NIC board on a flat and properly grounded anti-static mat. Place the Alvis-ASM board on top of the NIC card and align the ASM connectors on the Alvis-ASM with connectors on the NIC card (See Figure 1). Make sure that the Alvis-ASM board is oriented the correct way. The tip of the Odin Logo needs to be point towards the H.100 connector of the NIC board. Gently push the ASM board into the connector until you feel that the connectors are fully inserted into the ASM sockets.

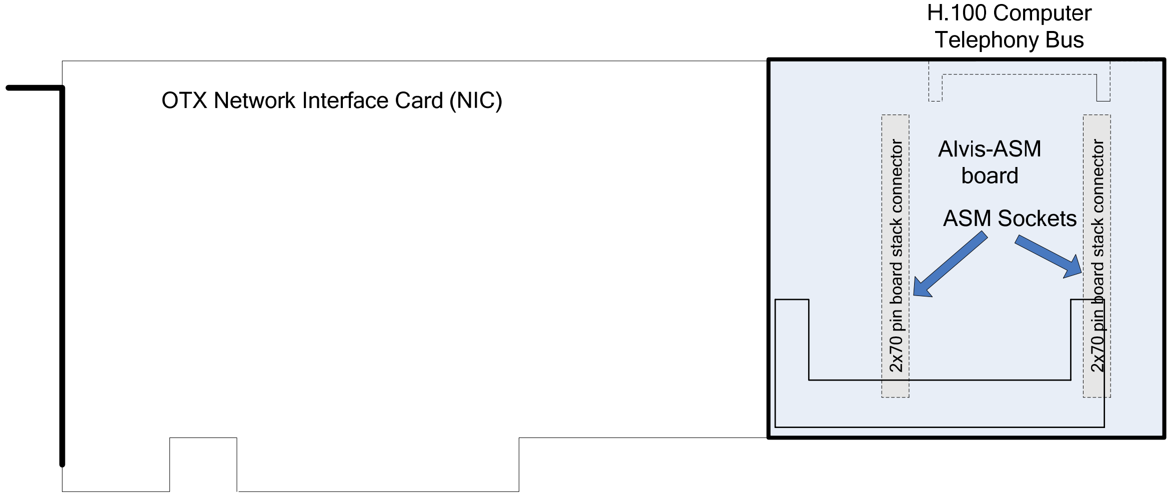

Figure 1

4 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. Physical Specifications View. Provides the dimensions of the board.
2. 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.
3. Data Architecture View: The data architecture view illustrates how the Time - Division Multiplexed (TDM) serial data is connected and transferred through the board.
4. Control Architecture View: The control architecture view describes how the internal devices and modules can be controlled by the host processor.
5. 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.
6. 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.

4.1 Physical Specifications

Alvis-ASM is a daughter card that is designed to be seated in the ASM (Application Specific Module) slot of an OTX PCI card. The physical dimensions of Alvis-ASM are shown in Figure 2:

