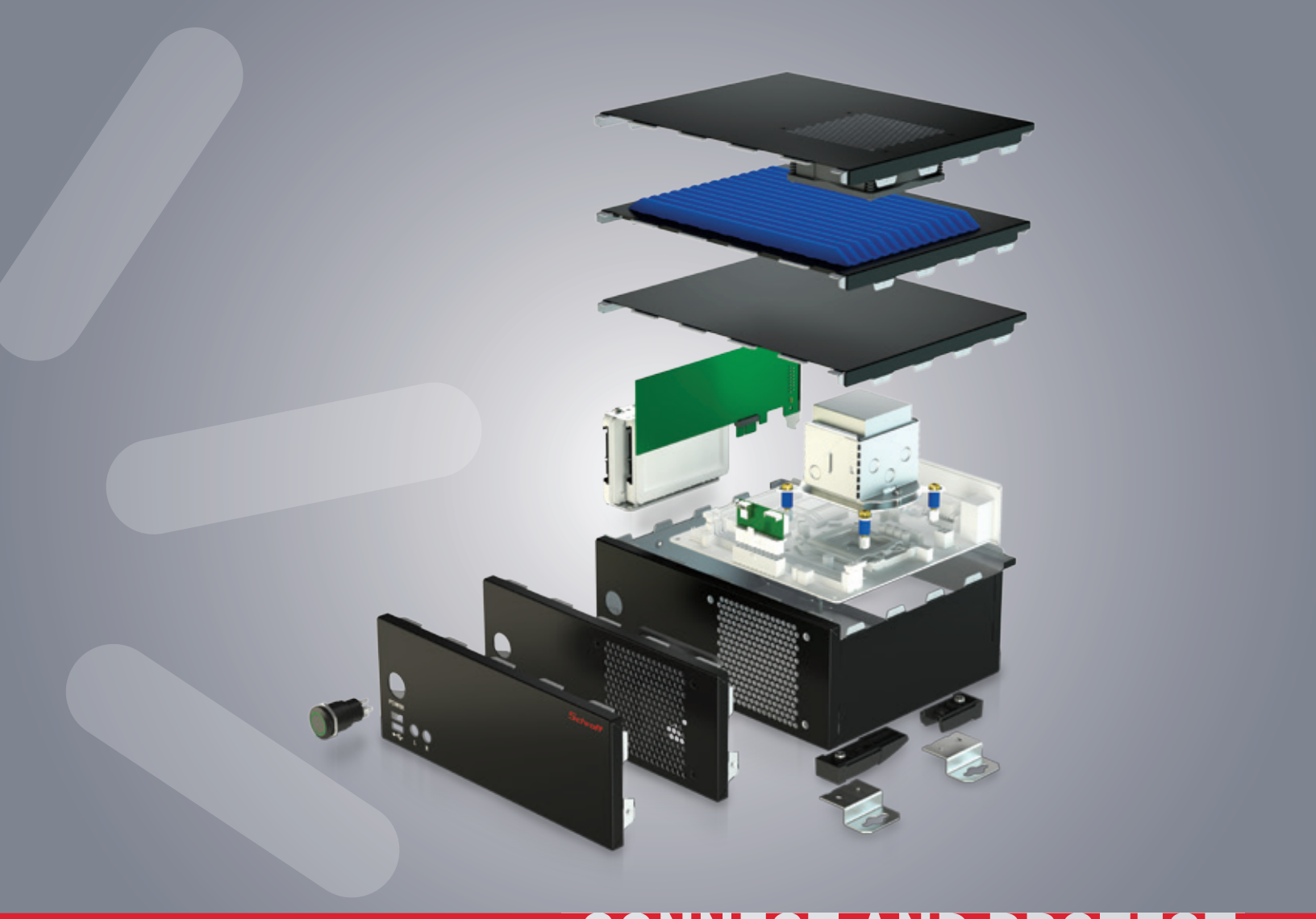

CONNECT AND PROTECT

Interscale

A Comprehensive Concept for the Configuration of Industrial IoT Systems

Save Time And Money When Configuring Your Individual Embedded Application

nVent

SCHROFF

Interscale

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SAVE TIME AND MONEY WHEN CONFIGURING YOUR INDIVIDUAL EMBEDDED APPLICATION

