NEXCOM
The Intelligent Systems

White Paper

Bring Factories Online with IoT Controllers

Integrated Solution Combines Gateway and Controller

Manufacturers are enthusiastic about the Internet of Things (IoT) but face significant barriers to connecting their equipment. Most plants are full of legacy devices that run on closed-loop intranets separate from corporate networks. To create a smart factory, manufacturers need to bring this equipment online without an expensive factory overhaul.

In this article, we explain how a new generation of IoT controllers solves this problem using the fanless NEXCOM NIFE 100 as an example. We show how the NIFE 100 connects fieldbus networks, enterprise systems, and smartphone and tablet operator interfaces – and we demonstrate how this connectivity helps manufacturers increase competitiveness, anticipate trends, and improve the bottom line.

We also illustrate how the NIFE 100 consolidates multiple factory functions – including logic control, human-machine interface (HMI), and communications – using multicore Intel® Atom™ processors. We consider how supporting tools like CODESYS SoftLogic facilitate control programming and remote management. Finally, we show how as an Intel® IoT Gateway solution, the NIFE 100 simplifies network design and security.

The need for an Industrial IoT controller

Factories are full of legacy field devices including machinery, robots, programmable logic controllers (PLCs), and sensors. These devices typically use different communication protocols and run independently. If a factory network exists, it is usually a closed-loop intranet separate from the enterprise network.

To realize the advantages of the factory-of-things, manufacturers must lift the communication barriers among these field devices and connect them to the Internet. What can help are industrial IoT controllers – that is, IoT gateways purposely built for manufacturing. These controllers serve as the cornerstone of big supervisory control and data acquisition (Big SCADA), a vision to integrate wide-range control and monitoring of factory operation and data analytics using the enterprise cloud (Figure 1).

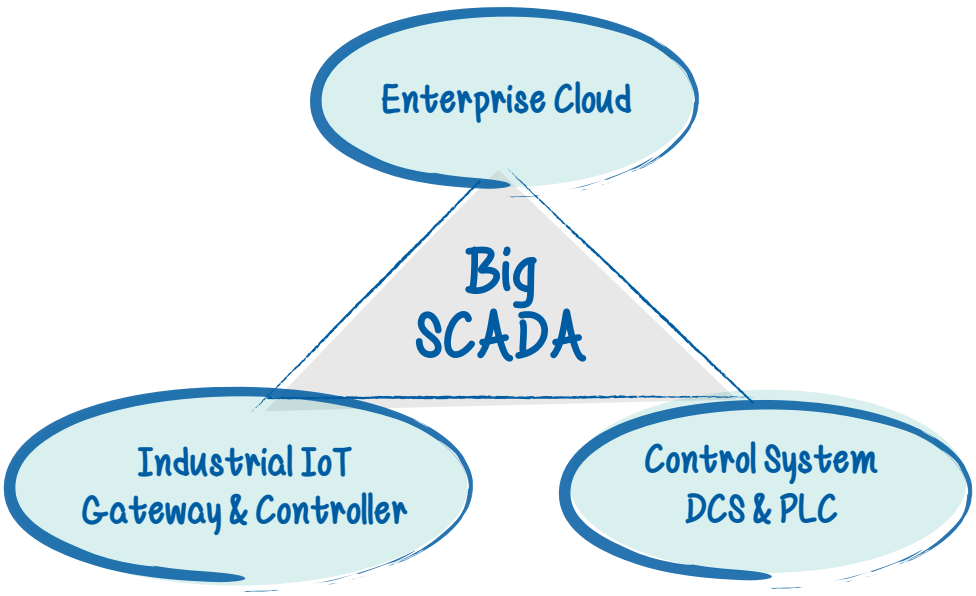

Figure 1. Big SCADA integrates wide-range control and monitoring as well as data analytics.

