A Community of Asynchronauts: 20+ Years of the ASYNC Conference

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Abstract. Since its founding in 1994, the IEEE Symposium on Asynchronous Circuits and Systems has been a premiere venue for publishing results from the asynchronous research community. Perhaps more importantly, it has also been an annual meeting where people gather, form and renew friendships, and build a strong sense of community. In this paper I will give a brief history of the ASYNC Symposium with a special focus on the social events that have contributed so much to the tremendous sense of community we enjoy among asynchronous researchers.

1 Introduction

Researchers interested in asynchronous circuits and systems have always been a bit on the fringe of the computer engineering world. Although there were interesting examples of asynchronous approaches in the early days of computer design, the codification of a synchronous design style, and the subsequent support for that design style in computer-aided design tools, resulted in the vast majority of digital systems using a synchronous timing regime. In spite of that inertia, an intrepid group of researchers has continued to be intrigued by the possibilities of asynchronous approaches, both in terms of design (at circuit and system levels) and analysis/theory.

Like researchers in many "niche" areas, their results were sometimes not appreciated by the larger research community, and often had to struggle to be recognized at the larger conferences and journals. As sometimes happens, when the critical mass of research becomes great enough in an area, this spawns a new conference series devoted more specifically to that area of study.

In the case of asynchronous design, this critical mass was reached in the early 1990's. Leading up to this point researchers such as Chuck Seitz at Caltech [36, 39, 38], Charles Molnar, Tom Chaney and Wes Clark at Washington University in Saint Louis [13, 12, 14, 25], Steven Unger at Columbia [49, 50], and Victor Varshavsky at the St. Petersburg Electrical Engineering Institute [51–53] were doing foundational work from the late 1960's to the early 1980's, without the benefit of a specific conference venue.

One standout conference series that included a nice set of early asynchronous and self timed papers was the Caltech Conference on VLSI which would become

the Advanced Research in VLSI (ARVLSI) conference series. The very first Caltech Conference in 1979, for example, had three seminal papers on asynchronous subjects [45, 48, 37] and the 1983 version of that conference included another set of important papers on asynchronous circuits and systems [16, 17, 40].

In the 1980's researchers such as Alain Martin at Caltech [19–21], Bob Sproull and Ivan Sutherland at Caltech and Carnegie Mellon University [41, 47, 15], and Theresa Meng at Stanford [23, 22, 24] were extending the work of earlier pioneers, and they, along with the pioneers, were producing a new generation of asynchronous researchers including Peter Beerel [2, 3, 1], Erik Brunvand [10, 7–9], Chris Myers [27, 28, 26], Steven Nowick [29–31], and Ken Stevens [44, 42, 43], Kees van Berkel [4–6], Alex Yakovlev [54, 18, 55] , and many others (note that references chosen in this section are specifically the early works from these selected researchers).

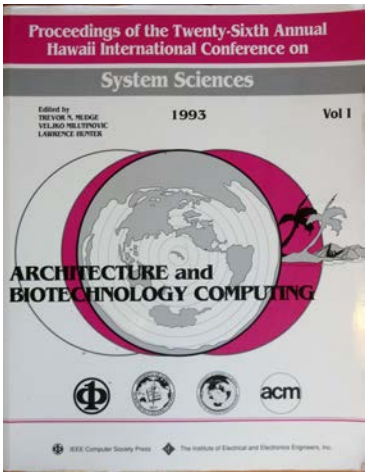
With the backdrop of the expanding world of asynchronous and self-timed research, the time was right for a conference devoted to this research area.

2 Pre-history: HICSS 1993

The first foray into thinking about a discipline-specific conference was to propose and organize a special session on Asynchronous and Self-Timed Circuits and Systems at an existing conference. Erik Brunvand and Ganesh Gopalakrishnan from the University of Utah took up the challenge and organized just such a special session at the 1993 Hawaiian International Conference on System Sciences (HICSS) (see Figure 1). This conference had the double benefit of being open to such a special session on a niche topic, and also being held in Maui, Hawaii in January. The conference "mini-track" was a huge success with 14 papers accepted and presented by most of the leading researchers in the area. In fact, the Hawaiian conference organizers were apparently not prepared for the success of the mini-track, and for the avid nature of the asynchronous research community. The conference session was held in a tiny room that was overflowing with attendees anxious to participate in the session and hear about the research. The organizers of the conference were apparently thinking that people would be at the beach rather than listen to papers on such a topic! But the interest and enthusiasm was clear. That session was enough to encourage the organizers to think in grander terms and organize a whole conference dedicated to the subnect of asynchronous and self-timed circuits and systems research.

3 Async 1994: Salt Lake City, UT, USA

The first official IEEE Symposium on Advanced Research in Asynchronous Circuits and Systems was organized and held in November 1994 in Salt Lake City at the University of Utah. The conference was primarily organized by: General Chairs Erik Brunvand (University of Utah), Al Davis (University of Utah), and Program Chairs Ganesh Golpalakrishnan (University of Utah) and Steven Nowick (Columbia University). The name for the conference was a bit of a mouthful,



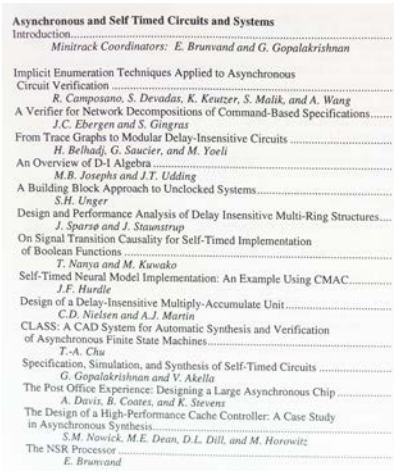


Fig. 1. The proceedings cover, and the session contents, for the Special Session on Asynchronous and Self-Timed Circuits and Systems at the 1993 Hawaiian International Conference on Systems Science held on Maui, Hawaii.

but chosen to echo the name of the premiere VLSI conference of the day, the conference on Advanced Research in VLSI (ARVLSI). The Async conference name was eventually shortened to remove the "Advanced Research in" portion of the name.

