Unmatched Global Market Coverage

ATCA World

Advanced Telecom & Computing Architecture

ATCA - AMC - MicroTCA

Hi-end Embedded Computing Boards & Rack Scale Systems
Modular Multi-vendor Standardized HA Redundant Platforms

Best for Sophisticated & Critical Applications and Telecom
Communication - Military/Aero - Industrial - Physics - Research

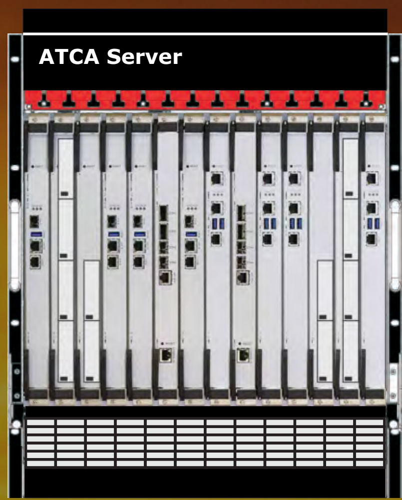
ATCA World is a Global Publication of e2mos

Sep-Oct 2020

Success Stories of the ATCA - AMC - MicroTCA Family High-end Embedded Computing for Sophisticated & Critical Applications and Telecom

■ Huawei and ATCA to the Top « the Evidence »

ATCA was Key for Huawei to reach $Billion 129 in 2019
more than the Total of Ericsson, Nokia & Cisco



■ ATCA used as Platform in EU Quantum Project

For Communication Infrastructures Research (2019 to 2021)

■ ATCA is deployed in all the World's Major Networks

Better CAPEX - OPEX, Higher Performance, Very Easy to Integrate,
Most Flexible Platform, Modular, Easy to Upgrade to Latest Silicon,
Standard, 99.999% Availability, Lower Power, Smaller Footprint ...

■ The ONLY Standardized Platform for Carrier Grade Telecom Systems

Multi-vendors offering Second Source and Many Standard options

■ ATCA systems UNDERSEA off the coast of Alaska installed in the salt water in 2005 for 15 years operation! Still in service as of September 2020

for data acquisition & networking for thousands of low-noise,
precision measurement sensors, done by SAIC / Leidos

■ 100's of Companies have adopted ATCA & MicroTCA

In Communications, Defense & Aerospace, Physics, Research,
Hi-end Industrial, Chip Manufacturing Equipment and more

DESY.

9th Virtual MicroTCA Workshop for Industry and Research

1 to 3 December 2020 at DESY

ATCA stands for Advanced Telecom Computing Architecture but is also used in volume in many Critical Applications
ATCA is the ONLY Standardized Platform for Carrier Grade Telecom Systems
ATCA is for Hi-end, MicroTCA is smaller size - MORE: www.atcaworld.com and www.picmg.org

Time to Highlight some Top Success Stories about ATCA and MicroTCA

For these 20 pages we have selected only projects deployed globally (see cover) with the following **criteria's**:

- Deployed by large companies
- Large Volume
- Top Hi-tech in complex applications & critical systems
- Prestigious Projects
- Redundant Computers "No single point of failure"
- High Availability "the Five Nine 99.999 %"

Market Segments include:

- Telecom Large Data Centers and Networks
- Military & Aero: AIRBORNE | AFLOAT |GROUND CONTROL | TACTICAL OPERATIONS
- Government: Geophysics and Next Gen Telecom Systems
- High-Energy & Nuclear Physics
- Research Institutes

Visit our New Dedicated Website www.atcaworld.com

ATCA Deployment Today

Mainly Redundant Applications & Complex Systems
Telecom Large Network Datacenters (ETSI and NEBS)
Military & Aero: Mobile Networks, Multi-mission Aircraft
Government, Geomatics
High-Energy & Nuclear Physics
Semiconductor Manufacturing Equipment
Research

MicroTCA Deployment Today

Communication - Industrial - Medical
Mobile Edge Computing (MEC)
Network Packet Analyzers
Oil & Gas Exploration
Geomatics
Automation • Production Control
Digital Imaging/Video Processing
Enterprise/Industrial Data Processing
Transportation: Rail & Others
Test & Measurement • Telemetry • IoT

Military & Aerospace: Land, Air, Sea, Underwater
Signal Processing
RADAR / SONAR Systems
SIG-INT / COMINT/ELINT Systems
C4ISR
Electronic Warfare Systems

High Energy Physics
Particle Accelerators
Colliders

Daniel Dierickx
CEO & co-Founder at e2mos
40 Years Business & Market Expertise in Chips, Embedded Computing & SW
Together with my Partners we have built a PREMIER Global Customer Database

Dear Reader,

Here is your free copy of:
ATCA World One of our Six Global and High Focus e-magazines

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Embedded Systems World
aiworld
Telecom COTS World — Broadband Broadcast IoT AI Convergence
IoT World
ATCA World — Advanced Telecom Computing Architecture

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Huawei takes ATCA to the Top
"The Evidence of ATCA Supremacy”

ATCA Platforms were Key for Huawei to become the dominant #1 in Telecom Equipment Worldwide.

Huawei Total Sales $Billion 129 in 2019 - More than the Total of Ericsson, Nokia (including Alcatel-Lucent) and Cisco.

ATCA by far Best CAPEX - OPEX and TCO - Many Success Stories published about ATCA Technical & Financial Advantages by Huawei.

Press Releases in abundance from Huawei and their Customers the Service Providers stating some of the ATCA Key Success Factors:

- Standardized
- Modular
- Multi-vendor
- Reduces Power Consumption by more than 70%
- Much Smaller Footprint
- Larger Capacity
- High Integration
- Higher Throughput
- Easily Upgrading the Existing Platform through New Blade Cards while the Systems are in Operation
- and so much more.

Examples of Huawei Press Releases

Huawei Deploys ATCA-Based CDMA Mobile Softswitch Solution for Movistar Peru

"We are greatly impressed by the dedication, reactivity and positive working attitude demonstrated by Huawei's team. Huawei' s cutting-edge ATCA-based CDMA mobile softswitch solution and proven delivery capability meet our highly demanding requirements, and our joint effort will help us to improve our network efficiency, reduce our operation costs, and better serve our customers," said Mr. Seneca De La Puente, CTO of Movistar Peru.

Telefonica o2 Germany: NGIN platform created synergies thanks to Huawei ATCA

Telefónica o2 Germany was determined to leverage its fixed and IMS network assets to create synergies for the organic growth of its mobile business. To realize this strategic target, and lay the foundation for future growth, the operator carried out service network optimization using a new NGIN platform.

Future-proof hardware platforms ATCA-based

One of the reasons why o2 selected Huawei's platform was its hardware concept that is based on the advanced telecommunications computing architecture (ATCA). This platform is widely accepted as the standard in telecom infrastructure. By deploying this platform, the operator expects that future demands on the network will be quickly tackled by easily upgrading the existing platform through new blade cards.

A smooth and future-proof evolution

No interruption of revenue-generating services

Grasping new service opportunities

See next page the Huawei magazines about ATCA « Huawei COMMUNICATE »

... to next page

Huawei takes ATCA to the Top
"The Evidence of ATCA Supremacy"

... from previous page

Huawei magazines « Huawei COMMUNICATE »
Already in 2011 Huawei was accelerating drastically the ATCA Business Worldwide

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Securing the future

COMMUNICATE: Operators today are looking to transition to an All-IP network. How are you preparing for the same?

Rahman: Given the massive growth in data traffic worldwide, this is certainly a major focus area of operators. You have to get prepared from every aspect, from radio access, from transmission and also from core, to cater for the growth.
We have already introduced A over IP Solution, so this is one step towards All-IP solution. And we are currently evaluating Abis over IP, and hopefully we will be able to start implementation by the end of this year. Apart from this, we are getting prepared in terms of access network capacity by introducing hybrid microwave and also exploring the feasibility of developing partnerships with fiber optics networks and infrastructure solution providers.
In addition to SingleRAN, we will also deploy Huawei's SingleCORE, ngHLR (nextgeneration home location register), and IP STP (signaling transfer point) solutions. We hope the SingleCORE solution, with ATCA platform-based mobile softswitches, will help us build a more robust and flexible mobile network with a highly reliable and simplified architecture. All of this is expected to help GP move to an All-IP network, most probably by next year.

