AdvancedTCA™ HW Profile

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1. PURPOSE

The purpose of this document is to provide guidelines to standardization bodies and to the vendors' industry who want to migrate from proprietary solutions to PICMG's open standard based platform: AdvancedTCA™. The level of detail used in this living, changeable document is the starting point for further activities either initiated by the addressed audience or will be rendered more precisely during further investigations by SCOPE. The second release of the document will update the profile for AdvancedTCA™ products for control and service plane applications in central office environment. This document is intended to help the adopters of AdvancedTCA™ specifications by identifying the features important for the telecom equipment providers and call out gaps which have to be solved for better interoperability of the AdvancedTCA™ components. While overall time to market will be reduced, lower upfront development costs are required and cost savings due to economy of scale effects can be anticipated, it will also help customers to start on stable product basis and make long-term investment.

In essence, the main purpose of the document is to create a solid competitive environment for common building blocks and avoiding fragmented market initially for Control and Service application products.

In addition to NEPs, this document is targeted to telecommunication industry particularly hardware vendors; manufacturers of the blade level, shelf building blocks and base platform integrators; anybody building AdvancedTCA™ based components.

2. AUDIENCE

This document is intended for the following audiences:

- ✓ hardware vendors;
- ✓ manufacturers of the blade level and shelf building blocks and base platform integrators;
- ✓ telecom equipment manufacturers who are building or planning to build systems based on AdvancedTCA specifications;
- ✓ standardization bodies and related trade associations, who are made aware of gaps in current standards definitions and who may find proposals or requirements for necessary amendments.

3. REFERENCES

1. PICMG 3.0 R2.0 ECN002: AdvancedTCA Base Specification – PCI Industrial Computer Manufactures Group
2. PICMG 3.1 R1.0: Ethernet/Fiber Channel for AdvancedTCA Systems – PCI Industrial Computer Manufactures Group

3. PICMG® AdvancedMC.0 R2.0: Advanced Mezzanine Card Specification – PCI Industrial Computer Manufactures Group

4. PICMG® AdvancedMC.1 R1.0: PCI Express and Advanced Switching – PCI Industrial Computer Manufactures Group

5. PICMG® AdvancedMC.2 R1.0: AMC Gigabit Ethernet/10 Gigabit XAUI Ethernet – PCI Industrial Computer Manufactures Group

6. PICMG® AdvancedMC.3 R1.0: AMC Storage – PCI Industrial Computer Manufactures Group

7. PICMG® AdvancedMC.4: Serial Rapid I/O – PCI Industrial Computer Manufactures Group

8. IPMI – Intelligent Platform Management Interface Specification v2.0; Defines message and system interface to platform management hardware. Intel Corporation, Hewlett-Packard Company, NEC Corporation, Dell Computer Corporation.

9. IPMI – Intelligent Platform Management Bus Specification v1.0 defines an internal management bus for platform management within chassis Intel Corporation, Hewlett-Packard Company, NEC Corporation, Dell Computer Corporation.

10. HPM.1 – PCI Industrial Computer Manufactures Group

11. HPI – Service Availability Forum: Hardware Platform Interface, SAI-HPI-B.02

12. SCOPE: AMC port map gap analysis

4. INTRODUCTION

The PCI Industrial Computer Manufacturers Group (PICMG) has defined an open standard platform for central office telecom equipment called AdvancedTCA™ defined by a set of specifications named PICMG 3.x. The specification defines architecture for many modular components that can be quickly integrated to deploy high performance and carrier grade service solutions. In essence, the components from different vendors will interoperate with each other and, thus, giving flexibility to combine components from different vendors.

The published AdvancedTCA™ specification covers many aspects of design and operation including mechanical and electrical characteristics, data transport, and more. While specifications of many features are comprehensive, some aspects are left ambiguous to allow customization, application in markets beyond the telecom arena, and future extensions. As a result the specification has become unwieldy and demanding for vendors to formally claim compliance. Consequently, the vendors are uncertain of development effort in making a marketable platform product.

In this document, we identify a subset of features from AdvancedTCA™ specification that are sufficient to address most of service & control applications of the telecom mar-

ket's needs. In addition to AdvancedTCA™ the document will also comprise some basic use cases for AdvancedMC™ which could be used on AdvancedTCA™ blades as mezzanine cards. Detail description of the feature set of an AdvancedMC™ is done in a separate AdvancedMC™ profile within SCOPE. The equipment vendors can use this as reference to develop their products in phases and yet generate revenue with AdvancedTCA™ formally.