The conference was organized with support from the IEEE Technical Committee on VLSI - support that it continues to have to this day. It was also started with a small grant from the National Science Foundation to support student attendance at the conference, and also non-monetary support from IFIP Working Groups 10.2 and 10.5. The November time frame of the original conference was designed to be loosely compatible with the International Conference on Computer Aided Design (ICCAD) so that attendees could plausibly come to both conferences one after the other, ICCAD being held in November 1994 in Santa Clara, California.

The program committee for the first Async conference in 1994 reads like a "who's who" of asynchronous and self-timed researchers at the time: Graham Birtwistle, Steven Burns, Raul Camposano, Tam-Anh Chu, David Dill, Steven Furber, Luciano Lavagno, Bill Lin, Alain Martin, Teresa H.-Y. Meng, Charles Molnar, Martin Rem, Jens Sparsø, Robert Sproull, Pasupathi (Subra) Subramanyam, Jan Tijmen Udding, Steven Unger, Kees van Berkel, Peter Vanbekbergen, and Alex Yakovlev. The conference registration fee for IEEE members was $225, and students could register for $65. The conference included 25 refereed papers and one invited paper. The keynote speaker was Ivan Sutherland (Sun Microsystems).

Perhaps the most memorable keepsake from this first Async conference was the "Async wallet card" (see Figure 2). This card, given to all conference atten-

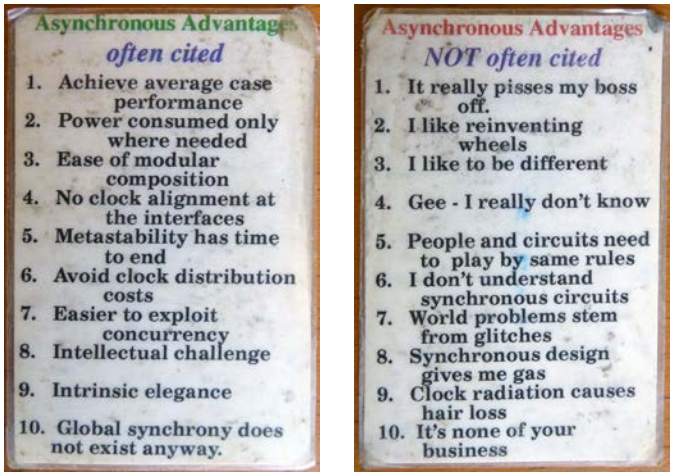


Fig. 2. The front and back sides of the wallet card given to Async 1994 attendees. This card was designed and produced by Al Davis and Erik Brunvand.

dees, was designed and produced by Al Davis and Erik Brunvand back in the day when color printing and laminating had to happen at a commercial printing shop. The card featured a list of the most common asynchronous advantages that we had seen repeated in virtually every paper, along with humorous "advantages" not often cited in papers. For many years afterwards at future Async conferences a challenge was given by Ivan Sutherland to hold up your Async wallet card if you still had it with you.

Although there was no organized outing at this first Async conference, it was definitely a starting point for the community of Asynchronauts. Friendships and research collaborations initiated at this very first Async conference persist to this day. From my clearly biased perspective, it was a rousing success!

4 Async 1996: Aizu, Japan

Although the continuation of any new conference is not a sure thing, the success of the first Async Symposium meant that this conference series would definitely continue. For the second conference, a group of Russian ex-pats who had found an academic home, for the moment at least, in Aizu-Wakamatsu, Japan, would host the second conference, along with their Japanese colleagues. The General Chair for the second conference was Tosiyasu Kunii, a largely ceremonial position for a senior researcher at the University of Aizu. The actual Conference Chairs were Takashi Nanya (Tokyo Institute of Technology) and Alex Kondratyev (University of Aizu). The Program Chairs were Luciano Lavagno (Polytecnico di Torino) and Alexander Taubin (University of Aizu). There were 24 papers accepted, and two embedded (invited) talks by Rajit Manohar (Caltech) and Alain Martin (Caltech), and Steve Furber (Univrsity of Manchester).

Fig. 3. Dinner group from the conference excursion to the Japanese baths at Async 1996. Attendees in this photo are (clockwise from left): Takashi Nanya, Chris Myers, (unknown - perhaps Peter Beerel?), Bill Richardson, Steve Furber, Erik Brunvand, and Doug Edwards

While the symposium format did not change much, the time frame did. Having the first conference in November was an attempt to let attendees amortize travel to Async 1994 and to ICCAD 1994. This didn't make as much sense for a conference held in Japan, and the organizers wanted to move to a spring conference schedule. So, the second conference was held from March 18-21 1996. The year-and-a-half gap meant that there would be no Async 1995 in the series, but the conference would actually be on-schedule for its second year.

One major social outing for the second conference was having the conference banquet in a Japanese bath. The conference attendees enthusiastically embraced the opportunity to experience this Japanese tradition. After washing carefully, the attendees soaked in hot baths, recovered in cool baths, and donned traditional Japanese robes for dinner at the baths. This was possibly the most relaxed collection of researchers ever assembled at a conference banquet!

After the conference a second outing was organized to a local ski area. Many conference participants assembled at the ALTS Bandai Resort near Aizu. The skiing conditions were good, but quite spring-like including a short bout of rain on the slopes, but great fun was had by all the skiers in the group. The resort's ski rental facilities, however, were greatly stressed by a group of large western visitors all requesting large ski boot sizes! The rental facility ran out of large ski boots and had to have more boots shipped in from a nearby resort.

5 Async 1997: Eindhoven, The Netherlands

The third Async conference was held in another hotbed of asynchronous research: The Netherlands. Starting with Martin Rem [33–35] there had been a flurry of papers from Dutch researchers that had been influential especially in the area of synthesizing circuits from program descriptions. The third conference was held in Eindhoven, The Netherlands, from April 7-10, 1997, with cooperation from Eindhoven University of Technology and Philips Research Labs where some of the Dutch researchers had landed. The conference General Chair was Martin Rem (Eindhoven University of Technology) with Co-Chair Peter Hilbers (Eindhoven University of Technology). The Program Chairs were Kees van Berkel (Philips Research Laboratories) and Mark Josephs (South Bank University, UK). The conference included 25 accepted papers and a set of five invited keynote lectures from Cees Niessen (Philips Research Labs), Roger Brockett (Harvard University), Steve Furber (University of Manchester), Ivan Sutherland (Sun Microsystems), and Hiroaki Terada (Osaka University). The conference banquet was held at the Philips Evoluon: a Philips showcase housed in a building shaped like a flying saucer (really!).

