

INFORMATION SOCIETY TECHNOLOGIES (IST) PROGRAMME



Contract for:

Concerted Action/Thematic Network

Periodic Report 1

Project acronym: ACiD-WG

Project full title: Working Group on Asynchronous Circuit Design

Contract no.: IST-1999-29119

Period: 1 September 2000 - 31 August 2001

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1. Project summary

Objectives

ACiD-WG aims at improving the systematic exchange of information and the forging of links between teams which carry out RTD or take-up activities around the theme of asynchronous circuit design. Its objectives in FP5 are as follows:

1. **To encourage excellence in science and technology research pertaining to asynchronous circuits and systems.**
2. **To facilitate the development of methods and tools that are usable by engineers for the design of asynchronous VLSI systems.**
3. **To promote the adoption of asynchronous circuit design in industry.**

Description of the work

Four workshops will be organised, hosted by members of the Working Group and will take place in different member and associated states of the European Union, on the theme of asynchronous circuits and systems. Attendance and presentations by all members of the Working Group and by industrial affiliates will be encouraged. Invitations to participate will also be extended to non-members of the Working Group. In addition, visits between members will take place and special interest group meetings will be organised.

A summer school will be organised for the second year of the contract. The school will be hosted by a member of the Working Group. Additional teaching and training activities will take place. For example, ACiD-WG co-operates with the organisation of six-monthly meetings in the UK aimed at PhD students.

Members of the Working Group will engage in activities aimed at generating interest and awareness in asynchronous circuits and systems, e.g., exploratory visits to companies, and tutorials at conferences. They will also disseminate the results of their research, e.g., posters and presentations at conferences, and publication of books and journal articles. Trip reports will be produced and linked to the ACiD-WG website.

To demonstrate the strength of European RTD in asynchronous circuits and systems, participation in the annual "Async" international symposium is particularly desirable.

A report "Design, Automation and Test for Asynchronous Circuits and Systems" will be commissioned, which should be of value to potential users of asynchronous circuit technology and to tools developers. It will be followed up by an annual public overview of the status of asynchronous design in industrial use.

Milestone

There is a single milestone, two years from the start of this four-year contract. The work carried out up to this point will include organisation of

- two workshops (contributing to the systematic exchange of information and the forging of links),
- a summer school (resulting in the training of future designers), and
- an "Async" symposium (facilitating participation by researchers from European industry and academic institutions),

and the production of three reports (informing actual and potential

2. Membership

With the exception of MBUK and NNT, all organisations named in the contract had signed a membership agreement with SBU during this reporting period, as follows:

<i>Participant No.</i>	<i>Short Name</i>	<i>Country Code</i>	<i>Type of Organisation</i>	<i>Date of entry into force</i>	<i>Requesting Contribution from Commission</i>	<i>Scientific Person</i>
1	SBU	UK	U	1/9/00	Yes	Mark Josephs
2	Philips Research	NL	I	1/9/00	Yes	Ad Peeters
3	Infineon	D	I	1/9/00	Yes	Christoph Heer
4	ST	F	I	1/9/00	No	Pascal Vivet
5	CSEM	S	R	1/9/00	No	Christian Piguet
6	IHP	D	R	1/9/00	Yes	Eckhard Grass
7	MBUK	UK	I		No	Eric Campbell
8	UoM	UK	U	1/9/00	Yes	Doug Edwards
9	UNEW	UK	U	1/9/00	Yes	Alex Yakovlev
10	UCAM-CLAB	UK	U	1/9/00	Yes	Simon Moore
11	UPC	E	U	1/9/00	Yes	Jordi Cortadella
12	UDI	I	U	1/9/00	Yes	Luciano Lavagno
13	TUE	NL	U	1/9/00	Yes	Tom Verhoeff
14	INPG-TIMA	F	U	1/9/00	Yes	Marc Renaudin
15	DTU	DK	U	1/9/00	Yes	Jens Sparsø
16	Technion	IL	U	1/9/00	Yes	Ran Ginosar
17	Åbo Akademi	FIN	U	1/9/00	Yes	Kaisa Sere
18	AT&T	UK	I	1/9/00	No	Phil Endecott
19	NNT	IL	I		No	Victor Varshavsky

U = University; R= Research Institute; I=Industrial organisation

The scientific persons, Campbell of MBUK and Varshavsky of NNT, anticipate their organisations signing a membership agreement during the second reporting period.

