ABOUT ATRENNE INTEGRATED SOLUTIONS

Atrenne Integrated Solutions® is a vertically-integrated, component and system provider serving aerospace, defense, computing, communications, and other technology-driven industries. Atrenne delivers integrated components, electronic packaging, fabricated metal, electronic assemblies and value-add build-to-print manufacturing services to industrial markets across the globe. With more than 40 years of experience, Atrenne provides innovatively engineered products and services throughout the program lifecycle, from concept to manufacturing to obsolescence management. Atrenne is proud to provide customers with fully-tested, reliable, electromechanical solutions on-time and with world-class quality.
INTRODUCTION

Chances are that at this stage of your system development you have already selected your software environment and defined key elements of the chassis architecture as well as key requirements for your payload.

As the industry’s leading supplier of rugged COTS embedded computing modules, backplanes, and chassis, Atrenne Integrated Solutions is uniquely positioned to help you optimize the selection of COTS and Modified COTS (MCOTS) elements in order to minimize your risk and speed your development schedule.

No matter what your system needs or how you plan to cool it, Atrenne is ready to assist you with expert guidance and support from end-to-end. Whether you are building a development, demonstration, or deployable application, and whether you need it air-cooled, conduction-cooled, liquid-cooled, or even want to use AFT, we can be your one-stop shop. If you prefer to develop the chassis in-house, we can still help you with a backplane solution.

BACKPLANE CATEGORIES

Backplanes come in many shapes and sizes, and handle a wide range of signal integrity, connectivity, mechanical, standards compliance, environmental, and electronic criteria. This guide explores three broad backplane categories:

- **COTS Backplanes**: These can be OpenVPX®, VITA67 OpenVPX, VXS, VME64x, CompactPCI® (cPCI), or hybrids.
- **Modified COTS Development Backplane Solutions**: intended for benign and/or lab environments; these can be OpenVPX, VITA67 OpenVPX, VXS, VME64x, cPCI, or hybrids, and may also be 3U/6U hybrids and/or mixed pitch.
- **Rugged Backplane Solutions**: intended for ruggedized applications; these are often modified for application-specific requirements.

SIGNAL INTEGRITY CRITERIA

Signal Integrity is a key chassis criteria and is particularly critical with high speed serial fabric interconnects (e.g. OpenVPX). Other important signal integrity criteria that need to be defined up-front include:

- What types of high speed serial fabric connections (e.g. Ethernet, Serial RapidIO®, PCI Express®, InfiniBand™, Aurora™) are required on the backplane?
- What baud rates are required on the backplane’s high speed serial fabric connections? Higher baud rates greatly increase signal integrity challenges, leading to program risk that needs to be managed.

Atrenne is the market leader in OpenVPX; we can help you manage and reduce your signal integrity risk with Gen-2 and emerging Gen-3 applications.
WORKING WITH GEN-3 OPENVPX

New OpenVPX designs are rapidly moving to new Gen-3 signaling rates. Achieving a robust OpenVPX solution at Gen-3 signaling rates of >10 Gbaud is a daunting task that requires advanced modeling tools, high speed signaling know-how and expertise. As the market leader in OpenVPX modules, backplanes, chassis, and system solutions, Atrenne has made significant investments in Gen-3 OpenVPX signal integrity analysis of variations in:

- PCB laminates
- Weave effects
- Impedance tolerances
- Trace geometries
- Via geometries
- Atrenne proprietary Signal Integrity methods used to minimize return loss, crosstalk, and mode conversion.

Our investment in signal integrity research, make Atrenne uniquely qualified to ensure reliable operation at Gen-3 signaling rates. If signal integrity isn’t addressed appropriately the result can be system development problems that wreak havoc on your program. To help you understand the challenges of designing with Gen-3 OpenVPX please download our new white paper: The Importance of Signal Integrity: Achieving Robust Gen 3 >10 Gbaud Signaling in OpenVPX Systems.

OPENVPX INTEROPERABILITY

In the halcyon days of VME, any VME64x card could be used in any VME64x backplane, and all of the system slots provided the same pinout for the VMEbus. This made life relatively simple, as a VME chassis could often be used for many different applications that required different payloads.

