The Ring

The Newsletter of the University of Cambridge Computer Laboratory Graduate Association

The Cambridge Cluster Report

How is Local Technology Business Actually Doing?

A talk to the Cambridge Computer Lab Ring

Report by Stephen Allott
Council Member, Cambridge Computer Lab Ring

Lecture Theatre 2 was packed with over 100 people for Trinity College, Cambridge graduate, Mark Littlewood's talk on the Cambridge Cluster. This subject has been much studied. The Cambridge Phenomenon Report was first published in 1985. Since then the growth in the Cambridge Cluster has been watched closely. After the technology bubble of the late 90s, we were very interested to see if Cambridge is bouncing back to growth or still languishing after the bust.

Mark first introduced his employer, Library House, which is a Cambridge research house selling information to the venture capital industry. For the Cambridge Cluster Report, Library House conducted 2,500 hours of research filtering over 2,000 companies in the Cambridge area. As well as selling research, they hold deal days where start-ups present their business plans to venture capitalists and host regular business networking events. They have a large research team headed by Judge Institute MBA Kjell Nace.

How many technology companies are there in Cambridge? The first thing is to agree on the definition of a company. Many definitions have been used. The Greater Cambridge Partnership has used a categorisation based on administrative boundaries and SIC (standard industry classification) codes. Segal, Quince & Wicksteed, the authors of the Cambridge Phenomenon Report used a more restricted definition which excluded non-profits but included companies applying technology commercially and marketing, distribution and sales companies. Library House have their own, more restricted definition, which is limited to companies which have their own innovation. Sales, marketing, distribution and mere services companies were excluded.

The St. John's Innovation Centre Report in 2001 said that there were 1,500 technology companies in Cambridge. Others have mentioned figures of up to 3,500. In 2003 Library House found, based on their own definition, 898 innovation based companies

employing 28,209 people. The average company has 31 people. Even on this restrictive definition, this is a sizeable technology cluster. On some measures we are still some way behind the USA. The value of companies created by Stanford graduates is estimated at £550 billion compared with £11 billion for Cambridge. In the biotech field, according to a Boston Consulting group study in 2002, Cambridge is behind only Boston and the Bay Area in employment. Cambridge has about half the number of companies which are each about 1/3rd the size of those in Boston or the Bay Area. This makes the Cambridge biotech cluster about 1/6th the size of the next larger ones. Interestingly this makes Cambridge, per head of population in the UK, about the same size as that of the Bay Area or relative to GDP per head, larger than the Bay Area.

IT is the biggest sector within the Cambridge cluster as measured by number of companies and by employment.

Sector	Company nos.	Employment
IT	536	14,418
Life sciences	202	6,626
Industrials	63	2,602
Telecom services	49	2,862
Materials	25	1,238
Consumer	21	not available
Energy	2	not available

The average size of an IT company is 27 employees, smaller than the average size of 33 for a life science company and 41 employees for industrial companies. These small figures for average size reflect a long tail of small companies as well as the fact that the Cambridge Cluster is still relatively young. Many people would also say it reflects the preference for Cambridge companies to stay small and perhaps Cambridge's failure to grow any really big IT companies. From a positive viewpoint, one could also say that the small size means there is plenty of growth potential and opportunity amongst the 536 IT companies. Significant growth in the Cluster is relatively recent. ARM was founded in 1990. nCipher was founded in 1996. Autonomy was founded in 1997. Active Hotels was founded in 1998.

Within the IT sector, Application Software is the largest single sub-sector with 160 companies

followed by Electronic Equipment and Instruments with 106 companies.

Sub-sector	Company nos.	Employment
Application Software	160	4,208
Instruments	106	2,947
Internet	53	668
IT services	37	659
Systems software	34	881
Comms hardware	29	885
Peripherals	29	1,128
Others	88	3,042

The “Others” category contains substantial diversity including 23 computer hardware companies, 16 in Photonics, 10 in semi-conductors and 6 in discrete components.