SBU forwarded an advance of €6,225 to each member requesting a contribution from the EC, apart from Philips Research and TUE who failed to supply their bank details.

Note that the Technical Management Committee (TMC) of ACiD-WG consists of the scientific contact person of each member organisation.

In pursuance of Objectives 2 and 3, it is desirable to involve more companies than just those that are members of ACiD-WG. Thus companies (whether operating inside or outside the EU) that are actual or potential users or designers of asynchronous circuits and systems, or suppliers of microelectronics-design tools or services, are eligible to become **industrial affiliates** of ACiD-WG. Companies that become affiliates (but not members) are not offered funding and do not sign a membership agreement with the contractor. An application form was linked to the ACiD-WG home page URL.

Five companies became industrial affiliates during this reporting period, as follows:

<i>Company Name</i>	<i>Country Code</i>	<i>Home Page URL</i>	<i>Date of application</i>	<i>Contact Person</i>	<i>Position</i>
Arm Limited	UK	www.arm.com	22/12/00	Tim Caspell	Collaborative Projects Manager
Cadence Design Systems	USA	www.cadence.com	24/1/01	Ted Vucurevich	Corporate VP Research
Kramer-Consulting	D	www.kramer-consulting.de	6/2/01	Torsten Kramer	Design Engineer
Theseus Logic	USA	www.theseus.com	7/2/01	Alexander Taubin	Senior Scientist
Philips Semiconductors Nymegen (Automotive)	NL	www.semiconductors.philips.com/markets/automotive/	8/2/01	Patrick Heuts	Digital IC Design Engineer

Their completed application forms were placed in a password-protected electronic repository, for which members of ACiD-WG were given access instructions.

3. Workplan and Progress

3.1 General description

The three objectives of ACiD-WG can be met by following a workplan that consists of four workpackages:

- WP1 facilitates the systematic exchange and dissemination of information, and the forging of links between members of the Working Group and other parties. By this means,
 - research problems will be articulated and addressed,
 - the potential of applications to benefit from asynchronous circuit technology will be examined,
 - a consensus will build up on design flow, methodology, tools and libraries,
 - plans for standardisation can be formulated, and
 - individual RTD projects (e.g. funded by national research councils) will receive the attention of a wider audience, which should be mutually beneficial.
 WP1 is associated with six tasks and four deliverables.
- WP2 is concerned with training measures that promote and support the dissemination, exploitation and enhancement of research knowledge. WP2 is associated with one task and deliverable.
- WP3 produces reports that will help companies assess and evaluate asynchronous design. It is associated with two tasks and six deliverables.
- WP4 is for Project Management. It is associated with five tasks and no deliverables.

3.2 Workpackage list

Workpackage list						
Workpackage No ¹	Workpackage title	Lead contractor No ²	Person-months ³	Start month ⁴	End month ⁵	Deliverable No ⁶
WP1	Systematic exchange and dissemination of information	1	0	0	48	D1 - D4
WP2	Training	1	0	0	48	D5
WP3	Assessment and evaluation	1	0	0	48	D6 - D11
WP4	Project management	1	10	0	48	
	TOTAL		10			

¹ Workpackage number: WP 1 – WP n.

² Number of the contractor leading the work in this workpackage.

³ The total number of person-months allocated to each workpackage.

⁴ Relative start date for the work in the specific workpackages, month 0 marking the start of the project, and all other start dates being relative to this start date.

⁵ Relative end date, month 0 marking the start of the project, and all end dates being relative to this start date.

⁶ Deliverable number: Number for the deliverable(s)/result(s) mentioned in the workpackage: D1 - Dn.

3.3 *Workpackage descriptions and progress*

Workpackage description

Workpackage number/title :	1. Systematic exchange and dissemination of information
Start date or starting event:	0
Participant number:	1
Person-months per participant:	0

Objectives

Objectives 1, 2 and 3 are relevant to this workpackage.

Description of work

Four workshops will be organised in all, one per year. The workshops will be hosted by members of the Working Group and will take place in different member and associated states of the European Union. Workshops may target specific themes relevant to asynchronous circuits and systems. Attendance and presentations by all members of the Working Group and by industrial affiliates will be encouraged. Invitations to participate will also be extended to non-members of the Working Group. Thirty or more participants are anticipated at each workshop.

In addition, visits between members will take place and special interest group meetings will be organised.