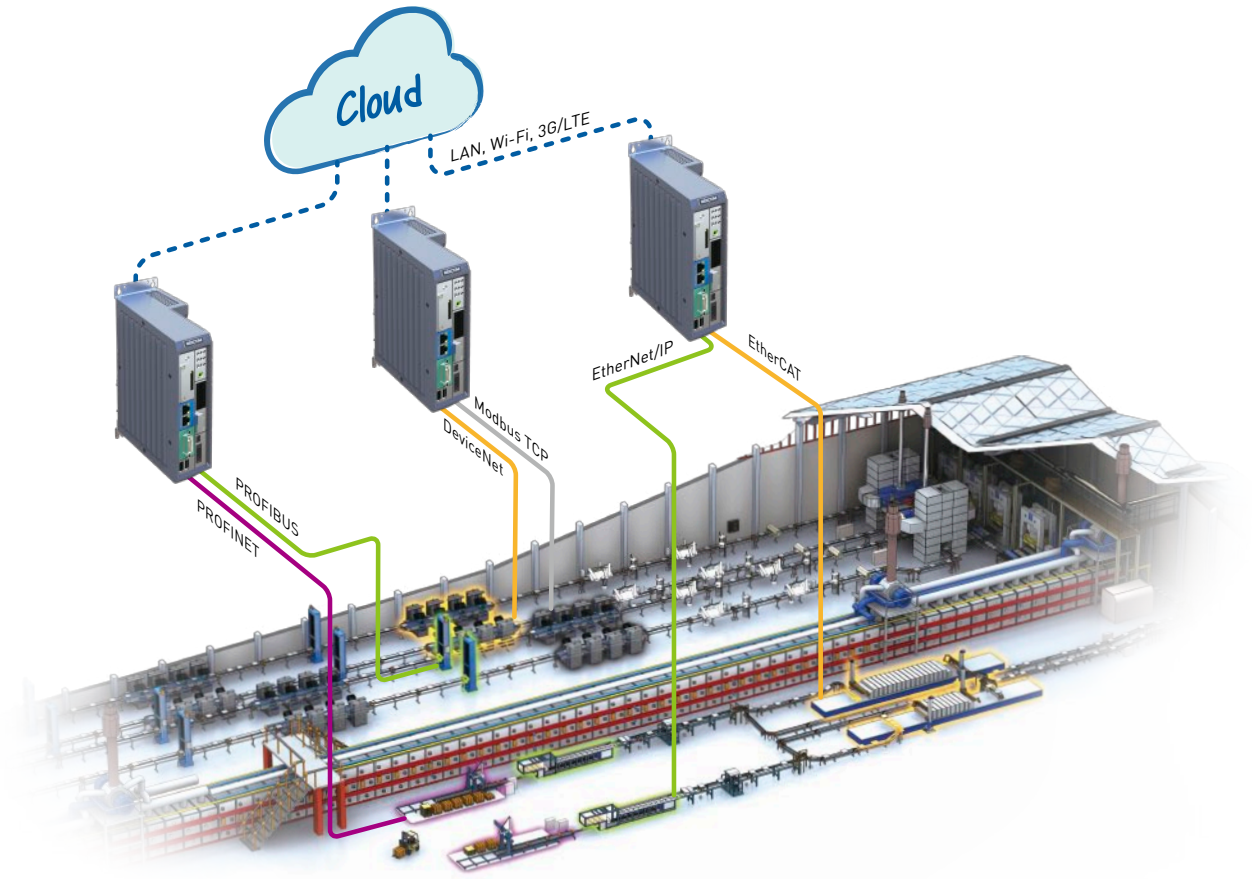

Figure 2. The NIFE 100 connects factory systems to the cloud.

The NEXCOM NIFE 100 meets this need by delivering an open-architecture solution for cross-protocol communication, providing the missing connection between closed-loop control and the Internet. Based on Intel Atom processors, these IoT controllers feature fieldbus extension modules that enable flexible connections to factory systems and the cloud (Figure 2). Cloud functions may be hosted on-premise or off-premise, allowing manufacturers to implement Big SCADA as best suits their needs.

The NIFE 100 provides a rich set of software for networking, control, and manageability. This software enables the NIFE 100 to play many roles – from data acquisition server to high-level industrial controller. Manufacturers can connect PLCs, remote I/Os, and legacy field devices using different protocols and across different control subsystems. Manufacturers can also send field data to the cloud for Big Data analytics and remote monitoring of factory operations.