Fig. 4. Pre-conference outing during Async 1997. Attendees are (from left): Erik Brunvand, Ken Yun, and Ken Stevens.

The conference was actually held at a conference center in Veldhoven, a small town close to Eindhoven. The conference center had all the facilities for the conference under one roof including a fascinating set of sports and recreation facilities. The recreation opportunities included swimming, sauna, darts,

billiards, and a wonderful 9-pin bowling alley. This style of bowling is a European version, played since medieval times, and is quite different from the North American 10-pin bowling. There are, as you might expect, nine pins, arranged in a diamond shape and having strings on the top of each pin to hoist them back to their starting positions. The ball is 16cm in diameter and has no finger holes. Async conference attendees were enthusiastic bowlers, especially after a few drinks, in the evenings at Async 1997.

6 Async 1998: San Diego, CA, USA

Returning to the United States, the fourth Async conference was held in SanDiego, California from March 30-April 2 1998. The General Chair was David Dill (Stanford University) and the Program Co-Chairs were Peter Beerel (University of Southern California) and Ken Yun (University of California, San Diego). The conference program featured 23 papers, and keynotes by Steven Unger (Columbia University), Ivan Sutherland (Sun Microsystems), and Mark Horowitz (Stanford University). The conference social events included a visit to Qualcom, a respected high tech company headquartered in San Diego, a visit to the historic Hotel del Coronado, a San Diego landmark, and a California beach party for the conference banquet. This conference also marks many attendees' first encounter with a San Diego delicacy that was relatively unknown at the time, but has since become a wide success, the "fish taco."

Fig. 5. Included in the conference registration at Async 1998 was a pair of "Async socks" with the C-element control circuit for a micropipeline and the conference date.

A standout souvenir from the Async 1998 conference was the "Async socks" given to each conference attendee (see Figure 5). These socks were sponsored by Sun Microsystems and featured Async98 and a series of C-elements organized into a micropipeline-style two-phase control circuit [47]. This basic circuit structure of "half-cocked" C-elements connected into a FIFO-like circuit would become a common theme in future Async conference logos with some characteristic glyph representing the conference location taking the place of the C-element.

Fig. 6. Winners of the Best Paper Award at Async 1999 posing with their trophy: "Sync: the evil dragon that must be destroyed" (based on an original sculpture by Gaudí). They are (from left) Rakefet Kol, Chris Myers, Ken Stevens, Ran Ginosar, and Peter Beerel. Not shown are additional authors Shai Rotem and Ken Yun. (photographer unknown)

7 Async 1999: Barcelona, Spain

In 1999 the Async conference moved back to Europe to Barcelona, Spain from April 18-22. the General Chairs were Jordi Cortadella (Universitat Politècnica de Catalunya) and Mark Josephs (South Bank University). The Program Chairs were Steven Nowick (Columbia University) and Alex Yakovlev (University of Newcastle upon Tyne). The program consisted of 21 papers and keynotes from Richard Lyon (Apple Computer), Mike Gordon (Cambridge University), and Wesley Clark (Washington University). Dr. Clark's lecture, entitled "Asynchronous

Macromodules Were a Pain to Build but a Joy to Use" was especially memorable. The Macromodules project at Washington University in St. Louis, MO, USA in the 1960's involved the design and implementation of shoebox sized asynchronous computing modules connected through asynchronous interconnections [32, 46]. They were large physical versions of what we would imagine as VLSI circuit modules today, and were used to build many examples of "... arbitrarily large and complex computers that work." [32] Dr. Clark even brought some original macromodules to the conference to show.

While in Barcelona the conference attendees were treated to not only wonderful Catalan food, but tours of the city showing off some of the famous sites, including many sites designed by perhaps the most famous Catalan artist Antoni Gaudí (although painter Joan Miró might dispute that claim). The city of Barcelona has many wonderful buildings and sculptures that were designed by Gaudí in his characteristic flamboyant style. The Best Paper award at Async 1999 was a small reproduction of Gaudí's famous lizard sculpture. The original lizard sculpture is found in Parc Güell in Barcelona and is known locally as "El Drac" (The Dragon). It was made in collaboration with another artist, Joseph Maria Jujo, out of concrete and ceramic tiles. For the Best Paper award, the smaller version was christened "Sync, the evil dragon that must be destroyed" (See Figure 6).

8 Async 2000: Eilat, Israel

Ran Ginosar (Technion) organized the 2000 Async conference as General Chair in Eilat, Israel. The Program Chairs were Steve Furber (University of Manchester) and Mike Kishinevsky (Intel). The conference program featured 20 papers and keynote addresses by Avinoam Kolodny (Intel), Shimon Even (Technion), and Udi Shapiro (Weizmann Institute of Science). The conference also presented a full day of hands-on tool demos showing off a set of tools that would come to be seen as hugely influential in the asynchronous research community: ATACS by Chris Myers (University of Utah), Petrify by Jordi Cortadella (Universitat Politècnia de Catalunya), Minimalist by Steven Nowick (Columbia University), and Balsa by Doug Edwards (University of Manchester).

As exciting as the tool demos and conference program were, perhaps the highlights of the Israel conference were the location in Eilat, and the excursions organized for conference attendees. Eilat is a resort town at the southern tip of Israel on the Red Sea. The conference hotels were essentially right on the beach, and the scuba and snorkeling opportunities were tremendous. The conference banquet was held at an undersea restaurant where the windows from the dining tables looked out to an underwater scene with curious fishes looking back at the dinner guests.

On Friday after the conference there was a one-day excursion to the ancient city of Petra in neighboring Jordan. This 2000 year old city (established as early as 312 BCE) was the capital of the Arab Nabataens. The buildings in Petra are carved out of living rock in the sandstone cliffs of the Petra valley (Figure 8).