This document is result of an effort to protect customer's long-term investments. It is consolidation of features that are required from a platform to support most of the current and future telecommunication applications.

5. TERMS AND DEFINITIONS

AdvancedMC	Advanced Mezzanine Card
AdvancedTCA	Advanced Telecommunication Computing Architecture. A registered trademark of PCI Industrial Computer Manufactures Group® referring to PICMG3.x set of standards.
API	Application Programming Interface
Backplane	A passive circuit blade providing connectivity of front blade Slots in the shelf. The connection includes high-speed differential pairs, power distribution, management, and auxiliary signal connections.
Data Transport Interface	Direct point-to-point fabric links between any pair of slots; dual star topology is subset of full mesh interconnection, i.e. a full mesh backplane can also support a dual star configuration.
Dual Star Topology	An interconnect fabric topology in which two switch resources provide redundant connections to all end points within the network. A pair of switch boards provides redundant interconnects between node blades.
Front Blade (ATCA)	A blade that conforms to PICMG® 3.0 mechanicals (8U x 280 mm), including a Printed Circuit Board and a Panel. Further, a blade connects with the Zone 1 and Zone 2 backplane connectors and, optionally, may connect with a Zone 3 midplane connector or directly to an RTM connector and is installed into the front portion of a shelf.
FRU	Field Replaceable Unit. Any entity that can be replaced by a user in the field
Full Meshed	An interconnect fabric topology in which a direct data path (i.e., Channel) to/from each Board in the system. In a system consisting of n Slots, there is n-1 Channel from each Slot to all other Slots.
GbE	Gigabit Ethernet
HPI	HW Peripheral Interface defined by SAF™: Standardized interface between HW platform Management system and Middleware or other application SW.
IPMB	Intelligent Platform Management Bus
IPMC	The Intelligent Platform Management Controller is used to provide the IPMB interfaces
NEP	Network Equipment Provider
PICMG	PCI Industrial Computer Manufacturers Group®
POST	The Power-on Self test is a diagnostic testing sequence run by the CPU's BIOS as the computer's power is initially turned on.

	After performing the POST the BIOS loads and starts the master boot from disk or another storage device.
RTM	Rear Transition Module. An 8U x 70 mm x 6 HP assembly installed into the rear portion of a Shelf and mated with a front blade through Zone 3 connectors to provide I/O connectivity.
SAF	Service Availability Forum™: Consortium of industry-leading communications and computing companies working together to develop and publish high availability and management software interface specifications
Shelf	The Shelf consists of the Subrack Sub rack, Backplane, Front blades, cooling devices, RTMs, power supplies, etc. also historically known as a shelf.
ShMC	Shelf Management Controller. Entity responsible for managing power, cooling and electronic keying in an AdvancedTCA™ shelf and forward any error indication received via IPMI to system management.

6. PROFILE TABLE

6.1 AdvancedTCA™ Specification Related Issues

The AdvancedTCA™ specifications describe extensive sets of features and options. The following table defines mandatory and optional requirements which have been consolidated between telecommunication equipment manufacturer defining their needs for set up control and service plane applications in central office environment based on AdvancedTCA™.

ID	Requirement group	Feature description	Comments
1. Mechanical			
1.1	Cable management	Both front access and rear access for shelves with RTM usage: Service connection can be front only Network interfaces to be flexible to be connected either front or rear	Front cable tray either top or bottom Rear cable tray on top or bottom side must not interfere with air outlet
1.2	Face plate / handles	It should be possible to mount NEP specific face plate assemblies (similar look and feel, handling and EMC sealing): Board shall provide possibility to accept different front-plates, handles and handle switch locations as defined in PICMG3.0 Face plate should provide space to put company trademark sticker on (real estate on the blade front plate needed).	If there is only one common face plate assembly (face-plate, sealing, handles, similar look and feel…) NEPs would accept to have clip cover/overlay if the requirements e.g. EMC, easy handling, … are met. As long as this is not solved, NEPs request exchangeable front-plates and han-

