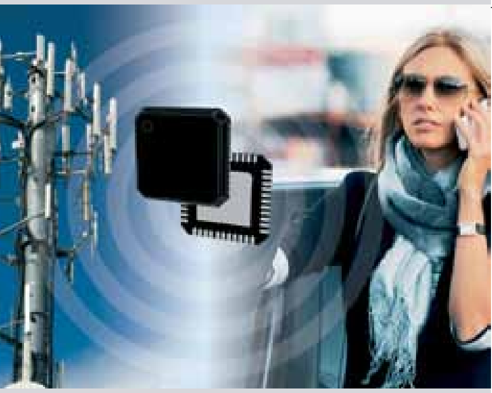
PROJECT RESULT

High speed communications systems

2A106: Ultra-high data-rate wireless communication (Qstream)



Ultra-fast wireless to transform data streaming

Very high-speed data communications have in the past been limited to specialist and military applications, owing to the cost of building the sophisticated integrated circuits required. Now the Qstream project has come up with an alternative route to building such chips using much cheaper CMOS technology. The project started out focusing on fast point-to-point wireless links for applications such as high definition multimedia streaming, but its results – using the licence-free 60 GHz band to deliver a ten-times increase in transmission speed – could have profound implications for future WiFi.

Ultra-fast data communications have the potential to transform key consumer applications – multimedia streaming being an obvious example. Yet while everyone likes the idea of watching a film on their mobile phone, few to date have been prepared to pay the cost of providing a usable service.

The MEDEA+ 2A106 Qstream project set out to overcome this problem. The target was to develop semiconductor technology which would underpin low-cost, ultra-fast data-streaming applications in the millimetre-wave (MMW) frequency range, in particular for the licence-free 57-to-66 GHz industrial, scientific and medical (ISM) band.

Attracting consumer use

Such ultra-fast communications capabilities have traditionally been limited to specialist or military applications, based on comparatively expensive gallium arsenide (GaAs) chipmaking technology. Qstream, by contrast, aimed to develop complete transmitter and receiver ICs – radio frequency (RF) and digital baseband – using relatively cheap-to-produce CMOS technology. The end result would also be a system-in-package (SIP) implementation, one that facilitated both MMW front-ends containing aerial arrays and active chips on a low-cost substrate.

A key target was to deliver an effective demonstration of ultra-fast point-to-point communications at 60 GHz. Qstream partners believed such capabilities would drastically improve a number of consumer applications, especially in domestic communications systems.

Wireless high-definition multimedia streaming is a typical example. High-definition multimedia interface (HDMI) connections conserve the quality of the digital signal between a DVD player or set-top box and the TV, yet consumers do not like the additional cabling required. An affordable wireless system which offered the same transmission quality would be much more attractive and instantly marketable.

Ten times faster WiFi

During the project, it emerged that the potential for ultra-fast data communications was not limited to fixed point-to-point applications. The technology being developed in the MEDEA+ project had potential for use in a much wider market. It offered a significantly faster – of the order of ten times – WiFi technology which could transform swathes of consumer applications.

Qstream delivered several demonstrations of circuits in a standard CMOS semiconductor technology. The first demonstrator was an eight-path phased-array 60 GHz receiver front-end using 45 nm technology, in combination with a laminate aerial array. The second was a full-speed wireless link including a phased-array beam-forming MMW transceiver module, with baseband signal processing running on a personal computer. This second demonstrator achieved a maximum data transfer speed of 4.6 Gb/s.

A third demonstrator comprised a real-time set-up running media-access control, baseband, beam-forming and beam-tracking algorithms on an field-programmable gate array platform, in addition to a phased-array beam-forming front-end. This system made use of quality-of-service and beam-steering techniques to achieve the best communications results.

While the MEDEA+ project was running, the WiFi scene had been advancing fast. During 2011, Wireless Gigabit (WiGig) Alliance consolidated the tri-band communication concept at the 2.5, 5 and 60 GHz bands. WiGig Alliance is positioning 60 GHz technology as the next step in WiFi networking, a market which has much greater potential than HDMI-cable replacement.

And it is for this future WiFi market that the results of Qstream are most significant. Existing WiFi operates on congested frequency bands of 2.4 and 5 GHz, reaching a maximum speed in the best case of around 300 Mb/s. With speeds of up to 4.6 Gb/s, the Qstream platform can deliver results in the 60 GHz band of approximately ten times the speed of present-day WiFi.

Application breakthrough

Qstream has laid down the technological foundations for a number of new market concepts. And it has shown that this technology can be produced at much lower implementation costs than with conventional approaches using low-temperature co-fired ceramic substrates. In addition, the CMOS circuits showed performance comparable to and in some cases better than mainstream implementations in silicon-germanium and GaAs technologies.

The project partners are already applying these results within their own market-development operations. NXP Semiconductors, for example, is actively seeking to license the technology to at least one external partner. It also hopes to develop it further for applications which use even higher frequencies – such as automotive radar products in the 76 to 81 GHz band.

Another project partner, Technicolor, is preparing use of the results in its set-top box and home-gateway products, where it is already a market leader. A new wireless high-definition multimedia streaming system will replace the HDMI connector and cable with a wireless link, thus delivering a new and highly marketable product at the same time as simplifying user installation.

Significant competitive edge

Qstream provided the European dimension which enabled researchers in companies across Europe to complement each other in advancing MMW communication systems faster. The project's results will provide Europe with a significant competitive edge in this area.

The MEDEA+ project also contributed significantly to international standardisation efforts. Project partners IMEC, NXP, STMicroelectronics and Technicolor are all involved with the IEEE, ECMA and WiMedia standardisation efforts; Qstream has enabled them to propose some important additions to the standards.

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KEY PROJECT DATES:

Start: April 2008
End: November 2011

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MEDEA+ focuses on enabling technologies for the Information Society and aims to make Europe a leader in system innovation on silicon.