So, the heart of the Cambridge Cluster is IT and within that application software and to a lesser extent instruments. Cambridge has been in the instrument business since the 1890’s when Cambridge Instruments and Pye were founded. Software is a more recently established business but one where Cambridge has a substantial industrial base. Within the Application Software category, 71 companies are in Business Application software, 18 in Graphics reflecting early work in CAD and 14 in communications software. The largest category within the 106 Instrument companies is Electronic Test and Measurement with 27 companies.

The Life Science cluster is concentrated in Biotechnology which makes up 153 of the total 202 companies. 32 companies are in Healthcare Equipment.

So that is a snap shot of the Cambridge Cluster in 2003, how has it been growing? Mark Littlewood said that company formations grew rapidly towards the end of the 1990’s with IT as a whole running at a rate of 40 formations per year and Life Sciences at 20 per year. By 2002, this formation rates had fallen sharply to 20 in IT as a whole and 14 in Life Sciences. Looking a little deeper into the company formation rates showed differences between the 3 main sub-sectors:

Sub-sector: co. formations	Peak yr	Peak rate	2002 rate
Biotechnology	2001	18	12
Application software	2000	14	9
Instruments	1998	6	1

These formation rates illustrate neatly how leadership has passed from one sub- sector to another. In the mid - 80s, Instruments led formations but was overtaken by Application Software in 1986. Biotechnology overtook Application Software in 1996, peaked higher and later and is now the largest sub-sector in new company formations. The higher rate of formations means that Biotechnology is fast approaching Application Software in number of companies (153 vs. 160).

Having described the size and growth of the Cluster, Mark Littlewood moved on to discuss how the Cluster works. Before doing so he made the whole audience stretch their legs by standing up and sitting down twice, commenting that this would probably be the only thing people remembered his lecture for!

3 separate things, the University, corporate research laboratories and a range of technical consultancies have combined to give the city of Cambridge a strong technology skills base. This has produced world class research, plenty of commercial know-how and sufficient business management expertise to develop a track record of success. Professor Michael Porter suggested that clusters emerge where local demand is stronger than global demand. In the case of Cambridge, local demand for scientific instruments in the 1890s exceeded global demand. This initiated the growth of local technology business. Mark commented that 5 growth conditions were needed for a cluster to thrive (before the Government steps in to claim the credit!) namely infrastructure, ideas, customers, people and capital. Mark said he would concentrate on the last 2 items; people and capital.

Cambridge biotech companies in 2003 sought £106m of capital compared with £30m sought by semiconductor companies, £28m by application software companies, £18m by wireless companies and £14m by peripherals companies. Adding up the total for IT at £90m makes it only slightly smaller than the capital sought by biotech.

MONEY RAISED 2000-2002

Sub-sector	Amount £m	Per deal £m
Biotech	362	4
Wireless	86	6
Alternative telco Carriers	75	8
Semiconductors	70	5
Application software	68	3

Biotech is the single largest area and larger than the total (£300m) of the IT and telecoms related areas.

One of the most interesting facts in Mark’s talk was that whilst venture capital across Europe as a whole had declined, in 2002, to 20% of its level in 2000, the amount of venture capital raised by Cambridge companies had remained broadly stable in this period. Venture capital raised by Cambridge IT companies actually increased in 2002 compared with 2001. In a very tough market for venture capital, Cambridge has been doing well.

In addition to capital, Cambridge has a deep skills base and many networks of people. University origin networks such as the Ring are growing. Cambridge has many business networks from the Cambridge Network to the Cambridge Angels and Library House itself. A third important type of network is Corporate Alumni networks. Mark mentioned that the management team of Smallworld, a software company, had remained working together in many different businesses. Alumni from Virata have been active in many separate businesses. David Greaves has founded a new company Tension whilst Martin Jackson is now CTO of Frontier Silicon.

Mark’s final subject was a look forward into the future. After conducting an informal poll in Cambridge, Mark identified 9 people who were expected to be leaders in the Cambridge Cluster in the future:

Lily Cheng	Splashpower
Tim Haynes	Nujira
Steve Pope	Level 5 Networks
Michael Ledzin	Polight
Jonathan Milner	Abcam
Gordon Smith-Baxter	Biowisdom

Richard Green	Ten Sails
David Klenerman	Solexa
Tim Minshall	Engineering Dept

In conclusion Mark said that Cambridge technology business is doing very well after the bust. Good businesses are getting funded and many are growing. Cambridge Silicon Radio is preparing for flotation. There are huge opportunities in the convergence of IT and life sciences and Cambridge relies on people to make the cluster work.