Connecting the Industrial IoT

To construct a smart factory, everything on the factory floor must be connected. Considering that legacy devices use a variety of fieldbus protocols, industrial IoT controllers need to provide cross-communication capabilities for both downstream and upstream data communication.

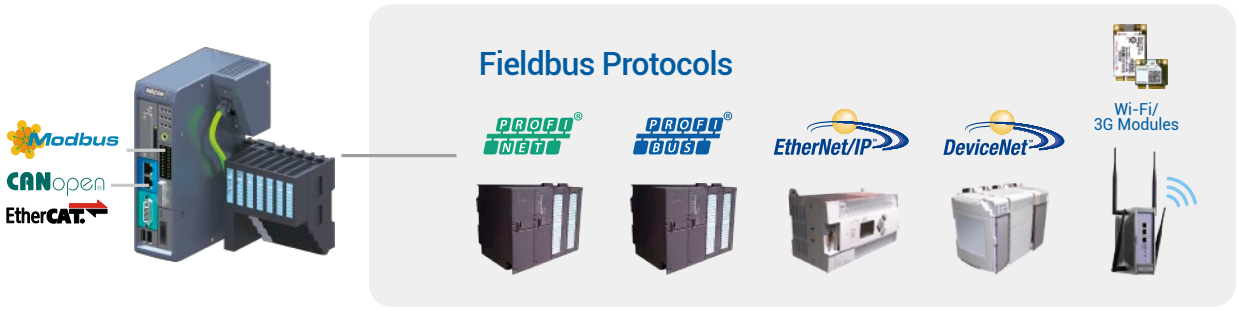

Figure 3. The NIFE 100 supports fieldbus communications through built-in interfaces and modular extensions.

To aggregate field data, the NIFE 100 supports industrial communications with a range of fieldbus modules. These modules include PROFINET, PROFIBUS, EtherNet/IP, DeviceNet, EtherCAT, CANopen, and Modbus. From the cloud perspective, the NIFE 100 provides the last-mile connection for field devices and provides a gateway to LAN, Wi-Fi, and 3G/4G networking (Figure 3).

To reduce factory footprint and overall hardware cost, the NIFE 100 combines the functions of an IoT gateway with those of a cyber-physical system (CPS) – that is, a computational controller for physical equipment (Figure 4). Specifically, the NIFE 100 can control multiple systems over multiple fieldbus protocols and provide HMI functionality.