OpenVPX is significantly different from traditional VME, and that difference is game-changing. There is no such thing as a “generic OpenVPX backplane” that is suitable for all applications – with OpenVPX, backplane selection is application dependent. Here are some key ways in which designing with OpenVPX is different:

- Many OpenVPX backplanes have slots with different pinouts (e.g. payload slots and switch slots) and those slot pinouts, called “Slot Profiles,” often differ from one another
- The selected OpenVPX modules must be compatible with the backplane Slot Profiles while Module Profile fabric types and baud rates must be compatible both with the backplane and with the other modules being used in the system
- The system interconnect needs to be determined at the beginning of the development process and compatible modules and backplanes need to be selected (or developed)

As the market leader in OpenVPX modules, backplanes, chassis, and system solutions, Atrenne has the expertise and know-how you need to ease and speed the selection of the right OpenVPX modules and backplanes for your application. To learn more, please see our new white papers for more information:

- Special Report: Avoid 4 Common Pitfalls of Designing an OpenVPX System
- OpenVPX Interoperability and Rugged Signal Processing

BUILD-TO-PRINT BACKPLANES

Atrenne also offers build-to-print backplane manufacturing services. We have extensive experience building backplanes and circuit card assemblies that support VPX, PCI, VME, CompactPCI, uTCA and aTCA platforms. We can provide design support and development, prototype manufacturing, obsolescence management, molded and metal fabrication, and a variety of finishing options.
# COTS BACKPLANES

Atrenne offers a wide range of COTS backplanes, below are some examples of our COTS solutions.

<table>
<thead>
<tr>
<th>6U OPENVPX BACKPLANES</th>
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</thead>
<tbody>
<tr>
<td>• OpenVPX (VITA 65), VPX (VITA 46.x/48.1) and Hybrid VME64x/VPX</td>
</tr>
<tr>
<td>• Slot Count: up to 16 slots, 1.0” pitch.</td>
</tr>
<tr>
<td>• Stiffeners placed every other slot to ensure backplane rigidity</td>
</tr>
<tr>
<td>• Signal Integrity compliant per VITA 68</td>
</tr>
<tr>
<td>• Gen-3 models rated up to 10.3 Gbaud</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>6U VXS BACKPLANES</th>
</tr>
</thead>
<tbody>
<tr>
<td>• VXS (VITA 41.x) and Hybrid VME64x/VXS</td>
</tr>
<tr>
<td>• Slot Count: up to 21 slots, 0.8” pitch</td>
</tr>
<tr>
<td>• Atrenne Integrated Solution’s superior signal integrity built-in VMEbus tested to 320 Mbytes/s</td>
</tr>
<tr>
<td>• ANSI/VITA 1.7-2003 increased current level</td>
</tr>
<tr>
<td>• ANSI/VITA 1.5-2003 2 eSST</td>
</tr>
<tr>
<td>• Stiffeners placed every two slots for rigidity</td>
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</tbody>
</table>

<table>
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<tr>
<th>6U VME64X BACKPLANES</th>
</tr>
</thead>
<tbody>
<tr>
<td>• VME64x/(ANSI/VITA 1.1)</td>
</tr>
<tr>
<td>• Slot Count: up to 21 slots, 0.8” pitch</td>
</tr>
<tr>
<td>• Atrenne Integrated Solution’s superior signal integrity built-in VMEbus tested to 320 Mbytes/s, 2eSST</td>
</tr>
<tr>
<td>• ANSI/VITA 1.5-2003 2 eSST</td>
</tr>
<tr>
<td>• Stiffeners placed every three slots for rigidity</td>
</tr>
<tr>
<td>• ANSI/VITA 1.7-2003 increased current versions</td>
</tr>
<tr>
<td>• ANSI/VITA 31.1 gigabit Ethernet versions</td>
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<table>
<thead>
<tr>
<th>6U VME BACKPLANES</th>
</tr>
</thead>
<tbody>
<tr>
<td>• VME (ANSI/IEEE 1014-1987)</td>
</tr>
<tr>
<td>• Slot Count: up to 21 slots, 0.8” pitch</td>
</tr>
<tr>
<td>• 6-layer and high performance 10-layer versions</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>3U OPENVPX BACKPLANES</th>
</tr>
</thead>
<tbody>
<tr>
<td>• OpenVPX (65), VPX (VITA 46.x/48.1) and Hybrid OpenVPX &amp; VITA 67.1 RF FeedThru</td>
</tr>
<tr>
<td>• Slot Count: up to 12 slots, 1.0” and 0.8” pitch</td>
</tr>
<tr>
<td>• Signal Integrity compliant per VITA 68</td>
</tr>
<tr>
<td>• Gen-3, models rated up to 10.3 Gbaud</td>
</tr>
</tbody>
</table>
### 3U COMPACTPCI BACKPLANES
- PICMG 2.0 R3.0, cPCI
- PICMG 2.1 R1.0 Hot Swap
- Slot Count: up to 8 slots, 0.8” pitch
- 33 MHz & 66 MHz versions
- 3.3V & 5V (I/O) versions

### 6U COMPACTPCI BACKPLANES
- PICMG 2.0 R3.0, cPCI
- PICMG 2.1 R1.0 Hot Swap
- Slot Count: up to 8 slots, 0.8” pitch
- 33 MHz & 66 MHz versions
- 3.3V & 5V (I/O) versions
- PICMG 2.16 Ethernet Packet Switching versions

### APPLICATION SPECIFIC BACKPLANES
This section features examples of our application-specific backplane solutions, including solutions for ISR and Radar applications. These are just some of the many rugged solutions we offer.