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Enhanced SGSN: Facing the impact of smartphones, network equipment should feature large capacity, powerful processing ability, and sustainable expansion to cope with the growing signaling and traffic pressures.
Based on the ATCA platform, Huawei SGSN is known for its large capacity, high integration, and high throughput. The SGSN is able to process 24,000 sessions per second, accommodate 12 million concurrent users and 24 million PDPs. This helps

Huawei ATCA Telecom Server

The TOP 30 Mobile Network Data Centers are equipped with ATCA Telco Servers

ATCA-based Telecom Servers are deployed in all the World 's Major Networks

If you visit those Top 30 Telecom Data Centers you will see it
They are installed next to the Servers of HPE, Dell, Lenovo, Huawei (ATCA-based)

Our Database counts 900 Service Providers in 200 Countries, it is difficult to find one without ATCA www.e2mos.com

ATCA is The ONLY Standardized Platform for Carrier Grade Systems and Networks www.picmg.org

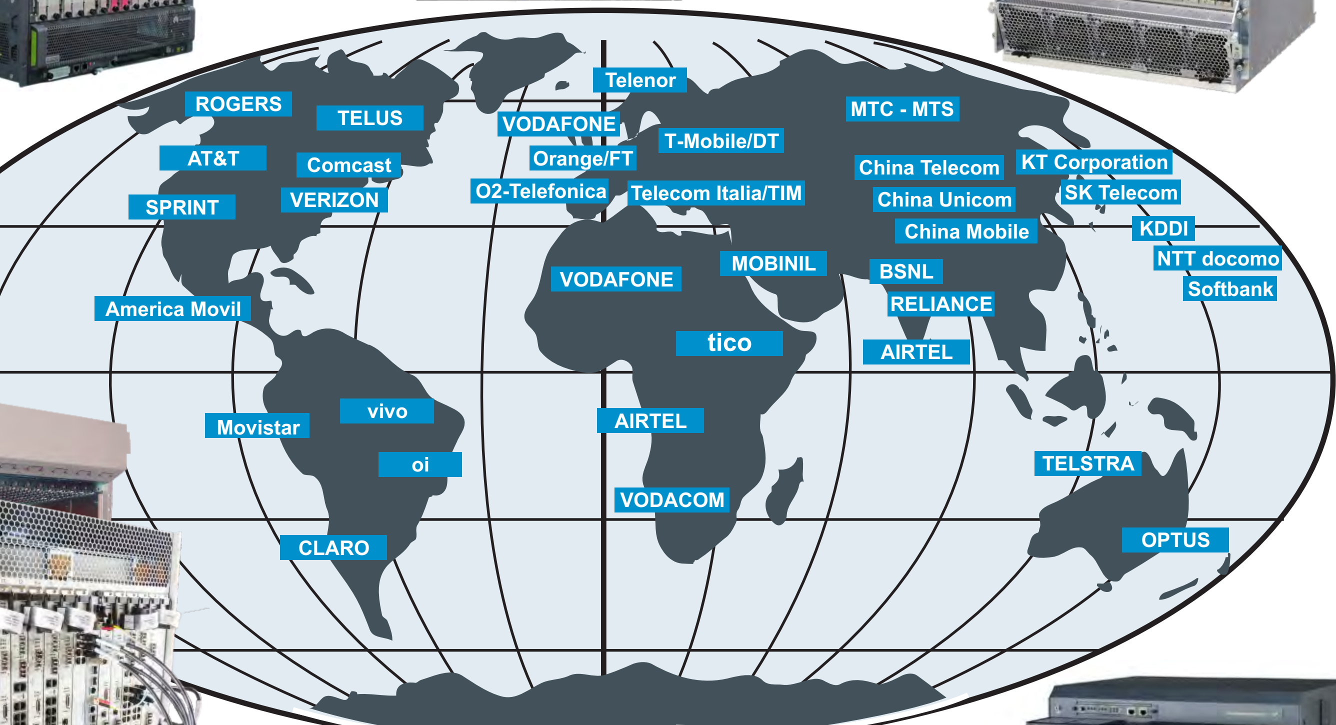
Open Modular Multi-vendor Architectures - Not Locked in ONE Vendor www.atcaworld.com and www.picmg.org

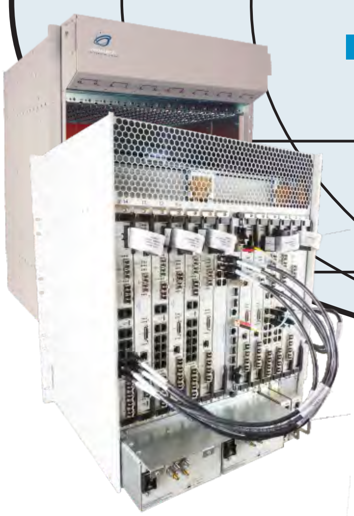
Very Large Number of STANDARD OPTIONS for Telecom Large Networks and Mission-Critical High Performance Computing www.atcaworld.com

Huawei
All-IP ATCA System
and many others
(includes AMCs)

Radisys ATCA Platforms
NFV/SDN-ready - Video Networks

ATCA Telecom
Datacenter Server
SMART Embedded Computing
(formerly: Artesyn, Emerson, Motorola)





VadaTech
ATCA Redundant System
14 RTM's (Rear Side)
Rear Transition Modules
Deliver more Connectivity
with Less Cables

Military Mobile Communications
ATCA System
SMART Embedded Computing

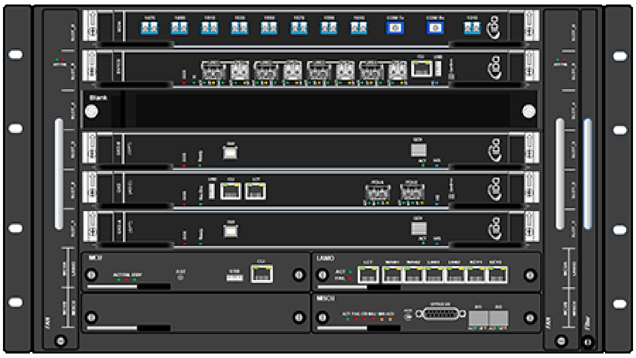
ATCA is the brain of
all Alcatel-Lucent
LTE deployments (incl. AMCs)

Nokia Siemens
ATCA Network System
(includes many AMCs)

ATCA is used in the European Union Quantum Project (2019-2021) for Communication Infrastructures Research

ATCA 19'' 6U chassis
Quantum Access Network

ATCA 19'' 6U chassis
40 Gbps Encryptor



ID Quantique and three other Swiss organisations receive funding from the European Union, as part of OPENQKD, a Secure Quantum Communication Infrastructure

October 2019 marks the launch of a 3-year European research project, named OPENQKD for Open Quantum Key Distribution, that will install test quantum communication infrastructures in several European countries. Source: Click Here

Today, we are happy to announce that ID Quantique has been selected together with Mt Pelerin, the University of Geneva and the Services Industriels de Genève by the European Union for its OPENQKD research project.
Funded by the EU with €15 million, the purpose of OPENQKD is to create and test on the continent communication network infrastructures with a built-in quantum element, known as Quantum Key Distribution (QKD). The secret keys distributed through QKD enable an ultra-secure form of encryption that allows data to be transmitted with a very high level of security. It will lay the groundwork for a pan-European quantum communication infrastructure that uses satellite as well as ground-based solutions. OPENQKD will boost the security of critical applications in the fields of telecommunication, finance, health care, electricity supply and government services.
To do so, the EU has selected 38 organizations from 13 countries across the continent to work on specific use cases related to their respective sectors of activity. The EU has chosen 4 partners in Switzerland, which were mentioned above and which are all based in Geneva, to work on four use cases.
ID Quantique will provide the QKD systems for the use cases in Geneva and many others in Europe.