Members of the Working Group will engage in activities aimed at generating interest and awareness in asynchronous circuits and systems, e.g., exploratory visits to companies, and tutorials at conferences. They will also disseminate the results of their research, e.g., posters and presentations at conferences, and publication of books and journal articles.

Trip reports will be produced and linked to the ACiD-WG website.

To demonstrate the strength of European RTD in asynchronous circuits and systems, participation in the annual "Async" international symposium is particularly desirable. ACiD-WG will provide financial sponsorship for Async 2002 and Async 2004.

Deliverables

The proceedings of each workshop is a deliverable. They will be published as a technical report of the host institution and will also be made available in electronic form linked to the ACiD-WG website.

Tasks and expected result

The organisation of four workshops by members of the Working Group are tasks that will contribute to the systematic exchange and dissemination of information, and the forging of links between members of the Working Group and other participants. The organisation of two "Async" symposia by members of the Working Group are tasks that will facilitate participation by researchers from European industry and academic institutions.

Progress with Workpackage No. 1:

- There was a session of 4 papers (including 1 by SBU and Philips Research, and 1 by UNEW) on asynchronous circuit design at PATMOS, 13-15 September 2000.
- Grass (IHP) continued his collaboration with Bartlett (University of Westminster, London) on Low-Power Asynchronous DSP, visiting in September 2000.
- Lavagno (UDI) continued his collaboration with Cortadella (UPC), visiting in December 2000.
- Renaudin (INPG-TIMA) visited Gemplus, January 2001, Gemenos, France, to give a talk on asynchronous circuit design.
- Piguet (CSEM) hosted the first ACiD-WG workshop, 12-13 February 2001, Neuchatel, Switzerland. There were 47 participants from 25 organisations in total (7 x CH, 6 x UK, 3 x F, 2 x NL, 2 x D, 1 x I, 1 x E, 1 FIN, 1 x DK, 1 x IL). 15 members of ACiD-WG were represented, the exceptions being MBUK, IHP, TUE and NNT. The cost of organising the workshop was €8.3K. In addition, travel bursaries were given to 2 non-member organisations (1 x NL, 1 x DK) at an additional cost of €1.3K.

The workshop consisted of 18 presentations over 7 open sessions:

1. Asynchronous Interconnect I
2. Asynchronous Decoupling
3. Asynchronous Interconnect II
4. Asynchronous Design Projects
5. Discussion: "Is asynchronous design ready for widespread industrial use?"
6. Asynchronous Implementation of Petri Nets
7. Verification and Test of Asynchronous Circuits

Handouts of abstracts and slides were given to attendees. Revised versions, including the minutes of the discussion session, were uploaded on to the ACiD-WG website, to form an electronic version of the proceedings of the workshop. (See deliverable D1.)

Workshop attendees also learnt about the canton system of government in Switzerland!

- SBU, Philips Research, UoM, UNEW, UCAM-CLAB, UPC, UDI, INPG-TIMA and Technion were represented at Async 2002, 11-14 March 2001, Utah, USA. 9 of the 20 accepted papers were from members of ACiD-WG: 5 x UoM (1 joint with Ericsson Microelectronics, and 1 joint with ST), 2 x Philips Research (1 joint with Kramer-Consulting and Philips Semiconductors), 1 x UPC, 1 x UNEW.
- Piguet (CSEM) and Renaudin (INPG-TIMA) gave an embedded tutorial on low-power issues for systems-on-chip, which included a talk on asynchronous design, at DATE 2001, 13-16 March 2001, Munich, Germany.
- Renaudin (INPG-TIMA) visited the French Department of Defence, June 2001, Paris, to give a talk on asynchronous technology for secure circuits.
- Yakovlev (UNEW) was programme co-chair of the 2nd Int'l Conf. on Application of Concurrency to System Design, sponsored by the IEEE Circuits & Systems Society. This was held in co-operation with ACiD-WG and featured a session of 4 papers (1 by UPC) on asynchronous circuits. Lavagno (UDI) organised a satellite workshop on synthesis of concurrent systems.
- Ginosar (Technion) visited SBU, July 2001, to discuss system-on-chip design, self-timed signalling, etc.
- Sparsø (DTU) and Furber (UoM) collaborated on a textbook "Principles of Asynchronous Circuit Design - A Systems Perspective".
- Cortadella (UPC) and Yakovlev (UNEW) are co-editing a book "Advances in Concurrency and Hardware Design".

