

Containerized Computing for Telecommunications Applications

Modular Deployment using Emerson Network Power Products

Brian Carr, Strategic Marketing Manager
Embedded Computing

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Introduction

The concept of modular deployment of equipment in pre-fabricated and pre-assembled containers or shelters has been familiar to sectors of the telecommunications industry and as a disaster recovery strategy for some time now, but this modus operandi has recently received wider publicity in the IT industry. Announcements by Microsoft and Google have brought the concept of a containerized or “modular” data center to a wider audience, and there is growing interest in this concept as a means of fast and efficient deployment of computing resources where they may be needed temporarily, or even as a cost-effective and speedy replacement for brick-and-mortar data centers.

Deploying any sort of equipment, let alone hundreds of high-powered servers, in an enclosed space such as a container or shelter is a big challenge for the power and cooling infrastructure. At the same time, there is a strong industry push for power and cooling to be more efficient in responding to society’s continuing demand for more computing and telecom resources to satisfy our “always-on” lifestyle aspirations.

As a leading supplier of power and cooling infrastructure, Emerson Network Power is at the forefront of providing solutions to these issues. At the NXTcomm 2008 industry show in Las Vegas, Nevada, Emerson displayed a range of capabilities for use in modular or containerized solutions, illustrating its ability to construct “a central office in-a-box.” This article explains the principal elements of a containerized system (for networking or computing) and identifies Emerson’s solution within each function.

The Interest in Modular Solutions

There are a number of situations where modular deployments are an optimum solution:

Speed of deployment – a factory pre-tested, totally integrated solution will be much faster to get up and running on site than starting from scratch with the individual equipment. Furthermore, it is easier to deploy in remote locations where site work is challenging.

Disaster recovery – the “ready-to-go” nature of pre-tested modular units make them especially suitable for disaster recovery following an incident, or even for temporary or permanent “hot-spot” relief.

Ease of expansion, upgrade and scalability – when deployed as modular units, individual units can be added to provide more capability or capacity, and can easily be replaced by higher performance units when upgrade is needed.

Easier planning and permitting – often the planning process for new buildings is long, drawn out and expensive. A modular solution can get around this problem by being a less overtly permanent structure, and therefore easier to permit.

In total, a pre-tested modular solution enables an easier and faster deployment, and even if complex, ensures a low total cost of ownership due to reduced build and service demands.

Considerations when Building a Modular Unit

The functions required to build a central office in a box are, unsurprisingly, the same sort of capabilities required in a more permanent installation. Depending on the application, some of the functions described below can be provided at the deployment site. For example, chilled water may already be available from an on-site cooling plant. However, the principal functions that need to be considered are:

- Power Input Management
- Power Conversion and Protection
- Environmental Conditioning and Cooling
- Equipment Racking
- Embedded Computing and Networking Equipment
- Shelters and Enclosures

Emerson’s “grid-to-chip” solution provides any or all of these needs, offering simplicity of supply along with integration services.

Power Input Management

The power input component manages all the incoming power feeds to provide a regulated power source for the rest of the equipment in the shelter. The principal requirement is to terminate the power supply from the utility company grid, and to provide a seamless switchover to a backup generator (either fixed or portable) should the supply fail.

Emerson’s Solution

Emerson Network Power offers a wide range of ASCO Power Transfer Load Centers which integrate power distribution, surge protection, remote monitoring and power transfer between utility and up to two different on-site generators. These world-class products are available in Series 300 and 7000 platforms allowing data center professionals to meet the needs of various applications. Both products are available up to 3-phase 480V supply and meet UL, ANSI, NEMA, IEC and other standards. The shallow, space-saving design provides easy access and serviceability. These products have controls and a status indicator panel for testing, engine exercising, source position and source availability status.



Figure 1—ASCO 7000 Series PTLC

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Power Conversion and Protection

Historically, telecom networking and switching equipment is powered by a -48V DC power systems. Hence for telecom networking applications, a DC power source is preferred.