Fig. 7. A reunion at Async 2000 in Eilat, Israel of some members of the asynchronous research group of Victor Varshavsky. From left: Alex Kondratyev, Alexander Taubin, Mike Kishinevsky, Victor Varshavsky, Alex Yakovlev, and Masha Yakovlev. (photographer unknown)

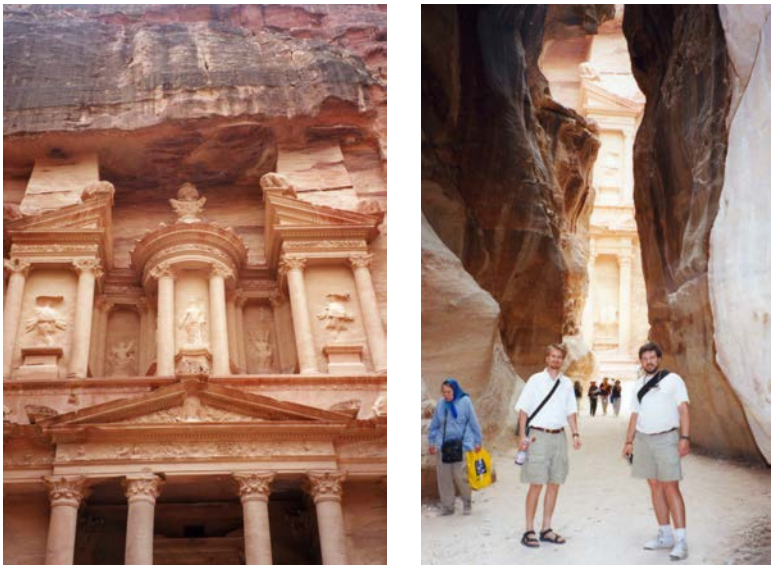


Fig. 8. Images from the excursion to Petra, Jordan during Async 2000. On the left is a building from the archeological site of Petra. On the right are attendees Hans Jacobsen and Erik Brunvand in the narrow canyon (the Siq) leading to the main Petra city.

Amazingly, this spectacular site (a UNESCO World Heritage Site since 1985) was unknown to the western world until 1812 when word of the city was spread by a Swiss explorer. In a poem by John William Burgon Petra was described as "a rose-red city half as old as time." [11] The conference attendees who went on this excursion were awed by the city, and slightly worried as the buses were driving back to the border with Israel trying to make sure they reached the border before sundown and the beginning of the Jewish sabbath when the border would close (the buses made it with minutes to spare).

The second excursion was a two-day tour of the "best of" Israel featuring the Dead Sea (see Figure 9 with some Async attendees "floating like a cork" in the Dead Sea), the ancient fortress of Masada (the last stronghold of ancient Israel that fell to the Romans in 70 CE), and Jerusalem (Holy city to at least three major world religions: Judaism, Christianity, and Islam). The conference time of Spring 2000 was a calm time in the Middle East and was a perfect time for the conference, and the Asynchronauts to visit.

Fig. 9. Async 2000 conference attendees floating in the Dead Sea. The floaters are, in the front row (left to right) Kees van Berkel and Charlie Molnar, and in the back row Jo Ebergen and (unknown). (photo by Jo Ebergen)

9 Async 2001: Salt Lake City, UT, USA

In 2001 the Async conference returned to Salt Lake City and the University of Utah. This was the first time that a location for the conference had been

repeated, and the conference organization included some familiar names from the original 1994 conference. The General Chair was Erik Brunvand, and the Program Co-Chairs were Chris Myers and Al Davis (all from the University of Utah). Other names in the 2001 Symposium Committee that were also in the original 1994 Committee included Ganesh Gopalakrishnan (Finance Chair) and Steven Nowick (Best Paper Chair). The conference program included 20 papers and keynotes from Bill Athas (Apple Computer), Kevin Normoyle (Sun Microsystems), and Ajay Koche (Agilent Laboratories) (who had attended the original 1994 conference as a student). In the Message from the Chairs it was noted that the original conference name (IEEE Symposium on Advanced Research in Asynchronous Circuits and Systems) was meant to evoke the history of the highly influential Advanced Research in VLSI (ARVLSI) conference series. For this occasion in 2001 the ARVLSI conference was co-located with Async 2001 with Async being the first two days (March 12-13, 2001, a shared day in the middle (March 14) and then ARVSI taking over for the final two days (March 15-16). The banquet on Wednesday March 13 was combined for the both conferences. Ironically, 2001 was also the year that the Async Steering Committee voted to shorten the official name of the Async conference to leave out the "Advanced Research" description. This was also, sadly, the final offering of the venerable ARVLSI conference.

Fig. 10. The multi-colored scarf given to conference attendees in Salt Lake City at Async 2001. This scarf proved very valuable for finding other Asynchronauts during the ski outing to Park City Mountain Resort. The combined logo shows that Async was co-located with the 2001 Conference on Advanced Research in VLSI (ARVLSI).

The conference attendees at Async 2001 were given a multi-colored scarf with the logos of both Async 2001 and ARVLSI 2001 conferences (Figure 10). These scarves were greatly appreciated by the attendees and proved to be a valuable way of identifying conference skiers during the ski excursion. The Wednesday afternoon excursion took skiers and sightseers to the resort town of Park City, Utah, just 40min from the conference site. Good skiing was had by all with no rain this time (see the 1996 excursion description...).

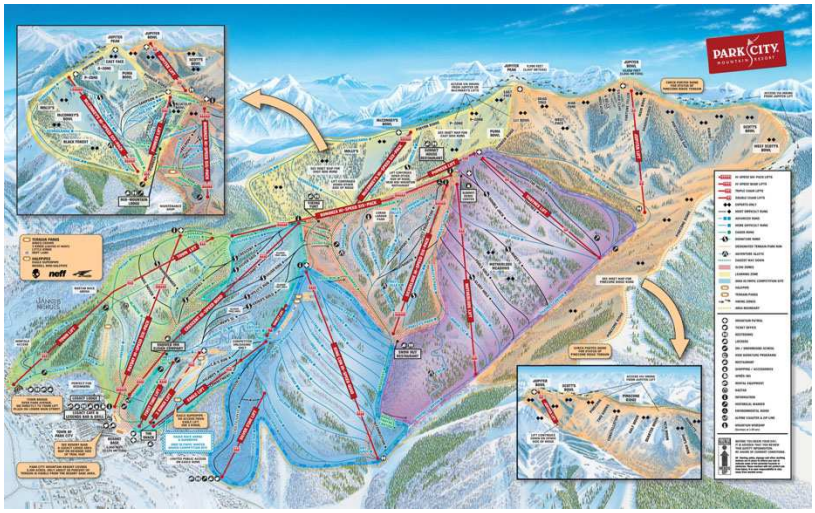


Fig. 11. Trail map from Park City Mountain resort - site of the ski excursion from Async 2001.