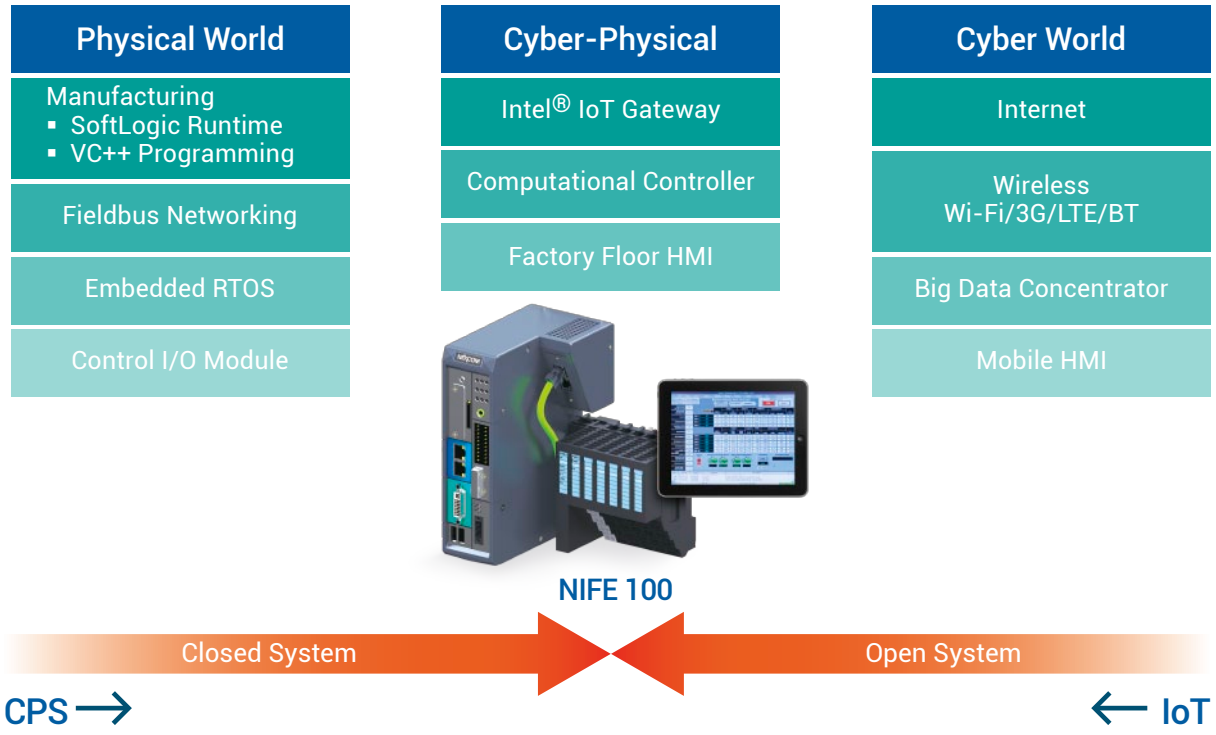

Figure 4. The NIFE 100 combines cyber-physical systems (CPS) with the Internet of Things (IoT).

To facilitate programming across multiple controllers, the NIFE 100 is built with the CODESYS SoftLogic programming tool based on the IEC 61131-3 PLC programming standard. This allows the NIFE 100 to adapt to different factory settings. The NIFE 100 provides the interoperability necessary for IoT controllers and sets up a solid foundation for the industrial IoT, transforming a plant into a smart factory without a costly overhaul.

On the IoT side, the NIFE 100 implements the Intel IoT Gateway architecture. This architecture integrates Intel® processor-based hardware, the Wind River Intelligent Device Platform (IDP) XT, and McAfee Embedded Control, delivering a full suite of networking, embedded control, integrated security, and remote manageability technologies. These pre-integrated, pre-validated hardware and software building blocks simplify connectivity, enabling seamless and secure data flow between the factory and the cloud. (Like NEXCOM, McAfee and Wind River are Associate members of the Intel® Internet of Things Solutions Alliance.)

Real-Time Performance and Graphics

Real-time capability is essential for an IoT controller. Control algorithms often require complex responses within a matter of milliseconds. Here, the NIFE 100 benefits from the growing computational power of Intel Atom processors. Available in single-, dual-, or quad-core configurations, the NIFE 100 can control a large number of field devices and carry out control schemes ranging from logic control to proportional-integral-derivative (PID) control.

An IoT controller may also be required to provide HMI functions. Factory floor HMI stations may incorporate a large volume of graphics, images, and sometimes surveillance videos to deliver a vivid representation of factory status. Visual processing advancements in the Intel® Atom™ processor E3800 product family can help. The processors' Intel® HD Graphics engine provides powerful 2D and 3D capabilities that support application programming interfaces (APIs) such as Microsoft DirectX 11, OpenGL 4.0, and OpenGL 1.2. The graphics engine also includes hardware video encode and decode engines for smooth recording and playback.

The NIFE 100 uses these capabilities to support its integrated Object Linking and Embedding (OLE) for Process Control (OPC) software. This software can be used to provide graphical information such as factory layout, logical schema, changing trajectory of a phenomenon, and live high-resolution surveillance video. The built-in graphics engine also allows the NIFE 100 to power two independent screens at a maximum resolution of 2560 x 1600 at 60 Hz.

The ability to consolidate control and HMI functions can reduce equipment footprints and overall costs. However, such system consolidation requires careful consideration of operating system (OS) support. The Intel® Virtualization Technology (Intel® VT) integrated in the Intel Atom processor E3800 product family aids system consolidation by allowing the NIFE 100 to run two OSs simultaneously – a real-time operating system (RTOS) for control applications and a general-purpose operating system (GPOS) for HMI applications. On the RTOS side, the platform supports real-time Linux included in the Wind River IDP XT. General-purpose operating system (GPOS) support includes several versions of Microsoft Windows.