However, the concept of containerized computing for data center applications is becoming more notable. Although the vast majority of computing systems in data centers are AC powered, several studies and initiatives have suggested that a DC UPS powered compute equipment installation offers significant benefits over an AC UPS solution:

1. Elimination of several conversion stages resulting in improved efficiency of the total power delivery system, especially when used with AdvancedTCA® based computing and networking (see Figure 2 below. More info on AdvancedTCA is on page 5). A DC UPS solution eliminates the following conversion stages:
 - DC to AC conversion step in AC UPS
 - Power transformation loss in AC PDU (Power Distribution Unit)
 - Chassis power supplies if ATCA is used (-48 VDC is carried directly onto the blade)
2. High availability as a result of redundancy and excellent resiliency (fault tolerance)
3. Scalability on rectifier and cabinet level
4. Space savings due to compact footprint in redundant configurations
5. Simplicity in application – no need for load balancing and elimination of harmonics

6. Safety due to low voltage
7. Ease of maintenance – hot swappable rectifier modules

This is especially relevant for systems deployed in shelters or containers since power inefficiencies show up as extra heat that has to be extracted. The batteries provide back-up power during switching to generator upon utility failure in minimum space and with reliable operation. Both computing and networking systems are usually available in both AC and DC powered variants, and AdvancedTCA equipment is natively DC powered.

Emerson's Solution

Emerson Network Power's Energy Systems business unit supplies the NetSure™ range of DC power conversion systems. Both the NetSure 701 and 801 series modular power systems are scalable to cope with the power demand of the latest networking and compute solutions, and provide the capability of backup battery power to bridge any supply interruptions.



