



Smart Networking: Revolutionizing Ethernet and USB with SBC Integration Networking Solutions

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In modern military operations, the ability to process and respond to information in real-time is crucial. As technology advances, the integration of Single Board Computers (SBCs) and Systems on Modules (SOMs) into Ethernet switches and USB hubs presents a significant opportunity to enhance battlefield awareness and operational efficiency. Military environments are inherently unpredictable and fast-paced. Traditional networking systems often rely on external servers for data processing, which can introduce delays and reduce the effectiveness of threat detection and response. In scenarios where every second counts, these delays can have serious consequences.

Integrating SBCs and SOMs into Ethernet switches and USB hubs addresses these challenges by enabling local, real-time data processing. This integration allows the switch and hub to handle complex tasks directly, without the need to send data to external servers. As a result, threats can be detected and countermeasures deployed almost instantaneously. Consider a convoy moving through potentially hostile territory. With an SBC or SOM-equipped Ethernet switch and USB hub, data from various sensors—such as radar, cameras, and connected USB devices—can be processed on-site. This setup provides a comprehensive and up-to-date picture of the surroundings, allowing for immediate identification of potential threats. Once a threat is detected, the system can quickly analyze the data, confirm the threat, and initiate appropriate countermeasures. This rapid response capability enhances the safety and effectiveness of military operations.

In addition to real-time threat detection, integrating SBCs and SOMs into Ethernet switches and USB hubs significantly enhances security measures. By processing data locally, sensitive information is less exposed to potential cyber threats during transmission. Advanced encryption and security protocols can be implemented directly on the switch and hub, ensuring secure communication channels and protecting critical data from unauthorized access. This local processing capability is particularly important in military environments where secure communication is paramount.

Moreover, the integration of SBCs and SOMs into Ethernet switches and USB hubs improves network stability and reliability. Military environments are often harsh and unpredictable, which can affect network stability. SBCs and SOMs can enhance the reliability of Ethernet switches and USB hubs by providing robust error detection and correction mechanisms. They can also manage network traffic more efficiently, preventing issues such as network congestion and data packet loss. This ensures that critical data is transmitted accurately and promptly, maintaining the integrity of military operations.

Modern military vehicles and equipment are equipped with numerous electronic systems that need to communicate seamlessly. SBCs and SOMs can facilitate the integration of these subsystems, providing a centralized control point for diagnostics, navigation, and communication. This integration ensures that all components work together efficiently, improving overall operational effectiveness. For example, an SBC or SOM-equipped Ethernet switch can manage data from various onboard systems, ensuring that navigation, communication, and diagnostics are synchronized and functioning optimally.

The flexibility of SBCs and SOMs allows for the customization of Ethernet switches and USB hubs to meet specific mission needs. Military missions often have unique and evolving requirements. Whether it's adjusting to new communication protocols, integrating additional sensors, or implementing specialized software, the SBC or SOM-equipped switch and hub can adapt quickly without extensive hardware modifications. This adaptability is crucial in dynamic military environments where requirements can change rapidly.

Furthermore, the potential of using an SBC or SOM in a USB hub opens up additional possibilities. By integrating an SBC or SOM into a USB hub, you can enhance the hub's functionality, enabling it to manage multiple USB devices more efficiently. This setup can provide local processing power for connected devices, improving data transfer speeds and reducing latency. It also allows for advanced features such as device monitoring, security protocols, and automated responses to device issues. In military applications, this can be particularly useful for managing peripherals such as communication devices, sensors, and data storage units, ensuring seamless and secure operation in critical environments.

SBCs and SOMs can also improve the diagnostic and troubleshooting capabilities of Ethernet switches and USB hubs. They can monitor the health and performance of connected devices, detect anomalies, and provide detailed diagnostic information. This helps in quickly identifying and resolving issues, ensuring the continuous and reliable operation of military networks. Enhanced diagnostic capabilities are essential in maintaining the operational readiness of military systems.

Energy efficiency is another critical aspect of military operations, especially in remote or mobile scenarios. SBCs and SOMs are designed to be energy-efficient, which helps in reducing the overall power consumption of Ethernet switches and USB hubs. They can also manage power distribution more effectively, ensuring that critical systems remain operational even in power-constrained environments. This energy efficiency contributes to the sustainability and effectiveness of military missions.

Additionally, integrating SBCs into Ethernet switches can provide soft router capabilities, effectively turning these devices into routers. This allows for more flexible and dynamic network configurations, enabling the creation of secure, localized networks that can adapt to changing operational requirements. The ability to function as a router enhances the overall network management and connectivity, ensuring that data flows smoothly and securely across the military network.

To effectively address these challenges and enhance operational efficiency, Bel Aerospace & Defense has developed a suite of advanced solutions specifically designed for military applications. This paper will now present three key products: the MILTECH 404, MILTECH 9012C, and MILTECH 9117TSN.

The [MILTECH 404](#) is a cutting-edge solution designed to enhance the operational efficiency and safety of infantry soldiers in the digital battlefield. This integrated soldier power and data management system combines USB, serial, and Ethernet communication along with full smart power management, making it an indispensable tool for modern military operations. Equipped with a powerful System on Module (SOM) running Linux OS, the MILTECH 404 provides robust local processing capabilities and an open platform for additional field-deployed tactical

applications. Its rugged design, meeting MIL-STD-1275, MIL-STD-810, MIL-STD-461, and IP68 standards, ensures durability and reliability in harsh military environments.