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AUTHOR:
LINLY FOU
FIELD MARKETING SPECIALIST EMCA EUROPE

Schroff GmbH

nVent.com/SCHROFF

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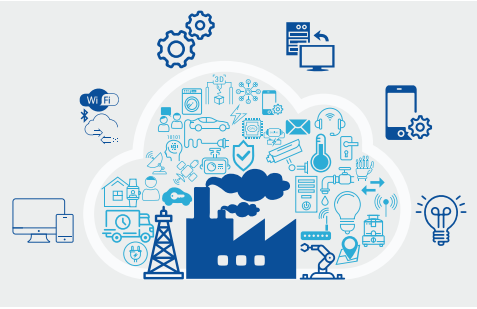
1. INTRODUCTION – IoT AND IIoT OR INDUSTRY 4.0

Wouldn't it be nice if the lights turn off when not in use, the thermostat would automatically adjust based on the outside weather or the refrigerator orders food as needed? The IoT - Internet of Things – makes all of this possible. The world is becoming more and more connected. Small embedded computers enable almost any object to be smart. In a networked "intelligent" home, connected devices can provide more safety, save valuable time and reduce the cost of energy. Thanks to smart home technology, everyday activities are automated, and the settings of connected devices, such as heating, lights and loudspeakers, can be quickly adapted to personal requirements using a computer or smart phone—either from home or remotely. In short: Things can communicate with us and with also with one another.

However, the Internet of Things not only applies to residential applications but also to industrial and commercial institutions. This is referred to as IIoT—Industrial Internet of Things- Also called Industry 4.0. in Europe. With IIoT, corporate efficiency and industrial manufacturing can be optimized driving competitiveness and growth.

Digitalization spans from the intelligent networking of individual machines and devices to entire production facilities and their supply chain. Production is becoming increasingly complex, in many areas the lot sizes are shrinking, the variety of products is increasing, and the life cycles of products are getting shorter. This shift in demand and change in the market conditions drives the networking of machines, services and people across the entire production chain. By collecting machine sensor data, connected factories are able to track and control machine operation as well as optimize efficiency, especially within challenging production environments, ultimately promoting growth and cost savings. Leading experts agree that by 2020, approximately 50 billion devices will be connected to the Internet, and the scale of IIoT will by far exceed the size of the consumer-driven IoT.



What is necessary to support this demand? First, companies must develop adequate strategies, for the implementation of intelligent software and hardware systems and services. The challenge here arises in networking existing systems and machines: Legacy machines can be very different from each other due to their technological and data processing capabilities. Embedded solutions can solve this challenge and are already used in many sensor and gateway applications today. Based on its Interscale product platform, nVent has developed a comprehensive hardware concept that allows customers to build their individual application to implement IIoT solutions. Leveraging the Interscale configurable product platform, time-to-market cycles are shortened, flexibility and security are enhanced, and quality and efficiency are increased.

2. EVERYTHING BEGINS WITH THE EMBEDDED BOARD

At the heart of an embedded system is either a small form factor board with a particular standard, such as an ATX, Micro ATX, Mini ITX or Pico ITX, a single-board computer such as the Embedded NUC™, Raspberry Pi and Arduino, or a proprietary board provided by the customer. These boards vary not only in size but also in function and slot configuration. Depending on the application and requirements, the customer selects a suitable board.

The board is selected based on various criteria:

- Which processor and what processor performance are required?
- How much RAM is needed?
- Which interface cards are going to be connected?

