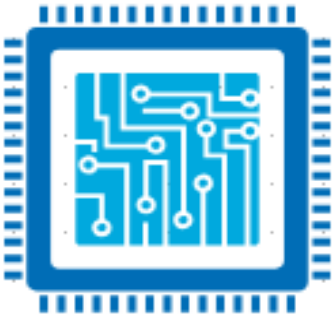

S M Technologies

Designing The Wireless World

Case Study of Design of Ultra-Wideband Radio

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SM Technologies Pvt ltd

SM Technologies Pvt. Ltd. is an Indian company and the sister concern of RFIC Solutions Inc., headquartered in USA. As a fabless RF design house, SM Technologies focuses on advanced wireless solutions, with its design and development activities carried out in India. The company specializes in highly integrated System-on-Chip (SoC) and System-in-Package (SiP) solutions, custom ICs, and IP cores using state-of-the-art GaAs, InGaP/GaAs, InP, CMOS, and SiGe semiconductor processes, utilizing MESFET, pHEMT, and HBT technologies. Its expertise includes the design and development of Low Noise Amplifiers (LNAs), Power Amplifiers (PAs), RF Switches, complete transceivers, millimeter-wave chips, and RF modules for a wide range of wireless applications, including WLAN, WiMAX, PCS, and cellular systems

The Client:

The client was working on development of Wireless systems based on Ultra-Wide Band Communication standards. They have experience in developing Wired and Wireless solutions with expertise in providing Wireless Mesh Network solutions. The client had expertise in Digital design with very little knowledge about RF and Analog Base-band. They were looking for a partner who can provide a RF and Analog Front-end for the Digital Base-band.

Design Challenges:

A Board level solution was desired that could be used as a Proof-of-Concept for the new technology being developed. The major design challenges are listed as below:

a. Low cost and Low power architecture was desired. However, the choice of the architecture was limited by the availability of off-the shelf components.
b. SM Technologies was required to support the frequency input from 3 to 8.4 GHz. It was difficult to find a single chip solution for RF or even building blocks that can support this broad range of frequency. Military grade solutions were available but we needed something that meets the low-cost requirements for the targeted commercial applications where the solution will be used.
c. FCC limits the power that can be transmitted over UWB system, utilizing 500 MHz bandwidth to be less than -14dBm. This made the sensitivity requirements for the receiver to be less than -105 dBm to obtain a respectable SNR.
d. In the transmitter analog Base-band design, a suitable circuit was to be designed to generate a 2n sec pulse from a 250 MHz input clock signal.

Our Solution:

Team at SM Technologies was responsible for design, testing and interfacing of the RF and Analog Base-band radio with the Digital Base-band board developed by the client. The approach and solution provided by us is discussed as below:

a. A detailed study of three architectures; Super Heterodyne, Direct Conversion (Zero IF) and Low IF architecture was done. The availability of commercially available components was the basis of comparison of these architectures. First hand system level simulations were done for each of these architectures with electrical parameters of the available off-the shelf components. Agilent's ADS tool was used for this. Based on the simulation results a super heterodyne architecture was found to be most suitable for the proposed system.
b. SM Technologies team used its expertise in RFIC design to select the best available off-the shelf devices and also ensured that the devices are procured on time.
c. A distinguishing feature of the proposed solution was the development of the 2n sec pulse generation circuitry. Design Team at SM Technologies, developed a low power and robust circuit for 2n sec pulse generation based on use of Delay lines and NAND gates.
d. We did the schematic entry, BOM generation, Net-list generation using OrCAD Capture CIS tool.
e. The Layout was done using OrCAD Layout Editor Tool. The Board stack-up was designed to ensure a good isolation between various layers and RF parts.
f. A very clean Power Supply was provided to ensure low noise performance.
g. EM simulation was performed for the complete board to ensure minimal effect of Board parasitic on the System level performance.
h. RFIC Solutions team used Vector Network Analyzers, Spectrum Analyzers and Digital Oscilloscopes (up to 50Gsps sampling rate) for testing and trouble-shooting of the system.
i. Finally, we helped the client in interfacing the RF and Analog base-band board with the Digital board. We worked with the signal integrity team of the client and helped them to develop suitable interface for the Digital Clock signal (for transmitter) and 250 MHz Analog output (for the receiver ADC).

Benefits for client:

Our expertise in RF Analog system & IC level design provided our client with numerous benefits. Some of the most significant contributions of our team are discussed below.

a. We proposed a Super Heterodyne architecture which was thought to be high power and high cost. This architecture was proposed based on the availability of off-the shelf ICs. However, selection of this architecture led to considerable savings of DC power consumption of the Digital Baseband Board by eliminating the need for IQ mismatch calibration algorithms in Digital Baseband design. This also led to considerable savings on engineering cost at the client's end.
b. We solved the problem of generation of 2n sec pulse using the 250 MHz clock available from digital baseband board. The client had earlier failed in its attempt to generate such pulse.
c. Our experience and relationship with IC vendors made it possible to get the components on time and hence avoided unnecessary delays in the project, due to long IC lead times.
d. With the effort of our team the client was able to demonstrate a Proof-Of-Concept for the UWB based communication system.