It is worth pointing out that these features are delivered with a thermal design power (TDP) as low as 10 W and extended temperature range of -40 ºC - 110 ºC. This thermal profile enables the fanless design of the NIFE 100 and supports reliable performance in harsh environments.

Simple, Secure Networks

It is important to simplify the management and maintenance of an industrial IoT system, especially a control

network nested with thousands of industrial devices. The Intel® Ethernet Controller I210-IT used in the NIFE 100 provides a virtual LAN (VLAN) feature to ensure network quality of service (QoS). The VLAN feature assures network performance by allocating bandwidth and limiting broadcast storms. The VLAN can group industrial devices into different subnets based on protocols and applications, and assign high priority to data packets relating to real-time control. Additionally, the VLAN feature allows authorized users to access the authorized subnets, avoiding changes by mistake and reducing security risks.

The Intel Atom processor E3800 product family also plays a key role in security. This processor family provides fast hardware- assisted data encryption and decryption through Intel® Advanced Encryption Standard New Instructions (Intel® AES-NI) and supports Secure Boot to allow only trusted software to run on a device. It also supports error-correcting code (ECC) for extra reliability.

The NIFE 100 also benefits from McAfee Embedded Control, a key ingredient of Intel IoT Gateways. This endpoint software uses whitelisting to allow only authorized software to run, blocking malware from installing and executing on the NIFE 100. Given the fact that an IoT controller like the NIFE 100 is a purpose-built appliance that executes only a limited set of applications, the whitelisting approach is more effective against zero-day attacks than traditional antivirus (AV) software. In addition, to assist with regulatory compliance, McAfee Embedded Control only allows policy-based changes that are expected and authorized.

Remote Management

The NIFE 100 is available with the JMobile mobile HMI app. This app provides remote real-time monitoring and control of factory operations. Starting a new manufacturing process only takes a few taps on a tablet or a smartphone. Instead of being confined to a desk in a factory control room, a factory operator can check a factory anytime, anywhere, making a virtual appearance on the factory floor (Figure 5). The app is bundled with NEXCOM Xcare 3.0 suite. This remote management utility integrates software applications and

Figure 5. The NIFE 100 enables factory monitoring using mobile devices.

a cloud server to support remote hardware status checks, remote system restore, remote keyboard/video/mouse (KVM) operation, and remote configuration of the NIFE 100. These features can help manufacturers perform preventive maintenance and take other measures to reduce downtime and increase efficiency. For example, the remote hardware status check gives IT staff an opportunity to detect a potential problem before a costly failure occurs, while system restore and remote KVM functions enable immediate response.

Conclusion

As an Intel IoT Gateway, the NEXCOM NIFE 100 provides an application- ready solution that can enable smart factories. Packed with cross-communication capabilities, high-performance computing, remote manageability, and security mechanisms, the NIFE 100 exemplifies how a smart factory can be built based on legacy devices, preventing costly factory overhauls.

With its open architecture, the NIFE 100 can play many roles – from data acquisition server to high-level IoT controller –to securely connect the Ethernet-based business domain and the fieldbus-based factory domain. Using the NIFE 100, industrial companies can begin to transform their factories by taking advantage of Big Data analytics. Equally important, they can immediately reduce business costs and improve operations with a simplified control scheme, simplified control network architecture, and reduced maintenance efforts.

Founded in 1992, NEXCOM integrates its capabilities and operates six global businesses, which are Multi-Media Solutions, Mobile Computing Solutions, IoT Automation Solutions, Network and Communication Solutions, Intelligent Digital Security, and Medical and Healthcare Informatics. NEXCOM serves its customers worldwide through its subsidiaries in five major industrial countries. Under the IoT megatrend, NEXCOM expands its offerings with solutions in emerging applications including IoT, robot, connected cars, Industry 4.0, and industrial security.

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NEXCOM is an Associate member of the Intel® Internet of Things Solutions Alliance. From modular components to market-ready systems, Intel and the 250+ global member companies of the Alliance provide scalable, interoperable solutions that accelerate deployment of intelligent devices and end-to-end analytics. Close collaboration with Intel and each other enables Alliance members to innovate with the latest technologies, helping developers deliver first-in-market solutions.