In making this selection, note that industrial standard main boards also provide different numbers of PCIe connector positions: an Embedded NUC™ board has no PCIe connector position, a Mini-ITX has one PCIe connector position, a Micro-ATX has up to 4 connector positions, and an ATX can accept up to 8 PCIe cards.

Fig.: Rear view of the Interscale Mini-ITX

For a functioning embedded system that can be used in its application, the following components can be configured:

- Case
- Hardware adaptions
- Electronic components
- Cooling
- Design
- Accessories
- Additional Services

To ensure the functionality of the system and its application, it requires a suitable case, and the necessary additional electronic components as well as elements for cooling. The customer can take care of designing and configuring these components, or leave this to experts who will group all necessary hardware components to fit the selected board and the IIoT application requirements.

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The nVent concept is based on the flexible and modular SCHROFF Interscale case platform with the customer leveraging this platform to design a suitable case for their board. Board size doesn't matter – flexible Interscale cases can be adapted to accommodate most board sizes and I/O cutouts. Following, various electronic components, such as power supplies and switches, as well as PCI/PCIe card and hard disk brackets can be integrated. A suitable cooling solution is selected, and the case is equipped with the desired cutouts, holes and branding, and its painting and printing is adapted to the desired design. Functional accessories for desktop use and mounting, such as plastic feet or clips for horizontal rails with lips, complete the application. As an added benefit, customers can integrate further value-added services into this concept, such as simulations and testing.

3. THE FLEXIBLE, MODULAR SCHROFF INTERSCALE CASE PLATFORM

Based on industry standard boards, nVent has developed its SCHROFF Interscale platform, which is specifically designed for small form factors to provide a high amount of flexibility for various applications. This case platform is based on a parametric model, allowing easy customization to the requirements of the board and thus to any desired height, width or depth.

Depending on the size of the case, it consists of two to four parts that are fastened with either two or four screws. The cases can be assembled and disassembled quickly and easily, which significantly reduces integration time. For conduction or fan cooled cases, the three-part case can be equipped with cutouts on two sides. In a four-part case, there is the additional option of equipping the case cover with a cutout to insert a heat conductor supported directly by the processor.

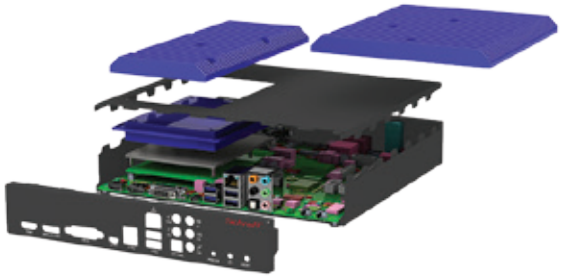

Fig.: SCHROFF CoM Express System

The special interlocking design of SCHROFF Interscale cases provides integrated EMC protection of 20 dB at 2 GHz without requiring additional EMC gaskets, and the design ensures a protection class up to IP 30. The results of the EMC test are available online. Depending on the board selected, pre-defined interfaces and cutouts are integrated into the design. Additional cutouts can be provided at the customer's request.

The SCHROFF Interscale cases are well-suited for industrial applications, railroad and transportation systems, test and measurement, security, medical, energy, communications and network technology. Possible applications include IoT gateways, PC-based point-of-sale (PoS) systems, video monitoring and security for households or peripheral control units for industrial applications.

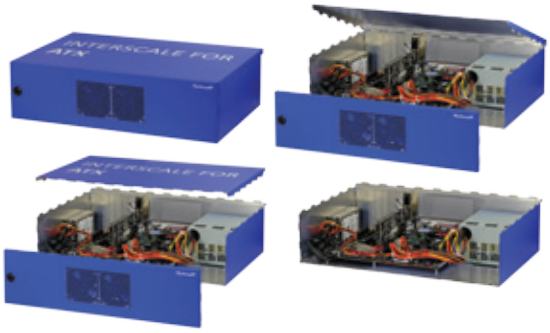

Fig.: Modular Interscale case platform

4. INTEGRATING ELECTRONIC COMPONENTS

Next, electronic components and interfaces can be selected for integration.