ID	Requirement group	Feature description	Comments
			dles Flat face plate surfaces are preferred for customization
1.3	Blade LED	Each blade shall support the following PICMG3.0 defined LEDs: Hot swap LED (Blue LED) LED1 (Out Of Service): red/amber LED2 (Health): green	Dual color red/amber LED may be used for LED1 to fulfill NEBS and ETSI requirements. Other general purpose LEDs depends on board application
1.4	Shelf	14 or 16 slots	There is a need for smaller horizontal chassis for smaller granularity. Number of slots depends on application.
1.5	Hub board positions	Ether centered or most left and most right position for vertical 14/16 slot shelves	
2. Hardware Management			
2.1	LED control	Setting of LED1 (out of service) and LED2 (health) shall be done by NEPs application SW (system manager). As long as application SW haven't taken over control of LED1/LED2 the board shall indicate "out of service" (LED1 on; LED2 off).	
2.2	IPMB topology	Redundant radial or bused topology	
2.3	Shelf Manager	Shelf manager shall be redundant Either separated ShMC or integrated ShMC on hub blade should be supported ShMC is considered as integral part of the shelf for low level hardware management	
2.4	Shelf Manager Software/Firmware	ShMC shall be fully compatible with usage by HPI implementations. Modular modifiable software/firmware	HPI doesn't have to be implemented on ShMC HPI specs include pro-

ID	Requirement group	Feature description	Comments
		with remote upgrade possibility and automatic fallback recovery if upgrade fails MMC, IPMC FW update shall follow HPM.1	visions for upgrading BIOS, IPMI firmware, disk firmware, etc. HPM.1 spec from PICMG is one mechanism that can fit under this HPI mechanism. Primary focus should be on HPI mechanism
3. Power/Grounding			
3.1	Power per slot	Backplane power distribution shall be capable to provide each slot for a fully populated shelf with at least 225 W (200 W for front board and in addition 25 W for RTM)	Power dissipation of front board should be limited to 200W, but power provisioning per slot could be even higher considering that power will be not dissipated within slot (e.g. support of power over Ethernet function via I/Os)
3.2	Power supply	Shelf to require redundant power feed Power level to be supported: - 48 V nominal : ETS 300 132-2 and ANSI T1.315-2001 and - 60 V nominal: ETS 300 132-2	 Gap in PICMG 3.0: for minimum power levels: in addition rack power distribution should be considered (additional voltage drop between connection point and shelf due to power distribution within rack)
3.3	Power entry modules	PEMs shall be in the same redundancy plane as battery plants Depending on application fuses/breakers in PEMs are optional	
3.4	Safety ground	Double lug connection for safety ground mandatory	
3.5	Power input filtering	EMI filtering shall be done within power entry module to fulfill EMI limits for conducted noise emissions according to NEBS and EN300132-2	Ref: "Environmental Engineering (EE); Power supply interface at the input to telecommunications equipment; Part 2: Operated

ID	Requirement group	Feature description	Comments
			by direct current (dc)".
3.6	Power feed monitoring	Power feeds should be monitored at FRU level.	Gap in PICMG 3.0: Necessary to detect any blown fuse on a blade
4. Thermal			
4.1	Air flow over pressure drop of blade/RTM	Minimal air flow over pressure drop curve per blade/RTM to be provided by the suppliers as defined in PICMG3.0	RTM characteristics needed to be stated by suppliers if >5 W power dissipation Gap: Thermal definitions for inter-working of shelves and boards/mezzanines are missing: Method to be define in PICMG, for better specification, prediction and management of thermals, e.g. definition of: minimum/maximum impedance for board/mezzanines/ RTM
4.2	Shelf cooling	Air flow over pressure drop curve (speed steps, failure cases) for shelf for front blade slots and RTM slots to be specified by the suppliers.	
4.3	Hydraulic impedance of blade/RTM	Hydraulic impedance must be specified by the board/RTM supplier	
4.4	Thermal constraints	Front board slot thermal design must be capable to cope with up to 200W power dissipation per slot (fully populated shelf) considering central office environment as defined in NEBS and ETSI standards. RTM thermal design must be capable to support in addition 25 W in each RTM slot. It must be able to fully populate a shelf with front blades consuming 200W and RTM consuming 25W.	
4.5a	Acoustic noise (system integrator)	Acoustic noise measurements for 23°C ± 2°C and maximum acoustic between	Acoustic noise requirements are defined on system level. The

