Overview of the vNassa Software Defined Radio

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Introduction

vNassa is the latest Software Defined Radio (SDR) platform from Vanteon Wireless Solutions. vNassa is based on the Analog Devices ADRV9002 highly integrated wideband RF transceiver and the Xilinx Zynq-7020 All Programmable System-on-Chip (SoC). The ADRV9002 is coupled with a custom designed, performance enhancing 915 MHz RF front end which provides 1W of transmit power. Together, these components create a flexible, cost-effective and highly integrated SDR platform that beautifully balances performance and cost, and is perfectly suited for the narrowband industrial market.

Software Defined Radio Overview

Software Defined Radio (SDR) is a technique used to develop radio platforms that are flexible and scalable. Flexibility and scalability are imperative now that radio technology has become ubiquitous in our society. Radio technology is foundational in a variety of markets including consumer, defense, industrial, aviation and smart grid, to name a few. In these markets, radio technology is used to provide voice and video communications, as well as exchange data information in support of applications like sensor networks and meter reading.

There are a number of benefits related to adopting SDR technology. SDRs are flexible, so they can be cost-effectively modified. There is no reason to physically modify the hardware in order to change the functionality. Within certain constraints, one common hardware platform can provide the functionality of multiple radios, which reduces productions costs. Software and firmware that run on the radios can be reused across various radio products, which reduces development costs. An SDR can be given upgraded functionality or bug fixes by simply changing its software and firmware, thus reducing maintenance costs. Lastly, SDR platforms reduce time-to-market for supporting new and emerging standards, since new hardware does not have to be developed.

The flexibility of an SDR comes from its ability to be reprogrammed, or the ability to change its software and firmware that defines how it works. That means an SDR uses processors that are easily reprogrammed. A major component of many SDRs is a Field Programmable Gate Array (FPGA). This device can be programmed using a Hardware Description Language (HDL) which allows it to perform parallel processing for fast operations. SDRs can also employ Digital Signal Processors (DSPs), General Purpose Processors (GPPs) and Integrated System on Chip (SoC) devices.

vNassa SDR Technology

Vanteon's vNassa is an SDR platform that is perfectly suited for the industrial market, due to its narrowband performance and lower cost than traditional SDRs.

vNassa is based on the Analog Devices ADRV9002 highly integrated RF transceiver. This device supports real time bandwidths between 12 kHz and 40 MHz. It has a broad RF frequency range from 30 MHz to 6 GHz. The ADRV9002 provides support for 2x2 MIMO, integrated DPD, FDD and TDD in a single package, low power consumption and fast locking for frequency hopping support.

vNassa also utilizes the Xilinx Zynq-7020 All Programmable System-on-Chip (SoC). The programmable logic in this device is used for very high speed signal processing. The high-speed interface provided by the ADRV9002 allows for the transfer of large volumes of I/Q samples for processing.

Vanteon offers a large number of Digital Signal Processing (DSP) soft core modules that utilize the programmable logic in an FPGA like the Zynq-7020. These DSP modules provide various modulation/demodulation techniques, digital down/up conversion, symbol timing recovery and tracking, carrier recovery and tracking, digital filters, automatic gain control, channel coding, multi-channel transmitters and receivers, forward error correction (FEC) techniques and spread spectrum coding. An example of the modulation/demodulation techniques available include ASK/AM, FSK/FM, PSK/PM, QAM and OFDM. Some of the digital filters available include FIR, IIR, multi-rate and adaptive filtering. FEC techniques that are available include convolutional and Reed-Solomon encoding/decoding.

The Xilinx Zynq-7020 SoC also contains two embedded ARM Cortex A9 processors. This allows for easy integration of the Programmable Logic with a real-time software application, making the ARM a perfect option for implementing a control/status interface and a custom communication stack from Media Access Control (MAC) layer up through the application.

vNassa also incorporates a custom, performance enhancing, RF Front End (RFFE). The RFFE improves on the RF performance of the ADRV9002 integrated transceiver for industrial applications by optimizing the operation in the Sub-GHz ISM bands between 860 and 930 MHz, as well as boosting the transmit power to 1 watt.

vNassa Benefits

Vanteon's vNassa SDR platform targets the narrowband industrial markets, balancing performance and cost to an optimal level. Industrial devices tend to be low data rate devices that can typically achieve their required throughput using less than 100 kHz of bandwidth. The Vanteon vNassa SDR can handle bandwidths as low as 12 kHz with operating frequencies as low as 30 MHz, which makes vNassa perfectly suited for industrial applications.

