

# EMBEDDED SYSTEMS ENGINEERING

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## Engineers' Guide to Networking & Data Center Technologies

Reliable Network  
Switching Increases  
Data Reliability

Networking Technology  
Steels Itself for  
Emerging Markets

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# CONTENTS

## EMBEDDED SYSTEMS ENGINEERING

### Networking & Data Center Technologies

Reliable Network Switching Increases Data Reliability <i>By Jarvis Wenger, MEN Micro</i>	3
Networking Technology Steels Itself for Emerging Markets <i>By Caroline Hayes, Senior Editor</i>	7

### Product Showcases

#### Hardware

##### Integrated Platforms

<b>Artesyn Embedded Technologies</b>	
<i>CG19-GPU Media Acceleration Sled</i>	10
<i>MaxCore™ Acceleration Platform</i>	10

## ENGINEERS' GUIDE TO NETWORKING & DATA CENTER TECHNOLOGIES 2017

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# Reliable Network Switching Increases Data Reliability

*It's open architecture-based systems to the rescue as both pressure to hasten time to market and the demand for reliable data transmission continue.*

By Jarvis Wenger, MEN Micro



IoT systems for data-intensive computing applications used in harsh industrial applications carry with them a range of reliability and security issues for the network components. But, secure data transmission and the networking of individual components are only two of the factors at play here. With the growing use of wireless communication methods, network switching plays a major role in computing infrastructure today.

Systems rely on a combination of wired, and increasingly wireless, Ethernet variants, audio and video transmission standards as well as legacy industry-oriented fieldbuses. Enabling separate parts, such as Ethernet protocols, components, and assemblies, to “speak the same language” results in lower costs of the application and faster time to market (Figure 1).

## OPEN COMMUNICATION BY DESIGN

Ethernet functions on the computer side range from a simple interface (device to device), via switches and routers (managing complex Ethernet networks) to gateways (interacting with devices or networks that speak different languages). This can put a lot of strain on the Ethernet network and impact performance.

In order to create fast switching Ethernet rings, some manufacturers use proprietary ‘ring protocols’, where the creating switch manufacturer owns the intellectual property and typically makes it incompatible to commonly agreed-upon standards. By contrast, systems employing commonly agreed-upon standards, like ITU-T G.8032 and ITU-T G.8031 protection switching with lower than 50 ms failover-switching time, adhere to a collaborative open systems approach.

In fact, using open industry standards in all aspects of hardware, software and communication protocols will allow you to stay vendor-independent and protected against obsolescence issues. Designed to lower non-recurring engineering (NRE) costs, MEN



Figure 1: Networking standards in today's computing systems are growing, but network switches are evolving to meet this complex environment.

Micro's network switching systems are all built on the following open standards:

- CompactPCI and CompactPCI Serial industry standards
- Commonly used copper interfaces
- Linux operating system platform
- Standard communication protocols and management protocols

## MODULARITY AIDS IN NETWORKING EFFICIENCY

Computer systems are subject to extreme cost pressures, particularly in industrial areas like automation. On the other hand, they need to be configurable. They need PCI components and fieldbus options. Ideally, everything has to come off the shelf to optimize the costs both on the manufacturer's side and on the customer's side.

Pre-configured network switching systems offer speed-to-market advantages, but may force a compromise in certain design elements,

based on the available arrangements. However, because they encompass so many standardized aspects, these open architecture-based systems can be easily adapted, and built-to-order, while still keeping time-to-market short and saving on development and integration costs.

Two additional aspects built into each system are easily customizable I/O and the ability to withstand rugged environments. This makes these modular, high-performance computing systems ready for a wide range of applications, including industrial IoT, railway, and mass transit.

**EASILY MEET NETWORKING REQUIREMENTS**

The size and complexity of computing systems can vary tremendously, which is why a modular approach can be extremely beneficial. For example, many base systems from MEN Micro use a 29 Gbit/s carrier grade switch matrix as well as include a wide operating temperature, rugged aluminum enclosure and a host of I/O options. Although each comes in a standard configuration, all network switching systems are part of the customizable built-to-order box PC line.

