ARM or x86?

Qseven modules for LPWAN gateways

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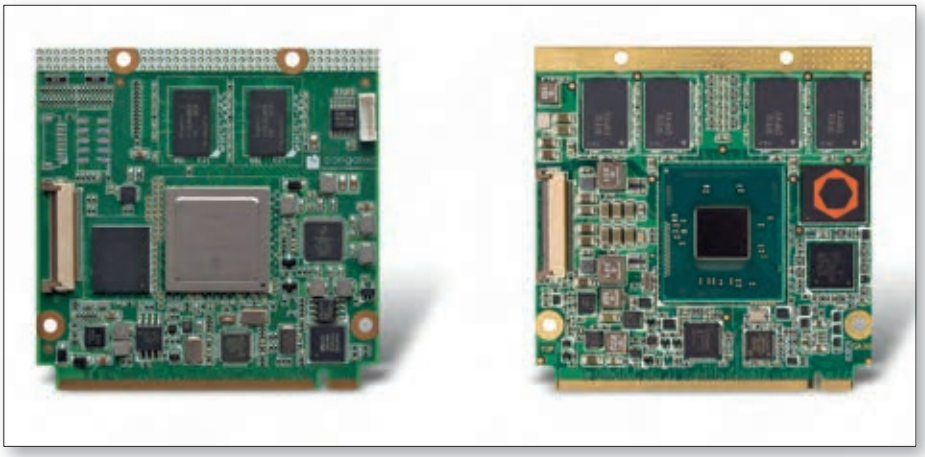
The FlexGate Low-Power Wide-Area Network (LPWAN) gateway from the French IoT and embedded systems engineering specialists EXPEMB is based on Qseven Computer-on-Modules from congatec. This gives the vendor the freedom to pick any ARM or x86 low power processor customers demand.

Connected distributed sensor and controller networks for monitoring, management and maintenance purposes are the driver behind the IoT. One of the major challenges is providing reliable connectivity and data exchange with distributed sensors and controllers over long distances from a few hundred meters up to several kilometers. This challenge is twofold: To meet the ultra-low power consumption requirements of the distributed sensors and controllers while enabling reliable and cost-efficient data exchange. Local wireless technologies don't have the broadcast range. Cellular technologies are too expensive and consume too much energy. Thus, new technologies are needed for these Low-Power Wide-Area (LPWA) connections in rural as well as urban areas that are major drivers of the progressive high growth rates of M2M and IoT applications.

While the total number of M2M connections will only grow from 5 billion in 2014 to 27 billion in 2024 at a CAGR of 18%, LPWA is a market that is expected to grow at 93% CAGR during 2016-2022 to reach 14% of the overall M2M connections in 2024. Today, Western Europe has the largest share of the LPWA market as the countries in this region were early adopters of these information systems. But major smart city projects in China, Singapore and India are also driving the growth. LPWA connections can be made available via different technologies. One path is based on a cellular type infrastructure with telecom like base stations. Examples are Sigfox or Huawei (Cellular IoT) which get deployed as open networks for usage of everybody. But most commercial users prefer private networks due to security concerns. One of the technologies for this market segment is LoRa. It uses a star topology for a bi-directional connection between devices like sensors or actuators, and one or several gateways that can – if supported –immediately forward all data via standard IP technology to a central cloud server. The data rate between the devices and gateways ranges from 0.3 kbps to 50 kbps. LoRa also encrypts all data via AES encryption technology by using a 64 bit unique network key, a 64 bit unique application key and a 128 bit device specific key. The single-hop wireless connection uses the unlicensed 868 MHz frequency band in Europe and 915 MHz in North America. By this, operators do not have to pay for third party infrastructures and licenses, which help to reduce cost.

The maximum capacity of accessible end devices or nodes for a LoRa gateway depends on the number of packets the gateway has to manage in a given time frame. A LoRa building block for a gateway with 8 channels can process up to 62,500 packets per hour. This equals the maximum amount of devices a gateway can handle if it is configured to send only one packet per hour. The maximum range in urban environments with no direct line of sight and deep indoor coverage ranges from 2 to 10 km. In suburban areas, up to 15 km can be achieved and 40 km for areas with a direct line of sight and little interferences.