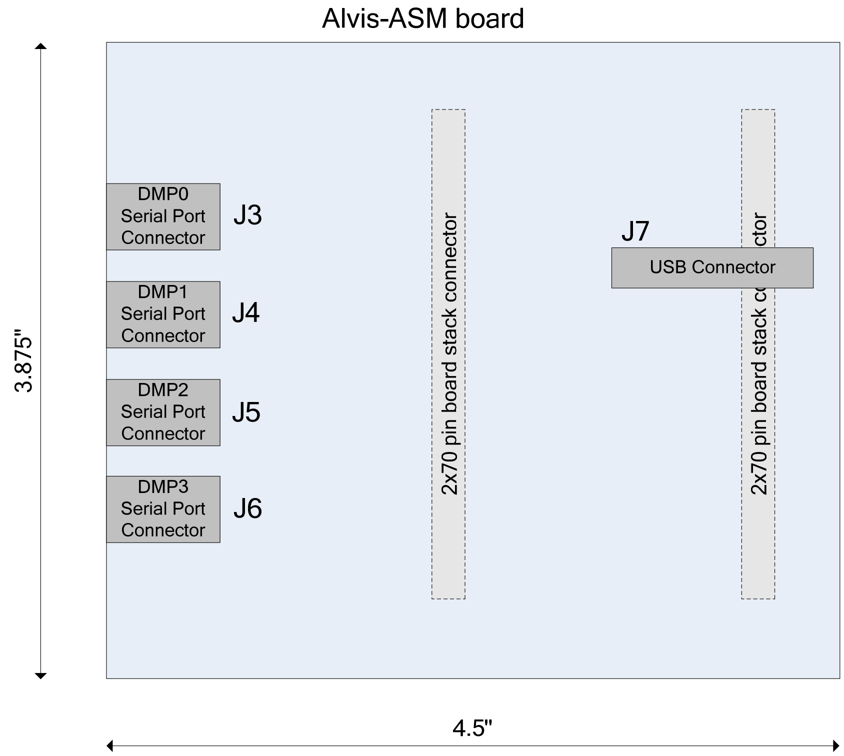

Figure 2

4.2 External Interfaces

4.2.1 ASM Interface

The Alvis-ASM contains the OTX ASM socket connectors, which are illustrated in Figure 2 (and Figure 1 shows the mating connector on the NIC board). The ASM connector contains the serial TDM highways, control signal, and data signals. It also carries the Ethernet signals to the Ethernet RJ-45 connector that is accessible from the harmonica that connects to the external board connector of the NIC board.

4.2.2 Serial Port Connector

The Alvis-ASM board has a connector which mates to another daughter card which in turn provides standard DB-9 serial port connectors (one for each processor on the Alvis board). The mating daughter board is ordered separately from Odin TeleSystems (part number HMA-1147-1).

The serial port can be used to debug and control both cores of the Digital Media processor.

- J3 – Serial port connector for DMP0
- J4 – Serial port connector for DMP1
- J5 – Serial port connector for DMP2
- J6 – Serial port connector for DMP3

The serial port cable can be ordered as an accessory to the Alvis-ASM board.

4.2.3 GB Ethernet connector (via OTX NIC board)

The Gigabit Ethernet (1000BaseT) connector is accessible via the OTX NIC board. The OTX NIC board has a 50-pin Centronix connector which externally connects to an OTX Harmonica (containing multiple RJ-45 connectors). One of these connectors is the GB Ethernet connector from the Alvis-ASM board. For a specification of the harmonica for a specific type of OTX NIC board, please see the Technical Description for that OTX NIC board.

The pinout for the GB Ethernet connector is shown in Figure 3 and Table 1.

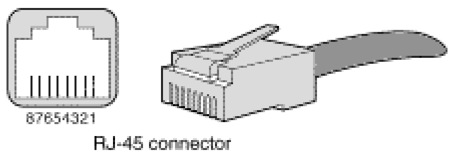

Figure 3

Pin #	Signal Name	Function
1	BI_DA+	Bi-directional pair +A
2	BI_DA-	Bi-directional pair -A
3	BI_DB+	Bi-directional pair +B
4	BI_DC+	Bi-directional pair +C
5	BI_DC-	Bi-directional pair -C
6	BI_DB-	Bi-directional pair -B
7	BI_DD+	Bi-directional pair +D
8	BI_DD-	Bi-directional pair –D

Table 1

Note that the GB Ethernet connector be connect to slower Ethernet speeds (100 Mbit/s and 10 Mbit/s) as well as 1000 Mbit/s.

4.2.4 JTAG Connector (via OTX NIC board)

The Alvis-ASM contains several JTAG chains which are used for board testing and board configuration during the manufacturing process. The JTAG chains are accessed from the JTAG connector of the OTX NIC card.

TMS#	Devices
TMS2	DMP devices
TMS3	Other Alvis devices

Table 2

Figure 2 shows the JTAG chains that cover the Alvis-ASM board. The TMS2 chain covers the DMP devices exclusively. A DSP software DSP emulator can connect to chain to facilitate development and debugging of customized DSP applications. To connect to the standard 13-pin JTAG connector from the DSP emulator to the OTX NIC board, the Hermod-JTAG adapter board (HMA-1057-1) is needed. The Hermod-JTAG board plugs onto the JTAG connector of the OTX NIC card, and the DSP Emulator connects to the Hermod-JTAG board.

4.2.5 Indicators

The Alvis-ASM board contains several LEDs for status and debugging purposes. The locations of the LEDs are shown in Figure 4.

Figure 4

The functions of the various LEDs are listed below:

- D2 – “FPGA Loaded”. Green LED. It is lit when the FPGA on the Alvis-ASM board is loaded and running.
- D3 – “General Purpose”. The purpose of this LED is TBD.
- D4 – “Power-Good”. This LED indicates whether the Alvis-ASM is powered properly.

4.3 Data Architecture

Vidar-ASM transfers data via Ethernet packets and via serial TDM (Time-Division Multiplexed) data streams. The serial TDM data streams are referred to as “Highways.” The ASM interface includes 4 Highways transmitting data between an OTX NIC board and the Alvis-ASM Daughter board. The serial highways provide data paths between physical devices as shown in Figure 5.