For systems with high data requirements, a full turnkey network switch that includes up to 25 Gigabit Ethernet ports and two power supplies for redundancy may be the ideal system. The main switch board occupies one slot, while six option boards configure front-panel

connectivity. This concept allows the unit to come with M12 A-coded and X-coded, RJ45 and SFP interfaces in mixed fiber/copper configurations (Figure 2).

But for applications with fewer data networking needs, a fully managed 8-port rugged Ethernet switch may provide the proper balance of power and performance. This managed switch provides the additional ability to configure, manage and monitor the LAN, allowing more control over how data travels through the network and who has access.

Or a network switch designed specifically as a mobile gateway can include up to six antennas on RP-TNC connectors as well as dual RF with simultaneous 2.4 GHz and 5 GHz band support. This arrangement provides reliable high-speed internet and local data connection to multiple WLAN-compatible devices. And a configurable firewall protects WLAN clients as well as supports secure and uninterrupted internet data access.

**SECURE DATA TRANSMISSION**

In addition to withstanding extreme environmental conditions and offering flexible configuration, network switching systems need to ensure data security. The application's requirements will determine what level of security is needed, and whether the information resides on an internal network platform or externally on the internet.

## PCI Express Networks

Connect GPUs, FPGAs, Processors and NVMe drives into an intelligent high speed network. Use standard PCIe to ensure compatibility and Dolphin eXpressWare™ software and hardware to provide advanced features, such as PCIe Multi-cast, remote peer-to-peer connections, and multi-processor connectivity with simplicity and speed.