Workpackage description (continued)

Workpackage number/title :	2. Training
Start date or starting event:	0
Participant number:	1
Person-months per participant:	0

Objectives

Objective 3 is relevant to this workpackage.

Description of work

A summer school will be organised for the second year of the contract. A member of the Working Group will host the school. Lecturers will be drawn from members of the Technical Management Committee and other distinguished scientists. Laboratory sessions will be based on design tools that are available in the public domain.

Additional teaching and training activities will take place. For example, ACiD-WG co-operates with the organisation of six-monthly meetings in the UK aimed at PhD students. ACiD-WG will assist in the placement of suitable PhD students with companies (e.g., summer internships).

Deliverables

The lecture notes of the summer school will be collated to form a deliverable.

Tasks and expected result

The organisation of the summer school is a task that will result in the training of university students, young researchers and practising engineers in asynchronous circuit design.

Progress with Workpackage No. 2:

- The 9th UK Asynchronous Forum was hosted by UCAM-CLAB, 18-19 December 2000. It attracted 43 participants. It included a tutorial on "Specifying Controllers using Petri Nets", prepared by Yakovlev (UNEW), but delivered by Lavagno (UDI).
- The 10th UK Asynchronous Forum was hosted by the University of Edinburgh, 2-3 July 2001. It attracted 47 participants.
- A PhD student from SBU received training at Philips Research, March - June 2001.
- Kessels (Philips Research) was an instructor on a System-on-Chip Design course, 18-27 April 2001, Graz, Austria.
- Heer (Infineon) and Piguet (CSEM) were instructors on the EuroPractice Advanced Digital IC Design course, 27-31 August 2001, EPFL - Lausanne, Switzerland. They taught "Asynchronous Design Methods" and "Low-Power Microprocessor Design", respectively.

Workpackage description (continued)

Workpackage number/title :	3. Assessment and evaluation
Start date or starting event:	0
Participant number:	1
Person-months per participant:	0

Objectives

Objectives 2 and 3 are relevant to this workpackage.

Description of work

The Working Group will commission a report "Design, Automation and Test for Asynchronous Circuits and Systems" which will describe the state-of-the-art in methods and tools for the design of asynchronous digital VLSI systems. The report is intended to be primarily of use to companies (members and non-members of the Working Group alike) who are aware of the potential benefits of asynchronous circuit technology, but who need to know more about available asynchronous design methods and tools before committing resources. The report will also highlight deficiencies in existing approaches and so provide the impetus for further tool development.

The Working Group will also produce an annual public overview of the status of asynchronous design in industry, including an update on tools.

Deliverables

Preliminary and final versions of the commissioned report will be delivered. The latter will be made available in electronic form on the world wide web during the first year of the contract. A report will be delivered at the end of each year of the contract to provide an overview of the status of industrial-design. Again, these will be made available on the web.

Tasks and expected result

The TMC will undertake the task of reviewing the preliminary version of the commissioned report and providing feedback to the author within one month of delivery. Members and industrial affiliates will have the task of contributing to the annual overview.

Progress with Workpackage No. 3:

- SBU concluded a **subcontract**, which entered into force 1/9/00, with Manchester Informatics Limited, a company based at UoM, under which Edwards would undertake Workpackage No. 3, including responsibility for Deliverables D6-D11. An advance of €7,050, representing 40% of the value of the subcontract, €15,000 + VAT, was made to that company.
- Manchester Informatics produced a preliminary list of tools to include in the commissioned report, which was forwarded by the Project Manager by e-mail 28 February 2001 to the TMC for comment.
- Manchester Informatics e-mailed 5 April 2001 a questionnaire to developers of asynchronous design methods and tools.
- Manchester Informatics produced 26 June 2001 a first attempt at deliverable D6 (Preliminary version of commissioned report on design, automation and test), but the Project Manager asked for it to be expanded to include more tools and something on test.
- Manchester Informatics produced 10 July 2001 an expanded report, which was accepted by the Project Manager as deliverable D6 and forwarded by e-mail to the TMC for comment. At the same time the Project Manager asked the TMC for suggestions about the format of deliverable D8 (1st overview of status of asynchronous design in industry), but did not receive any feedback.
- Manchester Informatics produced 24 July 2001 a revised version of the report incorporating feedback received to date.
- The Project Manager made detailed comments on the report and requested Manchester Informatics produce a final version, deliverable D7. This was not completed during the reporting period.