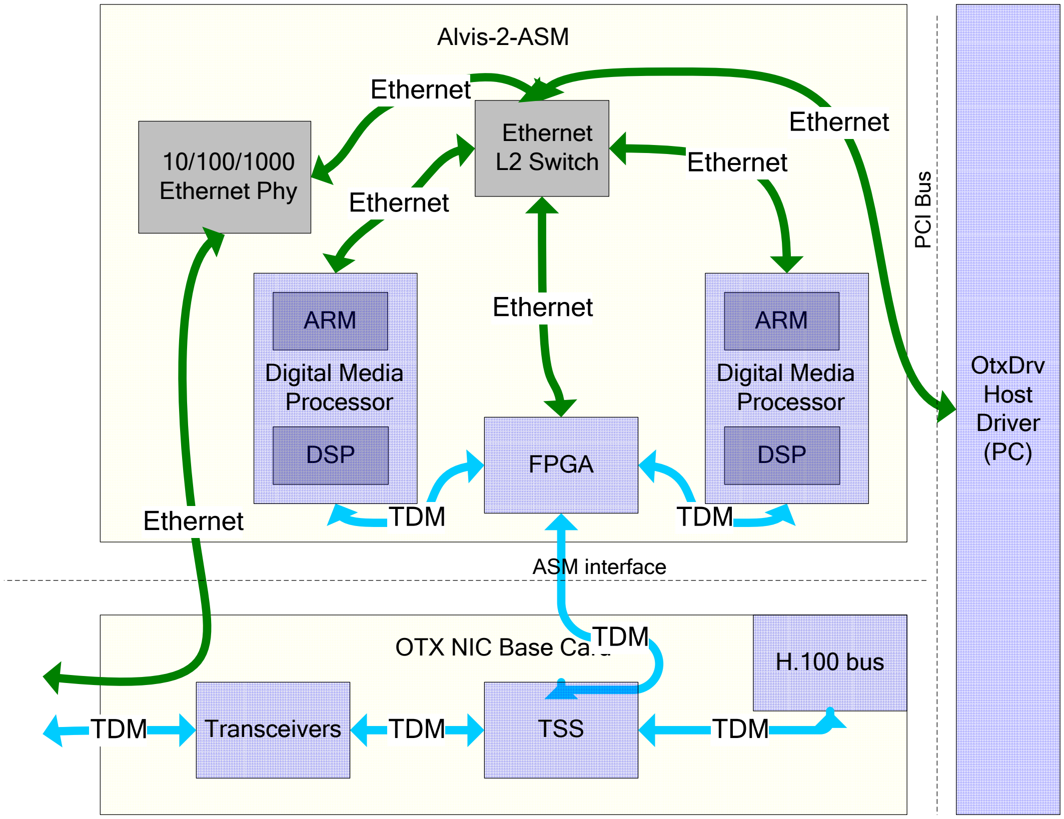

Figure 5

4.3.1 TDM Data Path

The OTX TDM highways run at 3 different speeds (2.048 Mbps, 4.096 Mbps, or 8.192 Mbps) depending on the architecture of the OTX NIC Base card. In the case of a Thor-8-PCI-Plus the ASM highways run at 4.096 Mbps. To fully utilize all four highways of the ASM interface, the four ASM highways are combined into one or two highways of a higher speed (8.192 Mbps) on Alvis-1-ASM and Alvis-2-ASM variants before it connects to the (single) TDM port of the Digital Media Processors (DMP).

TDM connections (pipes) are made using the standard OtxDrvConnectPipe() OTX API function.

Figure 6 shows the physical TDM highways and their TSS highway numbers for an Alvis-2-ASM populated on a Thor-8-PCI-Plus. The TSS highway numbers are used when the TSS pipe connection method is used (see the OTX Programmers Guide).

