Simultaneous multi-standard SDR platform

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Résumé du projet de recherche (Langue 1)

Software Defined Radio (SDR) has been a promising concept for many years. Finding its use mostly in military applications, it is getting closer everyday to devices, with SDR showing its face in consumer mobile applications (i.e. nVidia i500 SDR modem). Siemens has identified SDR as the future of wireless communication, but research is required to bring the current reality of SDR to the next level. The focus of the work will be entirely on commercial off-the-shelf hardware (COTS); no hardware design will be made. Using such existing hardware the final milestone would be to implement a SDR platform, which is able to receive and transmit different radio standards simultaneously. If the radio standards work on the same frequency band, they will use the same frontend, also simultaneously. However, to be able to implement such a platform, there are still many open questions, which will need to be answered during the research project. One problem which has already been identified is that, in order to receive simultaneous signals from two devices using one frontend (with one AGC), one signal may be significantly louder than the other, which would require higher resolution ADCs. Also, new architecture concepts have to be defined. Part of the research will concentrate on separating and potentially parallelizing the steps of the signal processing, some of which may be offloaded to other processing units, if there are any. The architecture and the concepts developed will need to be flexible enough so that they are not dependent on a specific hardware manufacturer and model. Our vision is one platform that can speak many radio protocols simultaneously, and is extendable over software. The specific hardware, its cost and capacity are of less importance to us at the moment, as we don’t expect to make it into a product in the next 3 years.

Résumé du projet de recherche (Langue 2)

As an example of our vision, we would like to be able to receive two 20MHz WLAN frames, sent by different devices in adjacent channels, using a single frontend and SDR unit. Another example would be to communicate over WLAN and Bluetooth simultaneously (again, using only one frontend). Yet another example would be the use of 868MHz communication simultaneous with 2.4GHz communication, using the same processing unit (e.g. General Purpose Processor); this specific example may use two frontends. Regarding the hardware platform to be used, Siemens has a report ready regarding the SDR capabilities of current COTS hardware. This can be used for defining the initial hardware platform to be used. Having said that, the use of “soft modems” through GPPs is our current target platform for the beginning of the project, as GPPs are faster/easier to program than DSPs, ASIPs, FPGAs and ASCIs. In the specific case of GPPs we are aware that energy consumption and hardware costs will most probably be higher than an FPGA/DSP solution, but the hardware development effort would be severely reduced. Some GPP-based SDR projects already exist, e.g. GNU-Radio, the Sora platform from Microsoft Research, or EURECOMs OpenAirInterface. Such project can serve as a starting point for the PhD. Nevertheless, the basic SDR platform has to be chosen carefully, as many GPP-based solutions suffer from the severe real-time communication requirements (e.g. IEEE 802.11 handshaking procedures on the MAC layer). An operative implementation of the system is also an important element of the research projects, as that will prove the validity of the newly developed architecture and concepts. After the first year, the hardware platform selected for the project must be up and working, implementing at least one standard selected by Siemens (for example OFDM-based WLAN). At the end of the second year, a system capable of simultaneously sending and receiving two communications standards (also chosen by Siemens) will be presented. The purpose of this implementation during the second year is to have hands-on experience with the types of problems and issues which will affect a simultaneous operation. This will also help the development of a methodology which will allow the integration of other communication standards for simultaneous operation, even standards which don’t exist yet. This new methodology will be refined during the third year. A full implementation will be delivered by the end of the project (3 years), which will, at least, be able to send/receive signals from two different devices simultaneously on the same frequency band (preferably 2.4GHz, for example WLAN and Bluetooth simultaneously), which is developed using the newly defined design methodology. An important aspect here is that the implementation should be based on a clear design methodology supporting the simultaneous reception of two or more communication standards.