Tektronix helps Stantec test their leading-edge UWB systems.

Solution Summary	
Challenge	To test new hardware being developed by Stantec for the ultra-wideband (UWB) Communications market
Solution	A Tektronix TDS6604B Oscilloscope offers the right combination of speed, memory and versatility to spot hard-to-find anomalies in complex UWB signals.
Benefits	Only a high-speed real-time oscilloscope can be used to observe the random, aperiodic signals that are an integral part of UWB technology. The Open Windows capabilities of the TDS6604B also make it easy to use Matlab software to simulate UWB communications systems with 'real world' signals as stimuli in the tests.

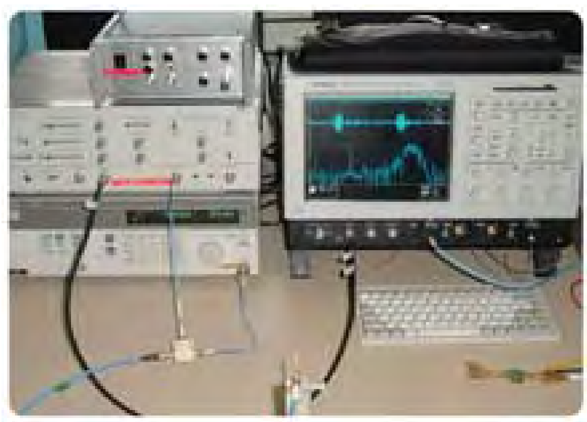
Stantec (www.stantec.fr) - a start-up company that has been spun off from the IMEP – L'Institut de Microelectronique, Electromagnetisme et Photonique in Grenoble, France, is a pioneer of UWB (ultra-wideband) technology: a high-bandwidth, short-range communication technology that is attracting considerable interests in applications ranging from fourth-generation mobile phones to industrial control.

UWB technology is based on the transmission and reception of impulse signals only a few hundred picoseconds long, but with an extremely wide frequency spectrum. At the beginning of 2002, the FCC (the regulating body for the use of the US radio spectrum) opened up the 3.01 to 10.6 GHz frequency band for license-free commercial use. This decision has generated tremendous opportunities for the development of new radio communications systems and, in particular, short-range high-speed data transmission systems.

UWB technology should enable complete system integration between the RF and baseband functions. It allows the transmission of hundreds of megabits per second over a distance of 10 meters with minimum power emission level. This would make it possible, for example, to transfer a high-quality film from a computer to a television set in real time, or transmit information between two USB2 computer ports via radio at a speed of 480 Mbit/s. This is no longer a dream as UWB technology now makes it possible. This gives it a potentially vast range of applications in general consumer electronics, computer peripherals, mobile appliances and indoor short-range networks.

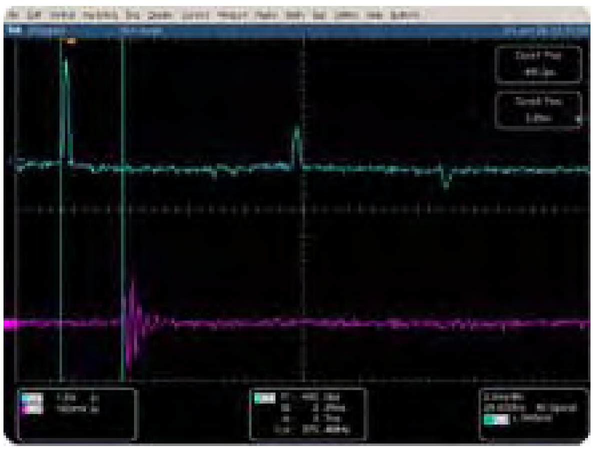
UWB can be used in many communication applications requiring broadband use, a constant signal level and an insensitivity to perturbations and other interferences. The implementation of wireless networks to control transducer systems or industrial processes is a concrete example of how UWB technology can be used. These communication devices can also offer services such as telephone, Internet, or sound and image in audio-visual systems.

UWB can also serve to accurately determine the position of an object or person inside a building or any other closed space where the GPS signal is inaccessible. Another possible use is in search and rescue activities. UWB has also been used in military radars as well as more specialized equipment such as ground-penetrating radars or imaging systems to see through objects.



