

A Survey of ASIC Design Centers at Austrian Universities

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Throughout the last years several groups at Austrian universities succeeded in establishing state-of-the-art ASIC design centers with the aid of regional, national, and European funding. These centers were by no means targeted to facilitate research and education activities alone. The direct support of Austrian enterprises – mainly but not exclusively small and medium sized companies – has been of equal importance to all groups. For the sake of clarification a brief historic summary will start this survey. Subsequently all partners at the Vienna University of Technology, at the Graz University of Technology, and at the Linz University will be introduced. After briefly describing the respective infrastructure, we will cover the areas of interest and special competencies of every center. Finally the results of selected projects will be presented.

1. Introduction

The ASIC design activities at Austrian universities started more than 15 years ago. Traditionally those university institutes engaged in this subject were not focused entirely on research and education alone but intended to address directly the needs of Austrian electronic industry. To accomplish this goal, ASIC design centers had to be established and maintained on a regular basis at every site. Besides the necessary hard- and software for designing integrated circuits specialized measurement equipment for verifying prototype ICs had to be at hand for every design center from the very beginning. Evidently, funding of such activities generally is far beyond the financial capabilities of a single University institute. As a consequence, a series of regional and later national projects were launched in order to facilitate the set-up and operation of ASIC design centers.

Efficiently funded by the GMe, the UNICHIP project was the first initiative of this kind with the Institute of Electronics at the Technical University of Graz and the Institute of General Electrical Engineering and Electronics at the Vienna University of Technology taking part. At that time access to both state-of-the-art design software and prototype fabrication facilities were tremendously expensive even if special discount rates for universities were taken into account. For the same reasons direct cooperation with industrial partners were somehow limited to those firms with previous knowledge on ASIC design. Our main target group – SMEs with little experience in computer aided design methods of integrated circuits and electronic systems – was very difficult to address. An ASIC design was linked to high investments which were considered too risky to undertake. Additionally, all those applications requiring only small and medium production quantities had to be ruled out anyway.

Luckily enough, things changed dramatically as soon as the European Commission launched an initiative to tackle the aforementioned problems on a European scale. Participating in the ESPRIT project EUROCHIP and later in the EURO PRACTICE project enabled universities all over Europe to establish advanced ASIC design facilities for research, education, and direct support of SMEs. Today EURO PRACTICE offers several basic services for Universities: State-of-the-art IC design software may be licensed with affordable annual fees. Secondly, prototype fabrication of integrated circuits based on multi project wafer runs has been setup in cooperation with European IC foundries. For new technologies such as multi chip modules (MCMs) and microsystems a similar approach has been chosen to cut down fabrication costs. Finally, the TBPS (Training and Best Practice Service), a European approach to co-ordinate training and continuous education in the area of microelectronics, concludes the EURO PRACTICE services¹.

Except for the software support service all services of EURO PRACTICE are open for industry as well. Key to the tremendous success of EURO PRACTICE was the extension of the prototyping program to small and medium production quantities of fully tested and qualified ASICs, MCMs, and microsystems. Together with an ASIC design center, SMEs are now able to launch to develop their own ASICs for a variety of applications.

As in most of the other EC member states, national programs were launched to fund the participation in EURO PRACTICE for universities dealing with ASIC design. In Austria the AUSTROCHIP project and later the TMOe initiative was proposed.

2. TMOe

The “Technologieverbund Mikroelektronik Österreich” is a loose union of now six university institutes with the goal to intensify the use of microelectronics within Austrian industry. Needless to mention that the participants are putting special emphasis on addressing SMEs. In the following paragraphs all members of the TMOe will be introduced together with their special field of interest in research and education. The TMOe members are in alphabetical order:

- Institute for Applied Electronics and Quantum Electronics, situated at the Vienna University of Technology
<http://www.iaee.tuwien.ac.at/agcad>
- Carinthian Tech Institute
<http://cti.ac.at>
- Institute for Computer Science, situated at the Vienna University of Technology
<http://www.ict.tuwien.ac.at>
- Institute for Electronics, situated at the Technical University of Graz
<http://www-ife.tu-graz.ac.at>

¹ Although this program is generously funded by the EC, the author has serious doubts about its success. A huge database of courses on nearly any subject in microelectronics offered in Europe has been built up, however, no information on the quality of a specific course has been collected. For engineers in industry seeking education possibilities in microelectronics, the TBPS service is quite useless without inside knowledge of the actual qualification of a course provider. On the other hand, university institutes usually know the relevant experts anyhow and use the TBPS database just as an on-line schedule for ASIC design courses. Hopefully, the role of TBPS will be re-investigated within the 5th framework program (IST)

- Research Institute for Integrated Circuits, situated at the Linz University
<http://www.riic.ac.at>
- Institute for Applied Information Processing and Communications, situated at the Technical University of Graz
<http://www.iaik.tu-graz.ac.at>

2.1 Institute of Applied Electronics and Quantum Electronics

The main areas of interest of the CAD working group are digital and analogue CMOS ASIC design, complex FPGAs and EPLDs, and design of electronic systems. In the recent past the group gained detailed experience in developing ASSPs – application specific digital signal processors. A total of four University lectures are given every year covering the computer aided design of integrated circuits, of field programmable integrated circuits, of printed circuit boards, and finally the test of integrated circuits. Apart from these lectures continuous education by means of specially tailored training courses is offered to SMEs upon special request.