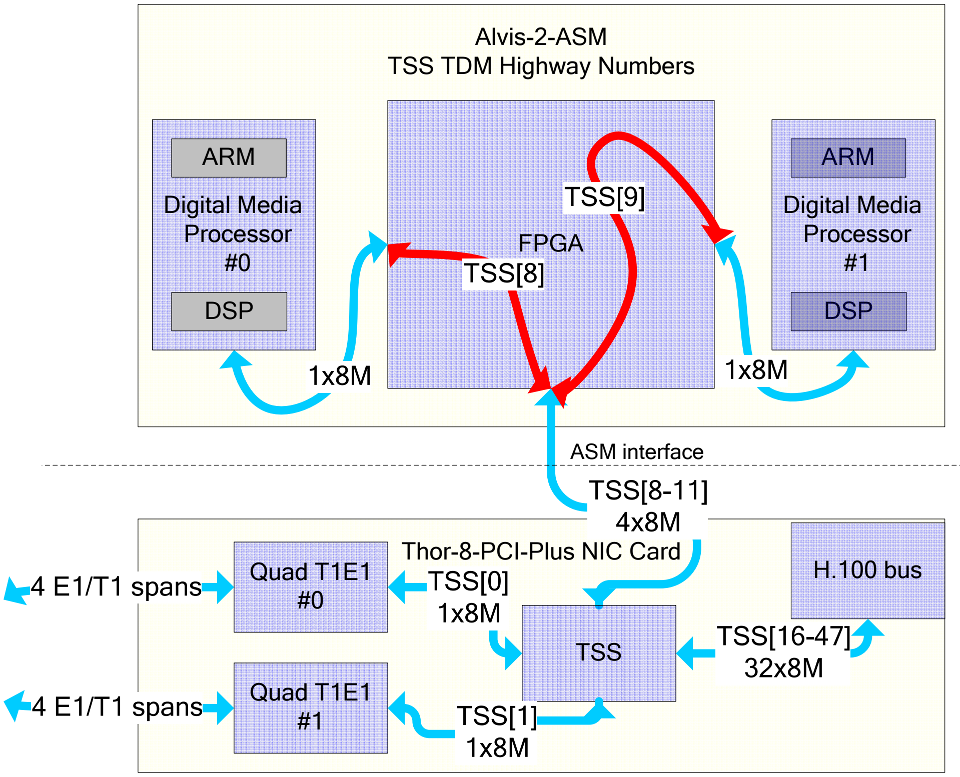

Figure 6

The highway number for the TSS device is denoted within '[]'. E.g. the highway that connects to Quad T1E1 device number 0 (Li0 – Li3) is TSS highway number 0 (TSS[0]).

It is also important to note that FPGA combines the two 4M highways into an 8M highway in an interleaved fashion. E.g. TS0 of TSS[8] becomes TS0 of the DMP#0 highway. TS0 of TS9 becomes TS1 of the DMP#0 highway. TS1 of TSS[8] becomes TS2 of the DMP#0 highway. TS1 of TS9 becomes TS3 of the DMP#0 highway, and so on.

Figure 7 shows the TDM highways and their device highways for an Alvis-2-ASM populated on a Thor-8-PCI-Plus. Device highway numbers are used when a Device-Device pipe connection method is used (see the OTX Programmers Guide).

