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EDGE: Europe's new ESPRIT project in high-frequency CAD

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Abstract

This paper describes the background, objectives and planned activities for a new European collaborative project in high-frequency analogue CAD. This effort is part-funded by the European Commission within the Information Technologies sector of the EC Fourth Framework Programme (ESPRIT 21404). The project acronym, EDGE, stands Enhanced Design for GaAs/Si in Europe, and the project will run for about two years from April 1996, with a total work-effort of about 27 Person Years.

Introduction

A. CAD Within Earlier ESPRIT Projects

Microwave CAD in a wide sense has been supported on a number of ESPRIT projects since around 1986. Usually this support has been directed towards the modeling of new and advanced active devices, and also to some extent passive structures. In nearly all cases, the rationale for the CAD activity has been clearly directed towards meeting the needs of device or circuit designers, specifically in the context of the development of applications using GaAs-based MMIC's. Many substantial achievements have arisen from this work over the years, as described in more detail elsewhere [1],[2].

As well as stressing the importance of a good CAD infrastructure for successful MMIC design, many European practitioners in the field have sought to encourage EC support over the years for European CAD as a strategic business activity in itself. They have particularly pointed to the numerous examples of successful research innovations developed within Europe, which have made (and continue to make) substantial contributions to the technical sophistication of US-sourced software.

One noteworthy initiative was launched in 1992 under the guidance of Philippe Dueme of Dassault Electronique. This proposal, named EuMiCAD, involved a large number of partners and had ambitious technical and commercial goals. Unfortunately, although successfully passing through technical evaluation within the EC, the project was not ultimately funded due to budgetary constraints. The effective consequence was an increasing domination of the world CAD market by US vendors, with a continuation of a rather fragmented, limited and disjointed market participation by European vendors, coupled with a continuing flow of European university research ideas across the Atlantic.

B. The EGIP Project 1994 - 1995

In late 1994, the European Commission launched a short 'bridging' contract called EGIP (European GaAs Infrastructure Project, ESPRIT 9603), to address a number of specific concerns in the manufacture, design, packaging and accessibility of GaAs MMIC technology. The project was led by Siemens and mainly involved the other foundries comprising the EuroGaAs consortium (GMMT, PML, Daimler-Benz, Thomson, Alenia, and Telettra). One Workpackage was devoted exclusively to CAD and included an effort in formulating a future strategy for CAD development in Europe, backed up by a major survey of user needs [3].

In the course of this study, the global evolution of the CAD market was discussed, and the strengths, weaknesses, opportunities and threats scenario faced by the European vendors was assessed. Clearly, the main weakness faced by any European commercial CAD enterprise would be its comparatively small size and lack of market credibility. On the positive side, the research strengths of Europe and certain changes now occurring in the marketplace (including the emergence of the PC as a serious challenge to the workstation), provide some grounds for optimism.

The overall conclusion from this study was that European a collaborative European effort in CAD would be highly desirable, but not, however, in direct competition with leading American vendors, rather offering a set of linked complementary capabilities to users. In the longer term, it was recommended that Europe should support an open, multi-vendor environment for CAD users, but in the short-to-medium term, a policy of closer business integration between European commercial vendors should be pursued as a matter of some urgency, leading to the offer on the market of a set of complementary, closely-linked CAD products, evidently belonging to a single family. At the same time, the strategy should ensure that meeting immediate user needs arising from existing commercial CAD investments must receive at least equal emphasis in the short-term.

C. Formulation of the EDGE Project

In the course of the EGIP project, certain principles were developed which should apply to any future CAD project within ESPRIT. These included:

- The commercial aspects of any proposed high-frequency CAD initiative must be clearly and convincingly worked out, within an aggressive but credible time-scale. Commercialisation of CAD expertise could include consideration of offering design/consultancy services in Europe and elsewhere;
- CAD proposals should have a strong orientation towards being supportive of, and complementary to, European foundry initiatives on the chip-manufacturing side, such as those originating through EuroGaAs. These might include achieving a specified increased target share of the III-V global MMIC market by a given date;
- Any European CAD initiative must take a realistic view of the present situation in the CAD market, and at least acknowledge that existing user-needs mainly relate to US-sourced products;
- Partnerships must be relatively small (< 10) for management cohesiveness, but imaginative and effective measures should be introduced to ensure that everyone with a useful contribution at world-level can be given an opportunity to participate (e.g. universities);
- All partners should bring a distinct, recognised, world-level competence to a future CAD proposal. It is not acceptable for the project to be used as a 'training vehicle' by any partner in order to acquire expertise which is already available within Europe;
- Any new software products proposed should conform as far as possible to an open architecture design philosophy;
- At the technical level, a proposal in CAD must place a very high emphasis on integration of tools: any point tools proposed must be designed for mutual inter-operability and have effective links with established US-based products;
- The needs of microwave design should not be addressed in isolation: requirements from related areas such as high-speed digital circuits, digital communications and optoelectronics should be taken into account;
- Proposals for European CAD projects should take a forward-looking, long-term view of the role of advanced CAD in design and production, emphasising true seamless integration of heterogeneous, modular CAD tools within a common design environment. The potential contribution of developments such as MHDL should be given serious consideration. The importance of reducing design times and design iterations, facilitating concurrent engineering, balancing technical aspects against cost issues etc. should also all be recognised. In addition to interoperability between other electrical CAD domains (digital, optoelectronic, DSP...), there will be a need for close links to mechanical, thermal, cost modeling and other tools.

The EDGE proposal was submitted to the EC in mid-1995, and sought to conform to these principles in so far as practicable given a realistic assessment of likely resources available. In particular, the consortium size had to be kept small and commercial issues were of uppermost importance in defining the work to be done. Of necessity, therefore, many excellent research groups in Europe could not be included directly within the consortium. In this context, it should be understood that the intention in defining EDGE, was mainly to create a local commercial infrastructure for exploitation of European research ideas, rather than to support such research directly. Given the current emphasis within ESPRIT, this infrastructure could be used to support future downstream projects once it had become established.

Following a successful technical evaluation, and a rather protracted negotiation to define a final contract, made more difficult by a more than 40% cut in allocated resources, the EDGE project has recently got underway. The membership of the project consortium is as follows:

Coordinator:	University College Dublin (IRL)
Partners:	Barnard Microsystems Ltd. [UK]
	Dassault Electronique [F]
	GaAsCode Ltd. [UK]
	GMMT [UK]
	Jansen Microwave GmbH [D]
	Philips Microwave Limeil [F]
Assoc. Partner:	University of Rome 'Tor Vergata' [I]

The project if of 2 years duration with a total work-effort of 27PY.

EDGE Project Objectives

The overall objective of the EDGE project is to provide a new, user-oriented and commercially-driven CAD resource to support high-frequency analogue design in Europe. This resource will be tailored especially to meet the needs of MMIC designers and the EuroGaAs consortium of foundries.

The project is intended to strengthen Europe's position in CAD and MMIC design for linear and non-linear microwave circuits, high-speed analogue IC's, as well as interconnect structures, for operation from 0.1GHz to 100GHz and beyond. The project's main outside industrial impact will be through enabling shorter time-to-market and reduced cost for successful circuit realisation in this sector. The need for greatly improved high-frequency CAD support is now evident across several key application sectors with major growth potential in the microwave, RF and mm-wave area, especially those related to Si- and GaAs-based components for wireless communications. Similar needs are emerging in terms of more accurate simulation capability, in the field of high-speed digital system design.

The specific core objectives of the project may be listed as follows:

- ***Links Between Existing European Tools***
  At present, a variety of independent European commercial high-frequency CAD tools are marketed by several of the companies in the EDGE consortium. From the users point of view this situation is undesirable, as the products appear disjointed and effort is required on the part of the user to combine them for specific applications. A key objective of the EDGE project is to demonstrate effective, working, user-friendly links between these different CAD tools at the conclusion of the project, and to take these product enhancements to the marketplace by way of exploitation of the project results;

- ***Links between European Tools and Established US Vendors***
  The consortium is well aware that the products of US CAD vendors, in particular HP-EEsof, are widely used in the industry at present for analogue MMIC design. The EDGE project intends to allow users to complement their existing investments of this kind with a set of easy-to-use extensions and links to European CAD tools, and will provide practical demonstrations of such capabilities at the conclusion of the project. Again, these extra functions will be exploited by individual CAD vendors;

