ATCA Software and Compatibility Test

Changrong Ge, Xing Fang
Energy Efficiency and Data Test Laboratory
National Engineering Research Center for Broadband Networks and Applications
Shanghai, China
chrge@b-star.cn, xfang@b-star.cn

Abstract — It is the largest specification effort ever in the history of PICMC association, which contains more than 100 companies participating, to work on ATCA technique. To be named as AdvancedTCA (ATCA), it is officially called PICMG 3.x protocol, which was stipulated by the PICMG organization in Dec, 2002. It is mainly targeted to achieve requirements for the next generation of "carrier grade" equipments, widely now used in telecommunication core or access networks [1].

Keywords-component; compatibility; ATCA; PICMG; practical test

I. BACKGROUND

There is a family of PICMG 3.x standards of which PICMG3.0 is the base specification. This defines the mechanical form factor, power and cooling parameters, backplane interconnects and the system management architecture necessary to construct a compliant backplane, chassis and plug-in boards. It also defines base fabrics for system control and management. Subsidiary specifications define fabric protocols for control and data plane communication. These include PICMG 3.1 for Ethernet, PICMG 3.2 for Infiniband and PICMG 3.3 for Star-Fabric technologies [2].

The board form factor is 7.25 U high by 230 mm deep and a pitch of 30.48 mm housed in a chassis that is from 10 to 12 U high depending on the choice of air flow for cooling. The cooling is designed to support up to 200 W of power per slot. The chassis width depends on the host rack that could be either a 19" instrumentation rack or 23", which is more common for telecom racks. In the first case there are 14 slots per chassis and in the second there can be either 14 or 16 slots. Two of the slots are redundant copies of each other and are the centre points for control switching and one of the data switching topologies, as illustrated later in this chapter. These are called the logical slots 1 and 2 and their physical position is not defined by the standard. Common practice puts them adjacent to each other, either at the centre or extreme left of the backplane. Table 1 compares the main parameters of the ATCA standard with current bus systems.

<table>
<thead>
<tr>
<th></th>
<th>ATCA</th>
<th>PCI (long)</th>
<th>VME 6U</th>
</tr>
</thead>
<tbody>
<tr>
<td>Board Area cm²</td>
<td>995</td>
<td>316</td>
<td>373</td>
</tr>
<tr>
<td>Power Watts</td>
<td>200</td>
<td>10/25</td>
<td>30</td>
</tr>
<tr>
<td>Bandwidth I/O Gb/s</td>
<td>20</td>
<td>4.3</td>
<td>2.4</td>
</tr>
<tr>
<td></td>
<td>full duplex</td>
<td>66 MHz 64 bits</td>
<td>VME 2eSST</td>
</tr>
<tr>
<td>Front panel H * W cm</td>
<td>30 * 2</td>
<td>8 * 1.2</td>
<td>21.5 * 2</td>
</tr>
<tr>
<td>Component Height mm</td>
<td>21.33</td>
<td>14.48</td>
<td>13.72</td>
</tr>
</tbody>
</table>

Table 1 Comparison of ATCA With Bus Based Standards

A major departure from previous instrumentation chassis implementations is the power distribution, which is dual redundant V. This result from the fact that there is no longer a single dominant voltage requirement for the electronics of choice, plus the telecommunications market long ago standardized on V. Individual board voltages are therefore generated by DC-DC converters on each board. This obviously subtracts from the useful board area.

Figure 1 ATCA Board Form Factor
The format of the board is shown in Fig. 1. The main board, A, has space for up to four of the popular PMC daughter-board footprints although these are not part of the specifications.

There is also an optional rear transitional module B which allows for the mounting of external connectivity from the rear of the chassis. Access to the transitional module is via the connectors D. These connectors do not make contact with the backplane F but pass over the top of it. The main board connects to the backplane data and control transport connections through the connectors E. Power is drawn through connector G. The board height allows for a chassis variant where the boards are mounted horizontally within a 19" rack and having a limited number of slots for more compact applications.

The backplane carries the following interconnects.

1) Shelf Management: Management of the chassis contents is a major part of the specification since it is understood that the chassis may be housing equipment from various vendors not all of whose I/O is compatible and therefore needs to be verified before power is applied. In addition many of the boards will be running full processor operating systems with their attendant needs of booting remote IP management and environmental monitoring. This is achieved over an I2C bus.

2) Base Interface: Logical Slots 1 and 2 are dedicated to being the redundant hubs for a dual star interface using a 10/100/1000 BASE-T Ethernet interconnect to every other slot. The base interface offers a medium speed control path that parallels the higher speed Fabric Interface.

3) Synchronisation Clock Interface: There are three clocks that are bussed across each slot, two of them are Sonet/SDH clocks at 8 Khz and 19.44 Mhz. The third is user definable. The clock sources can be in any user defined slot.

4) Update channel Interface: Each board has 10 differential pairs connecting it to its neighbor. These are expected to be used for proprietary uses with proprietary protocols.

5) Fabric Interface: The standard defines two different transport architectures and variants on the theme for special purposes. The first is the Dual Star and the second the Full mesh.

In the Dual Star every Node Slot, N, supports one channel (four pairs in each direction) to each of two Hub slots, H, that reside in logical slots 1 and 2. Each Hub Slot supports up to the maximum of 15 Channels. In a Full Mesh all slots, N, are equal peers and provide one channel to every other board in the backplane. This is shown graphically in Fig. 2. It is also possible to have Dual-Dual Star configurations in which all Node Boards/Slots support one Channel to each of four Hub Boards/Slots.