More partners:
ATOS
ETSI
Huawei
ITL
ITU-T
SK telecom

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ATCA is used in the European Union Quantum Project (2019-2021) for Communication Infrastructures Research

... from previous page

ID Quantique and three other Swiss organisations receive funding from the European Union, as part of OPENQKD, a Secure Quantum Communication Infrastructure

1. Quantum Vault:

The Quantum Vault is a new kind of Digital Asset Custody system designed by Mt Pelerin in cooperation with ID Quantique. Earlier in June, ID Quantique announced its partnership with Mt Pelerin.
This custody infrastructure aims at providing ultra-secure storage of digital assets by financial institutions such as central banks, global custodians, cryptocurrency exchanges, and asset managers.
The Quantum Vault relies on a QKD infrastructure provided by IDQ and transported over the SIG network. By adding this extra layer of quantum-safe security on top of a bank-grade custody solution, the Quantum Vault ensures that the safe storage of private keys (the proof of a digital asset's ownership) is "Information-Theoretically Secure" (ITS). ITS means that according to information theory, such a system cannot be hacked by an external adversary even with unlimited computing power.

2. Smart Grid:

Over the next seven years, SIG will create a smart grid network to connect its 800 power stations in Geneva. Each power station will be connected to the SIG telecom optical fiber network and to SIG's electricity network operations center. To secure data transmission and detection intrusion (hackers taking control of the electricity distribution network), SIG will test quantum technology provided by IDQ in a real production and operational environment. To this end, SIG will connect five power stations to the QKD testbed and assess available QKD technologies and services offered by the consortium.

3. Secured Datacenter Replication:

SIG intends to implement a quantum-safe solution between 2 main datacenters used as primary/backup. Data replication, fail over and load balancing imply the transfer of a large amount of highly sensitive data. Communication will be secured though QKD, with two nodes being deployed. This use case will focus on demonstrating high availability, high performance and failover solutions.

4. Encryption for Long Term Storage:

Encryption is more and more often required for securing critical data. This is particularly the case for user electronic data like the one of hospital patient frequently encrypted. As such storage is long term (10 years at least, possibly during the patients' lifetimes), it is key to use state-of-the-art technologies. The University of Geneva will be evaluating the use of QKD for strong and long-term encryption by measuring the delay to re-encrypt data due to key or algorithm change. With this testbed in Geneva and its corresponding use-cases, OPENQKD will develop an innovation ecosystem and training ground as well as help to grow the technology and solution supply chains for quantum communication technologies and services.
View the full press release here.

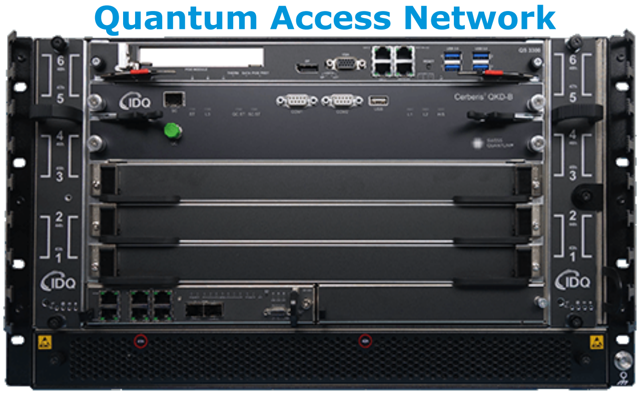
What is QKD
Quantum Key Distribution

In principle, cryptography works by using a key – such as a code – to encrypt a message. The recipient needs this key in order to decrypt and read it. However, to prevent unauthorised access to the message, there must be a way of securely sharing the key itself with the recipient.

In the next 5-10 years, infrastructure and encryption systems risk being compromised by ever more powerful computing brute force, and by advances in quantum computing. These could render all existing key encryption systems obsolete, leaving communication networks and services and sensitive data (health, financial, security and defence-related and more) extremely vulnerable. There is therefore a need to develop quantum-resistant cryptography – and QKD is a form of encryption that cannot be breached by quantum computers, thus enabling the long-term security of data and communication messages.

More precisely, QKD provides the sender and the recipient with an intrinsically secure random key that an attacker cannot access without being detected. One version of QKD is based on the phenomenon of "quantum entanglement": a pair of particles are linked to each other in such a way that any attempt to intercept one will modify the other's status. The recipient or sender will therefore be alerted immediately to this attempt.

ATCA 19'' 6U chassis
Quantum Access Network



ATCA 19'' 6U chassis
40 Gbps Encryptor

Navy relies on ATCA embedded computing system from Artesyn for upgrading Aegis weapon system

AUSTIN, Texas – U.S. Navy shipboard weapons experts needed embedded computing for upgrading the Aegis weapon system for Navy cruisers and destroyers. They found their solution from Artesyn Embedded Technologies in Tempe, Ariz.

Author: John Keller | Military & Aerospace Electronics | Jan 25th, 2018

NOTE: Artesyn Embedded Computing is now SMART Embedded Computing

Navy experts are ordering the Artesyn ATCA-7480 Quadstar 40G packet processing server blade for the latest efforts in upgrading processing capability in the Aegis weapon system being installed in new Arleigh Burke-class guided missile destroyers, says Robert Persons, senior presales architect for embedded at Artesyn.

The Artesyn ATCA-7480 is going into the Aegis Block III upgrade in an AdvancedTCA (ATCA) 14-slot chassis. The computer board has the dual-processor Intel Xeon E5-2648L microprocessor version 3. The system is specially hardened for shock and vibration for the shipboard electronics application. It runs the RedHawk Linux software operating system.

In the future this architecture is under consideration for backfits to existing Aegis systems aboard existing Arleigh Burke-class destroyers and Ticonderoga-class cruisers, says Persons, who made his comments this week in an interview at the Embedded Tech Trends conference in Austin, Texas.

The Aegis combat system uses powerful computers and radar to track and guide weapons to destroy enemy targets, including incoming ballistic missiles. More than 100 Aegis-equipped ships have been deployed in five navies worldwide. Aegis, not an acronym, refers to the shield of the mythical Greek God Zeus.

Aegis was developed by the Missile and Surface Radar Division of RCA, which after a series of acquisitions became part of the Lockheed Martin Corp. Mission Systems and Training segment in Moorestown, N.J. in 1995.
The Navy originally awarded the job to provide embedded computing for the Aegis upgrade to Artesyn in 2015, and qualified the system for installation on Navy warships in 2016, Persons says. This Aegis upgrade job could last as long as six years.

Navy officials also are considering the Artesyn ATCA embedded computing architecture for future embedded computing upgrades to the Ship Self Defense System, as well as the Surface Electronic Warfare Improvement Program (SEWIP).

For the Aegis upgrade, the Navy is swapping out IBM BladeCenter embedded computers for the Artesyn ATCA-7480 ATCA system. Navy officials expect to requalify next-generation Xeon-based Artesyn computer boards for future Aegis technology insertion, Persons says.

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Navy relies on ATCA embedded computing system from Artesyn for upgrading Aegis weapon system

... from previous page

NOTE: Artesyn Embedded Computing is now SMART Embedded Computing

Using ATCA for Aegis is part of an Artesyn project to adapt the **Network Equipment-Building System (NEBS)** design guidelines for the shipboard electronics in Navy surface warships.

Artesyn's Aegis-related work involving ATCA and NEBS is through the Navy and is not specifically tied to Lockheed Martin, Persons says. Managing the Navy's Aegis systems are officials of Naval Sea Systems Command in Washington.

The shipboard electronics environment is particularly demanding for its shock and vibration. Ship electronics must be able to withstand the effects of vibration from engines and other onboard systems, and must be able to withstand the intense shock of missile and torpedo hits.

Navy officials refresh Aegis electronics on a schedule of about every four years. **Previously designers had relied on the non-standard IBM BladeCenter architecture (*) for Aegis designs, but wanted to move toward the kind of open-systems architecture with ATCA that they previously used years ago with VME.** Aegis has been deployed by the Navy since the 1980s.

To adapt ATCA and NEBS building blocks to the Aegis Combat System, Artesyn engineers first stiffened an ATCA chassis sides and back, after having adapted the chassis top and bottom to the Aegis shock-isolated rack, Persons says.

Company experts also were able to screw boards into the chassis to resist the effects of shock and vibration. Navy officials say they would like to use this architecture aboard surface warships for eight years or more before considering new technology insertion approaches.

The Artesyn ATCA architecture for Aegis is particularly useful for adapting third-party embedded computing products, which can be modified easily for this architecture, Persons says.

