Box PC with SMARC 2.0 module based on the Intel Apollo Lake processors

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This article introduces an all-new Box PC developed as an IoT gateway. Not only is the system standard eNUC for Box PCs new, the SMARC 2.0 module standard is new and the Intel Atom, Celeron and Pentium processors that are being deployed in the system were just launched in October 2016.

Figure 1. The TeNUC-100 Box PC from Technagon was developed as an IoT gateway according to the eNUC standard and is based on SMARC 2.0 modules from congatec with brand-new Intel Atom, Celeron and Pentium processors (code name Apollo Lake)

■ Due to the increasing need for powerful solutions with IoT connectivity, Technagon made the strategic decision to develop its own IoT gateway to be used as an application-ready component in numerous customer applications. The inspiration for this development came from one customer, an automotive manufacturer, who had specific requirements for its charging stations at dealerships. A central system had to integrate several e-charging stations via a charge point server into the respective dealer network. The charge point server provides the dealer with access to all relevant on-site functions and allows the operator to carry out comprehensive remote management functions necessary for smooth operation of the charging stations, including functional upgrades. At the same time, the charge point server ensures a secure separation of the dealer network from the charging infrastructure.

In the past, Technagon developed and manufactured this type of gateway as 19-inch rack systems for server rooms of the dealers. Owing to the increasingly high performance of smaller embedded processors - such as the recently launched Intel Atom, Celeron and Pentium processors (code name Apollo Lake) - and the need for embedded systems in the outdoor area for individual charging stations or in digital signage products, the company decided to develop a rugged embedded Box PC family that can be deployed anywhere, i.e. in control cabinets, wall-mounted applications, outdoors (TeNUC-100 R) and even as a system on a Vesa mount installed at the back of a display.

The challenge was to cater for extremely diverse potential application areas while at the same time incorporating standardized basic technology. The mission was to develop a solution which is as innovative, forward-looking and comprehensive as possible and based on existing standards and therefore is able to reap the benefits of a comprehensive ecosystem of existing solution modules. As is repeatedly the case, the commercial sector delivered the blueprint for the embedded computer standard which best fits the requirements: embedded NUC, eNUC for short. The manufacturer-independent board and system standard developed by the SGET Standardization Group for Embedded Technologies e.V. specifies a 10.16 x 10.16 cm^2 board with a primary I/O area on the front and an optional one at the back. The cooling solution and power supply design are also specified to guarantee interchangeability of boards and housings. With a base area of just 100 cm^2, the board is predestined for small system designs. In future, the eNUC specification will also standardize the design of the housing so that users will be able to rely on a broad portfolio of system specifications, which will include system housing from Technagon. So, on the new TeNUC-100 system, everything is based on standards.

However, to qualify as an IoT gateway, the eNUC Box PC has to offer all the right interfaces. Along with two standard Ethernet interfaces, via which horizontal or vertical integration of the system into two separate nets is possible, wireless interface support is crucial too, as IoT applications are often connected via LTE or 3G/4G mobile radio interfaces to central cloud servers. Plus, they are also deployed as gateways for a whole range of different wireless sensor networks.

Radio standards for especially energy-saving long-range communication over several kilometres, such as LoRa, 6LoWPAN and Sigfox or 3GPP, LTE-MTC and UNB, are currently in great demand in smart city and smart energy nets. Additionally, for close-range communication wireless protocols, such as WLAN, BlueTooth (BTLE), NFC and other IoT radio protocols such as Zigbee, Z Wave or Thread as well as proprietary radio protocols are being deployed which also have to support a universally applicable IoT gateway. For this reason, the TeNUC Box PC is equipped with two flexible Mini-PCIe slots, which accommodate extension modules for all the mentioned standards. The system can be designed

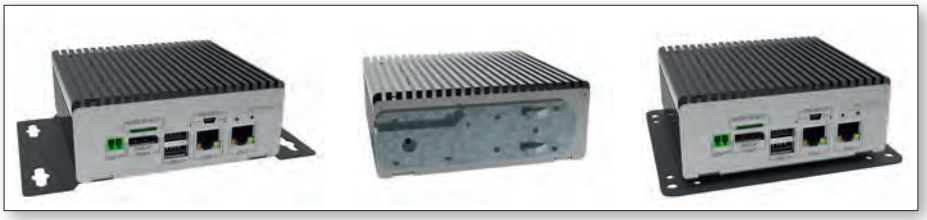

Figure 2. The TeNUC-100 Box PC can be installed flexibly as a desktop, a DIN rail PC or a wall and monitor mount and is also available as a TeNUC-100 R in a rugged version in the aluminium housing and with IP54 protection

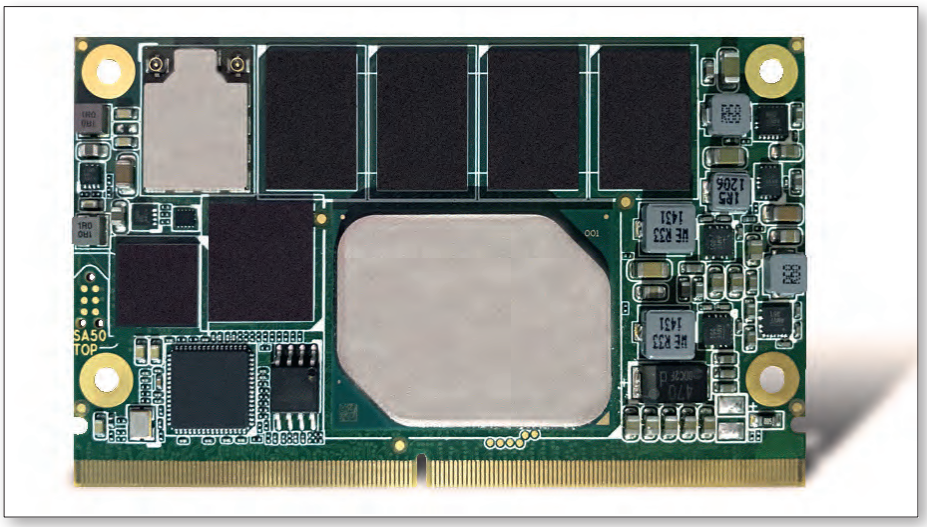

Figure 3. The congatec SMARC 2.0 module is equipped with Intel Atom, Celeron and Pentium processors (code name Apollo Lake) and suitable for outdoor use in smart city applications