10 Async 2002: Manchester, U.K.

In 2002 the conference was held in Manchester, U.K. organized by General Chair Steve Furber (University of Manchester) and Program Co-Chairs Marly Roncken (Intel) and Simon Moore (University of Cambridge). The program consisted of 21 papers and keynotes by Robin Saxby (ARM Ltd.), Russel Cowburn (University of Durham), Nick Foggin (Orange), Andrew Lines (Fulcrum Microsystems), and Uri Cummings (Fulcrum Microsystems). The conference signature gift was an "Async umbrella" with the conference logo. Sadly, in some sense, the weather at the conference (April 8-11, 2002) was beautiful and sunny with no need for an umbrella!

The conference banquet was held at the Manchester Museum of Science in the "steam hall" surrounded by large, impressive steam engines, many of which were fired up and running earlier in the visit. The other notable exhibit was the

faithful replica of the Manchester Small-Scale Experimental Machine (SSEM), nicknamed "Baby," and arguably the worlds first stored program computer. The Baby was designed and built in Manchester in 1948 as a testing interface for the Williams Tube CRT-based memory system also being developed at the time. In 1998 a working replica of the SSEM was built to celebrate the 50th anniversary of the running of its first program. The banquet speaker at Async 2002, Chris Burton, described the rebuilding effort and demonstrated the Baby replica in operation. Interestingly, he related that the most difficult part of the reconstruction was not finding the vacuum tubes or the other electrical components, but finding original examples of the metal racks that housed the Baby. Apparently almost all such racks had been scrapped after the project was originally completed. The final rack used in the reconstruction had been found in a local farmer's barn being used to hold farm equipment.

Fig. 12. Banquet talk by Chris Burton of the Computer Conservation Society at Async 2002. Chris led the rebuilding work of the Manchester SSEM - the world's first stored program computer - which was reconstructed for its 50th anniversary in 1998. The replica is now on display in the Museum of Science and Industry and Chris demonstrated the machine in operation before the banquet.

11 Async 2003: Vancouver, BC, Canada

The ninth Async conference was held in Vancouver, B.C., Canada from May 12-16, 2003. This was the first time the conference had been held in Canada,

and the latest in the year the conference had been held. The General Chairs were Mark Greenstreet (University of British Columbia) and Jo Ebergen (Sun Microsystems). The Program Co-Chairs were Jo Ebergen (in a rare dual role) and David Kinniment (Newcastle University). The program consisted of 21 papers and keynotes by Fred Brooks (University of North Carolina at Chapel Hill), Ted Williams (Morphics Technology), Barbara Chappell (Intel), and Rajiv Joshi (IBM).

Fig. 13. The SkyRide aerial tram at Grouse Mountain taking the Async 2003 attendees to the top of the mountain, the banquet site, and the brown bear enclosure.

The conference included two different outings: one to the Stanley Park and the Vancouver Aquarium, and one to nearby Grouse Mountain ski resort. The Aquarium included a huge variety of fishes and marine life including some very friendly Beluga whales. The banquet was held at the top of Grouse Mountain, accessed by an aerial tram ride (Figure 13). The attractions at the top of the mountain included a large bear enclosure where a friendly (?) pair of grizzly bears could be seen frolicking.

12 Async 2004: Crete, Greece

The 2004 conference was hosted by General Chair Christos Sotiriou (ICS-FORTH) on the beautiful Mediterranean island of Crete from April 19-23, 2004. The Program Co-Chairs were Ran Ginosar (Technion) and Ken Stevens (Intel). The

Fig. 14. Banquet group at Async 2003 including Alexander Yakovlev in the center with hand raised

conference program included 21 papers, and keynotes by Christer Svensson (Linköping University), Martin Jenkner (Infineon Technologies), and Ad Peeters (Handshake Solutions). The conference attendees were confronted with a difficult choice of attending conference sessions, or enjoying the lavish surroundings of the Aldemar Knossos Royal Village Hotel.

The conference included two separate excursions: one to the Palace of Knossos and visit to the FORTH research center, and one to the museum village of Arolithos. The Palace of Knossos was the ceremonial and political centre of the Minoan civilization and culture dating to the bronze age, 1380 – 1100 BCE. In Greek mythology, King Minos dwelt in a palace at Knossos. He had Daedalus construct a labyrinth; a very large maze in which to retain his son, the Minotaur. The Arolithos museum is a site that celebrates the tradition and history of the Cretan way of life. Dinner there was capped off by a performance of traditional Greek music played on the Bouzouki by conference General Chair Christos Sotirou (see Figure 16).

13 Async 2005: New York City, NY, USA

The 11th Async conference was held in the "Big Apple," New York City, NY, USA from March 14-16, 2005. The conference General Chairs were Steven Nowick (Columbia University) and José Tierno (IBM). The Program Chairs were

Fig. 15. Greek traditional dancing at the Async 2004 banquet. Alex Yakovlev is in the far left of this picture. (photo by Doug Edwards)

Fig. 16. Async 2004 general chair Christos Sotiriou (and friends) entertaining the excursion attendees with some excellent Bouzouki playing.

Prabhakar Kudva (IBM) and Rajit Manohar (Cornell University). 20 papers were presented along with keynotes from Bob Colwell (R. E. Colwell and Associates), Ivan Sutherland (Sun Microsystems) and Robert Drost (Sun Microsystems), with an additional invited tutorial by Phil Restle (IBM Research) and Ken Shepard (Columbia University).

Fig. 17. Banquet group from the Async 2005 Manhattan circle-cruise including on the left, Keith Heron, and on the right, David Kinniment, Jo Ebergen, and Gaurav Gulati.

The banquet/outing for the 2005 conference was held on a boat that encircled the island of Manhattan during dinner. Attendees were treated to spectacular views of the city, the statue of liberty, Brooklyn Bridge, and other New York sites. One "secret" about the cover of the Async 2005 proceedings is that if you look in the lower right of the cover you can see two birds flying away from the city. These birds represent the twin towers of the World Trade Center that had come down in terrorist attacks in 2001.