ID	Requirement group	Feature description	Comments
		23°C to 27°C shall be provided Measurements for degraded modes (e.g. fan failures, … etc) should be provided Measurements at 40°C ambient temperature should be provided (not required to meet noise level requirements)	acoustic noise emission should therefore be achieved for a fully equipped rack. System level performance could be simulated using a full rack of the equipment being measured.
4.5b	Acoustic noise (chassis vendors)	For given impedance profiles, shelf vendors shall provide measured values showing acoustic noise versus airflow volumes.	GAP: Missing requirements
4.6	Fan failure mode	Several fan trays should be envisaged, so that there will be a cooling also at single fan tray replacement to ensure in service replacement of the fans (without performance impact on the system)	GAP: Thermal definitions for inter-working of shelves and boards/mezzanines for single fan failure are missing: -> Values to be define in PICMG, for better specification, prediction and management of thermals
4.7	Fan tray swap interval	System should be capable to survive without any performance degradations during fan exchange for at least 5 minutes.	
4.8	Cold start	Cold start considered at normal operating condition (according to NEBS and ETSI)	
5. Data transport / Interconnect			
5.1	External connections or inter-shelf connectivity on hub/switch blades	Uplinks from Base interface: minimum: 4xGbE evolution to: 2x10GbE	General trend is 10GbE (in short term GbE could be sufficient)
5.2		Uplinks from Fabric interface: minimum: 8xGbE evolution to: 2x – 3x 10GbE	General trend is 10GbE (in short term GbE could be sufficient)

ID	Requirement group	Feature description	Comments
5.3	Fabric interface support within ATCA shelf	Ethernet: Short term: 1/2/4 with aggregation technology (PICMG 3.1. opt. 1, 2, 3) Evolution to 10 Gbit per slot (PICMG 3.1. opt. 9)	 10 Gbit XAUI shall provide option to fall back to 1xGbE
5.4	Fabric interface topology	Dual star	
5.5	Update Interface	Interface between logical paired slots using 10 differential pairs between two slots. Update interface necessary between hub slot pairs and node board slot pairs. Electronic keying as defined in PICMG to be used to ensure compatibility between paired slots.	
5.6	Backplane	Backplanes shall be passive	Possible exception could be inventory data storage (EEPROM)
5.7	Backplane bandwidth	All lanes must support 3.125 Gbps	Higher bandwidth may be expected in future (e.g. double XAUI, 10 KA)
6. AdvancedTCA board / RTM			
6.1	Mezzanine support	AdvancedMC according to AMC.0	
6.2	Power Dissipation	Maximum power dissipation per front board shall be 200 W. RTM power dissipation up to additional 25W.	
6.3	Sensor Thresholds	The severity levels of minor, major, and critical are application specific / customer specific / configuration specific: Threshold levels should be configurable Critical threshold behavior (automatic shut down or no shut down) should be configurable centrally per shelf	Customer may require being able to configure the definition of severity levels according to their configuration at a given time.
6.4	BIOS settings / compute boards	BIOS settings should be stored in non-volatile memory Goal: BIOS settings configurable over	

ID	Requirement group	Feature description	Comments
		IPMI/IPMB	
6.5	Flash for compute boards	Flash on compute board should be provided for boot SW	Size of Flash will be application specific
6.6	Airflow impedance	Front boards/RTMs shall be capable to balance air flow if necessary	Gap: Front boards/RTMs with low air flow impedance shall have provisions for adjusting airflow impedance.
7. Support for AdvancedMC usage on AdvancedTCA board			
7.1	Philosophy	Leverage of synergies between ATCA and uTCA for central office equipment by reuse of AdvancedMCs in both applications	
7.2	Port mapping	AMC port mapping: (derived from AMC profile/port mapping) Port 0,1 : GbE Port 2,3 : SAS/SATA Port 4 – 7 : PCIe x4 Port 8 – 11 : GbE/XAUI/sRIO Port 12: 'update channel' or Port 12 - 15: point-to-point or Port 15 - 12: RTM port 5 - 8 Port 20 -17: RTM port 1-4 Clock: "universal" AMC bays shall support Telco clocks and fabric clock	Mentioned due to impact on board design; Usage of ports and switching to base/fabric interface and update channel of ATCA depends on usage model/application. Point-to-point connection could be used for future application or application specific purposes (e.g. AMC to AMC, AMC to backplane …)
7.3	Thermal	ATCA boards with AMCs and ATCA AMC carriers shall cope with staggered AMCs and different mounting bays	Gap: Definition of higher operating temperature range within PICMG (AMC.0)
7.4	Form factor	Mid size modules for conventional carrier preferred	