For more information contact SMART Embedded Computing online at https://www.smartembedded.com/

(*) Back to the Future with ATCA Standards

As you can read here above, the NAVY and Lockheed Martin Corp. Mission Systems shifted back to ATCA for the obvious reasons as explained. ATCA has a long list of clear advantages compared to non-standard computer/server architectures. See www.atcaworld.com

More cases have been observed of shifting back to ATCA for several reasons:

1- the **NAVY** could not enter the computer room of a submarine with a new « non-standard system» because of the changed dimensions and as such they had to cut the frame of the door with a grinder

2 - similar situation at a **Chip Manufacturing Equipment** supplier, in this case they had to dismantle the machine body, several suppliers are now back to ATCA

AdvancedTCA joins the Navy

By John Walrod, SAIC

**Eleven 14-slot ATCA Systems & 3,000 High Precision Sensors
in the saltwater of the Ocean in Alaska
Lifetime of 15-year reached by now « October 2020 »**

John describes the challenges, overwhelming at times, of the SAIC engineering team's development of half a dozen AdvancedTCA instrumentation-grade products. The team's tasks included validating the prototype designs, running production, and pre-paring the first phase system, consisting of eleven 14-slot shelves and 1,500 sensors, tested and ready for installation in saltwater by the fall of 2005.

The concept of network centric military systems can trace its origins to Admiral Bill Owens, whose career included stints as the vice chairman of the United States Joint Chiefs of Staff, the president and COO of SAIC, and the president and CEO of Nortel. Not bad for a North Dakota boy with a math degree from the United States Naval Academy. In 1996, Admiral Owens introduced the seminal concept of system of systems in a national security study. He described the evolution of systems with increased connectivity among sensors, controls, computers, databases, communications, weapons, vehicles, and warfighters. In 2000, Admiral Owens authored the book "Lifting the Fog of War," a compelling case that the United States was not adequately prepared to win battles of the future.

Other Navy visionaries such as Vice Admiral Arthur Cebrowski and John Garstka further developed and espoused the concept of network-centric operations and sensor networks. So perhaps it's no surprise that the Navy is now leading the charge in AdvancedTCA deployment, arguably the best network-centric electronics platform ever invented.

Installing sensors off the Alaska coast

In 2003 my engineering team at SAIC was presented with an intriguing problem. We were asked to build and install some 3,000 sensors distributed across a remote undersea region off the coast of Alaska. The Navy required:

- High availability for mission-critical measurements
- A 15-year operational system lifetime **« reached in October 2020, call John and ATCA World »**
- Phase-synchronized sampling of all sensors to 1-degree accuracy
- Time stamped data traceable to GPS
- No use of fans for cooling

Our first thought after the surprise at this extremely challenging task wore off was that GPS receivers get lousy reception in hundreds of meters of saltwater. And we wondered how we could possibly achieve high availability and reliability with such a large system in a difficult environment.

Leveraging many techniques from fault-tolerant network-centric system design, we proposed a distributed sensor network based on a real-time Ethernet backbone in a redundant star topology, with redundant timing distribution and redundant power distribution. We recommended that the design be modular, based on open standards where practical, and, if possible, implemented in a standard form factor. We didn't know about AdvancedTCA at this stage of the project, but the Navy agreed that the architectural approach was sound from a systems engineering perspective and encouraged us to proceed with the detailed design.

Doing due diligence for an optimal solution, we reviewed VMEbus, CompactPCI, VXI, PC/104, and the many variations. Somewhere along the line, we stumbled upon a curious new standard called AdvancedTCA. There wasn't much support for this standard in late 2003, but it looked remarkably similar to the archi-tecture that we proposed to the Navy. Well, of course our first thought after the initial mind-numbing excitement was that PICMG must be conducting covert surveillance on our Navy design reviews. As the excitement subsided and more rational thought ensued, we started to wonder if we would ruin our careers by adopting a preliminary standard with no track record and limited product support for a mission-critical system of national importance.

In retrospect, we were very lucky to propose the emerging AdvancedTCA standard to the Navy at the critical design review in 2004. Little did we understand the risks, heartaches, and heartburn associated with adopting an emerging standard so early. Nor did we predict the phenomenal success that AdvancedTCA would provide in the proposed Navy system, nor the significant role that AdvancedTCA is now poised to play in future "systems of systems."

... to next page

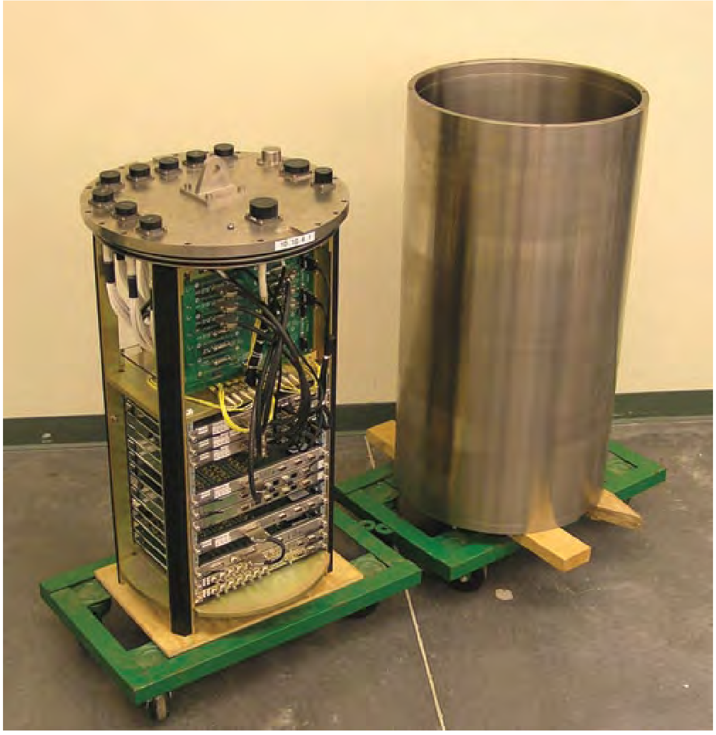
AdvancedTCA joins the Navy ... from previous page

Eleven 14-slot ATCA Systems & 3,000 High Precision Sensors
in the saltwater of the Ocean in Alaska
Lifetime of 15-year reached by now « October 2020 »

Just add saltwater

In 2004, most AdvancedTCA products were vaporware or crude prototypes. Shelf management was like the Wild West. Product availability and lead times were a gamble. While most manufacturers were still trying to figure out a decent ejector handle design, we had to finalize products and start system production. We evaluated every enclosure, backplane, and switch card we could get our hands on, which is to say, very few. And my team could not be tempted by the terrific AdvancedTCA forced-air convection features, so highly touted to reduce operating temperatures and improve reliability statistics.

« Despite the close proximity of sensitive analog circuits to noisy power, network, and computing circuits, the instrumentation noise performance was remarkably good »



"The AdvancedTCA enclosures need to be cylindrical titanium in order to withstand 2,000 psi of saltwater pressure and corrosion," said the Navy. We took a square peg in a round hole approach to this requirement, as Figure 1 illustrates.

The 4-foot long, 21-inch diameter cylindrical pressure vessels worked really well at keeping saltwater out and keeping heat in (remember, no fans). To minimize component operating temperatures, we relied on natural convection, designed conductive cooling for the main power supplies, and constantly battled trade-offs between power dissipation and nice-to-have features, like pull-down resistors. A short conductive path to 4 ºC water in the Northern Pacific certainly helped in this daunting situation. In the end, we were able to trim total consumption, including high-voltage power conversion, to a respectable 200 W per shelf. That's 200 W per 14-slot shelf, not the 200 W per card that most sane users of AdvancedTCA enjoy. As an aside, we found that low power AdvancedTCA cards have the serendipitous side effect of requiring smaller hold-up capacitors in the power entry circuit.

Based on the estimate of 200 W per cylindrical shelf, we predicted an average component operating temperature of less than 40 ºC, an acceptable temperature. As risk mitigation (that is, to stay below prescribed limits of our favorite mint antacid), we installed card cage fans for lab use only, to be turned off by remote management during operational measurements. We also installed temperature sensors on every card so we could keep a close eye on temperature.

Who spilled digital all over my nice analog circuit?