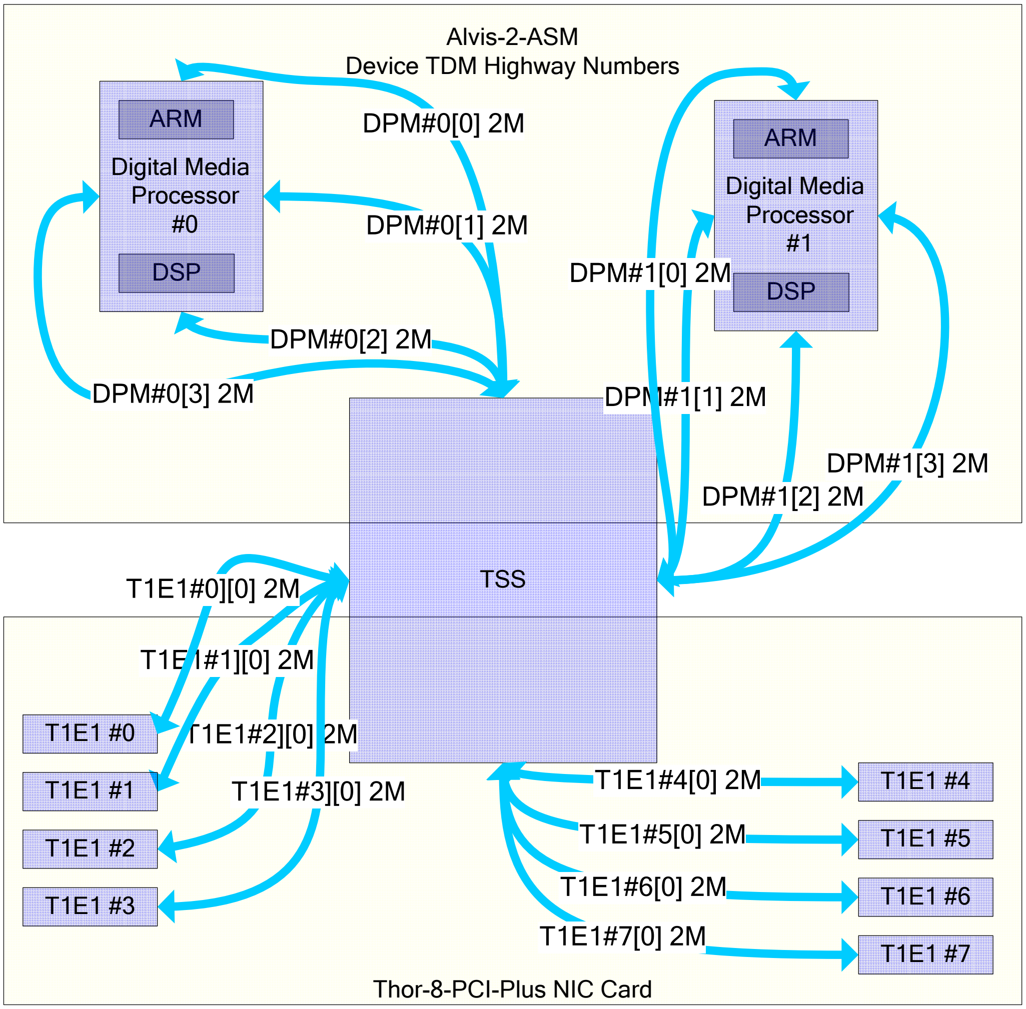

Figure 7

Note that when Device-Device connections are used then the OTX Driver will automatically connect (and pick the correct time-space path) between two devices on the board (in this case a DMP device and a T1E1 device). Please note that the devices can even be located on different OTX boards in the host system. In that case the OTX driver will choose a timeslot over the H.100 bus and make the proper connections in both TSS devices (of each of the OTX boards).

4.3.2 Packet Data Path

The data packets travel via an internal Ethernet network on the Alvis-ASM card. The packets are switched by an on-board L2 Ethernet switch device (OTX_DEVICE_ETHERNET_SWITCH) that offers the following support:

- L2 switching with self learning (up to 4k MAC addresses). The switch also supports IP multicast address learning, and IP Multicast with IGMP snooping (up to 4k IP Multicast groups).
- Supports jumbo frames of up to 4k in size.
- Provides the ability to monitor a link, detect a simple link failure, and provide notification of the failure to the Host PC. The application on the Host PC can

then failover that link to an alternate link.

- Supports the following spanning standards: IEEE 802.1D spanning tree and IEEE 802.1w rapid spanning tree.
- Ethernet multicasting and broadcasting and flooding control
- Provides powerful QoS functions for various multimedia and mission-critical applications using strict priority and/or WFQ transmission scheduling and WRED dropping schemes. The device provides 2 transmission priorities (4 priorities for uplink port) and 2 levels of dropping precedence. Each packet is assigned a transmission priority and dropping precedence based on the VLAN priority field in a VLAN tagged frame, or the DS/TOS field, or the UDP/TCP logical port fields in IP packets.

Data packets that have a non-Alvis destination are routed to the 10/100/1000 Ethernet PHY on Alvis-ASM card. It is connected via the OTX NIC card to a standard RJ-45 connector in the harmonica of OTX NIC card (see Figure 3 and Table 1).

4.4 Control Architecture

The OTX ASM Interface includes a 16-bit processor bus, which is used by the host PC to control the physical and logical devices on the Alvis-ASM daughter board. This interface offer functions to load programs into the DSP core, ARM core and to the persistent NAND flash memory.

A subset of the control functions are listed below:

- OtxDmpRunCodecEngineServer() - Load and Run a Codec Engine Server on a the ARM core from a formatted program file.
- OtxDmpRunStandardProgramModule() - Load and Run an OTX Standard Program Module (SPM) on the DSP core from a program image stored in the OTX library.
- OtxDmpIoControl() - Send a user command to a DMP application.
- OtxDmpReadData() - Read data from a DMP application
- OtxDmpUploadFile() – Upload a file to the ARM core file system
- OtxDmpDownFile() – Download a file from the ARM core file system
- OtxDmpSetNetworkParams() –
- OtxDmpRunStandaloneProcess() -
- OtxDmpKillStandaloneProcess() -

4.5 Clock Architecture

All the internal TDM data highways and the all the devices processing TDM data on the Alvis-ASM board are synchronized to one clock reference. The clock reference can be derived from multiple sources and then switched to all the devices. The Alvis-ASM board supports the same clock sources are available on the NIC card that it is populated on.

