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A Study on Optical Transport Platform on ATCA

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In this paper, we discuss a study on Advanced TCA (ATCA) based 40 Gbps level Optical transport platform having 120 Gbps (12, 10 Gbps modules) switching capacity as an OTP based large capacity multi service technology. The ATCA-based OTP (Optical Transport Platform) is composed of OTH (Optical Transport Hierarchy) 10 or 40 Gbps client signal interface module, OTH 10 Gbps transport module, high-rate OTH unit switch, system processor, and can be installed in ATCA platform.

OCIS codes : 060 0060,130 6750

I. INTRODUCTION

As the next-generation backbone optical transmission infrastructure is constructed on Wavelength Division Multiplexing (WDM), Optical Transport Hierarchy (OTH) [1] is necessarily demanded as a sublayer of the WDM optical channel. The OTH based 40 Gbps level multi-service transport technology is proposed to meet the requirements of newly emerging services (such as 10GbE, STM-256, 100 GbE), whose needs cannot be met by the current optical transport devices. Several core technologies, such as the enhancement of switch structure for managing network bandwidth to accommodate the shift in traffic mix and growth in traffic volume, OTH based transmission technology, 40 Gbps optical transmission technology, encapsulation technology of IP traffic adaptation to OTH, are needed. The basic unit of OTH transmission is 2.5 Gbps. In this paper, we discuss on Advanced Telecommunication Computing Architecture (ATCA) [2] based OTP (Optical Transport Platform) or MSPP (MultiService Provisioning Platform), which supports services of widely varying characteristics and enhances switching technology in next-generation OTH via accommodating a wide range of client signals, such as IP, Ethernet, SDH, FC (Fiber Channel) signal, into OTH-based signal. This paper is organized as follows: In chapter 2, we present the hardware structure of the 40 Gbps OTP. In chapter 3, we present the software of the 40 Gbps OTP. Finally in chapter 4, the conclusion will be presented.

II. HARDWARE STRUCTURE OF OTP

The OTH-based OTP as Fig. 1 is configured based on Advanced Telecommunication Computing Architecture shelf. It is composed of OTH 10 Gbps client signal interface module, 10 Gbps transmission module, OTH unit switch module, system processor, based on the ATCA. It is designed according to ATCA standard platform.

2.1 OTH 10 Gbps Client Signal Interface Module

This module accommodates and aggregates various client signals (such as GbE, STM-16, STM-64, OTU2), into OTH based signals (ODU-k, k = 1, 2) with the maximum capacity of 10 Gbps. It is designed to be installed on ATCA standard shelf. This module is functionally composed of Backplane Transceiver, Interface Conversion Module, OTU2 Frame Signal Processor, and Client Signal Optical Transceiver.

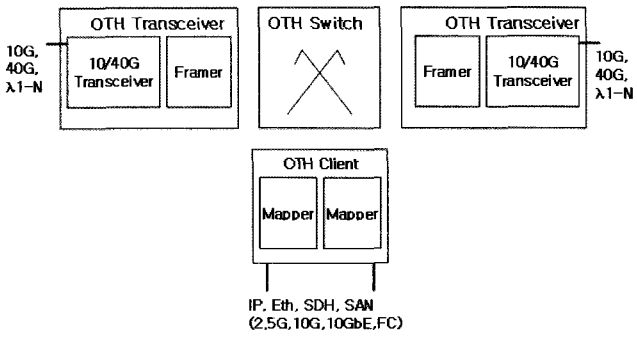

FIG. 1. OTP Configuration.

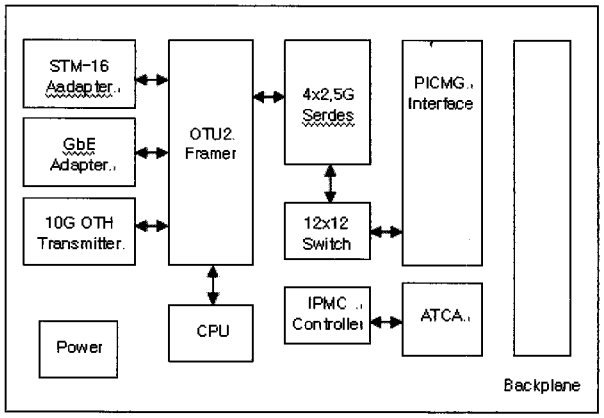

FIG. 2. Block Diagram of OTH Client Signal Interface Module.