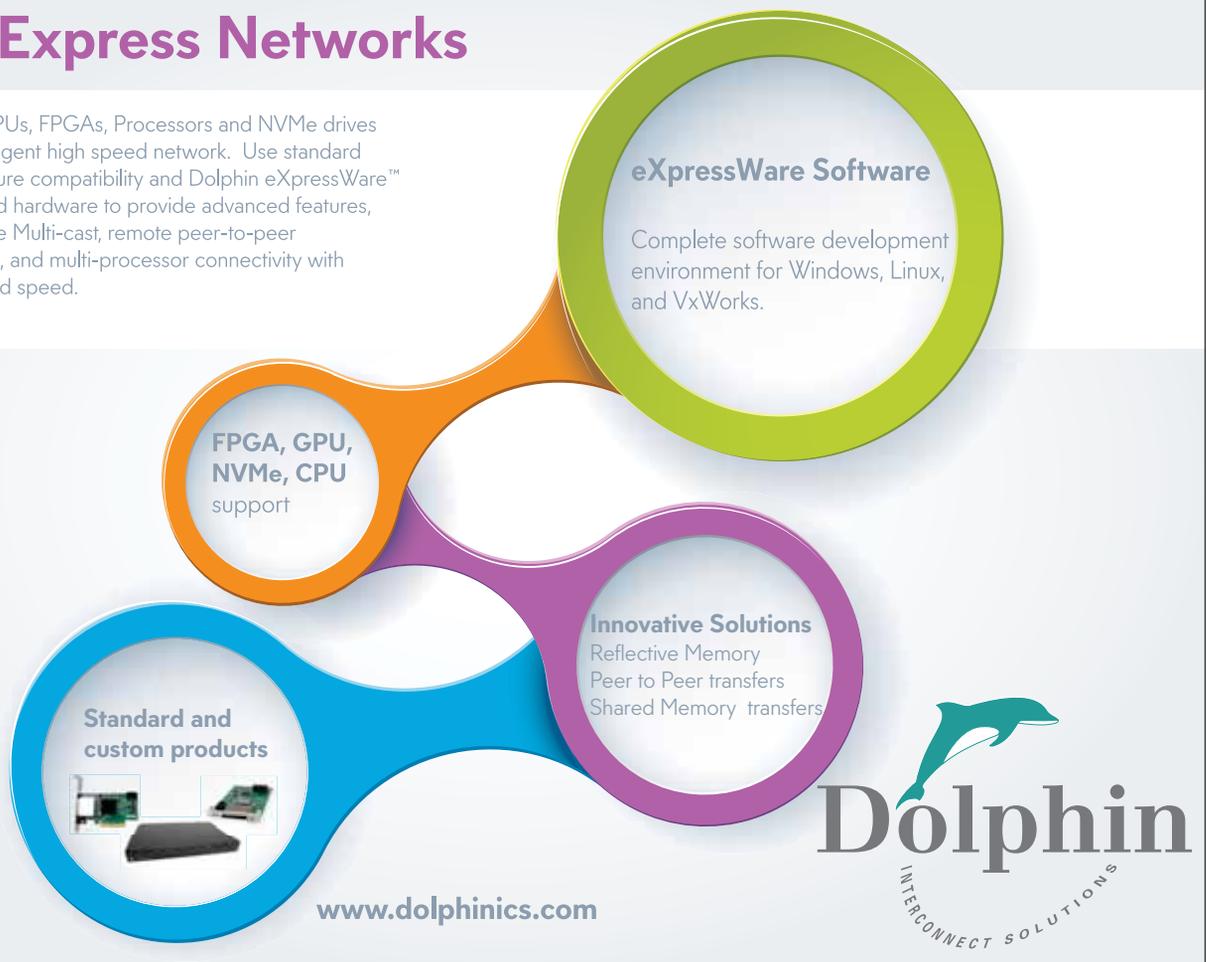




Figure 2: Built-to-order, rugged network switches provide design flexibility to meet data networking as well as environmental requirements.

While the main focus from a software point of view is on securing the transmission of data and the cloud, the hardware used must first establish the necessary conditions to ensure secure communication and protection against external attacks.

MEN Micro employs a variety of methods in developing its line of robust industrial computers, such as the use of a chip enabled with Trusted Platform Management (TPM) enabled to facilitate encrypted data storage and secure booting.

One of the advantages of encrypted data storage, for example in entertainment applications in trains and buses, is that it offers a reliable way for exclusive film material to be played solely on the operator's screens. Secure booting ensures that the system will only start after its integrity has been checked and if there have been no changes to the flash. This protects the system against unauthorized access. Encryption can be implemented through hardware encryption engines or software.

Systems can be partitioned in several ways using firewalls and white or blacklisting. Segmentation includes separating mission-critical networks securely and independently from non-critical networks as well as keeping certain systems from public networks.

## BUILT-IN RELIABILITY

No matter if data is living out on the great big internet or just being managed locally within a closed network, system requirements are going to demand reliability and design principles are going to demand secure, reliable data transmissions.

Network switching systems are asked to handle a large number of inputs as well as a growing amount of data and are expected to keep pace with the desire for faster transmission speeds, while ensuring data integrity across many layers. This is a tall order.

By using application-ready, rugged systems based on open standards and high performance, designers can attain low-cost, effective computing and implement systems tailored to meet the design's demands.

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*Jarvis Wenger is a Customer Support Engineer in the Technical Solutions group at MEN Micro. He graduated from DeVry University with a degree in Electronics Engineering more than a decade ago and continues to be passionate about creating embedded computing solutions across a broad range of industries.*

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# Networking Technology Steels Itself for Emerging Markets

*The Bluetooth Special Interest Group (SIG) announced Bluetooth mesh technology in July. It targets industrial automation and smart buildings by extending the reach of a network, while maintaining the low energy consumption of Bluetooth technology.*

By Caroline Hayes, Senior Editor



The distinctive feature of Bluetooth mesh networking is that it enables many-to-many (m:m) device communication. Rather than a star topology, where one central device communicates with others in a point-to-point network (or piconet), the mesh topology allows a device to communicate with every other device in the mesh.

Bluetooth mesh networking is designed for building automation applications, such as lighting, heating, cooling, and security. It can be used to expand sensor networks, beacons and for asset tracking—locating and tracking goods in real-time across an area.