4.6 Logical Subsystem

The logical subsystem view describes the logical design subsystems within the Alvis-ASM board. Each subsystem can comprise hardware, firmware, and driver or on-board processor software. The Alvis-ASM comprises of only one subsystem:

- Processor Subsystem
- Packet switching Subsystem
- Host-PC Communication Subsystem

4.6.1 Processor Subsystem

The processor subsystem on the Alvis-ASM board contains between one and four Texas Instruments TMS320DM6443 Digital Media Processors (DMP). These processors are sometimes also referred to as “System On Chip” since they are equipped with two different cores; one DSP C64x+ core and one ARM9 core.

The DSP core is clocked at 597 MHz and with an 8 lane wide instruction cache it is rated at 4752 C64x+ MIPS. The ARM9 core is clocked at 297 MHz.

Each DMP is connected to 256 Mbytes of DDR2 memory and a 64 MByte NAND Flash memory device for persistent storage. Both the DSP core and the ARM core share access to the memory devices. Both cores operate in the same memory space.

The processor subsystem is depicted in Figure 8.

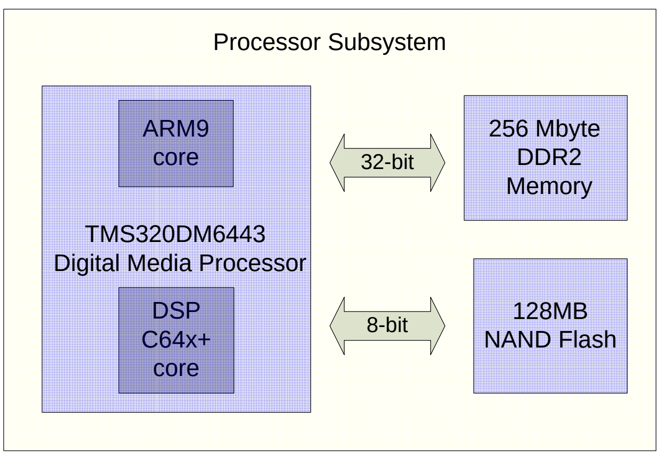

Figure 8

In addition, the processor subsystem provides LEDs (two per DMP) which can be turned on and off under DMP software control. The LEDs are typically used as heart-beat indicators (blinked on and off by the DMP applications) or displaying other custom status indications. There is also a Power-Good LED indicating that the DMP is powered adequately to function properly. The locations of the LEDs are shown in Figure 4.

4.6.2 Packet Switching Subsystem

The heart of the packet switching subsystem is the OTX_DEVICE_ETHERNET_SWITCH device (see chapter 5.1.3) which switches

Ethernet packets between the different Ethernet MACs on the Alvis-ASM board. It also switches Ethernet packets to and from the 10/100/1000 Ethernet PHY, which can be connected to the internet, LAN, or a WAN.

The Packet Switching Subsystem on the Alvis-2-ASM board is shown in Figure 9.