The Opera Research Group

Jean Bacon, Reader in Distributed Systems

The Systems Research Group is the largest in the Lab and divides roughly into networks and operating systems (NetOS) and middleware and distributed systems (Opera). We coined the name Opera in the early 1990s when systems were becoming capable of handling multimedia. There have been Opera acronyms involving openness, objects, pub/sub, persistence, events, reliability, replication, activity, access control ....

Systems research is not a solitary activity. Since I came to the Computer Lab in 1985 I've been privileged to work with many talented PhD students and postdocs. It's been an exciting time: our research is into how systems evolve when the predicted orders-of-magnitude increases in capability are realised; repeatedly! Opera is concerned with issues of scale in distributed systems, whether they are internet-wide, or more local such as in an active city or other sensor-rich environment.

Middleware

Looking back, SRG has always been concerned with middleware, from our early Mayflower RPC for Cambridge Ring based systems. Middleware standards soon developed; a major influence in this world was Andrew Herbert's ANSAware. Incidentally, I joined the Lab when Andrew left to lead the Alvey ANSA project, vacating a lectureship. I was the first woman to be appointed and, I'm told, the first to apply. Two styles of middleware emerged, object oriented (OOM), typified by CORBA and later Java, and message oriented (MOM), typified by IBMs support for transactional distributed applications through MQSeries. The former was predicated on LAN-based systems, the latter on WANs. The latter style has tended to dominate the marketplace if not the research domain.

The Opera group was early to realise that neither style would meet the needs of emerging applications and worked on event-based middleware (EBM) from the early 1990s. The OOM style assumes that the components of an application are closely coupled; are up-and-running together and can respond synchronously to requests, as is the case for LAN-based systems but not for large scale, internet-wide systems. The MOM style, although asynchronous, historically supports only one-to-one communication and never achieved the programming language integration of RPC and OOM.

Our event-based middleware uses publish/subscribe communication, which decouples (and anonymises) publishers and subscribers and supports many-to-many, asynchronous interaction as well as having a good programming model.

Our first EBM was the Cambridge Event Architecture, where we provided asynchronous pub/sub extensions for OOMs. Later, such things became available for standard OOM but, if you look carefully, you'll find that the asynchronous extensions are built above synchronous communication, and may use centralised implementations such as tuple spaces, so will not scale. More recently we have developed Hermes, where publishers and subscribers are lightweight clients of a network of event brokers. This in turn is based on a peer-to-peer overlay network to allow for automatic reconfiguration under dynamic arrival and departure of brokers through failure, recovery and normal evolution.

Event-based middleware is ideal for programming active buildings and cities, for sensor networks in general and for internet-scale applications such as providing news feeds or stock quotes.
A popular brainstorming example is the active city, where a number of services such as police, fire, ambulance, utilities, transport, share a message-broker infrastructure with communicating citizens. Suppose an emergency occurs such as a major traffic accident or a terrorist incident.

One research issue is security; how can a number of services trust a shared message broking infrastructure when confidential data is often transmitted? How can encryption and quantification of trust assist?

Another is expressiveness. We have worked on composing low-level events into more meaningful, higher level events. Does this approach allow the user to express all occurrences of interest? Some top-down approaches have arisen from the relatively new area of networks of huge numbers of tiny sensors. Here, we need notions of aggregation and storage of state, perhaps across a number of localised sensor clusters.

Access Control

One of our early projects was concerned with distributed storage services, in particular how multiple media types could be accommodated. We developed signed-capability-based access control for this project and later generalised the approach to the use of role certificates for authorisation at any service in a distributed system. We called the system OASIS (open architecture for securely interworking services) long before the W3C-oriented standards body of the same name was set up. We name our latest manifestation of this work the EDSAC21 project (Event-Driven Secure Application Control for the 21st century), reusing a local acronym that will surely not be adopted elsewhere.