The PICMG 3.0 standard is like an engineering work of art: a beautiful topology, striking modularity, and a bold vision where form factor meets function. But somewhere along our project development, we slowly began to realize that the AdvancedTCA specification didn't have much support for low-noise analog instrumentation. However, we found that, although not explicitly stated or advertised, AdvancedTCA actually sports some nice analog features.

Given the military application, we had adopted Side 2 back panels at the beginning of the program for rugged handling. And since the Side 2 panels are electrically grounded steel, they also serve as a decent electromagnetic shield between cards. The mesh foam EMC gasket on the bottom of each card, in combination with the front face panel, also provides a nice solid metal shield across the front of the card cage. It is in this front area of the enclosure where we routed the sensitive cabling carrying hundreds of low-noise analog sensor signals. We used high-speed SCSI connectors on the front-panels to achieve high-density analog I/O. Shielded SCSI cables transported the analog signals. The bundle of 34 twisted pairs in a very-high-speed SCSI cable is designed to carry high-frequency differential signals with minimal crosstalk between pairs – a good solution for analog signals. ... to next page

AdvancedTCA joins the Navy ... from previous page

Eleven 14-slot ATCA Systems & 3,000 High Precision Sensors
in the saltwater of the Ocean in Alaska
Lifetime of 15-year reached by now « October 2020 »

The AdvancedTCA power system was not so friendly. All those -48 VDC switching power supplies on every card sharing a common power bus are like a bad analog nightmare. Each supply typically switches at a different frequency depending on load, and frequencies from multiple switchers can mix together to create renegade beat tones, creating a plethora of EMI signals. Our solution was to synchronize the switching power supplies across all cards and lock the switching frequency to GPS time, in the same manner that we phase-synchronized the A/D converter sample rates across cards. We used the dual-redundant LVDS clock bus on the AdvancedTCA backplane for timing distribution (CLK1-CLK3 on connector J20).

GPS synchronized power switching provides a couple of advantages. One, all switchers are in tune, thereby eliminating beat tones. Two, the switching frequency and harmonics where most of the EMI occurs can be forced outside of the measurement band and/or set to an integer multiple of the A/D sample rate (fs) so that the interference (n*fs) aliases to 0 Hz when digitized per Nyquist's sampling theorem. GPS synchronized power switch-ing essentially moves most of the switching power noise out of the measurement band frequencies.

Once the switching power was properly controlled, we religiously followed best practices for low-noise mixed signal design:

- Separate analog and digital planes
- Filtering of signals (for example, clocks, controls) that crossed from the digital domain to the analog domain
- Single point star ground references
- Fully differential signal paths from sensor output to A/D input
- Linear regulators for noise filtering at the final stage of power supply chains for all sensitive analog circuits

We also discovered that the isolated -48 V supplies on each AdvancedTCA card formed a sound power architecture for feeding power and test signals to remote sensors from each data acquisition card, easing the management of ground loops and signal references across thousands of distributed sensors.

Figure 2 shows an example A/D converter card with 48 channels, sample rates up to 200 kHz per channel, and 24-bit A/Ds. The layout was partitioned into Zone 1 for GPS synchronized switching power, Zone 2 for noisy digital circuits (for example, timing, multiplexing, Linux, and Ethernet protocols), and Zone 3 for low-noise analog circuits such as amplifiers, A/D converters, sensor power, and calibration signal generators. Despite the close proximity of sensitive analog circuits to noisy power, network, and computing circuits, the instrumentation noise performance was remarkably good. AdvancedTCA has come through with clean, repeatable, low-noise performance across the 3,000 channels built to date.

Happily ever after?

More remains to be told about the Real- Time Protocols (RTPs) for sensor data transport, how we distributed precision GPS time underwater, the crossing of great spans of undersea cable with fiberoptics and high voltage, the reliability statistics, fun with O-ring grease, and other tales of military intellect, mind-numbing situations, and our favorite mint antacid tablets. Alas, these stories must wait for another day.

Let us just say in closing that the system was installed in the fall of 2005, was promptly certified by the Navy for low-noise measurements, and has been running smoothly ever since. With about 2 million hours of operation on AdvancedTCA cards to date, these systems appear to be roughly following Bellcore reliability predictions and are meeting military requirements for availability and system performance.

In fact, the Alaskan system is such a success, the Navy has asked SAIC to help build and install a similar sensor network in the Atlantic Ocean in 2008. In the meantime several new projects are in operation and in development.

Acknowledgements

Thanks to Robert Downing at Stanford Linear Accelerator for having similar crazy thoughts about AdvancedTCA instrumentation, Dr. Norm Gholson at SAIC for being the best engineering boss in the world, and "The Dudes" at the Naval Surface Warfare Center who supported this work.
ATCA World (Daniel Dierickx, e2mos) had the pleasure to meet John at the ATCA Summit 2007 Santa Clara, USA.

John Walrod is an assistant vice-president for SAIC's Advanced Systems Division. He has been doing work on undersea sensor networks since such a thing existed. His accomplishments include work on the first ATM-SONET sensor networks and the first real-time Ethernet systems for shipboard sonar arrays. He frequently lectures in the United States and Europe on the topic of sensor networks.

Note: John is now at Leidos a spin-off of the SAIC's Advanced Systems Division activity.

Using AdvancedTCA and MicroTCA in High Availability Military Systems

Here is another article about: AdvancedTCA joins the Navy by J. Walrod, SAIC (published in Electronics & Computers)
« Eleven 14-slot ATCA Systems & 3,000 High Precision Sensors in the saltwater of the Ocean in Alaska »

The section about High Availability fit multiple applications:

- Military Systems
- Telecom Large & Medium Networks and Data Centers
- Industrial - Physics - Research
- Any Complex, Critical Applications and Sophisticated Systems

The complexity of military and aerospace systems is growing — more components, interfaces, power, bandwidth, processing, features, and data — and these systems are being networked to form even more complex "systems of systems." Modern networkc-entric systems can contain hundreds, even thousands of electronic modules.

The reliability, or Mean Time Between Failure (MTBF), of an electronic system is inversely related to the number of components in the system. Each component has a statistical failure rate, and the summation of all component failure rates determines the system failure rate. Large complex systems will typically have some, and possibly many, component failures over time. System engineers should embrace a new mindset where frequent component failures in large networked systems is the "normal" operating condition, rather than the "fault" condition.

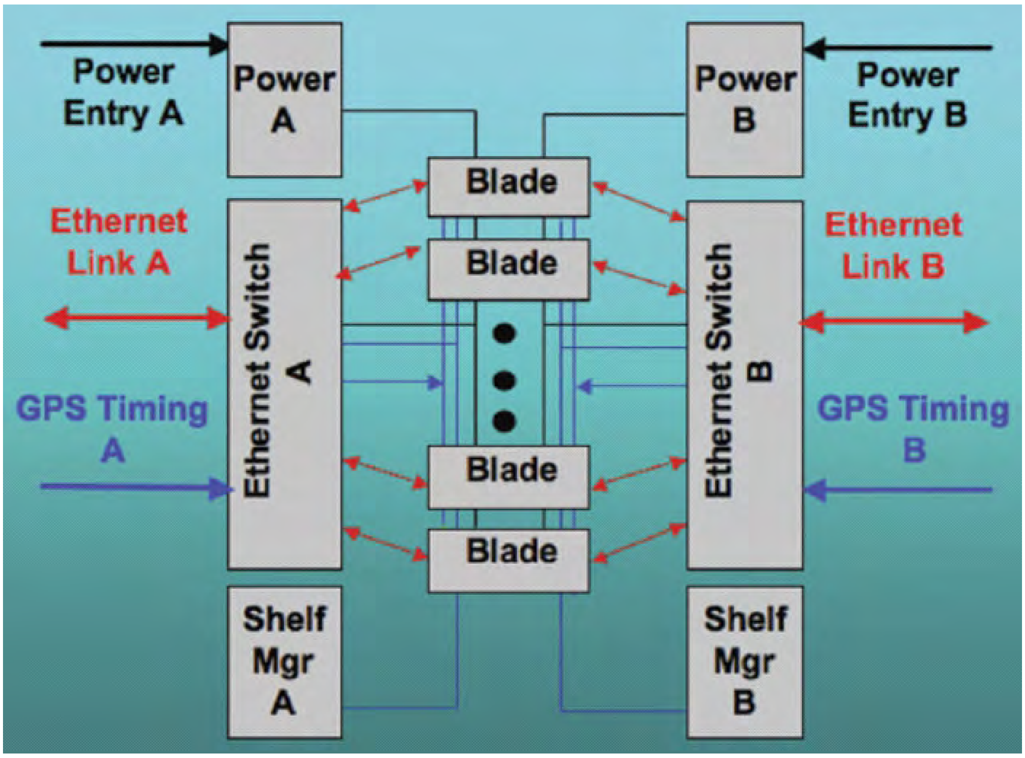


Figure 1. Simple example of a dual-star xTCA architecture platform.
Furthermore, a large system usually dissipates more heat and power. Module reliability is also inversely related to operating temperature. Simply put, modules operating at higher temperatures tend to fail more often. A rule of thumb is that the failure rate of an electronic module approximately doubles for every 10 to 20°C rise in temperature. There fore cooling is critical to system reliability. Other factors that contribute to system reliability include ESD protection, redundancy, fault localization, and fault isolation.