#### HYBRID 3U/6U OPENVPX DEVELOPMENT BACKPLANE SOLUTION FOR ISR APPLICATION
- Application-specific Hybrid 3U/6U OpenVPX backplane
  - (2) 3U OpenVPX slots
  - (7) 6U OpenVPX slots
  - Connectivity based on rugged ATR backplane
  - Application-specific I/O connectors
  - I/O based on rugged ATR backplane

#### 3U OPENVPX TEST BACKPLANE AND I/O PANEL FOR RADAR APPLICATION
- Application-specific 2-slot 3U OpenVPX backplane from ATR Solution
  - Connectivity to match ATR
  - I/O signals to match ATR
- I/O board
  - Early access version from ATR
  - I/O connections to match ATR Solution
  - 38999 I/O connectors to match ATR
**HYBRID 3U/6U OPENVPX DEVELOPMENT BACKPLANE SOLUTION FOR ISR APPLICATION**

- Application-specific Hybrid 3U/6U OpenVPX backplane
  - (14) slots 6U OpenVPX
  - (2) slots 3U OpenVPX
  - Pass-through I/O connections
  - Rear VPX+ cables

**14-SLOT 3U VPX ACTIVE DEMONSTRATION BACKPLANE SOLUTION FOR ISR APPLICATION**

- Application-specific 3U VPX backplane:
  - (14) 3U VPX mixed pitch 1.1” and 2” pitch slots
  - 6 Gbaud signaling rates
  - Active backplane with FPGAs on the backplane

**8-SLOT HYBRID 3U/6U OPENVPX VITA 67 DEVELOPMENT BACKPLANE FOR ISR APPLICATION**

- Application-specific 3U/6U OpenVPX backplane
  - (2) 6U OpenVPX slots
  - (6) 3U OpenVPX slots
  - VITA 67.1 and VITA 67.2 RF feed-through on selected slots
  - VPX+ cabling to VPX RTM connectors

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**RUGGED BACKPLANE SOLUTIONS**

This section features examples of our rugged backplane solutions, including solutions for EW, ISR, and Radar applications.

**ALTERNATIVE SOLUTIONS FOR DEPLOYED ATR I/O CABELING**

- Connectorized backplane interconnect to ATR front panel CCA
- Designed into application-specific backplane and I/O panel CCA
- Also use flex circuits when appropriate
4-SLOT SHIPBORNE HYBRID VME64X/VXS BACKPLANE SOLUTION FOR EW APPLICATION

- 4-slot hybrid VME64x/VXS backplane
  - (1) VXS Switch Slot
  - (2) VXS Payload Slots
  - (1) VME64x Slot
  - Application-specific I/O signals & I/O connectors
- 0 to +50ºC operating
- Shipborne above deck application with Salt Fog requirements
- EMI: MIL-STD-461F

8-SLOT VXS BACKPLANE SOLUTION FOR ISR APPLICATION

- Application-specific 8-slot VXS backplane
  - (2) VXS switch slots
  - (6) VXS payload slots
- 0 to +40ºC operating
- 0 to 20 kft operating
- EMI: MIL-STD-461

RUGGED 20-SLOT HYBRID VME64X/VXS BACKPLANE SOLUTION FOR EW APPLICATION

- Hybrid 20-slot application-specific VME64x/VXS backplane
  - (8) slots VME64x
  - (2) VXS switch slots
  - (8) VXS payload slots
- One of 3 different application-specific backplane configurations with different hybrid mixtures and different I/O

RUGGED 20-SLOT RF BACKPLANE SOLUTION WITH RF BLIND MATE THROUGH BACKPLANE

- 20-slot 6U application-specific backplane
- RF coax contacts feed-through the backplane to Rear I/O and Rear RF Components to 8 GHz
### RUGGED 10-SLOT CPCI BACKPLANE SOLUTION FOR SIGINT APPLICATION

- 10-slot Application-specific CompactPCI Backplane
- Application-specific connectivity to RESET (9) cPCI slots via SNMP
- Application-specific connectivity to monitor (10) cPCI board HEALTHY* pins

![SOLUTION 907-73](image)

### RUGGED SMALL FORM FACTOR ATR 3U OPENVPX BACKPLANE SOLUTION FOR ISR APPLICATION

- 7-slot 3U OpenVPX backplane
  - (5) 3U OpenVPX Backplane slots
  - Central Switch topology
  - 6.25 Gbaud Signaling
  - (2) 3U Power Supply slots
- I/O panel
  - EMI filtering
  - 38999 I/O connectors
  - -40 to +55°C operating
  - Altitude: 28 kft operating
  - EMI/EMC: MIL-STD-461E