Figure 3—NetSure 801 Power Unit and Rectifier

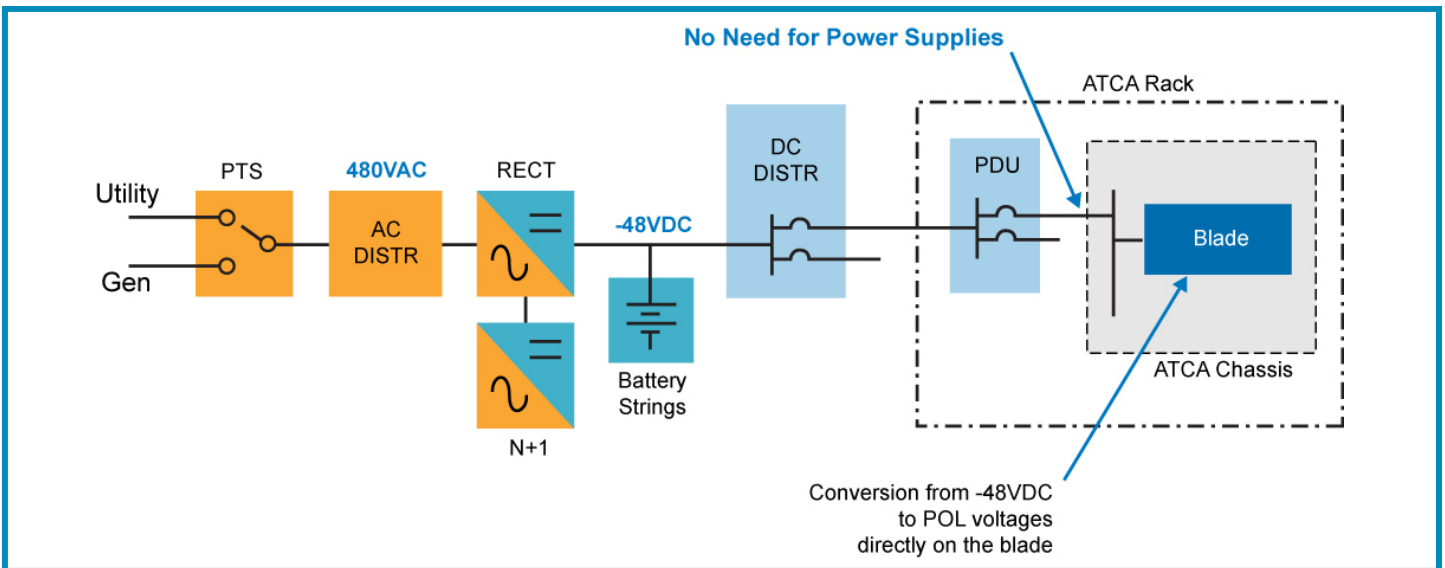


Figure 2—Power Architecture Using DC UPS

The systems all employ hot swappable 5.8kW rectifiers, offering a high overall power density together with a very high system efficiency. Hot swappable rectifiers allow improved maintenance and easy capacity expansion as demand increases.

Environmental Conditioning and Cooling

When mounting a large number of servers or other powerful networking gear in a constrained space such as a container, climate control is particularly important. The environmental control system must maintain the temperature and humidity inside the container to meet the operating parameters of the compute or networking equipment installed, and to cope with the increasingly high heat loads of modern bladed computing systems.

Emerson's Solution

Emerson Network Power, through offerings from its Liebert® business unit, is the world leader in cooling and temperature control. Liebert's Precision Cooling range is well suited to the application, featuring the XDC environmental control unit and several additional "hot spot" cooling systems that can cope with power densities of over 20kW per rack. All the Liebert XD series elements can operate with refrigerant rather than water so providing additional protection for sensitive electronic equipment in the case of a leak.



Figure 4—Liebert XDC Climate Control Unit

Equipment Racking

The type and extent of compute or networking equipment installed depends on what the shelter or container is required to do. However, whatever the task, all equipment requires installation into suitable equipment racks before the final assembled modular unit is shipped to the required location. The equipment racking must be robust enough to cope with shipping a full load of installed systems, and may need to cope with earth tremors when installed on site and operating.

Emerson's Solution

Emerson Network Power has a wide variety of racking solutions provided by its Knurr® business unit. The Miracel® range is well suited for server and networking applications, and is available in standard, heavy-duty, and EMC-proof versions. There are a range of depths to minimize the equipment footprint.

Embedded Computing and Networking Equipment

As discussed previously, the type and extent of compute or networking equipment installed depends on the application for which the shelter or container system is being deployed. There are a wide range of vendors and options for enterprise computing servers (as seen in traditional data centers) in both AC and DC forms.

The Advanced Telecom Compute Architecture (AdvancedTCA or ATCA) standard has been accepted in the telecom equipment sector and is getting significant levels of attention recently in carrier computing applications, particularly for applications that value the high reliability attributes that follow from its carrier grade telecom origins, and where DC power is used.

Although not developed to compete with enterprise computing, AdvancedTCA offers a compute density comparable to enterprise servers and has a number of potential advantages in the shelter or container environment:

Power efficiency – each individual ATCA blade is powered by a redundant -48V DC scheme standard, so particularly in conjunction with the DC power systems mentioned above, ATCA improves power efficiency by eliminating the losses in intermediate conversions and protection.

Thermal capability – typically, ATCA systems are designed to meet central office standards which include the requirement to operate at up to 55°C in case of cooling system failure.

Equipment density – ATCA systems can fit in racks that are only 600mm deep, offering more flexible equipment layout options in limited spaces.

About AdvancedTCA ...

AdvancedTCA is an open standard hardware specification developed particularly for use in telecom equipment, and intended as a means to allow telecom equipment manufacturers to buy commercial off-the-shelf platforms that meet their computing and networking needs for next generation equipment.

It is a bladed architecture supporting a wide range of processing and connectivity options in a thermally and power efficient package. It is designed for high availability applications, so features like blade-level management, latent fault detection and highly redundant enclosure topologies are built into the equipment.