The Bluetooth mesh system is based on the Bluetooth Low Energy stack. Bluetooth Low Energy is the Wireless Personal Area Network (WPAN) technology used by smartphones, tablets, and computers in smart homes, healthcare, and entertainment.

On top of the Bluetooth Low Energy stack is a bearer layer that defines how mesh Protocol Data Units (PDUs) will be handled. This will be by either advertising or scanning to send or receive PDUs (the advertising bearer), or by communicating indirectly with nodes on a mesh network

which support the advertising bearer; this is the Generic Attribute Profile (GATT) bearer.

Next is the network layer. This layer processes messages from the bearer layer and defines the network interface over which messages will be sent as well as the message address type and format. It can support multiple bearers.



Figure 1: Bluetooth mesh networking is particularly suitable for factory automation. (Source: Bluetooth SIG)



Figure 2: Bluetooth's low power consumption and accessibility are expected to appeal to mesh developers. (Source: Bluetooth SIG)

The lower transport layer takes PDUs from the upper transport layer, where encryption, decryption, and authentication of application data take place. The lower transport layer may perform segmentation and reassembly if required.

Above the upper transport layer is the access layer, which defines the format of application data, defines and controls encryption and decryption performed in the upper transport layer, and verifies the data received from the upper transport layer before forwarding the data.

The foundation model layer implements the configuration and management of a mesh network. Finally, the model layer implements behaviors, messages, and states (e.g. on/off) to define the functionality of a particular element within a node. For example, a Light Emitting Diode (LED) luminaire may have three LED lights. Each light is viewed as one element.

## NETWORK RANGE

Bluetooth SIG has opted for a managed flood message transmission system. Other mesh networks, (for example, ZigBee) use a routed mesh framework, where devices communicate on a defined path. Others, like Thread, use a flooding technique, where every device on the network communicates to every device. Managed flooding controls which device can pass messages. All devices will use Bluetooth Low Energy, but only mains-powered devices will relay messages, saving battery power.

The mesh's multi-hop communication method extends the range of connections and allows for network scalability, while reducing power consumption due to shorter transmission distances between the nodes.

## EMERGING MARKETS

ABI Research predicts nearly one third of the 48 billion Internet-enabled devices installed by 2021 will include Bluetooth, which will find new applications.

"While smartphones and audio accessories remain Bluetooth's largest markets, the technology is becoming more attractive to low-power IoT applications," says Andrew Zignani, Industry Analyst at ABI Research. "Though Bluetooth still faces strong competition from the other standards, mesh networking will enable new opportunities for the technology in the smart home, building automation, and emerging IoT markets in which robustness, low latency, scalability, minimal power consumption, and strong security are all additional critical requirements."

Three characteristics are particularly important for an industrial-grade network: reliability, scalability and security.

## RELIABILITY AND SCALABILITY

The peer-to-peer communication, where nodes communicate directly with each other, makes Bluetooth mesh connectivity reliable. The structure eliminates the need for a centralized hub or gateway, or routing nodes, so there are no single points of failure. Additionally, its managed flood message relay architecture is inherently multi-path and self-healing.

The Bluetooth mesh is specified to allow up to 32,000 devices, or nodes, per network, sufficient for high density lighting or sensor environments to scale in size as network demands increase.

Building automation uses multicast messaging, where messages are sent to various destinations simultaneously. Bluetooth mesh's managed flood message relay architecture and the publish/subscribe (send/process) procedure for group messaging are designed to handle the volume of multicast messaging traffic typically found in building automation environments.

## SECURITY

Large wireless device networks present security challenges. These are addressed by Bluetooth mesh technology with several architectural features. First, devices are added to a network using a 256-bit elliptic curve and out-of-band authentication. Within this provisioning process, security measures include an exchange of public keys between the provisioner and the device to be added, followed by authentication of the device and the issue of a security key, or NetKey, to add the device.