with two antennas for each module to ensure highest radio quality for every wireless interface. As an option, a third radio interface (also equipped with two antennas) can also be integrated on the eNUC carrier board. The system can take advantage of the SMARC 2.0 standard-compliant innovative modules as this standard allows direct implementation of native radio interfaces on the module.

The choice of SMARC 2.0 is also technically the most powerful module concept, as it integrates both ARM and x86 technology, which offers decisive scalability and caters for variants to match a wide range of device requirements and developer preferences. With its credit card-sized design, it is the module standard with the most innovative and largest number of interfaces. SMARC 2.0 offers up to four display interfaces, 2x Gigabit Ethernet, PCIe, 2x MIPI-CSI camera inputs, 2x USB 3.0, 6x USB 2.0, 4x COM, CAN, SPI and I2C as well as HDA and 2x I2S for audio, facilitating the design of highly innovative IoT gateways in the Box PC format.

Technagon developed the eNUC standard Box PC based on SMARC 2.0, so the housing and carrier boards were developed in-house. For the required modules used in TeNUC-100 Box PC design, Technagon chose the embedded supplier congatec. As a sales technology partner for customer-specific system design and manufacturing services in the field of POS and ticket systems, vending systems, digital signage and eMobility, congatec technology became an integral part of the Technagon solution. The development service provider performance bandwidth ranges from application-specific carrier boards and embedded Box PCs, it can cover system integration of all components including the design and manufacturing of the customer-specific housing which can even culminate in the complexity and size of an e-mobility charging station or kiosk systems.

This close sales technology partnership with congatec enables Technagon to integrate latest processor technology into customer-specific projects in a very fast way, giving their customers an enormous head start in terms of technology and time-to-market. The Box PC is equipped with first congatec SMARC 2.0 Computer-on-Module with Intel Atom, Celeron and Pentium processors (code name Apollo Lake). These processors were only released at the end of October 2016 parallel to the launch of the first congatec SMARC 2.0 module. And parallel to this, Technagon developed the TeNUC-100 Box PC and was in a position to present the system coinciding with the processor launch. The feature set of the TeNUC-100 Box PC with a wide-range power supply is convincing. The basic configuration includes a Displayport, LVDS and MIPI CSI camera support for smart digital signage, vision-based access control, general video surveillance and other interactive video applications. IoT wireless interfaces can be provided via two Mini PCIe slots, which, of course, can also accommodate other extension modules. Connections via 2x LAN with Power over Ethernet help to reduce cabling costs as the system does not need its own power supply. 2x USB 3.0 are available for peripherals and a USB client port as a local management interface.

In terms of storage media, the following is available: a MicroSD card slot and 1x SATA - including power - as well as up to 64 GB flash memory on the SMARC 2.0 module. As an option GPIOs, serial RS232 and RS485 interfaces as well as I2S and HDA, 2x CAN, SPI, eSPI and security chips as well as further sensors for temperature, acceleration, rotation, etc can be integrated via an extension slot. Various designs of the extension slot board can also be used to create customer-specific variants. This feature set is available in a wide range of housing configurations, i.e. a box version for desktop deployment, two for wall or DIN rail mounting, as well as a variant with Vesa mount for monitor mount. Further to this, different housing designs are available, even including a robust aluminium version for outdoor applications, i.e. in smart cities, the energy industry, in the field of bus and rail as well as in a wide range of other IoT applications.

As Technagon often delivers to its solution provider clients, such as the already mentioned automotive manufacturer, the complete middleware right up to the application layer or even the entire application for charge point servers as well as a wide range of other systems, the TeNUC-100 Box PC does not come as a standard product. It is provided to ODMS customers and verified both on the software side and with the corresponding extension modules that the OEM customer requires for each particular Original Design and Manufacturing project.

The boxes offer a myriad of different possibilities for the customers. They can be provided with, for example, an IoT gateway for sensor networks in smart cities or for all types of vending machines, which today all require IoT connections to integrate new payment systems such as NFC or, for example, to even comply with fiscal requirements for accounting as efficiently as possible.

To fulfil these demands, in smart city projects the company integrates, for example, the distributed sensors and in the case of machines the complete peripherals and offers OEMs an

individually tailored entire solution including the middleware and applications layers up to the device cloud. Its complete Extended Engineering Service is therefore always a major aspect and fits the needs of many new IoT start-ups, who need to get their innovative, genuine and high-quality solutions to market as quickly and efficiently as possible. OEMs who purely need standard platform configurations without additional ODM services do not have to feel left out, as congatec decided to extend its IoT gateway offer to include complete solution platforms. The reason for this is that the large and rapidly growing IoT market is best served with the classic range of embedded computer boards and modules from congatec, but OEMs increasingly require IoT gateways as completely application-ready platforms. In order to meet this growing demand, congatec is working on a portfolio of different configurable gateway platforms, which can be optimized to meet a wide range of very specific application requirements. Together with the matching Embedded Design and Manufacturing Services from Technagon, the result is a comprehensive range of solutions which meets every specific OEM requirement for IoT gateways. ■