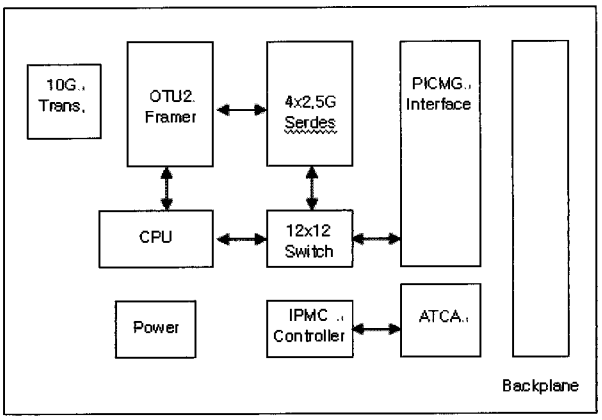

FIG. 3. Block Diagram of OTH 10 Gbps Transmission Module.

The OTH Client Signal Interface Module accepts client signals from various networks at the maximum rate of 10 Gbps, maps these signals into 2.5 Gbps OTH unit signals (ODU1) after optical-to-electrical conversion and feeds the signals into OTH unit switch fabric. This module also accepts ODU1 signals switched via OTH unit switch fabric, maps these signals into each client signal after electrical-to-optical conversion and feeds the signals into each external client network. OTH multiple service client signal interface can be achieved by this bidirectional functionality. The external interfaces of this module are optical interface via face panel for client signal interface, 2.5 Gbps electrical interface via backplane for OTH unit switch module interface. Backplane transceiver accepts duplexed four channels ODU1 electrical signal via backplane, recovers the signal, and outputs to SERDES (Serializer/Deserializer) after selecting Working/Protection signal. Also as the reverse processing, 1:2 fanout for transmitting four channel ODU1 electrical signal via duplexed switching module is processed using 12×12 switching chip.

2.2 OTH 10 or 40 Gbps Transmission Module

OTH Transmission Module transports 10 or 40 Gbps level OTH signal to (from) the Client Interface Module, for accommodating various client traffic (2.5 G, 10 G, GbE, 10 GbE, FC). This module is composed of, backplane transmission/reception unit, interface convertsion unit, OTU2 framer signal processing unit, and 10 Gbps optical transceiver. For interface conversion, this module accepts duplexed four channels 2.5 Gbps OTH unit signal (OTU1) as electrical signals via backplane. The module processes this signal for OTU2 framer and transmits it to optical link after 10 Gbps electrical-to-optical conversion. Also the reverse processing is supported.

2.3 OTH Unit Switch

Current SDH based Switch's maximum speeds are at maximum 155 Mbps, switching in the unit of VC-n (n=1,3,4). No OTH based Switch and Transport Technology is currently commercialized, and some companies are developing only in the form of basic devices or modules. Considering the increasing trend in traffic volume, switching in the bigger units is cost efficient because it can make hardware volume smaller and control software simpler. The OTH Switch's switching-speeds proposed in this paper are at 2.5 Gbps, because it switches in the unit of ODU-k (k = 1,2,3). And it is designed according to the unit design specification of ATCA Standard [2]. The Switch fabric provides 64×64 full switching function including the 1+1 redundancy, loopback, broadcast, multicast, and Drop & Continue function.

As seen in the Fig 4, the Switch is composed of crosspoint switching unit switching 2.5 Gbps signal interfacing with each lint unit and system processor unit to control the switching unit, 16 port L2 switch which switches the Ethernet signals for managing each line unit by the system main processor, Intelligent Platform Management Controller (IPMC) for I2C communication specified by ATCA, FPGA circuit which generates and controls Chip Select (CS) signals for driving each functional chipset, and -48V power supply unit.

For ideally providing the ODU-k switching function, the OTH Switch converts various client signals from line cards, such as GbE, 2.5/10 Gbps Synchronous Digital Hierarchy (SDH), 10 GbE, FC signals, into ODU-k signals and switches them to at maximum 128 lanes in the unit of 2.5 Gbps OTH unit signal (OTU1) at the speed of 320 Gbps.

A 32 bit microprocessor is used for the system main processor of OTP, which maintain all the functions of OTP. This processor also controls all functional blocks

of the OTH Unit Switch. Its dimension is designed as 2.4 (t) × 280 (W) × 320 (H).

We discuss an 120 Gbit/s switch fabric for switching OUT-k signals on the OTH based 40 Gbps level multi service transmission platform. Because the OUT-k signals contain several ODU-k signals, the ODU-k signals should be extracted to switch actual data. The input signals are converted into the ODU-k OTH signals in the line cards that process each client signal. Then, the converted signals are switched or multiplexed by the switch fabric and fed into the 40 Gbps transmission module. The 40 Gbps transmission module converts the signals from the switch fabric into OUT-k signals and transmits them. In addition, ODU-k signals are extracted by processing the OTU overheads of the OTU-k signals fed into the 40 Gbps receiving module, and fed into the switch fabric. In case of OTP having switching capacity more than 120 Gbps, it is difficult to apply ATCA platform because of the increment of signal connector pin.