HIGH AVAILABILITY

Availability is typically defined as the ratio MTBF/(MTBF + MTTR) where MTTR is the Mean Time to Repair. In simpler terms, availability is the percentage of time that a system is available for normal operation, or conversely the percentage of time that the system is not broken or under repair. For example, a system that is down for one day of the year is 99.7% available, assuming 24x7 operation. A system that is down for only one hour of the year is 99.98% available.

Until recently, most high-availability systems were "hand-rolled" with proprietary architectures. The Advanced Tele - com Computing Architecture (ATCA) and MicroTCA specifications from the PICMG organization, collectively known as xTCA, have changed this regime. The xTCA platforms provide a systematic approach to building standard, reliable, modular, network-centric systems with multi-vendor support. xTCA features include redundancy, cooling, fault isolation, ESD protection, rapid MTTR, and advanced system management.

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Using AdvancedTCA and MicroTCA in High Availability Military Systems

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HA - High Availability a must for Communication Systems

Availability %	Downtime/Year	Downtime/Month	Downtime/Week
90% "one nine"	36.5 days	72 hours	16.8 hours
99% "two nines"	3.65 days	7.20 hours	1.68 hours
99.9% "three nines"	8.76 hours	43.2 minutes	10.1 minutes
99.99% "four nines"	52.56 minutes	4.32 minutes	1.01 minutes
99.999% "five nines"	5.26 minutes	25.9 seconds	6.05 seconds
99.9999% "six nines"	31.5 seconds	2.59 seconds	0.605 seconds

Availability is usually expressed as a percentage of uptime in a given year

The xTCA specifications were developed and fine-tuned to provide availability as high as 99.999%. This is equivalent to an average system downtime of less than 5.26 minutes each year, using standard commercial off-the-shelf enclosures and boards! For the first time in embedded system engineering, there is a cost effective, standard commercial approach to building high-availability systems.

THE NETWORK RULES

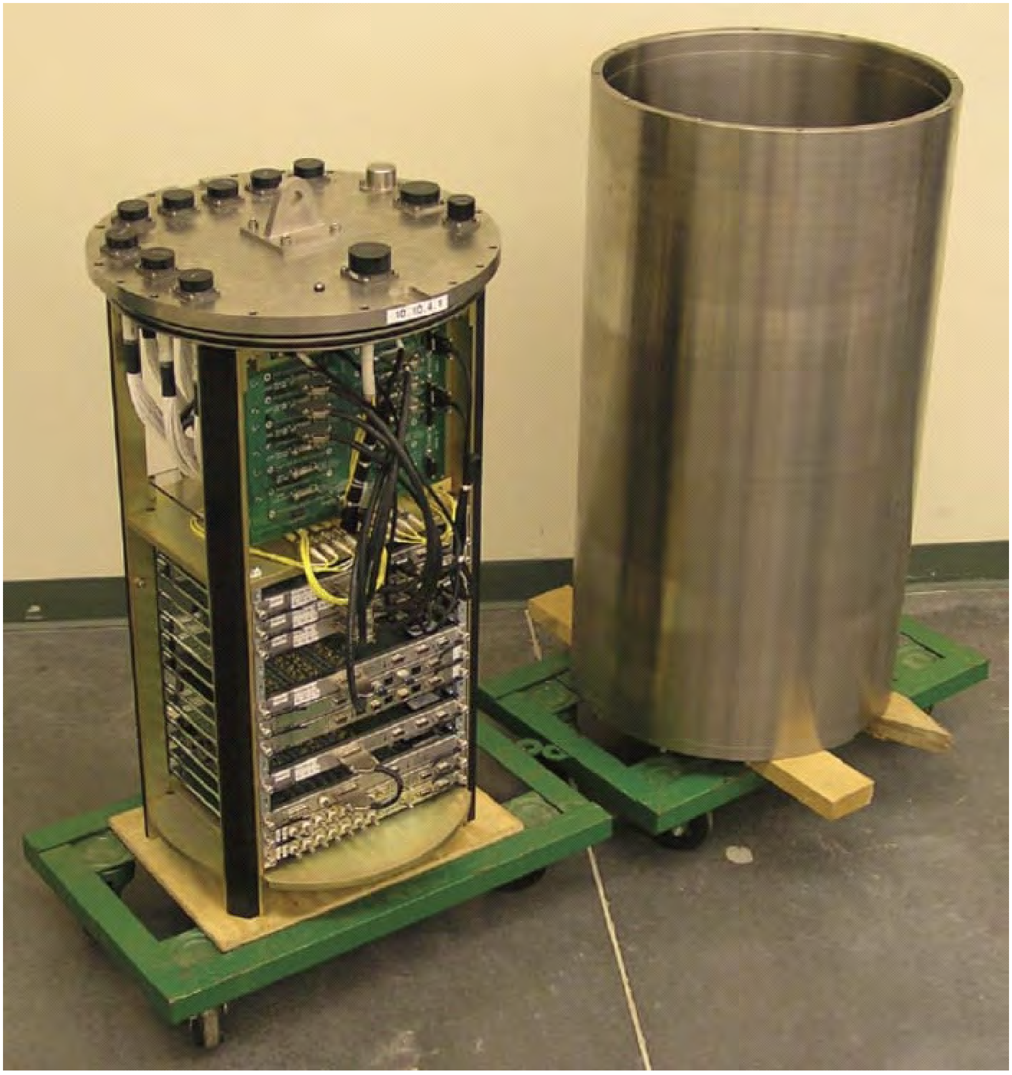

Figure 2. Fourteen-slot ATCA undersea enclosure with conductively cooled power units.

Not only does xTCA provide superb availability, it also provides an excellent open network-centric platform for modern systems. All xTCA blade slots have network connectivity with standard 1000BASE-TX dual-redundant Ethernet links to each card slot for a "base" dual-star network. In addition to the base network, the system engineer can select a platform with 1 and/or 10 Gbps high-speed "fabrics" network in dual-star and full mesh topologies. A single rackmount xTCA enclosure can support Terabits/sec of total data transport across the platform. In addition to Ethernet protocols, the xTCA platform can support protocols such as Infiniband, Fibre Channel, RapidIO, PCIExpress, and Serial ATA. Finally, front-panel ports on the blades are well suited to emerging link speeds such as 40 Gbps and 100 Gbps for state-of-the-art inter-platform networking.

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Using AdvancedTCA and MicroTCA in High Availability Military Systems

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ATTENTION TO DETAILS

To meet 99.999% availability goals, the xTCA specifications provide close attention to details. For example, cards can be hot-swapped. Ground pins connect before power pins during blade insertion. ESD strips on the blade connect discharges directly to the chassis. Ejector handle switches power down units upon ejection. Rogue cards that indicate a fault (e.g., high power or temperature) are powered down and isolated from other units. All blade power supplies are electrically isolated from the backplane power bus, and protected against over-voltage, under-voltage, and over-current. Hold-up capacitors guard against transient bus power dips such as those that might be caused by a power fault on another module on the redundant power bus. Power distribution is a modern point-of-load-architecture.