The basic idea of role-based access control (RBAC) is that the right to use a service is better associated with a role than an individual. In a large organisation people join, leave and change roles more often than access rights to services need to change. RBAC eases the administration of access rights by separating the registration of the users (and associating them with roles) from the privileges assigned to the roles, which can then be administered in a service-specific way. OASIS has a number of unique properties. Those interested in this area can find the details on our web pages.

A motivating example for access control in distributed systems is a national Electronic Health Record (EHR) service. The OASIS design started from an

assumption of the need for applications to operate across many different independently administered domains; in an EHR system we have primary care practices, hospitals, research clinics etc. with EHR access control policy in each domain determined both nationally and locally. When the Labour Government came to power in 1997 there were white papers announcing that such a scheme would be operational by 2005. We worked with Addenbrookes' Clinical and Biomedical Computing Unit (CBCU), and the associated company CBCL, to outline a design for such a system and, especially, to be able to meet the access control policy requirements. CBCL have prototyped the design, showing that OASIS is sufficiently expressive and powerful to do this.

Since the internet-based world-wide web came into widespread use society at large has come to expect large-scale distributed systems as the norm. Yet over the same time period we've seen the failure of many large but centralised systems, such as those for passports, social services and immigration, and there is little experience in developing large-scale distributed systems. It was interesting to see the government back off its promises of an early EHR system; the documents have vanished from the websites. However, OASIS is being used in a number of projects: for electronic courseware delivery, healthcare management in the IBHIS project and we are currently in discussions with the Police IT Organisation PITO on their project to federate IT services.

If you implement OASIS RBAC above an event-based middleware you can implement instant revocation of access, a holy grail of capability systems. You can also integrate an application workflow with RBAC, so that a role's privileges change as the application progresses.

Trust and risk

Global computing in its most general form does not have registered users working behind firewalls but is an environment where mutually unknown computational entities must decide whether to interact. Global connectivity can't be assumed and as much information as possible must be gathered to establish sufficient trust (or distrust) for decision making. We are working with Trinity College Dublin, BRICS Aarhus, Geneva and Strathclyde on the EU SECURE project (Secure Environments for Collaboration among Ubiquitous Roaming Entities) on a model for and implementation of computational trust. For such an environment we are adapting our access control policies to take account of the resources at risk and the related level of trust required for an operation to go ahead.

Postscript

As someone who has been in systems research for some years I've seen young graduates coming into research taking for granted the systems capabilities that were unthinkable a few years earlier. I've also found that the wheel can sometimes be reinvented (some ideas fall out of fashion and re-emerge as technology tradeoffs shift), some concepts persist (and it's important to know the fundamentals) and some ideas take time to be accepted (by the peer-review process associated with funding).

The research I've outlined above was done by a number of people over the years. I've not mentioned any individuals, however major their contribution. Our publications are available from our web pages and the funded projects are described in detail there. http://www.cl.cam.ac.uk/Research/SRG/opera/

Cambridge Computer Lab Ring events calendar

(see also www.camring.ucam.org)

June 2004

London Drinks Party

17:30-19:30
Venue: Oyster Partners Ltd
London WC1X 0JD
Guest of Honour: Dr Hermann Hauser CBE
(invitation enclosed)

Profile – Curious Software

In the latest in the series of articles profiling companies founded by Computer Lab graduates, 'The Ring' was delighted to talk to Justin Wise, co-founder, Director and Senior Software Engineer at Curious Software. Justin is a graduate of Trinity Hall.

TR: Justin, how did you first get involved in software development and when did you decide to get involved within the 3D arena?

JW: I played with computers on and off from childhood through into my teenage years – and this included a lot of software development just for the fun of it, including some reasonably successful commercial efforts when I was at school. A degree in something computing related seemed an obvious choice, and I was fortunate to be able to join the second year of the full three-year Computer Science Tripos at Cambridge. Alongside my interest in computer software I'd long nurtured a fascination for film special effects – and when one day in 1994 I received an email circular that a London company called Parallax Software, who made software used on Jurassic Park among others, was recruiting graduates, I jumped at the opportunity. I spent five years at Parallax working on film post-production software before the opportunity arose to set up Curious Software.

TR: Can you tell me why and how you started Curious Software?