14 Async 2006: Grenoble, France

The conference returned to Europe in 2006 being held in Grenoble, France and hosted by General Chair Marc Renaudin (Institut Polytechnique de Grenoble). The Program Co-Chairs were Alex Yakovlev (University of Newcastle upon Tyne), and Jens Sparsø (Technical University of Denmark). The conference program included 19 papers and keynotes by Nobuo Karaki (Seiko Epson Corp.),

Jean-Pierre Schoellkopf (STMicroelectronics), and Ferdinand Peper (National Institute of Information and Communications Technology, Japan). The official conference social outing was a banquet at a local restaurant Le Chateau de la Baume. In addition to the excellent food, one notable feature of the banquet location was a virtual-reality golf simulator in the adjoining hall. This simulator let attendees hit real golf balls with real golf clubs into a net and the tracking system would tell you how far and in what direction the shot went, and show the next picture from that location. Great fun was had by the participants, many of whom had never before swung a golf club.

Fig. 18. The intrepid Async ski adventurers from Async 2006 at the peak of the Aiguille du Midi ready to descend in the the Vallée Blanche.

The after-conference outing was perhaps the most memorable of any Async outing (at least from my perspective). A group of intrepid skiers embarked on a guided descent of the famous Vallée Blanche. This famous ski adventure involves a tram ride to the top of the Aiguille du Midi - a 3,842 m / 12,605 ft peak in the Mont Blanc massif within the French Alps. From there skiers descend through the Vallée Blanche - a 20 km long, unmarked off-piste ski route which begins very steeply from the Aiguille du Midi station and continues across crevassed glaciated terrain. Figure 18 shows the Async group at the peak ready to start out. The view from that peak includes alps in France, Switzerland, and Italy. The lunch hut halfway down the Valléee Blanche (Figure 19) included superb views of the glacier that the group had just descended, and the pathway to the

Mer du Glace, the largest glacier in France, 7km long and 200m deep and one of the biggest attractions in the Chamonix Valley.

Fig. 19. Lunch halfway down in the Vallée Blanche at Async 2006. From left: Peter Beerel (note the 2001 Async scarf, and Async 2006 hat), John Bainbridge, Alex Yakovlev, and Keith Heron

15 Async 2007: Berkeley, CA, USA

Async 2007 returned to North America to be held in Berkeley, California. The General Chairs were Peter Beerel (University of Southern California) and Marly Roncken (Intel). The Program Co-Chairs were Mark Greenstreet (University of British Columbia) and Montek Singh (University of North Carolina at Chapel Hill). The program included 18 papers and keynotes from James T. Kajiya (Microsoft Research), Carlo H. Sequin (University of California, Berkeley), Steven Jacobsen (Sarcos Inc.), and Kevin Nowka (IBM). The talk by Carlo Sequin was especially appreciated by attendees as he talked about "Thinking Outside the Box in Geometry and Art" including many examples of how mathematical functions can be the basis for sculpture and how the then-new capabilities of 3D printing could be used to teach 3D geometry (see Figure 20).

The conference banquet was held in the Steinhart Aquarium, echoing a previous banquet from Vancouver also held in an aquarium. The post-confernece

Fig. 20. A crowd at Async 2007 gathers around keynote speaker Carlos Sequin after his talk about geometric modeling for 3D printing.

outing was to the nearby city of San Fransisco featuring transportation on the famous cable cars. The tour started from the cable car turntable at Powell/Market Street in San Fransisco. Turntables are the endpoints of a cable car line. After the cable car has arrived, the passengers get off, and then the cable car is pushed onto the turntable and turned around 180 degrees by human power.

16 Async 2008: Newcastle, UK

The 14th conference returned to the U.K., this time being held in Newcastle and hosted by General Chair Alex Yakovlev (University of Newcastle upon Tyne). Conference Program Co-Chairs were Jordi Cortadella (Universitat Politcnica de Catalunya) and Alexander Taubin (Boston University). One notable feature of the 2008 conference is that for the first time Async was co-located with the emerging Networks on Chip Symposium (NoCS) hosted by Co-General Chairs Alex Yakovlev and John Bainbridge (Silistix). These two conferences were truly co-located with Async and NoCS sessions intermingled during each day of the combined conferences (April 7-11, 2008). The Async program consisted of 15 papers invited tutorials by David Kinniment (Newcastle University), Sachin S. Sapatnekar (University of Minnesota), and Mike Kishinevsky (Intel), and keynotes (shared by Async and NoCS) by Ad Peeters (Handshake Solutions), Arjan Bink (Handshake Solutions), David May (University of Bristol), Asen Asenov (University of Glasgow), Ian H. White (University of Cambridge), and Richard V. Penty (University of Cambridge).

Fig. 21. Ivan Sutherland "carries coal to Newcastle" at Async 2008 presenting a gift of coal to conference general chair Alex Yakovlev

One notable event at the conference was Ivan Sutherland "carrying coal to Newcastle" and presenting it to conference General Chair Alex Yakovlev (Figure 21). This phrase is an idiom describing a foolhardy or pointless action. It refers to the fact that historically the economy of Newcastle upon Tyne was heavily dependent on the distribution and sale of coal and therefore any attempt to bring coal to Newcastle from elsewhere for profit would be doomed to failure.

The major social event at the 2008 conference was an excursion to the open-air museum of Beamish. This museum preserves an example of everyday life in urban and rural North East England at the height of the industrial revolution in the early 20th century. It includes a mixture of translocated, original and replica buildings; a huge collection of artifacts, working vehicles and equipment; as well as livestock and costumed interpreters. Async attendee Simon Moore was intrigued by one of the historic coal cars advertising "S. Moore & Co" as the proprietors (Figure 22).

17 Async 2009: Chapel Hill, NC, USA

In 2009, from May 17-20, the conference was held in North Carolina in the college town of Chapel Hill. The General Chair was Montek Singh (University of North Carolina, Chapel Hill). The Program Co-Chairs were Ran Ginosar (Technion) and Luciano Lavagno (Politecnico di Torino). The program featured 21 papers and keynotes by David Tennenhouse (New Venture Partners), Bill

Fig. 22. Simon Moore finds a long-lost relative in the coal business in the Beamish open air museum during the Async 2008 excursion.