The MILTECH 404 directly addresses the challenge of real-time data processing and threat detection in military operations. By integrating a powerful SOM, the MILTECH 404 enables local, real-time data processing. This capability is crucial in fast-paced and unpredictable military environments where delays in data processing can have serious consequences. For instance, in a convoy moving through potentially hostile territory, the MILTECH 404 can process data from various sensors—such as radar, cameras, and connected USB devices—on-site. This setup provides a comprehensive and up-to-date picture of the surroundings, allowing for immediate identification of potential threats. Once a threat is detected, the system can quickly analyse the data, confirm the threat, and initiate appropriate countermeasures, thereby enhancing the safety and effectiveness of military operations.

The [MILTECH 9012C](#) is another advanced solution from Bel Aerospace & Defense, designed to meet the rigorous demands of military applications. This compact, rugged, military-grade managed 12-port Gigabit Ethernet router/switch offers both Layer 2 and Layer 3 network switching and routing capabilities. It features 12 triple-speed (10/100/1000Mbps) copper ports. The MILTECH 9012C is equipped with a powerful Single Board Computer (SBC) that can host specialized functions such as integrated Cisco-IOS industry-standard routing, unique encryption, and security measures. The integration of Cisco IOS simplifies network management for technicians who are already familiar with Cisco commands, enhancing operational efficiency. This familiarity reduces the learning curve and allows for quicker deployment and troubleshooting in the field, ensuring that military personnel can focus on their mission-critical tasks without being bogged down by complex network configurations.

Designed to meet MIL-STD-1275, MIL-STD-704, MIL-STD-810, MIL-STD-461, and IP68 standards, the MILTECH 9012C ensures high reliability and performance in harsh environments. Its rugged design provides robust protection against environmental factors such as shock, vibration, and extreme temperatures, making it suitable for deployment in a wide range of military scenarios. The device's advanced encryption and security measures protect sensitive data from unauthorized access, ensuring secure communication channels in critical operations. The MILTECH 9012C's ability to function as both a switch and a router, combined with its extensive port configuration, makes it a versatile and powerful networking solution. It supports various routing protocols, including BGP, OSPF, GRE, EIGRP, CDP, IGMP, and MLD, providing comprehensive network management capabilities. Additionally, its advanced Quality of Service (QoS) features help maintain adequate connection speeds for voice and video traffic, ensuring reliable communication and data transfer in mission-critical applications.

The [MILTECH 9117TSN](#) is a high-performance, rugged Ethernet switch designed for military applications, providing advanced timing solutions on top of standard Ethernet switching capabilities. It features 8 x 10/100/1000BT ports, 4 x 100M/1G/10G ports, and 4 x 1/10G F/O ports, offering extensive connectivity options. It also includes clock ports for 1PPS (In and Out) and 10MHz (In and Out), supporting RS422/TTL and Sine/Square waveforms, respectively. These clock ports are programmable and can be adjusted on the fly using CLI commands, providing flexibility in timing configurations. Equipped with a powerful SOM running Red Hat Enterprise Linux. The optional Cisco Catalyst 8000V soft router enhances its functionality, allowing the

running of customer proprietary applications and simplifying network management for technicians familiar with Cisco commands. This integration of Cisco IOS reduces the learning curve and enables quicker deployment and troubleshooting, ensuring that military personnel can focus on their mission-critical tasks without being bogged down by complex network configurations.

The MILTECH 9117TSN supports advanced TSN features, including Time-Aware Shaper (TAS), Frame Preemption, and Per-Stream Filtering and Policing (PSFP). These capabilities ensure deterministic data delivery and low-latency communication, which is essential for real-time military applications. The switch's hardware-based timestamping and synchronization mechanisms, compliant with IEEE 802.1AS and IEEE 802.1Qbv standards, enable precise time coordination across networked devices. This makes the MILTECH 9117TSN ideal for applications requiring high precision and reliability, such as manned/autonomous vehicles, avionics, UAVs, and mobile equipment in battlefield environments.

In terms of networking capabilities, the MILTECH 9117TSN offers extensive Layer 2 and Layer 3 functionalities, including software-based IPv4/6 L3 static routing, VLAN support, Spanning Tree Protocol, Link aggregation, and sFlow. It also includes advanced security features such as MACSec, ACLs, port isolation, spoofing and inspection, port mirroring, and more. These features ensure robust and secure communication, protecting sensitive data from unauthorized access and maintaining the integrity of military operations.

The MILTECH 9117TSN is designed to meet IP67, MIL-STD-810, MIL-STD-461, MIL-STD-1275, and MIL-STD-704 standards, ensuring high reliability and performance in harsh environments. Its rugged design provides robust protection against environmental factors such as shock, vibration, and extreme temperatures, making it suitable for deployment in a wide range of military scenarios. The device's advanced encryption and security measures protect sensitive data from unauthorized access, ensuring secure communication channels in critical operations.

The chassis of the MILTECH 9117TSN is made from low-profile rugged machined aluminium, conductively cooled, and provides ingress protection against sand, dust, and moisture. It is designed to withstand harsh conditions with ease, making it suitable for almost any application. The power input is 28VDC nominal (18-48V), with a maximum power consumption of 22W, and it meets MIL-STD-1275 and MIL-STD-704 standards.

In conclusion, the integration of Single Board Computers (SBCs) and Systems on Modules (SOMs) into Ethernet switches and USB hubs represents a significant advancement in military technology, addressing critical challenges such as real-time data processing, enhanced security, and network stability. Bel Aerospace & Defense's solutions, including the MILTECH 404, MILTECH 9012C, and MILTECH 9117TSN, exemplify the potential of these integrations. These products offer robust local processing capabilities, advanced timing solutions, and versatile networking features, ensuring reliable and secure communication in harsh military environments. By leveraging these cutting-edge technologies, military operations can achieve greater efficiency, responsiveness, and operational effectiveness, ultimately enhancing the safety and success of mission-critical tasks.