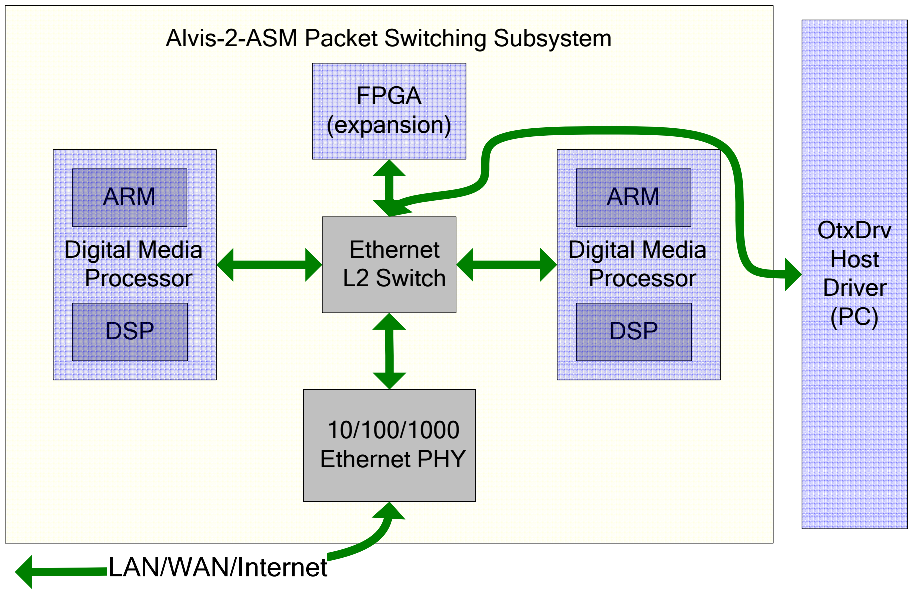

Figure 9

4.6.3 Host PC Communication Subsystem

The Host PC communicates with the devices on the Alvis-ASM board via its Host PC Communication Subsystem. An application that runs in User Mode on the Host PC can send commands and receive events from the Alvis devices via the API functions in the OTX Hardware API. The communication path goes via OTX HW Driver, the OTX NIC Board and the FPGA on the Alvis-ASM board. Figure 10 illustrates this communication path.

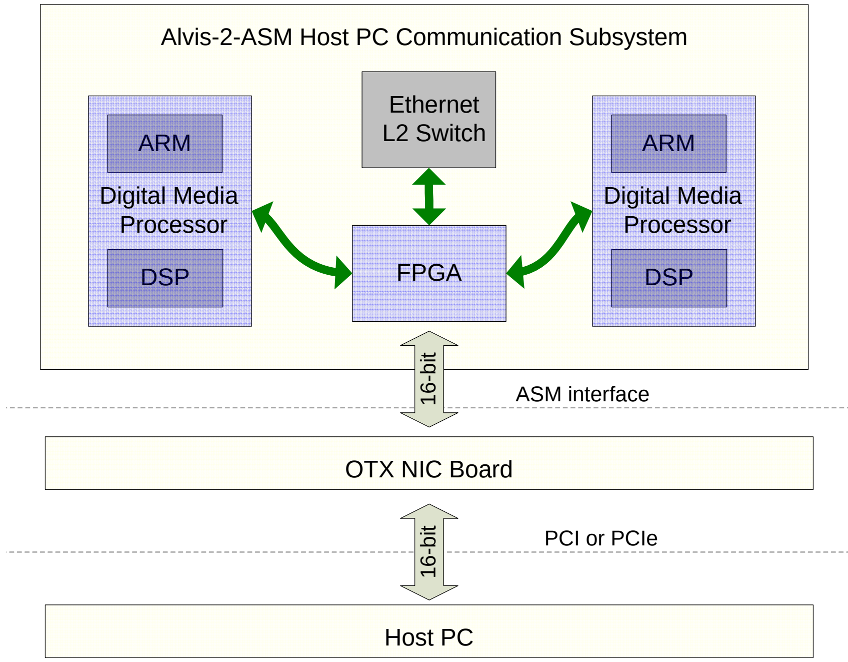

Figure 10

5 API Supported Devices

5.1 Physical Devices

5.1.1 Board Device (OTX_DEVICE_ALVIS_ASM)

The Alvis-ASM board itself is considered a physical device in the OTX HW terminology. An application should always start by opening the OTX NIC board device that hosts the Alvis-ASM (after connecting to the OTX Library), and thereafter open the Alvis-ASM board providing the handle to the OTX NIC board as the “parent” parameter.

The sequence number of the Alvis-ASM board device is always 0 (zero). The Alvis-ASM board hosts a number of other devices listed in the chapters below.

5.1.2 Digital Media Processor (DMP) Device (OTX_DEVICE_DMP)

The Alvis-ASM boards hosts a number of Digital Media Processor devices OTX_DEVICE_DMP). The number of DMP devices that are hosted by the board varies with the different Alvis-ASM board options (1, 2, and 4).

The sequence number of the first DMP device is 0 (zero) and increases by one for every DMP devices that is populated on the board.

When a DMP device is opened it is booted into its standard configuration. The boot image can be changed using the OtxDmpUploadFile() API function. The Boot image is stored in a persistent NAND flash device on the Alvis-ASM board.

The DMP device has two cores:

- ARM9 core
- DSP C64x+ core

The ARM9 core runs either Linux or Windows CE as its operating systems. The ARM core can run standard OTX libraries such as OTXRTP and OTXHDLC. It is also possible to run custom supplied libraries and applications.

The ARM9 core also controls the DSP core. It loads the DSP program into memory region for the DSP and then executes the program.