Power supply units of varying power output and form factors are available:

- A desktop power supply unit at 19V and 65W
- Various PICO PSU kits for passively cooled systems at 80W, 120W and 160W
- A space-saving 1U ATX power supply unit at 300W
- ATX power supply units in the PS2 form factor at 300W and 500W

Depending on the selection of the board, the processor, the storage and the PCI cards, a power supply unit is selected to cover the overall capacity output.

Fig.: ATX power supply

An illuminated power button switch with connection cable is also available. For active cooling, SCHROFF offers fan kits and perforations in various sizes and positions.

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Fig.: PCI card with slot cover

The appropriate number of installation options or connector positions for PCI or PCIe cards can be integrated depending on the selected form factor. The case height can be reduced if either half-height PCIe cards are used or full-height PCIe cards are going to be installed horizontally using riser boards.

For fastening hard disc drives, various solutions are offered. The smart case concept makes it possible to accommodate multiple hard disc drives integrated in the case using brackets. It is also possible to install them below the main board without restricting accessibility, and allowing access through an maintenance opening at the bottom of the case.

Fig.: Case with maintenance opening on bottom

5. CUSTOMIZED COOLING SOLUTIONS

Factors such as ambient temperature, processor performance and the Thermal Design Power (TDP) of the processor determine what kind of cooling solution needs to be used. The Raspberry Pi board, for instance, can be operated under normal ambient temperature conditions using a perforated case without a fan. If the power loss increases and processors of approximately 15 watts TDP and up are used, thermal transfer becomes necessary, either by active or passive cooling. The cases can be equipped with perforations and fan kits. Fan cooling provides effective and cost-efficient thermal transfer. However, if high IP protection, noise reduction, or a long life span of the entire system are required, passive cooling should be considered. The heat is dissipated through conduction cooling using integrated heat conductors and/or flexible heat conductors (FHCs). Various heat conductor geometries are available for specific dissipation losses and application areas, such as heat conductors integrated into the case cover with cooling fins of various heights, which are adapted to the processor and the ambient temperature accordingly. SCHROFF has specially developed a flexible aluminum heat conductor (FHC) (see image) for the high power loss range. The FHC features an innovative design that provides tolerance compensation, allowing processors to form a continuous heat path. Integrated springs enable vertical length expansion of the aluminum block and reduce thermal resistance so that no thermal conductive pad (or only a very thin one) is necessary.

Fig.: 20 mm FHC (top) and 70 mm FHC (bottom)

6. CUSTOMER-SPECIFIC HARDWARE MODIFICATIONS

For industrial mainboards such as Mini-ITX, Pico-ITX, ATX, Micro ATX or computer standards like Raspberry Pi the case size and cutouts are predefined to save design time, while still being modifiable to suit individual needs.

For open standards such as Embedded NUC™, COM Express, QSeven, Smarc or proprietary boards, simply decide on the case size required, specify the location of the board mounting studs as well as the size and location for I/O cutouts. The Interscale platform includes mechanical modification of the case with an extensive CAD library for standardized cutouts (such as round holes in various sizes, and common geometries), but it also offers the opportunity of implementing other, individual geometries/ shapes in the case. If a fan-cooled case is required, the necessary perforations that match the desired air flow is accommodated.

7. DESIGN AND BRANDING

A wide range of powder coatings and printing options are available for customizing an IIoT system. Customers have the option of choosing a case color and to include design elements and multi-colored logos up to photo-realistic images through digital print according to their unique design or corporate branding. Not only can you print device names and logos on cases using screen printing, but you can also depict names for operational elements and reproduce important functional elements such as dials.