ID	Requirement group	Feature description	Comments
		Full size modules for cut-away carrier Mid size modules for cut-away-carrier with full size face plate	 Mid size modules may provide possibility to be adapted to full-size by exchange of face plate or other mechanical solution. Thermal requirements of target bay must be met.
8. Regulatory guidelines (e.g. EMC)			
8.1	EMC	For single shelf solution: minimum: Class A – 6dB goal: Class B equivalent for standalone shelf For multi-shelf equipment on rack level: Class A - 6dB for fully populated rack with no doors/doors open	
8.2	Environment	ETSI standards relevant for central office applications, as listed in chapter 7, 'Regulatory guidelines' of PICMG 3.0 R2.0 'Advanced TCA base specification'. NEBS level 3. (Ref: SR-3580 "NEBS Criteria Levels - A module of NEBSFR, FR-2063".) EU directives regarding restriction of the use of harmful substances in electronic equipment (RoHS, WEEE), and requirements for lead free products by EU directive: 6/6 is preferred	Implementation of world's relevant standards Products shall be designed to meet the following directives:• (RoHS) • (WEEE)• (EuP) DIRECTIVE 2005/32/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 6 July 2005 establishing a Framework for the setting of eco-design requirements for energy-using products and amending Council Directive 92/42/EEC and Directives 96/57/EC and 2000/55/EC of the European Parliament

ID	Requirement group	Feature description	Comments
			and of the Council PICMG 3.0 specifications, there is no defined RoHS level
9. Serviceability			
9.1	Serviceability	All FRUs (blades, RTMs, AdvancedMCs, power units, fan units, filters …) shall be hot swap capable and in-service replaceable Supplier shall list whether the unit requires regular maintenance, and what type of service. Status LEDs of FRUs accessible only from back side, should be visible also at front side (except status LEDs on RTMs)	Serviceability of FRUs from front preferred In service replaceable means that there shall not be produced any downtime of the system by exchanging the units.

6.2 Beyond ATCA Specifications

The following table includes the telecommunication equipment manufacturing requirements for migrating from proprietary hardware platforms to AdvancedTCA™ not described in the ATCA specification.

ID	Requirement group	Feature description	Comments
10. Others			
10.1	Cabinet	3 shelves in rack, including power distribution equipment	
10.2	Diagnostic/Tests	Diagnostic tests to be done for all FRUs: Power-on tests (launched automatically): POST (should cover the basic HW health required in order to run) long POST option desirable by configuration setting Test for service activation (launched automatically): Communication of this kind of test via IPMI. Tests will be done by application SW. Framework necessary.	Other test as: Off-line diagnostic tests (launched on request): e.g. extensive memory tests, I/O tests; highest coverage for HW test Background diagnostic tests (on-line; during operation) (launched automati-

ID	Requirement group	Feature description	Comments
			cally) ….. -> see CGL profile/ SAF profile
10.3	Diagnostic/test reporting	Reporting via IPMI: Short form messages to be reported over IPMI for the test results for power-on tests, for service activation Reporting via on-line SW for background diagnostic Reporting of off-line diagnostic should be via the launching interface	
10.4	Storage solutions	Local storage: Hard disk drive on-board/RTM Hard disk drive on AMC SAS Hard disk drive preferred Storage units within ATCA: Storage blades using iSCSI over IP over Ethernet External storage: supported via iSCSI or FibreChannel or SAS	Fibre channel may be used in current application, but it is expected to be replaced by iSCSI over 10GbE
10.5	Hard disk	Disk life expectancy should be at least 5 years: Operating condition: 24/7; Duty cycle: 100% Environment: NEBS/ETSI central office	SAS hard disk drives preferred for local storage
10.6	Upgrade	Remote firmware upgrade to enable automatic procedure for firmware upgrade without service interruption with fall-back feature. HPI's FUMI (detailed in HPI B.02.01) is recommended for use of remote FW upgrade. HPM.1 might be used for FW upgrade of MMC/IPMC/ShMgr via IPMI un-	GAP: Usage of HPM.1 by HPI

ID	Requirement group	Feature description	Comments
		der control of HPI FUMI.	