The DSP core of the DMP devices on the Alvis-ASM can also be used to run the Standard Program Modules (SPMs) provided in the OTX SDK library. These SPMs, or DSP application packages, provides supports for many common telecom applications; such as tone detection and generation, FSK, and HDLC sending and receiving.

The DSP core can also be used to run user developed custom applications. For more information on custom DSP application development, please refer to “Programmer’s Guide for OTX C64x DSP Software Development Kit” (Odin document number 1412-1-SAA-1014-1).

5.1.3 Ethernet Switch Device (OTX_DEVICE_ETHERNET_SWITCH)

The Ethernet switch device (OTX_DEVICE_ETHERNET_SWITCH) handles the data packets between the DMP devices, the FPGA, and the external Ethernet PHY devices on the Alvis-ASM board. It is optional to open this device. The Alvis-ASM board will automatically switch Ethernet packets even if this device is not open. Only if an application wishes to override the standard Ethernet switching behavior (such as enabling the Traffic Mirroring feature) this device should be opened.

The sequence numbers of this device is always zero (0).

For more information regarding the Ethernet switch device please see chapter 4.3.2.

5.2 Logical Devices

The Alvis-ASM board supports a number of logical devices depending on which Codec Engine Server and which Standard Program Module that is loaded into the DSP core.

A subset of the supported devices is listed below:

- OTX_LDEVICE_VOICE_CODEC_G723_ENCODER – logical device that compresses (encodes) voice audio in 30 ms frames according to the ITU-T G.723.1 codec standard. G.723.1 is commonly used in Voice over IP (VoIP) applications.
- OTX_LDEVICE_VOICE_CODEC_G723_DECODER – logical device that decodes voice audio according to the ITU-T G.723.1 standard.

- OTX_LDEVICE_VOICE_CODEC_G729_ENCODER – logical device that support audio data compressing (encoding) according to the ITU G.729 algorithm (Annex A and B). Operates at 6.4 kbps, 8 kbps, and 11.8 kbps. G.729AB is commonly used in Voice over IP (VoIP) applications.
- OTX_LDEVICE_VOICE_CODEC_G729_DECODER - logical device that support audio data decoding according to the ITU G.729 algorithm (Annex A and B).
- OTX_LDEVICE_TONE_DTMF_DIALER – logical device that generates DTMF dial tone sequences.
- OTX_LDEVICE_TONE_MF_DIALER - logical device for generating MF tone sequences.
- OTX_LDEVICE_TONE_DTMF_DETECTOR - logical device for detecting DTMF tones.
- OTX_LDEVICE_TONE_MF_DETECTOR - logical device for detecting MF tones.
- OTX_LDEVICE_TONE_DATA_HDLC_SENDER - logical device for sending (encoding) HDLC frames.
- OTX_LDEVICE_TONE_DATA_HDLC_RECEIVER - logical device for receiving (decoding) HDLC frames.

6 Power

The Alvis-ASM operates from 3.3 Volt and 5 Volt supplied from the OTX NIC card (via the ASM connector). Power consumption is TBD.

7 Certifications

Final certifications are TBD. The Alvis-ASM will be designed with the following list of planned certifications:

- FCC Part 15 (CFR47, Part 15, Subpart B)
- FCC Part 68
- CE EMC (EN61326-1 Class B Equipment, AS/NZS 2064 Class B Limits)
- Safety EN60950 and UL60950

8 Reference documents

The following documents provide further detailed information related to the Alvis-ASM board:

- Programmer's Guide for OTX Hardware Driver (Odin document # 1412-1-SAA-1006-1)
- Installation Guide for OTX PCI Adapters (Odin document number 1512-1-HCA-1001-1)
- Programmer's Guide for OTX C64x+ DSP Software Development Kit (Odin document number 1412-1-SAA-1014-1)

- Alvis-ASM Product Brief (Odin document number 2020-1-HCA-1018-1)

9 Glossary

- OTX – Odin Telecom FrameworX
- NIC – Network Interface Card. Refers to the OTX Base board that this ASM board is connected to. Examples of OTX NIC cards are Thor-8-PCI-Plus, Thor-2-PCI-Plus, and Thor-2-PCI-Express.
- DMP – Digital Media Processor. Refers to the dual core System On Chip processors on the Alvis board.
- DSP – Digital Signal Processor
- SDK – Software Development Kit
- API – Application Programmer Interface
- CPU – Central Processing Unit. Refers to the host PC in this document.
- EEPROM – Electrically Erasable Programmable Read Only Memory.
- FPGA – Field Programmable Gate Array.
- LED – Light Emitting Diode
- LS – Least Significant
- MS – Most Significant