Dally (NVIDIA Research), and Chuck Seitz (Myricom, Inc.). The first social event was, unfortunately, rained out. The plan was for the conference attendees to attend a baseball game of the local minor-league baseball team the Durham Bulls. Unfortunately, that game, and the social event, had to be cancelled.

The second outing was much more successful - a trip to Fearrington Village - a mixed-use community located on farmland dating back to the 18th century in Pittsboro, North Carolina. Started in 1974, the community has grown to include over 1800 residents, an award-winning country inn and restaurant (The Fearrington House), and a variety of shops. The conference banquet was held in the Fearrington House and included entertainment by a local Bluegrass music trio. It turns out that Async Steering Committee Chair (at the time) Erik Brunvand plays in a Bluegrass band in Salt Lake City, Utah, and convinced the band to let him join the group on upright bass for two songs (see Figure 24). Along with the band, Prof. Brunvand sang two songs - "Walking the Dog," and "On and On" - Bluegrass songs that both Brunvand and the band knew. The conference attendees were somewhat astonished to see this impromptu performance!

18 Async 2010: Grenoble, France

In 2010 (May 3rd through 6th) the conference returned again to Grenoble, France. This time the General Co-Chairs were Pascal Vivet (Cae-Leti) and Marc Renaudin (Tiempo). The Program Co-Chairs were Alex Yakovlev (University of Newcastle upon Tyne) and Ken Stevens (University of Utah). The conference

Fig. 23. Async 2009 attendees relaxing before the banquet at Fearrington Village. On the right, Alex Yakovlev and Chuck Seitz. On the left (from the left) Hao Zheng, Ian Jones, Steven Nowick, and Jens Sparsø.

Fig. 24. Async 2009 attendee (and Async Conference Steering Committee Chair at the time) Erik Brunvand joins the Bluegrass band after the banquet at Fearrington Village. He played two songs with the band: "Walking the Dog," and "On and On." This image is a capture from a video of the performance (thus the blur). (videographer unknown)

was once again co-located with NoCS. The Async 2010 program featured 17 papers and there were three (shared) keynotes: Mohamad Sawan (University of Montreal), Keren Bergman (Columbia University), and Alessandro Cremonesi (STMicroelectronics).

Fig. 25. Asynchronauts at the Async 2010 conference in Grenoble. From left: Ran Ginosar, Erik Brunvand, Ken Stevens, Alex Yakovlev, and Pascal Vivet.

The main social event at the conference itself was dinner at La Bastille - a small fortified mountain located at the crossroad of three valleys. The route we took to the restaurant was the famous "bubbles" of Grenoble - the connected set of five spherical gondolas whisking conference attendees from the center of town to the top of the mountain. Because the conference was held in May, there was no skiing to be had this time. Instead a post-conference sightseeing excursion was planned including the Chartreuse monastery and the Voiron Cave where the monks produce traditional liqueurs.

19 Async 2011: Ithaca, NY, USA

In 2011 the 17th Async conference returned to the state of New York in the USA, but this time was held at Cornell University in Ithaca. the General Chair was Erik Brunvand (University of Utah) and Program Co-Chairs were John Bainbridge (Silistix) and Ian Jones (Oracle Labs). The conference program consisted of

11 accepted papers, with keynotes from David Albonesi (Cornell University), and Yannis Tsividis (Columbia University). The program was filled out with three invited industrial papers that addressed current industrial approaches to leveraging asynchrony.

Fig. 26. Async 2011 conference attendees at the conference banquet. From left: Alex Yakovlev, Jens Sparsø, Ivan Sutherland and Peter Beerel (facing away).

The main social event at the conference (April 27-29) was dinner at a local winery. With good food and good wine, the conference attendees were put into an excellent mood with an evening full of socializing.

20 Async 2012: Lyngby, Denmark

In 2012 General Chair Jens Sparsø (Technical University of Denmark) hosted the conference in Lyngby, Denmark. Program Co-Chairs were Pascal Vivet (Cea-Leti) and Montek Singh (University of North Carolina at Chapel Hill). The conference program included 18 regular papers, and keynotes by Kwabena Boahen (Stanford University), Steve Furber (Univrsity of Manchester), and Mogens Balsby (Oticon). The conference was co-located (for a third time) with the NoCS conference - this time having the two conferences run back to back with Async on May 7-9 and NoCS from May 9-11. Tutorials were also held on the day before the main conference and were presented by Eslam Yahya (American University in Cairo), Laurent Fesquet (TIMA), and Marc Renaudin (Tiempo).

Fig. 27. Async conference regular Montek Singh makes sure that no wine is left over after the Async 2011 banquet ...

The conference outing/banquet involved a boat tour of Copenhagen followed by dinner. With drinks flowing on the boat before dinner, attendees arrived in a good mood for dinner. There were also opportunities to explore beautiful Copenhagen as the hotels were located in Copenhagen with a short bus ride in the morning to arrive at the conference site in Lyngby.

21 Async 2013: Santa Monica, CA, USA

2013 brought the conference back to California in the USA - this time in Santa Monica in the Los Angeles area. Santa Monica is on the Pacific and enjoys wonderful weather, and seaside activities including a famous pier with amusements. The conference was hosted by General Chair Peter Beerel (University of Southern California) from May 19-22. The Program Co-Chairs were Tomohiro Yoneda (National Institute of Informatics, Japan) and Ran Ginosar (Technion). The program consisted of 22 papers and keynotes by Vivek De (Intel), and Jeanne Trinko Mechler (IBM). The conference also featured talks by three representatives from asynchronous-related startup companies on the state of their chips: Michel Lawrence from Octasic Inc, Richard Terrill from Wave Semiconductor, and Chuck Moore from Green Arrays, Inc.

The banquet was in a restaurant on the beach and featured a talk by Erik Brunvand on the folklore of “hacking” - specifically featuring the on-line legend

Fig. 28. A portrait of the Async conference steering committee taken at the Async 2012 conference in Lyngby, Denmark. From left - Front row: Ian Jones, Steven Nowick, Jens Sparsø, Marly Roncken, and Rajit Manohar. Second row: Montek Singh, Mark Greenstreet, Andrew Lines, John Banbridge, and Peter Beerel. Third row: Pascal Vivet, Alex Yakovlev, Tomohiro Yoneda, Erik Brunvand, and Mark Renaudin. (photo by Peter Beerel)

Fig. 29. Async 2012 attendees enjoy the boat ride around Copenhagen. From left: Alex Yakovlev, Montek Singh, and Ivan Sutherland.

of "Mel, a real programmer." This is a story that has been circulated on the network starting with the USENET in the 1980's about what it means to be a "real programmer" and features a hero named Mel who played some amazing tricks on a drum-memory based machine called the LGP-30 in the early days of computers.