Up to 32 million colors from the CMYK palette can be printed as a standard. The printing offers extra-high color fastness for the RAL, Pantone and HKS color ranges. The inks used are durable and resistant to light, heat, cold, chemicals, and other environmental influences. Color transitions and intricate details with miniaturized font sizes to as small as 3 point font can be implemented.

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Fig.: A wide range of case colors and design elements is available.

8. ACCESSORIES

The wide range of standard accessories for SCHROFF Interscale cases enables a diverse range of configurations and extensions.

Bild: Wide selection of standard accessories upon request

With these standard accessory components, customers have a lot of options of positioning and mounting their application, fast and uncomplicated. Further, more specialized accessories can be provided upon request.

9. SER2VICES

The concept developed for the SCHROFF Interscale case platform also includes accompanying services that save the customer both time and cost. For example, cases are shipped to customers pre-assembled, including all selected mounting hardware and accessories if required. Even components supplied by the customer can be installed.

Additionally, there is the option of having nVent conduct thermal simulations in the laboratory. In the hands of an experienced specialist, simulations deliver results that guarantee optimum heat dissipation. By this and by other testing options such as shock and vibration tests and tests for IP protection and thermal tests, nVent supports their customers in the certification of their products and the necessary documentation.

10. APPLICATION EXAMPLE

The following case study illustrates the concept developed by nVent for the SCHROFF Interscale case platform and its benefits of the configurable design process. The task was to configure and set up a small, high-performance PC unit for use as an IoT edge gateway configured for automation, visualization or monitoring. The customer selected an Embedded NUC™ board suited to industrial applications. Embedded NUC™ has been developed by the SDT.03 team of the SGET (Standardization Group for Embedded Technologies e.V.) society on the basis of the Intel-NUC® system (NUC=Next Unit of Computing). Such a board combines many functions of a PC on a base board measuring only 10 cm x 10 cm (approx. 4 x 4 in) and takes into account the interfaces relevant to industrial applications, long-term availability of processors and other electronic components, as well as failure-resistant conduction cooling without fans, using heat conductors.

The SCHROFF Interscale case configured for this application consists of three parts (body, top cover and front panel) and includes EMC protection. It measures 35 mm in height, 110 mm in width and 103 mm in depth. In view of the size of the embedded NUC™ board (101.60 mm x 101.60 mm), it is required that further integrated hardware would need to fit in a very small space. Conduction cooling using the flexible heat conductor (20 mm) integrated into the case can reliably mitigate any power loss that may otherwise have resulted. The embedded NUC™ board is directly attached to the flexible heat conductor, so that no unnecessary heat resistance is created. The most efficient cooling solution was ascertained by nVent through a thermal simulation process performed in their climate control laboratory. Depending on the application, individual branding with respect to color and logo were incorporated. It is possible to use the case as a desktop device or mounted on a DIN rail in the control cabinet, secured with available standard accessories.

11. SUMMARY

The configurable Interscale case concept developed by SCHROFF enables design engineers to quickly configure solutions to enclose, cool and protect their electronics for IIoT applications at a modest cost in a multitude of environments.

Europe

Betschdorf, France	Tel. +33.3.88.90.64.90
Straubenhardt, Germany	Tel: +49.7082.794.0
Dzierzoniow, Poland	Tel: +48.74.64.63.900
Assago, Italy	Tel: +39.02.5776151.224

North America

Minneapolis, MN	Tel: +1.763.421.2240
Mexico City, Mexico	Tel: +52.55.5280.1449
Toronto, Canada	Tel: +1.416.289.2770

South America

Sao Paulo, Brazil	Tel: +55.11.5184.2100
Boitura, Brazil	Tel: +55.15.3363.9148

Asia

Shanghai, P.R. China	Tel: +86.21.2412.6943
Singapur	Tel: +65.6768.5800
Shin-Yokohama, Japan	Tel: +81.45.476.0271
Seoul, Korea	Tel: +82.2.2129.7755
Qingdao	Tel: +86.532.8771.6101

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