- ***Support of Advanced User Interface Development and a Common Interface Style***
  From the point of view of the user, a flexible, powerful yet intuitive interface is of the greatest importance in promoting attractiveness of CAD products and ensuring maximum design productivity. The EDGE project will demonstrate major enhancements to existing CAD interface formats which will provide real benefits to MMIC designers, in particular through the provision of direct access to foundry library modules, standardised wherever possible. Furthermore, the consortium intend to work towards a common European style of user interface during the course of the project, demonstrating a similar 'look-and-feel' across the tools, to complement the links at the data exchange level described earlier;

- ***Integration of Time-Domain Tools for MMIC Design and Yield Enhancement***
  The consortium wishes to address the continuing serious problems of MMIC designers in performing reliable non-linear analysis of MMIC's which are complex, multi-function and operating in strongly non-linear and/or low-power regimes. Furthermore, yield evaluation for self-bias circuits presents particular problems. Integrating a series of existing advanced complementary capabilities in Europe, the EDGE project will demonstrate an EDGE Large Signal time-domain simulator, with links via convolution analysis to frequency-domain data. The main emphasis in this work will be on low-cost, PC-oriented software solutions;

- ***Provision of a Standardised, Advanced Non-linear European FET Foundry Model***
  Foundry users around the world have persistent problems with circuit-level, non-linear models of FET-based devices. The EDGE project intends to offer an advanced, standardised non-linear FET model for at least two of the foundry processes represented in the consortium, using a synthesis of the best available research ideas. Among the latter is included a unified, physics-constrained modelling strategy already existing within the consortium. The final model will have a well-documented parameter identification procedure, and will be as general-purpose as possible in the sense of being usable over a wide range of typical DC operating conditions, with a single set of model parameters.

In addition to meeting the above objectives, the project will address related 'horizontal' issues such as independent testing and evaluation both of tools and inter-tool links, and, very importantly, the production of professional-level documentation. Furthermore, following the recommendations for a future European CAD strategy defined in the EGIP project, the EDGE project will also investigate possible specific options for allowing users to configure future open, multi-vendor families of point tools for analogue CAD applications.

Besides continued individual company efforts at direct exploitation of the results of the project, the project partners have agreed to work together to formulate a preliminary joint business plan at a very early stage in the project. This plan

will be further refined and communicated to the European Commission at a point 9 months into the project. Hence, the EDGE project involves a commitment among the leading partners to collaborate closely not only in a technical but also in a commercial sense.

Business principles will be applied in progressing the proposition of eventual convergence at a business level between the CAD vendors represented within EDGE. Given that most of the project members are in the business of providing CAD solutions that users will wish to use and buy, the consortium as a whole is completely committed to ensuring maximum user involvement in and acceptance of the developments proposed within EDGE. For this purpose, it is proposed to contribute project resources to the creation of an *EDGE User Board*, made up of key users within Europe, which will be briefed on the progress of the project and will help to ensure that its activities are constantly relevant to user needs.

Conclusions

At a general level, the main objectives of the EDGE may be stated as follows:

- To establish a sound basis for a linked European microwave tool-set which will be complementary to and compatible with US-vendor offerings (in particular, from HP-EEsof);
- To interface existing European commercial software in a user-friendly way, so that a low-price overall CAD package could be offered to the market at the conclusion of the project;
- To meet the needs of European users in the area of high-frequency CAD, including the needs of SME's and the EuroGaAs foundries;
- To provide an attractive European environment for European software developers (from Universities, companies and institutes) to interface their products, as well as providing a route to commercial exploitation of European research ideas in CAD.

Despite its relatively limited resources, the EDGE project is expected to provide at its conclusion a real and visible improvement to the CAD infrastructure available to MMIC designers in Europe, which will help not only to ensure the survival of an independent commercial CAD capability in Europe, but will also assist European high-frequency MMIC manufacturers to strengthen their position in the strategically-important market of high-frequency electronic components. Most importantly, users of the project's results will be enabled to create timely, cost-effective and technically-sophisticated MMIC components for the many new markets opening up in the high-frequency microelectronics sector.

References

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