![SOLUTION 32-131](image)

### 3U 6-SLOT OPENVPX ATR BACKPLANE & I/O PANEL SOLUTION FOR RADAR APPLICATION – RTCA/DO-160 LIGHTNING PIN INJECTION

- Application-specific 3U 6-slot Hybrid OpenVPX/cPCI backplane
  - (2) slots 3U OpenVPX
  - (1) slot 3U cPCI
  - (2) slots for future expansion
  - (1) slot for application-specific power supply
- I/O panel circuit board
  - Protection circuitry for severe RTCA/DO-160 Lightning Pin Injection
  - EMI filtering
  - 38999 I/O connectors
  - -45 to +71°C operating
  - 0 to 25 kft operating

![SOLUTION 89-90-176 FRONT AND BACK](image)

### HYBRID 11-SLOT 3U/6U 6U OPENVPX ATR BACKPLANE SOLUTION FOR ISR APPLICATION

- Hybrid 11-slot 3U /6U mixed pitch OpenVPX backplane
  - (2) 3U OpenVPX slots
  - (7) 6U OpenVPX slots
  - (2) Power Supply slots
  - PCIe, GigE, SATA fabrics
  - I/O signal conditioning on backplane
  - -40 to 55°C operating
  - Altitude - 50,000 ft operating
  - Shock - 20Gs, 11ms
  - Vibration - 4.74Gs RMS
  - EMI/EMC: MIL-STD-461E

![SOLUTION 58-151](image)
7-SLOT VXS ATR BACKPLANE SOLUTION FOR EW APPLICATION

- Application-specific 7-Slot VITA 41 VXS backplane with I/O Provisions
  - (5) VXS Payload Slots
  - (1) VXS Switch Slot
  - (1) Application-specific Power Supply Slot — application-specific pitch
- Signal Conditioning on backplane
- EMI: MIL-STD-461

HYBRID 3U/6U 12-SLOT OPENVPX ATR BACKPLANE SOLUTION FOR ISR APPLICATION

- Hybrid 3U/6U 12-slot OpenVPX ATR Backplane
  - Active circuitry on backplane
  - (10) 6U OpenVPX slots, 1.0” pitch
  - (2) 3U OpenVPX slots, 1.0” pitch
- -40 to +40°C operating
- 0 to 35 kft operating

16-SLOT 6U OPENVPX GEN3 ATR BACKPLANE SOLUTION FOR ISR APPLICATION

- 16-slot 6U OpenVPX Gen-3 ATR Backplane:
  - Central Switch Topology
  - (2) 6U OpenVPX Switch Slots
  - (11) 6U OpenVPX Payload Slots
  - Ultra High Speed Gen-3 >10 Gbaud signaling
  - (3) 6U VITA 62 Power Supply Slots

10 GBAUD GEN-3 OPENVPX BACKPLANES

- PCI Express Gen-3 (8 GHz)
- 40 Gb Ethernet (4x10GHz)
- USB 3.1 (10 Gbps)
- Infiniband QDR and FDR-10
### 6.25 GHZ GEN-2 / GEN-1 OPENVPX BACKPLANES

- VPX data/expansionplane support for Gen-2, 6.25 Gbaud backplanes compatible with:
  - Serial RapidIO® (SRIO) Gen-2
  - InfiniBand® DDR
  - PCIe Gen-2
- VPX data/expansion plane support for Gen-1, 3.125 Gbaud backplanes compatible with:
  - SRIO Gen-1
  - 10 GbE (10Gbase-BX4, 10Gbase-KX4)
  - PCIe Gen-1
- Central, distributed and pass-through topologies
- 3U and 6U with varied slot counts
- Compatible with Atrenne lab development chassis and ready for deployment in rugged applications.

### 6U VXS VITA 41.X BACKPLANES

- Adds high-speed serial fabric while maintaining VME P1 and P2 compatibility
- Supports high-speed serial interfaces such as: Infiniband, Serial RapidIO, Gigabit Ethernet, PCIe Express.
- Able to support system management IPMB perVITA 38

### 3U VPX BACKPLANE

- Slots: 5 3U
- 2 interchangeable I/O daughtercards for I/O flexibility
- Power supply: up to 200W per slot
- 28-layer board
Atrenne Integrated Solutions also offers a wide range of COTS development chassis and COTS rugged chassis products in different styles, and can provide Modified COTS versions of these chassis if required. To learn more, please see the contact information below and reference the resources available.

CONTACT INFORMATION

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