Workpackage description (continued)

Workpackage number/title :	4. Project management
Start date or starting event:	0
Participant number:	1
Person-months per participant:	10

Objectives

This workpackage is concerned with project management.

Description of work

N/A

Deliverables

N/A

Tasks and expected result

The four progress reports are tasks. They will be made available in electronic form on the world wide web at the end of each year of the contract. Another task is to communicate news on a more regular basis. An e-mail distribution list will be maintained for this purpose and web pages will be kept up-to-date.

Progress with Workpackage No. 4:

The TMC met twice during this reporting period:

1. The first meeting took place Thursday 5 October 2000, Brussels, following the formal review of the FP4 ACiD-WG contract. SBU, Infineon, IHP, MBUK, UoM, UNEW, UCAM-CLAB, UDI, INPG-TIMA and DTU were represented. Minutes were circulated by e-mail 1 November 2000 to all members, to the Project Officer and to the Reviewer. It was agreed that Piguet would host the first ACiD-WG workshop, Heer and Eckhard would jointly host the second workshop, Renaudin would host the summer school, and Edwards would take responsibility for Workpackage No. 3 (assessment and evaluation). It was noted that UoM would host Async 2002.
2. The second meeting took place Monday 12 February 2001 and continued Tuesday 13 February, during the first ACiD-WG workshop. SBU, Philips Research, Infineon, ST, UoM, UNEW, UCAM-CLAB, UPC, UDI, INPG-TIMA, Technion, Abo Akademi and AT&T were represented. Minutes were not taken, but the action points of the previous meeting were checked and each attendee reported on the activities of their organisation. The main suggestions were: the commissioned report D7 might be launched at a press conference at the second workshop; test requirements for asynchronous circuit design might be provided by Heer and Peeters to encourage research in this area.

Other business of the TMC was carried out by electronic mail.

3.4 Deliverables list and status

Deliverables list

Del. no.	Deliverable name	WP no.	Lead participant	Estimated person-months	Del. type*	Security**	Delivery (proj. month)
D1	Proceedings of 1 st workshop	WP1	1	0	Report	Pub.	12
D2	Proceedings of 2 nd workshop	WP1	1	0	Report	Pub.	24
D3	Proceedings of 3 rd workshop	WP1	1	0	Report	Pub.	36
D4	Proceedings of 4 th workshop	WP1	1	0	Report	Pub.	48
D5	Lecture notes from summer school	WP2	1	0	Report	Rest. ¹	24
D6	Preliminary version of commissioned report on design, automation and test	WP3	1	0	Report	Int.	6
D7	Final version of commissioned report	WP3	1	0	Report	Pub.	10
D8	1 st overview of status of asynchronous design in industry	WP3	1	0	Report	Pub.	12
D9	2 nd overview	WP3	1	0	Report	Pub.	24
D10	3 rd overview	WP3	1	0	Report	Pub.	36
D11	4 th overview	WP3	1	0	Report	Pub.	48

* A short, self-evident description e.g. report, demonstration, conference, specification, prototype...

**Int. Internal circulation within project (and Commission Project Officer if requested)

Rest. Restricted circulation list (specify in footnote) and Commission PO only

IST Circulation within IST Programme participants

FP5 Circulation within Framework Programme participants

Pub. Public document

¹ To include attendees at the summer school, and ACiD-WG members and industrial affiliates.

Status of deliverables:

Deliverables D1, D6, D7 and D8 were scheduled for the first reporting period. D1 and D6 were delivered, but there has been some slippage with D7 and D8, as follows:

D1 (Proceedings of 1st Workshop) was delivered online at <http://www.scism.sbu.ac.uk/ccsv/ACiD-WG/Workshop1FP5/> since there seemed little point in printing out hardcopy of the proceedings. (A preliminary version was printed and handed out to attendees at the workshop.)

D6 (Preliminary version of commissioned report on design, automation and test) was delivered by Manchester Informatics 10 July 2001, and forwarded by e-mail to members of the TMC and to the Project Officer.

D7 (Final version of commissioned report) was not completed during the reporting period. (It is critical that the report should be ready in good time for distribution at the Munich workshop.)

D8 (1st overview of status of asynchronous design in industry) was not completed during the reporting period. (Again, it would be desirable that the overview — in some form or other — should be ready in good time for distribution at the Munich workshop.)