AdvancedTCA now forms the basis for common platform initiatives at many top telecom equipment manufacturers, and supports a vibrant ecosystem of suppliers.

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Emerson's Solution

The Embedded Computing business of Emerson Network Power is a leading supplier of AdvancedTCA systems and blades. Platform offerings include the Centellis™ 2000 which can carry two blades, and the Centellis 4100 which can carry 12 blades with fully redundant 10GbE switch fabric hubs. Blade offerings include the latest Intel® Architecture server blades, and a range of high performance packet processing blades. Enhanced mass storage solutions, qualified for use with Emerson's ATCA servers, are available in DC powered versions from EMC.

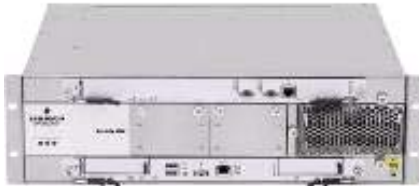


Figure 5—Centellis 2000 two-slot ATCA platform

Summary

Modular equipment deployments are considered an effective way of reducing cost and time over more traditional building methods. These deployments scale easily, and can be replaced as quickly as they were deployed. By their enclosed nature, they must be highly power and thermally efficient – thus addressing one of the biggest issues in telecom and in data centers today.

Emerson Network Power offers the complete portfolio of equipment and capabilities for use in constructing shelter or container-based systems, and can also undertake development and assembly according to customer need.

Shelters and Enclosures

In addition to all the equipment discussed already, one must consider the shelter or enclosure they are to be fitted into. The difference between a shelter and an enclosure is that a shelter is designed for walk-in access, hence it is physically big, and may feature other amenities such as lighting and power points for technician use. As stated before, a standard shipping container outline is becoming a popular choice for shelter design for modular data centers, allowing it to be carried using the same transport infrastructure as other shipments. Other aspects to be considered include physical security and other customized power and drainage requirements appropriate to the deployment site.

Emerson's Solution

Emerson Network Power has the capability to design, build, assemble and deliver shelter or container-based systems worldwide through its Energy Systems business unit. Emerson has already successfully deployed container-based systems for diverse industry segments ranging from telecom installations in Sweden to oilfield control rooms in Nigeria.



Figure 6 - Backbone Shelter for Telecom Application

The projects have been managed by Emerson from the customer needs statement, through concept and design stages, to on-site commissioning, and can include equipment integration and test as well as shelter build. This integration capability offers the best possible risk reduction for a deployment, consequently improving the commissioning time and lowering the total cost of ownership.

About Emerson Network Power

Emerson Network Power, a business of Emerson (NYSE:EMR), is the global leader in enabling Business-Critical Continuity™ from grid to chip for telecommunication networks, data centers, health care and industrial facilities. Emerson Network Power provides innovative solutions and expertise in areas including AC and DC power and precision cooling systems, embedded computing and power, integrated racks and enclosures, power switching and controls, monitoring, and connectivity. All solutions are supported globally by local Emerson Network Power service technicians.

For more information on Emerson Network Power's embedded computing products and services including ATCA®, MicroTCA™, CompactPCI®, VMEbus and OpenSAF™ for original equipment manufacturers and systems integrators in the telecommunications, industrial automation, aerospace/defense and medical markets, visit www.emersonnetworkpower.com/embeddedcomputing. Learn more about Emerson Network Power products and services at www.emersonnetworkpower.com.

Embedded Computing Regional Offices:

Tempe, AZ U.S.A. 1 800 759 1107 or +1 602 438 5720 ▪ Madison, WI U.S.A. 1 800 356 9602 or +1 608 831 5500

Shanghai, China +8610 85631122 ▪ Paris, France +33 1 60 92 31 20 ▪ Tokyo, Japan +81 3 5403 2730

Munich, Germany +49 89 9608 2333 ▪ Hong Kong, China +852 2176 3540 ▪ Tel Aviv, Israel +972 3 568 4387

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