Figure 3: Silicon companies such as Toshiba Electronics have already announced Bluetooth mesh support in their Bluetooth products. (Source: Toshiba Electronics Europe)

In operation, all mesh communication is encrypted and authenticated with 128-bit keys. Encryption and authentication is also implemented on both the network layer and the application layer. Content is secured with a separate application key for end-to-end security.

Each mesh packet is obfuscated so that identifying content is removed from the message. This prevents tracking and is particularly useful when devices move within range of other networks.

#### DESIGN SUPPORT

Silicon companies are already providing support for the Bluetooth mesh standard. Toshiba Electronics Europe has announced support for its Bluetooth Low Energy products.

Heiner Tendency, System LSI Marketing Manager, Toshiba Electronics Europe, believes Bluetooth mesh will introduce the technology to new areas. "This standards-based approach means that new untapped markets, such as industrial and commercial, can now leverage ever-present Bluetooth cell phones or tablets to easily control and monitor their systems," he says.

Silicon Labs has also announced that its Blue Gecko Bluetooth Wireless Starter Kit provides Bluetooth mesh connectivity as well as Bluetooth 5 capability. The company can also provide a Bluetooth mesh stack for Android, allowing smartphones to configure and control nodes on the mesh.

*Caroline Hayes has been a journalist covering the electronics sector for more than 20 years. She has worked on several European titles, reporting on a variety of industries, including communications, broadcast and automotive.*

# Artesyn Embedded Technologies

## CG19-GPU Media Acceleration Sled

**Compatible Operating Systems:** Linux

**Specification Compliance:** CG-OpenRack-19

The CG19-GPU media acceleration sled from Artesyn Embedded Technologies is compatible with the OCP-Accepted architecture, CG-OpenRack-19, offering acceleration for video or deep learning applications.

The sled is half-width by two rack units (RU) high and features a dual Intel® Xeon® E5-2630L v4 server with up to four NVIDIA GPU cards. In-rack network connectivity is provided via blind-mate optical connections to the pre-wired rack network. The sled blind-mate connector simplifies the insertion and extraction of the sled into the cabinet without the need for connection/removal of sled-associated cables.

In-sled SSD storage is provided. Front panel LEDs allow for clear indication of sled status.

### TECHNICAL SPECS

- ◆ Half-width 2U CG-OpenRack-19 sled
- ◆ Intel® Xeon® server with 4 NVIDIA PCIe GPU cards
- ◆ Blind-mate optical network interfaces



### APPLICATION AREAS

Deep learning or video- and graphics-intensive applications such as video transcode or augmented reality.

### CONTACT INFORMATION



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# Artesyn Embedded Technologies

## MaxCore™ Acceleration Platform

**Compatible Operating Systems:** Linux, Windows using VM

**Specification Compliance:** PCI Express

The MaxCore™ platform offers a versatile and dense architecture to achieve maximum compute and media processing density, allowing for peak CapEx and OpEx efficiency. Utilizing Artesyn or third-party, off-the-shelf PCI Express cards, the MaxCore platform provides maximum flexibility, maximum density per rack unit (RU), and unmatched innovation in design for data center, carrier grade, and industrial applications. The unique architecture simplifies and accelerates deployment and can be configured with several independent server domains in the same shelf or can share individual PCI Express cards between many CPUs.

The MaxCore™ family of platforms also include the MaxCore HA for high availability wireless applications; MaxCore Hyperscale for rack scale architectures; MaxCore IPC for industrial applications; and the MaxCore Micro, a low cost, versatile 2-slot configurable platform.

### FEATURES & BENEFITS

- ◆ Highest performance density in 3U chassis with 15 PCIE slots
- ◆ Cloud-in-a-box architecture with up to 360 X86 cores in 3U



- ◆ Configurable in any mix of Artesyn microservers, media processors and 3rd party PCI Express cards
- ◆ PCI Express and Ethernet networking infrastructures
- ◆ Redundant and hot-swappable cooling and power for up to 150W per slot

### APPLICATION AREAS

Data center, carrier grade, telecom, broadcast, networking, cloud, industrial, mil/aero applications, industrial applications.

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