A clear advantage for this approach over the bus based systems is that the devices that interface the custom electronics of the application are no longer low volume vendor specific bridges. Now the links can be driven and switched by the competitively sourced transceivers and switches appropriate for the technology of choice. For example in the case of Ethernet a node or hub board would employ integrated Ethernet transceivers and SerDes, as well as single chip switches, all of which have been developed for a mass market and are independent of any particular processor vendor [3].

II. PRACTICAL ATCA COMPATIBILITY TEST

A. ATCA Tester Software

ATCA Tester is a special designed test software to estimate practical performance of ATCA devices from different manufactories. It is designed for Hardware manufacturers, System Integrators and Telecom Equipment Manufacturers who wish to reduce the time and resources spent on ATCA, AMC and Hardware Platform Management (HPM) testing and interoperability issues during the development and qualification of building-blocks or during system integration. The tester also helps meet interoperability and certification requirements of their systems for compliance with the ATCA certification suite. By checking building-block (chassis FRUs, boards, mezzanine) compatibility with respect to AdvancedTCA®, AdvancedMC™ system management requirements (Chapter 3) and Hardware Platform Management IPMC Firmware Upgradation implementation with respect to PICMG® HPM.1 and by testing independently or simultaneously all building blocks in an integrated system, ATCA-Tester enables to increase interoperability of building-blocks as well as decrease development and integration time [4].

According to the effective and exact test result on ATCA devices, it is selected as the key test tool for the following compatibility test on ATCA from different manufactories.

B. ATCA Compatibility Test

The tester consists of one board for every slot in the chassis, two of them are Hub Boards and twelve are Node Boards. Each Hub Board drives one channel to every Node Slot and each Node Board drives one channel to each Hub Board. There are six Hub Boards, thirty-six Node Boards and three shelves involved into the test and divided into three groups which are designed and manufactured by three different companies (Considering the confidential notes with every test manufacturer, alias name A, K, and F has been used here to instead.)

The models of equipments from vendors include 8505 shelf, 3420 Hub Boards, 6900 Node Boards of A; 9141 shelf, 8904 Hub Boards, 8050 Node Boards of K; and specific shelf, Hub Boards, Node Boards supplied by F as well.
According to the technique specifications and characters of ATCA, every single device or gadget should have satisfied with the regulation of PICMG 3.0 Rev3.0 specification, AMC Rev2.0 specification and IPMI 1.5 specification [5][6]. However, there is not enough proof from academic agency which shows the exact practical performance of ATCA devices among different manufacturers meets all regulations listed above. Moreover, the compatibility between different parts working together still be a big question to be considered.

Regarding to the questions mentioned above, the test is listed to investigate into two main parts, practical performance test of each device offered from their manufacturers and selecting two devices with better performance from previous test to observe inter-compatibility by different devices combined using, for example, when A shelf is chosen, B Hub Boards and Node Boards will be deployed and tested as whole frame; vice versa. Tests will be settled via ATCA Tester from IPMC, FRU, Shelf, Network and HPM to analyze practical data. Result of test can be shown as Table 2.

![Table 2 ATCA Software Test Performance Comparison](image)

From Table 2, ATCA frame from A and K has more preferable performance than the one from F, with 60% of pass, and K is even best. Furthermore, K and A obtain good results from all five directions of the test, however, there still be kinds of fail and skip alarm information on the report attached by ATCA TESTER. It is because of these manufacturers just considering themselves own benefits on specific design of hardware or software to be unique in the market without satisfying ATCA general specifications that ATCA TESTER software can not get correct data or capture useful response from shelves, which occur lots of interruption and data lost to be shown in the table as fail and skip. Manufacturer should realize the importance of this problem, and fairly offer service and compete against rivals in the market.

![Table 3 ATCA Software Compatibility Test Comparison](image)

Comparing with the previous test results, ATCA devices from A and K have been selected for the following inter-compatibility tests. From Table 3, it is obviously to see, when boards and shelf deployed under same test situation, Boards on K shelf can get much better results in IPMC and Shelf tests than ones on A shelf, which implies K shelf and its backplane has advantage in compatibility with different boards from other manufacturers to ones from A. However, even though, when comparing the test with pervious test result, compatibility between different products of ATCA manufacturers is still a big problem of using. More alarms of failure and skip information have been placed than single manufacturer products test, since different parts from different manufacturers can not communicate with each other when ATCA TESTER intends to collect data or respond from the test. According to the point, all ATCA devices from different manufacturers are somehow not fully compatible to each other in the market, although all vendors have confirmed their products have definitely satisfied with the PICMG specifications and compatibility regulations, which may cause huge potential threats of stability and compatibility on daily maintenance when different devices have been composed to use.

### III. Conclusion

Regarding to the results of above, it is not satisfying that the compatibility of ATCA products from different manufacturers is pretty disturbing and it may cause severe potential problems being in practical use. How to set up one relative specification and alarm the importance of compatibility to ATCA products manufacturers will be the way to solve the situation nowadays. On the other hand, as being a buyer, it is recommended to purchase your ATCA products which have been tested and confirmed on effect of compatibility from the third party test agency.

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Biography
[1] Changrong Ge, male, postgraduate student of University of Leeds, UK, Electronic and Electrical Engineering School, Senior telecommunication engineer, Leader of ATCA project.
[2] Xing Fang, female, postgraduate student of Fudan University, Director of BNC energy efficiency and data test laboratory, Senior Engineer of energy efficiency.

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