Fig. 30. Conference attendees at Async 2013 in Santa Monica, Alex Yakovlev and Ran Ginosar, enjoy (?) a shot of fresh squeezed wheat grass - a quintessential California treat. (photo by Ran Ginosar)

22 Async 2014: Potsdam, Germany

Milos Krstic (IHP) and Eckhard Grass (IHP and Humboldt University) hosted the 20th Async conference as Co-General Chairs in Potsdam Germany from May 12-14, 2014. The Program Co-Chairs were Marly Roncken (Portland State University) and Andreas Steininger (Vienna University of Technology). The program consisted of 12 papers and keynotes from Jan Rabey (University of California, Berkeley), Joseph Sylvester Chang (Nanyang Technology University, Singapore), and Paul Mitcheson, (Imperial College, London). In addition to regular papers and keynotes, the conference included industry reports about the latest impacts of asynchronous design concepts in industrial products and prototypes, and a "Fresh Ideas" session to provide a forum for controversial statements and unconventional ideas that are not yet fully explored.

Fig. 31. Excitement at the pre-conference reception at Async 2014 in Potsdam, Germany. Sandy Brunvand's hair catches fire in the bar while posing for pictures with (from left) Ivan Sutherland, Marly Roncken, Sandy Brunvand, and Graham Birtwistle. Photo is a still from a video (thus the blur).

Fig. 32. Async 2014 conference attendees (from left): Alex Yakovlev, Marly Roncken, Marios Elia, and Luciano Lavagno.

The conference outing/banquet started with a boat trip covering seven lakes surrounding Potsdam with a view on historical and natural attractions. This trip Included a buffet dinner with local German culinary specialties, on the boat. At the dinner, Erik Brunvand gave a presentation on "Twenty Years of Async" which provided a history of, and reminiscences about, 20 years of the IEEE Symposium on Asynchronous Circuits and Systems - and was the impetus for this very article.

23 Async 2015: Silicon Valley, CA, USA

In some ways it is surprising that it took 21 iterations of the conference before it found its way to the heart of Silicon Valley. For the 21st conference, General Chair Ian Jones (Oracle Labs) organized the conference in Silicon Valley - Mountain View, California to be precise. Program Co-Chairs were Jens Sparsø (Technical University of Denmark) and Eslam Yahya (Benha University, Egypt). The conference program consisted of 18 papers, two industrial short papers, nine "Fresh Ideas" papers. There were also three keynotes by Bob Iannucci (Carnegie Mellon University, Silicon Valley), Paul Cunningham and Steev Wilcox (Cadence), and Ron Ho (Altera).

Fig. 33. The venue at Async 2015 in Silicon Valley was the Portuguese Cultural Center in Mountain View, California - a great old building with oak walls and benches along the sides.

The conference was held from May 4-6 near downtown Mountain View in the S.F.V Lodge. This is a Portuguese Heritage Center with a lovely main auditorium featuring old oak floors, walls, and benches (see Figure 33). Afternoon treats were provided by an old-fashioned ice-cream truck (see Figure 34). The conference banquet was at a restaurant in downtown Mountain View - a surprisingly quaint downtown area in the middle of bustling Silicon Valley.

24 Async 2016: Porto Alegre, Brazil

In 2016 the conference found its way for the first time to South America - hosted by General Chair Ney L. V. Calazans (PUCRS, Brazil) in Porto Alegre, Brazil

Fig. 34. Async 2015 conference attendees Montek Singh and Erik Brunvand enjoy an ice cream treat from the afternoon break at the conference.

from May 8-11. The Program Chairs were Peter Beerel (University of Southern California) and Julian J. H. Pontes (ARM). The program consisted of 12 regular track papers, four industrial track papers, and eight "Fresh Ideas" papers. The keynote speakers were Patrick Groeneveld (Synopsys), and Paulo A. dal Fabro (Chipus Microelectronics).

Sadly, this is the first Async conference that I personally was not able to attend. Up until this point there were only two researchers who had attended **every** Async conference: Peter Beerel and Erik Brunvand. With the 2016 conference that list has narrowed to only one stalwart conference attendee who has been at every single conference. Peter Beerel is now the sole member of that club.

25 Conclusions

When I, along with colleagues, started this conference series in 1994 (or 1993 if you count the HICSS special session) I had no way of knowing whether it would be a long-lasting conference series, or run its course in a few years. It is immensely gratifying that the conference is, if not growing, at least still vital and healthy some 23 years later. The conference series has had a wonderful core of researchers, some of whom have been involved from the very start. If we look at the Organizing and Program Committees from the very first conference in 1994, we can see the following names still on the conference committee in

Fig. 35. Web splash screen for the 2016 Async conference in Porto Alegre, Brazil

Fig. 36. Erik Brunvand modeling some Async conference swag from over the years. Included are a scarf from Async 2001 (Salt Lake City), an umbrella from Async 2002 (Manchester), an insulated cup from Async 2005 (New York City), a hat from Async 2006 (Grenoble), and a rain jacket from Async 2008 (Newcastle).

some capacity in 2016: Erik Brunvand, Luciano Lavagno, Alain Martin, Steven Nowick, Jens Sparsø, and Alex Yakovlev.

The conference has also attracted a growing corps of younger researchers interested in the field, and who have made good connections at the conference, and found mentors and collaborators there for their research.

Strong research collaborations and strong friendships have been forged over the many years of this conference. It truly seems like one of the friendliest and congenial of the research conferences of which I am familiar. Through the Async conference series we have developed and maintained a community of Asynchronauts that has remained close throughout the years. Perhaps there is no better legacy for a conference series than that.

Acknowledgments. The IEEE Symposium on Asynchronous Circuits and Systems would not be the congenial conference series that it is without the support of a great many wonderful researchers, academics, students, and supporters. Photographs not otherwise credited are by Erik Brunvand (or Erik Brunvand's camera).

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