To balance battery life and signal strength, the LoRa network server uses an Adaptive Data Rate (ADR) algorithm to automatically define the optimal performance under the local environmental conditions. The algorithm is based on advanced information such as Signal Noise Ratio (SNR), Received Signal Strength Indication (RSSI) and different channels to optimize signal strength and power consumption for each end device individually. By this, end devices can achieve a battery life of up to 105 months with a 2000 mAh battery, which is about 10 times more than current cellular based protocols offer. Besides the technological aspects, LoRa also receives great industry support, which helps to accelerate its roll out across the world. In July 2016, for example, KPN made its LoRa network throughout the Netherlands available for IoT applications. LPWAN specialist Actility also supports



The QSeven modules used in the FLEXGATE gateways

LoRa. This setup makes LoRa one of the most interesting low-power wide-area network technologies for many applications. Target application areas include IoT and M2M installations in smart cities and industrial applications such as agriculture, infrastructure, utilities, and logistics.

EXPEMB has developed a modular and scalable multi-service gateway for such LoRa networks that is designed for both commercial as well as harsh industrial environments and can be deployed in various applications, from control cabinets in facilities, to substations in energy grids, to cellular base station like infrastructures for smart city and smart agriculture projects. The FlexGate gateway that is ThingPark approved by Actility includes a real LoRa concentrator structured around a dedicated Semtech SX1301 chip. It has the capability to simultaneously listen to 8 LoRa channels in order to communicate with several thousands of connected nodes. FlexGate gateways also offer rich connectivity towards the central cloud with 1Gbit Ethernet link, Wi?Fi, 3G/4G and Bluetooth. All links are simultaneously available on the gateway and fall back can be set according to different scripts. This approach ensures reliable communication regardless of the local topology.

The FLEXGATE Gateway

A broad range of field I/Os such as 2x USB ports, 1x serial port and GPIOs makes it possible to interface other local devices with wired communication in different flavors including Modbus fieldbus support. Integrating only industrial components without any moving parts such as fans or HDDs, the FlexGate gateway is a high reliability platform designed for 24/7 operation. It is powered by DC or PoE+, where the later reduces cabling efforts. Outdoor configurations support the extended temperature range and IP67 protection with associated waterproof connectors.

The FlexGate gateways are designed as application-ready platforms and offer management services based on a modular Linux framework that is dedicated to the IoT. This open architecture allows easy integration of any new services required. Services that are already part of the standard configuration include highly secured communication layers as well as an open packet forwarder that forwards RF packets received by the concentrator to a server through an IP/UDP link, and emits RF packets that are sent by the server. Beyond the extensive LoRa network support in the field, the FlexGate gateway also offers flexible cloud-to-field connectivity which is ready to adapt local LoRa configurations and to facilitate every required service needed, from field deployment services to operational monitoring and management as well as maintenance services including remote firmware upgrade (FOTA) functions. As the product line has been designed to address all various needs of LoRa gateway deployments, the system family can integrate all common processor technologies independently from the microarchitecture. This enables EXPEMB to offer its gateway technology in absolutely all customer projects that might occur one day. Because the company didn't want to limit its LoRa core competence to a certain processor technology as this would limit our market potential too much. It therefore designed a twin architecture platform capable of hosting both ARM and x86 technologies, which allows to participate in all calls for tenders.

Current FlexGate gateways are equipped with flexible processing power based on two major processor families: One is the latest generation of Freescale i.MX6 low power multi-CPU cores. The other one is the Intel Atom E3800 product family with 1 to 4 cores (code name Bay Trail). Both flexible architectures of the FlexGate portfolio offer a processing power that can easily be adapted to different use cases due to its wide performance scalability up to fog and edge server intelligence. The implemented hardware platform as well as the performance flexibility have been made possible by integrating Qseven Computer-on-Modules that support both architectures, ARM and x86.

The usage of such modules also enables EXPEMB to switch one of these processor families to the next latest state-of-the-art technology without any need to change the hardware design. This makes the FlexGate gateways a platform that can be deployed longer than the lifecycle of the processors, which is 15 years for Freescale and 7 plus years for Intel. Additionally, future processors like the next Intel Atom generation codenamed Apollo Lake can also be implemented.

From the vendor point of view, EXPEMB has chosen modules from congatec because they are leading in Computer-on-Modules in Europe and offer best in class service and support as well as one of the broadest Qseven portfolios available. And even though this company has highest market share – which could imply complicated processes to get the right support due to a huge fragmented organization – the personal integration support is what EXPEMB is most happy with.

The challenge was to get a more or less identical functional setup for the different architectures to enable to scale the solutions in the most efficient way. For this purpose, congatec provides perfect platform support to build uniform families with both x86 and ARM. Most standard Computer-on-Module vendors have dedicated experts for each architecture. Congatec had the same expert for both architectures. That made communication very efficient. ■