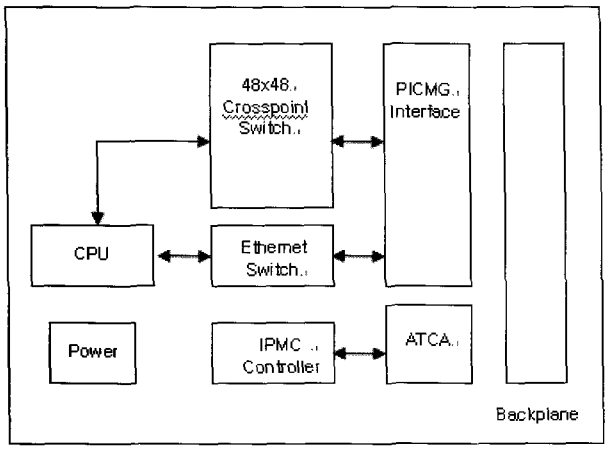

FIG. 4. Block Diagram of 120 Gbps level OTH Unit Switch.

III. SOFTWARE STRUCTURE OF 40 GBPS OTP

The software is simply composed of User Interface, Message Processing, Driver Controller and Hardware Controller. The User Interface provides Web-based GUI (Graffic User Interface) and text type CLI (Command Line Interface). The Message Processing receives messages coded by each function, interprets and dispatches them for executing the appropriate driver functions. The Driver Controller controls basic functions, such as connection control for driving OTH Switch. The Hardware Controller controls the hardware by accessing the value of registers or memory in the Switch.

IV. CONCLUSION

In this paper we have discussed an ATCA based OTP having 120 Gbps switching and 40 Gbps multi-service capacity.

This OTP can substitute the existing 2.5 Gbps or 10 Gbps SDH/MSPP optical transport devices or SDH-based broadband crossconnects of backbone network (such as DXC, OXC) as an upgrade to meet the growth in traffic volume or the deterioration of devices.

The OTH based Switch and Transmission Module, the core modules of the MSPP, can be applied in place of medium capacity optical transmission system (such as SDH, WDM, DXC/OXC) used in central office or bigger centers to provide efficient classification/distribution (such as grooming) of the traffic and management of the bandwidth. The 40 Gbps Optical Tran-

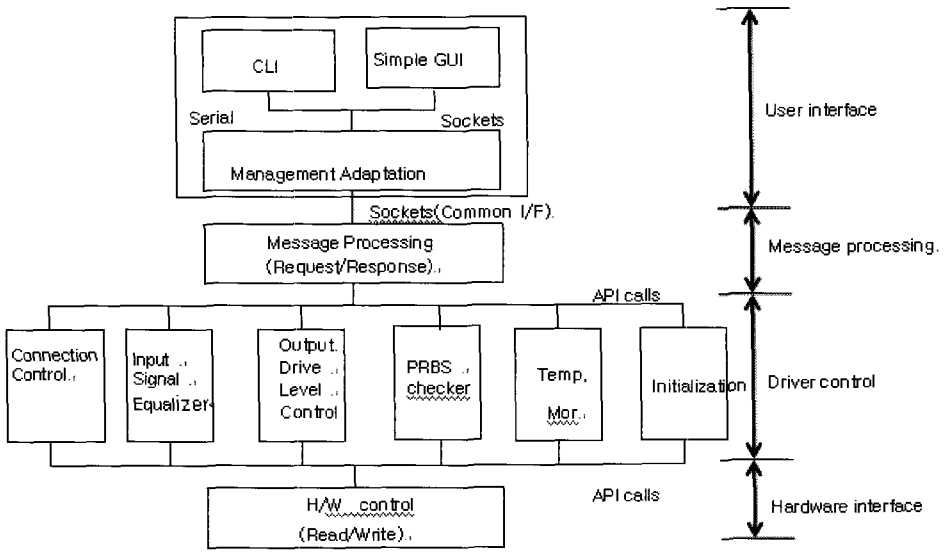

FIG. 5. Functional Block Diagram of Software.

sceiver, another core module of the MSPP, can be applied to 40 Gbps TDM transmission devices for Metro Ethernet long haul transmission, SAN or MPLS network construction, and short-haul high-capacity transmission.

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