Enclosure airflows are engineered to optimize xTCA module cooling and power dissipation. The platforms support up to 200-300 Watts per ATCA blade and up to 40-80 Watts per MicroTCA blade, permitting a single rack-mount 14-slot ATCA chassis to operate nearly 3000 Watts of electronic gear in a 55°C environment. Commercial xTCA platforms generally sport redundant fans and cooling units with temperature monitoring and fan speed control. For those engineers who shun fans as a rule, low-power ATCA systems have been fielded without fans, and conduction-cooled Micro TCA systems have been demonstrated.

The xTCA specifications also raise the bar in system configuration, monitoring, and management. All commercial modules are typically heavily instrumented, with temperature, power, timing, and network health monitors. Intelligent Platform Management Interface (IPMI) defines the management protocols and architecture, with an I2C interface to each blade for communication to the shelf managers and out-of-band channels to each platform for remote management of the systems, while still supporting common in-band management protocol standards such as SNMP. Configuration reports, electronic keying, multi-tenant support, and remote configuration updates (software, firm - ware) provide leading-edge embedded system management and control.

ATCA IN THE MILITARY

More than **100 organizations currently support xTCA systems and products**. Sales of xTCA systems and products are estimated to be more than $1B annually and have been projected to reach levels **as high as $15B in the next five years.** Although much of this rapid growth is attributed to commercial telecom, wireless, and computing systems, a number of military and aerospace programs are also using xTCA platforms for high-availability network-centric systems.

In 2005, the **U.S. Navy** began using ATCA in large, networked, undersea sensor systems for the purpose of tests and measurements on submarines. **Since that time more than 35 ATCA-based systems have been built and delivered into programs for similar applications in harsh undersea environments**. An example of a 14-slot ATCA undersea enclosure with conductively cooled power units is shown in Figure 2.

Boeing selected the ATCA platform for the P-8A Poseidon Multi-Mission Maritime Aircraft program. This new Navy aircraft provides long-range support for a wide variety of operations including anti-submarine warfare, anti-surface warfare, intelligence, surveillance, battle damage assessments, and reconnaissance. The electronics suite on the Poseidon must be configurable, open, scalable, reliable, and high performance to handle a wide variety of mission requirements including electro-optic sensors, infrared sensors, signal intelligence, magnetic sensors, acoustic sensors, radar, satellite comms, surface-to-air and air-to-air comms, countermeasures, and weapons control. The aircraft essentially operates as a complex, mobile airborne sensor network and data communications hub — a great application for the versatile network-centric xTCA platform. More than 100 P8-A aircraft are now planned for production. Future network-centric aerospace platforms such as **AWACS, ACS, and BAMS** would do well to consider xTCA for their electronic payloads.

Other military ATCA developments include **high-speed adaptive radar and electronic warfare processing systems that are 1000 times faster than legacy systems**; wideband data subsystems that can switch and process multi-gigabit/sec data flows at processing rates on the order of 10 million packets per second; and antenna array digitization and beam-forming systems that can process signals at compute rates up to 15 Teraops. ATCA is clearly enabling the next-generation of reliable high-performance embedded systems.

MicroTCA ESTABLISHES A BEACHHEAD

The ATCA standard was released in 2003. MicroTCA, the small form factor relative of ATCA, was released later in 2006, but it is quickly catching on in military applications. The smaller size, lower power, and lower cost of MicroTCA make it well suited for applications where ATCA is a bit too much, **while retaining the five-nines availability**, superb system management, and high-performance networking of ATCA.

In October 2007, at the industry military communications conference MILCOM, vendors showcased a ruggedized Micro TCA chassis that has reportedly been selected by **BAE Systems for the WIN-T JC4ISR network radio**, a key component of the Army's future wireless combat system network. Information on these impressive ruggedized MicroTCA radios was also presented recently at the **ATCA Summit in Santa Clara, CA**.

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Using AdvancedTCA and MicroTCA in High Availability Military Systems

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Two commercial manufacturers have announced the development and testing of Air Transport Racks (ATRs) for MicroTCA blades. One of the vendors has announced a shock-mounted MicroTCA enclosure with military-standard shock, vibration, thermal, EMI, and EMC qualifications. The other manufacturer, Schroff, has announced a prototype ATR enclosure for conduction cooled, ruggedized, MicroTCA. These rugged enclosures will help enable new network and computing applications in rough environments.

ATR System (Air Transport Rack) from Vadatech

Conduction Cooled AMC Extreme Rugged

The success of early military ATCA systems, the emerging availability of commercial rugged xTCA products, the sophisticated network-centric xTCA architecture, and the significant cost and performance advantages of the xTCA platform should help military and aerospace system engineers develop better, more reliable systems for the future.

This article was written by John Walrod, Assistant Vice President, Advanced Systems Division, SAIC (San Diego, CA).

ATCA is a solid choice for Military Network Systems Operating in a Harsh Environment

AIRBORNE | AFLOAT | GROUND CONTROL | TACTICAL OPERATIONS

- Sheltered **Mobile Battlefield** Command-and-Control
- Scalable Computing Centers on Board **Naval Vessels**
- High Bandwidth Net-centric **Tactical Aircraft Missions**

With ATCA being tested in some of the most extreme conditions and with systems deployed in theaters of operations today, we can confidently say that the ATCA architecture is at a technology readiness level of 8-9.

Programs operating with ATCA based systems and payload boards:
- P8 Poseidon Multi Mission Aircraft (MMA) – heterogeneous blend of ATCA products from Smart Embedded Computing and other manufacturers
- Aegis Weapon System TI-16 Refresh (Smart AXP1440 & ATCA-7480)
- Ship Self Defense System TI-16 Refresh (Smart AXP1440 & ATCA-7480)
- Common Ground Station for UAVs
- DARPA ASW Continuous Trail Unmanned Vessel (ACTUV)

ATCA is a solid choice for network systems operating in a harsh environment but not requiring full military ruggedization. Ideal applications include sheltered mobile battlefield command-and-control, scalable computing centers on board naval vessels, and control and other computing systems for high bandwidth net-centric tactical aircraft missions.

By virtue of its almost universal adoption in the telecoms equipment industry, the ATCA standard has proven itself to be the most successful open, bladed architecture for high-performance, ultra-reliable network computing.

Its compact, light and power-efficient design and moderate ruggedness makes it the ideal choice for military, aerospace and security equipment makers who want to take advantage of the latest processor technology in shock, vibration and heat-resistant design.

Other Military Applications include:
- Network Data Analytics
- Radar Data Processing
- Weapons Control
- Shipborne Data Center
- Ad Hoc Cellular Networks
- Airborne User Stations
- Drone Control

High Energy Physics Research Centers are using MicroTCA & ATCA including leaders: CERN - DESY – SLAC

Check it on Google: type CERN or DESY or SLAC plus ATCA and MicroTCA

The ATCA & MicroTCA Standards and Features are fitting perfectly the requirements of the High Energy Physics Research Centers

ATCA & MicroTCA Unmatched Standard Features Set

- HA High Availability Five Nines 99,999%
- Application-ready Redundant Systems
- Open Modular STANDARDIZED Blade Architectures
- Multi-vendor - Mix-and-Match - Not Locked in ONE Vendor
- Best CAPEX OPEX TCO
- In-service UPGRADE HW & SW (Board swap NOT the entire System)
- Reduces Power Consumption by more than 70%
- Much Smaller Footprint
- Larger Capacity
- High Integration
- Higher Throughput
- Large Choice of Standardized Options (AMC and Carriers)
- Connectivity in abundance via Rear Transition Module (RTM)
- Systems & Boards Deployed Worldwide
- Freedom "Make or/and Buy" at any time back and forth
- .... and more

1U MicroTCA
12 Single AMC 's or 6 Double AMC 's

8U MicroTCA
Mix 24 Single & Double AMC 's
Full redundancy - RTM 's
RTM = Rear Transition Module

14-Slot ATCA System
Full redundancy
here in picture
with 12 AMC 's

Rear view
here in picture
with 14 RTM 's

Research Centers need a lot of Functions like: RF, Analog, Large FPGA, Specials and Connectivity

Those functions are available from:
- Vadatech : Complete product range - Over 350 AMC Cards
- CommAgility : RF and DSP Specilist
- Concurrent Technologies
- N.A.T.
- Pentek : DSP, SW Radio, Data Acq., RF, High Speed Digital, Analog

See next page

Specifications - All Products are Standardized

This series of specifications incorporates the latest trends in high speed interconnect technologies, next generation processors and improved reliability, manageability and serviceability.