The integrated DPD capabilities of the ADRV9002 also benefit applications requiring highly efficient transmitters with varying envelope waveforms. This feature enhances battery operation by reducing size, weight and power for applications requiring waveforms using OFDM, QAM, or ASK, such as Wi-SUN and legacy meter reading radios. The DPD is also a crucial feature for certain licensed band applications like Land Mobile Radio (LMR) where high transmit power, efficiency, and spectral purity are of critical importance.

The fast frequency locking capabilities of vNassa make it perfect for industrial protocols that utilize frequency hopping techniques that are used for interference avoidance and transmission robustness. Frequency hopping is also an FCC mandated feature for some of the ISM band utilizations that are so popular among industrial radios. The ability to lock quickly on the next frequency in a hopping plan increases Over the Air (OTA) throughput, since there is less dead time between frequency changes. Fast frequency hopping is also an important feature for GSM cellular applications worldwide.

vNassa's reprogrammable Xilinx Zynq-7020 SoC enables software defined capabilities. The ability to change the programmable logic, as well as the firmware of the built in ARM cores, makes vNassa a very flexible platform. For example, in its simplest form, vNassa can be used as a single channel narrowband radio. By changing the programmable logic and/or ARM core firmware, the same vNassa platform becomes a wideband multi-channel radio, capable of receiving up to 128 simultaneous narrowband radio signals. This is accomplished by utilizing the wideband receive capabilities of the ADRV9002, which is capable of up to 40 MHz of instantaneous bandwidth. By opening up the RF front end, a wide spectrum can be sampled and processed by the Zynq-7020 into multiple narrowband channels, simultaneously. That makes vNassa a cost effective Industrial IoT collector radio. It becomes a single device that is capable of servicing thousands of narrowband, frequency-hopping endpoints in a typical industrial application. The radio equipment cost savings becomes quite large when vNassa is deployed in this manner.

vNassa Target Applications

Vanteon's vNassa SDR platform was developed with a number of target applications and standards in mind. The first is Wi-SUN. Wi-SUN is based on 802.15.4g, which defines the Physical (PHY) and Medium Access Control (MAC) layers of the communication stack. Wi-SUN is the standard being used in next generation smart utility and smart city wireless applications. For example, advanced metering, distributed automation, municipal lighting, smart parking, and environmental sensing are just a few of the ways Wi-SUN is being deployed. By utilizing the Wi-SUN standard, the equipment deployed for these applications will allow for interoperation, even when delivered by different vendors.

While Wi-SUN is growing in popularity, the utility industry moves slowly, and it will take a while to see widespread deployment. In the meantime, legacy waveforms for meter reading, sensor networks, equipment tracking, and other applications can all be handled today using the vNassa platform and the investment of deploying vNassa today is not lost when Wi-SUN becomes more ubiquitous. vNassa's software update capability protects your hardware investment by handling your legacy waveforms today, while allowing upgradability to handle future waveforms like Wi-SUN.

Conclusion

vNassa is Vanteon's SDR platform that is optimized for narrowband industrial applications. Contact us to learn more about how it can be used in your application, or, if needed, customized for your specific IoT application.

Have a different SDR application you need to solve? Visit Vanteon's website to see our full portfolio of SDR platforms. From low cost to high performance, Vanteon has an SDR platform that will be the foundation of your next wireless solution.

Vanteon Background

Vanteon is an electronic solution design and engineering consulting firm, specializing in collaborative design, development and sustaining engineering for electronic hardware and software products.

Vanteon has more than 30 years of experience in developing next-generation solutions with emphasis on Wi-Fi, IoT, Energy Harvesting, embedded hardware/firmware, and software development.