There are two main technologies used in UWB systems. In the first - known as DS-UWB (Direct Sequence UWB) - signals representing the information to be transmitted are coded by random pulse sequences. This is a carrier-free frequency technology, with no modulation in the traditional sense of the term. This transmission mode allows a processing gain, and makes it possible to operate communications with a low signal to noise ratio. The second approach endeavors to adapt the traditional transmission technique via multicarrier orthogonal frequency division modulation (OFDM), to very wideband channels. This approach – known as MB-OFDM (Multi-Band OFDM) - has excellent potential for realizing broadband and short-distance communications in indoor environments, with strong multiple reflections of radio waves.

The Stantec team – Emil Novakov, Stanislas Voinot, Jean-Michel Fournier and Stéphane Gégout - brings together a wealth of scientific and technical knowledge in a number of disciplines, allowing them to manage the complete development cycle from basic concept to final hardware. This includes the design, analysis and simulation of system architecture, realization of the necessary radio-frequency integrated circuits, the implementation of communication protocols and the global validation of UWB systems. Stantec is also working closely with manufacturers such as Taiyo Yuden Co., Ltd., who have developed passive components and antennas for UWB applications.



The company is currently working on an experimental UWB system targeting ad hoc networks. This system uses standard integrated-circuit technologies and aims at a complete integration of the RF side and the low band side, with a minimum use of energy. The work currently being carried out is based on techniques of transmission made via modulated pulses and pulses with direct spreading of the UWB spectrum (Direct Sequence UWB). This system enables an accurate control of the emission spectrum, as well as processing gains. Other work is being carried out on standardization as well as in the field of Multi Band OFDM techniques.

Standardization of UWB technology is currently being carried out by the 802.15 work group of the IEEE. The adopted norm imposes very strict limits to the emission level. The maximum level allowed in UWB communications is 2000 times less than that used within GSM narrowband communications. UWB transmission involves very short pulses – typically 200-300 ps – at amplitudes of about 1 V and very low power levels below 500 µW. This poses a significant challenge to the designers of UWB communications systems, and means that any work that Stantec carries out requires high-performance test equipment.

A key element in the performance of a UWB system is the shape of the pulses and what happens to them in the transmission process. Stantec's experimental set-up involves signals being transmitted and received by very large bandwidth antennas and examined at all stages to check on any distortions that might occur in the air interface, the antennas or the internal circuitry.

The signals used for these tests are not periodic, but are based on a random sequence, which means that test instruments such as swept spectrum analyzers or network analyzers are not appropriate for this particular application. "In fact, the only instrument currently available that can be used is a high-frequency real-time oscilloscope with a long memory and a high bandwidth," says Stantec's Emil Novakov.

> ***"The Tektronix TDS6604B oscilloscope has proved invaluable to our development program. Without this instrument we were completely blind."***
> - Dr. Emil Novakov, Scientific Advisor, Stantec

Tektronix introduced their TDS6000B Series of 6 GHz oscilloscopes at about the same time that the Stantec team was deciding on their test-instrument requirements. The decision was taken to purchase a TDS6604B 4-channel model. This enabled Stantec to view the qualitative effects and complex interactions in signals in real time and any anomalies could be instantly spotted by the investigating team.

A further benefit for the Stantec researchers is the fact that the TDS6604B is based on an Open Windows platform, and can thus be used to run Matlab software. This allows the users to capture real-life signals offline and then use them, with the aid of Matlab, to stimulate the UWB hardware to assess the effect of various occurrences – an interruption in line-of-sight communications, for example.

"The Tektronix TDS6604B oscilloscope has proved invaluable to our development program. Without this instrument we were completely blind." says Dr. Novakov: "It gives us a detailed insight into the way the signals are actually behaving in our designs: something which would not be possible using traditional techniques."

As this case study demonstrates, customers have successfully used the Tektronix TDS6604B/6804B and TDS7704B oscilloscopes for Ultra Wide Band (UWB) applications using their own analysis solutions. These applications need maximum bandwidth and simultaneous high sample rate and long record length. Instruments such as the TDS6604B are most appropriate and useful when the RF transmission is intended to occupy the lower frequency band, which for most standards extends from 3.1GHz to about 5GHz.

In order to fulfill customer requirements for other UWB types covering the full spectrum (3.1GHz to 10GHz) as well as for designs based upon second-generation serial data standards, Tektronix has introduced the TDS6000C series featuring the world's fastest real-time oscilloscopes. Key specifications of TDS6154C are: 15GHz bandwidth, 19ps risetime (20% / 80%), 40GS/s sample rate and up to 64Megasamples record length.

The TDS6154C's accurately calibrated magnitude and phase extends across the entire UWB spectrum defined by the U.S. Federal Communications Commission (FCC), enabling the TDS6154C to accurately capture as real time waveforms the complex wavelet shapes common with UWB.