Please visit PICMG

... to next page

High Energy Physics Research Centers are using MicroTCA & ATCA including leaders: CERN - DESY – SLAC

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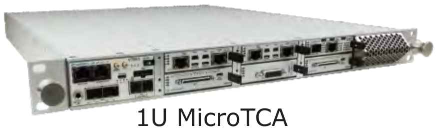
I/O Options and Connectivity for « MicroTCA Systems »
RF, Analog, Large FPGA, Specials ... and more
All-based on the same AMC Standardized Architectures

Standard data interconnects are supported, including Ethernet, PCI Express, Serial Rapid I/O and Fibre Channel.



1U MicroTCA
12 Single AMC 's or 6 Double AMC 's

8U MicroTCA
Mix 24 Single & Double AMC 's
Full redundancy - RTM 's
RTM = Rear Transition Module

More Chassis
Click Here

AMC Cards: over 500 Standard AMC Cards available

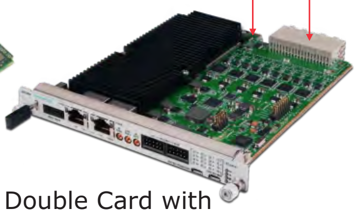
3 formats, all 3 with the same system bus connection
- Single
- Double
- Double with µRTM Connector (RTM = Rear Transition Module)

same system bus connection for all modules

µRTM Connector

Single Card

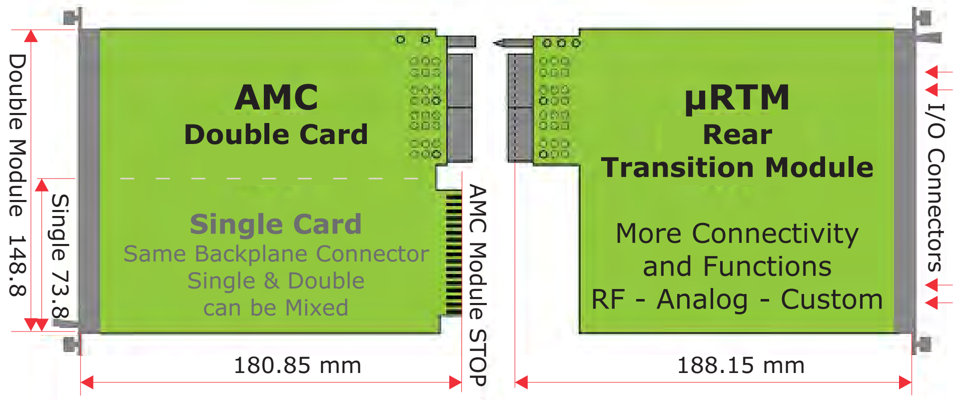
Double Card



Double Card with µRTM Connector

µRTM - Rear Transition Module for more Connectivity and Options

Chassis for Double AMC Cards can accommodate µRTM 's offering unlimited options including custom



Example
AMC Card 10-Channel ADC
Vadatech AMC520

Example
µRTM Card for AMC520
Vadatech MRT520

AMC Cards - Example of Vendors
- Vadatech : Many Functions CPU - I/O - Storage, 350+ Cards
- CommAgility : RF and DSP Specialist
- Concurrent Technologies
- N.A.T.
- Pentek : DSP, SW Radio, Data Acq., RF, High Speed Digital, Analog

NOTE: AMC's are used in MicroTCA & ATCA
- MicroTCA: for Basic Computing & I/O
- ATCA: as Mezzanines via a Carrier Card

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High Energy Physics Research Centers are using MicroTCA & ATCA including leaders: CERN - DESY – SLAC

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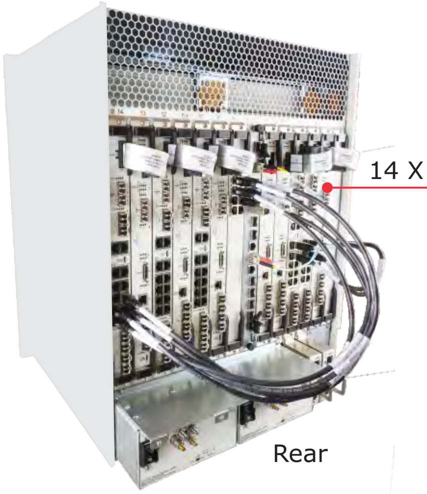
I/O Options and Connectivity for « ATCA Systems »
RF, Analog, Large FPGA, Specials ... and more
All-based on ATCA and/or AMC Standardized Architectures

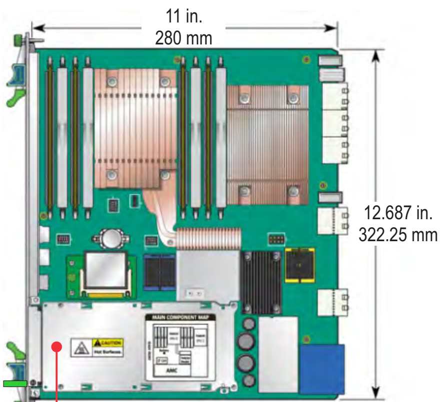
Standard data interconnects are supported, including Ethernet, PCI Express, Serial Rapid I/O, Fiber Channel and IPv6



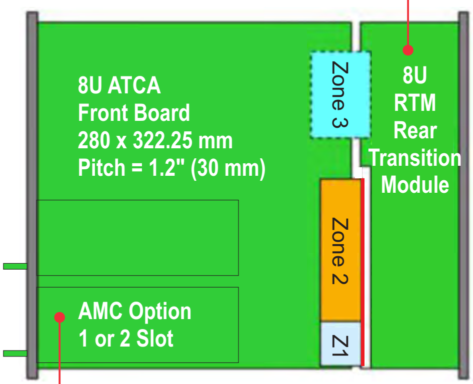
14-Slot ATCA System - Full Redundancy
Here in picture with 12 AMC's (via Carrier Board) and 14 RTM's (RTM = Rear Transition Module)

3U ATCA-MicroTCA Hybrid Chassis
with 8 AMC's and 2 ATCA RTM's (RTM = Rear Transition Module)

RTM Modules



ATCA Front Board



AMC Modules

Rear Transition Modules - RTM
Connects directly to ATCA Front Board (Zone 3)
Size: 8U x 70 mm
Board width 6HP (1.2")
Alignment/Key pins
Zone 1: Management and Power
Zone 2: Base Interface and Fabric Interface
Zone 3: Interface to RTM size and connectors

ATCA Systems - Example of Vendors

- Radisys
- SMART Embedded Computing
- Vadatech

ATCA Boards (CPU - Switch - I/O) - Example of Vendors

- Radisys
- SMART Embedded Computing
- Telco Systems: 100G Switch and Line Cards
- Vadatech

AMC Cards - Example of Vendors

- Vadatech : Many Functions CPU - I/O - Storage, 350+ Cards
- CommAgility : RF and DSP Specialist
- Concurrent Technologies
- N.A.T.
- Pentek : DSP, SW Radio, Data Acq., RF, High Speed Digital, Analog

Large choice of RTM
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Market Segments Examples covered Worldwide

Electronic OEMs - Equipment Manufacturers - Embedded Applications

- Industrial Automation • Transportation • Medical • Energy • Infotainment • Vision
- Defense & Aerospace (Top 100 Contractors mainly USA, Europe, Israel) • Automotive • Agriculture
- IoT Internet of Things • AI Artificial Intelligence
- Communications • Edge Computing • Industry 4.0 • Physics • Research

Telecom IT and Video Networks Equipment Manufacturers "TEMs"

- HPC Servers • Appliances • Data Center • Cloud • RAN • Security • Storage
- Digital Video • Digital TV • Media Networks • Video Severs • OTT • Transcoding • Streaming
- Broadband Broadcast IoT AI Convergence

Telecom Service Providers "TELCOs": CSPs - DSPs - MSOs Cable/Fiber/Optical

900 Service Providers Worldwide from 200 Countries - The Key Contacts are in our Database

YES it is a lot, but in 40 Years you can do a lot !