Industrial support and know-how transfer in the area of microelectronics is by far not limited to training courses alone. Typically, an SME seeks assistance on a specific topic such as evaluation of EDA tools or asks for an analysis on whether it is both technically and commercially justifiable to introduce ASICs into a product. As a result of such a feasibility study a design project is defined and in some cases jointly worked on.

During the last few years more than 30 firms took advantage of the service offers of the group, 28 design projects were completed in close cooperation with eight partner enterprises.

2.2 Carinthian Tech Institute (CTI)

Recently the Carinthian Tech Institute became a member of the TMOe. It replaces the Institute für Technische Informatik at the Vienna University of Technology, because Prof. Herbert Grünbacher, former full professor at the institute, shifted his professional interest and is now in charge of coordinating electronic and microelectronic research and education at the CTI. Prof. Grünbacher's work is dedicated to high level system and ASIC design with special emphasis in VHDL based design capture and synthesis. Within the scope of an ESPRIT cooperation (TTA – Time Triggered Architecture), a microcontroller for distributed fault tolerant systems has been developed. The promising results obtained so far will lead to interesting ASIC design activities at the CTI.

2.3 Institute for Computer Science

Methodologies of high level digital circuit design with special emphasis on ICs is one of the main responsibilities of the institute within the computer science curriculum at the faculty of electrical engineering. Several lectures held in combination with hands-on courses are dealing with this subject. Closely linked to the ASIC design work the institute focuses on communication systems paying special attention on field bus systems. Direct support of Austrian SMEs was successfully established in the latter subject by means of special field bus courses. Together with Motorola a hardware accelerator ASIC (LDC, Lower Layer Driver Chip) for the LON field bus has been developed.

2.4 Institute for Applied Information Processing and Communications

Over the past years, this institute has gained advanced knowledge in the area of computer networks and operating systems with special emphasis on data security issues. Custom made complex digital VLSI chips are indispensable for designing reliable and fast data encryption systems. Furthermore, the Institute has successfully supported both private and public organizations in solving data security problems. Naturally, digital VLSI design is a substantial part of undergraduate education the institute is responsible of.

2.5 Institute for Electronics

Originally, research was focused on designing high accuracy sensors for measuring physical quantities like temperature or density of fluids. As a consequence, the opportunities that analogue, digital, and mixed mode ASICs are offering to tackle these problems have been investigated for several years. Thus, the institute has acquired advanced know-how in all areas of CMOS ASIC design, which are now taught in several undergraduate courses in integrated circuits.

The close vicinity to AMS, an Austrian chip foundry, helped to establish a long term relationship between the institute and AMS. Many diploma theses have been completed in the framework of this cooperation. The actual research work on sensors has led to several successful products which have been developed in cooperation with the Austrian firm Anton Paar KG.

2.6 Research Institute for Integrated Circuits (RIIC)

In 1997, the RIIC has been founded with the intention to concentrate all activities in integrated circuit design in one single institute. One of the duties is of course educating computer science and mechatronics students by offering theoretical lectures on communication science and electrical engineering together with hands-on courses in ASIC design. The institute has targeted its research efforts towards the analogue analysis of SiGe devices. In the area of digital design, the main field of interest is located in automated testing of digital ASICs.

Direct support of Austrian SMEs has been accomplished in several ways. The RIIC is participating as a Technology Transfer Node within the ESPRIT EURO PRACTICE FUSE (First User) initiative. Within the frame of the EUREKA project NESSI the RIIC acts as a Support and Competence Center for Austria. Both of these projects are purely focused on direct support of SMEs in introducing microelectronic technologies. As an accompanying measure post graduate training courses are offered on a series of topics such as VHDL-based design techniques or VIEWLogic[®] software training courses.

3. Selected Projects

This survey shall be concluded by presenting the results of two typical ASIC design projects. Both are examples for an efficient combination of a successful ASIC development with detailed know-how transfer of computer aided design methodologies.

3.1 HST - Headset Transceiver ASIC

Together with Frequentis Nachrichtentechnik an analogue CMOS ASIC has been developed to be used in data communication systems for air traffic control. The HST comprises two independent transceiver circuits, each of which consists itself of two differential power amplifiers together with a microphone input amplifier. Several amplifiers and switching elements provide analogue loop-back functionality for testing purposes. The HST acts as a front-end circuit and thus allows the direct connection of standard headsets to the system.

As our partners did not intend to launch an analogue ASIC design group for their own needs, the know-how transfer was focused on project related issues such as ASIC specification, project flow, sharing and partitioning of responsibilities between all partners.

The HST has been fully qualified by Frequentis and is an integral part of every new design.

3.2 IVASIC-16

The Austrian firm AKG-Acoustics has developed a new method of virtual acoustics which improves in an impressive way the sound perception when using headphones. By means of complex digital filters, a natural sound impression comparable to normal loudspeakers is achieved. After having proved the principle using a standard DSP, AKG decided to introduce ASICs into the system. Two different ASICs, one for professional applications and the other for consumer products, have been developed in close cooperation with AKG. The latter ASIC has been transferred into volume production with the very successful product HEARO777, a wireless headphone with virtual acoustic features.

Although technology transfer was done in a similar way as described in the previous project, AKG was encouraged to participate actively in the design process itself as well. Interface circuits and part of the verification was performed by design engineers of AKG.

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- Amt der Steiermärkischen Landesregierung
- Amt der Niederösterreichischen Landesregierung
- Amt der Oberösterreichischen Landesregierung
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