Trends in Wireless Communication Boards

By Jean Hummel

Market demands for higher cellular density in urban areas, broadband internet wireless, and better data security, while using a minimum amount of frequency spectrum is driving wireless developments forward at an amazing speed. Forward leaps in computing power have resulted in GIGAFLOPS of processing power, available on COTS DSP boards, that allow telecom engineers to process more in the digital domain.

SDR

The newest generation of radios are Justly-called software defined radios (SDR), since the entire signal processing chain is implemented digitally using reconfigurable firmware and software. A typical SDR has these components:

- Analog interface to the RF stage and antenna, via high-speed converters (ADC and DACs) able to digitize a wide portion of the spectrum
- High-speed front-end signal processing including digital down-or up-conversion
- Protocol-specific processing using spreading/de-spreading, chip rate and frequency-hop rate recovery-code/decode functions.
- Data Communications—Interfacing with carrier networks and backbone for data I/O and command-and-control processing, usually handled by general purpose ARM or DSP processors and an RTOS.

FPGA: for ultra high-speed processing

The front-end signal processing is usually a very high speed process that is best suited for FPGA processing. The front end signal processing, such as cascaded integrated comb filters and decimators used in up-down-conversion, fit well within most FPGA architectures and employ simple arithmetic, but intensive in computation cycles because they run at the digitizing rate. These functions are ideal for FPGAs because they scale-up easily for parallel processing and usually do not involve highly complex algorithms.

Programmable logic density and speed are a driving force behind new SDR architectures. FPGA device sizes now approach the 10 million gate mark, offer speeds 200-400 MHz, and allow very complex interfaces to be mapped in logic. A huge body of IP cores is available which allows firmware engineers to rapidly integrate interfaces such as PCI, Ethernet, as well as communication-specific functions like Digital Down Conversion etc.

DSP: for smarter, complex processing

Complex algorithms found in protocol-specific algorithms are more suited to programmable digital signal processors (DSPs) such as those from Texas Instruments. Demodulation, error correction, data packetizing, and radio control loops are well supported by DSP hardware and software. These DSPs incorporate hardware acceleration for common functions such as Viterbi decoding and a large body of software is available for most wireless applications. DSP software development tools now feature high performance RTOS that speed development with standardized plug-in software functions, thereby greatly reducing software development time.

COTS Development and test platforms for SDR systems, such as those from Innovative Integration, coalesce all the processing stages into a single compactPCI board: analog converters, FPGA and DSP. The advantage of such integrated designs is that it provides radio firmware and software engineers a complete hardware platform that they can be used in the field to develop and test new IP algorithms (intellectual property) or as a powerful, reconfigurable station to test hardware.

Wireless board technology continues to be driven by the emergence of newer, more powerful logic and DSP devices, software standards and system architectures. Tighter integration of analog with enormous signal processing power seems to be the name of the game and is leading wireless communications boards to new levels of performance. ◆

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