JW: Parallax was sold very successfully in 1995 to Avid Technology Inc, and a few years later the still-functioning Parallax team in London was closed down. It was the perfect opportunity to start something new. A few of us who'd been involved in Parallax teamed up with Gareth Griffith, our Chairman and the previous founder of Parallax, to set up Curious Software and address new challenges.

TR: What made you decide to develop World Maps and who is World Maps' target audience?

JW: We wanted to find a niche market with unrealised potential, and had some knowledge and experience of the television news production environment. A few visits to major news broadcasters confirmed our suspicions – they were all producing maps to illustrate their broadcasts in extremely expensive and time consuming ways. The most common technique involved capturing an image of a paper map using a rostrum camera, and then painting it by hand. We knew we could automate this

process – cutting the production time down from half an hour or more to seconds – and that we could add capabilities beyond anything commonly possible at the time. Our primary market consists of television news broadcasters – from the very big (CNN, Sky, BBC) to local stations that may cover only part of a city. Today, using Curious World Maps, our customers can produce beautiful animated map graphics, seamlessly integrating high-resolution satellite imagery, street data and digital terrain data – in a fraction of the time that it used to take to produce a single static map. You can see the results almost anywhere you turn on a television in Europe or the United States.

TR: *Can you tell me about Curious gFx? Did you have to explore different animation techniques?*

JW: Curious gFx – in its first incarnation – is aimed squarely at the high-end film and video post-production market. It occupies a crucial step in the complex compositing process by which many separate elements – some of which may be computer generated and others real film footage – are combined together to give a seamlessly convincing image to the audience. As with Curious World Maps, the idea is to make a complex and repetitive task extremely efficient, and to put the best tools in the hands of the graphics artist. We've had some great early successes – and Curious gFx is already in use on major feature films due for release in the very near future. We expect to extend the product's range into broadcast television graphics and also to produce paint and animation tools for the wider "pro-sumer" computer video market.

TR: In your opinion, what will be the biggest growth area in computer graphics software in the near future? (games development, TV, film…?)

JW: The field of computer graphics is so huge and all-pervasive that it's difficult to identify one single growth area. In our own markets – television, film, and desktop video production – I expect to see a huge growth in professional quality tools available to the home and semi-professional user in the near future. You'll be able to use the same tools on your desktop that are being used on *The Lord of the Rings*, and produce some fantastically exciting results.

TR: What are your goals for Curious Software for the next 5 years?

JW: We hope to reach a point where almost every frame of graphics content in major movies and broadcast television has been touched in some way by a Curious Software product – and to become the best-known name in the industry for delivering quality, innovative solutions to the communication of visual information.

TR: Finally, what advice would you give to others thinking of starting their own business?

JW: Try to find a rewarding niche market that everyone else seems to have overlooked – often the most obvious products have never been developed because everyone else thought somebody else must have been working on them already. We've been able to do this with Curious World Maps – which now provides us with a growing revenue on which we can build the exciting products we have planned over the next few years.

ICT Unplugged: Horizon Seminar 9 December 2003

On December 9th 2003, the University's Corporate Liaison Office and Cambridge enterprise held the third of its Horizon seminars at the William Gates building in West Cambridge. Delegates from companies including Toshiba, Sanyo, Boeing, NTT and the BBC joined researchers and academic staff to explore the new frontiers of research in information and communication technologies. This article has been reproduced courtesy of the Corporate Liaison Office.

At the start of the day there was a real sense of anticipation as one hundred and thirty delegates looked through the programme of talks from the Computer Laboratory, the Department of Engineering, the Statistical Laboratory, and the Laboratory for Communications Engineering. Some were obviously wondering what Andy Hopper would have to say about 'Virtual Signs in Physical Space', asking whether their maths would be up to Elena Punskaya's session on 'New developments in Sequential Inference', or speculating about what 'Dasher', the topic of Chris Ball's talk at the end of the day, could possibly be.

When Professor Ian Leslie used his introductory presentation to argue that 'we [the market] are still primarily seeing the obvious convergences' between different technologies and different disciplines, it seemed he was deliberately downplaying the innovative thinking taking place all around him.

In this wide-ranging event, connections were made between the engineering, mathematical, computational, social and - above all - practical aspects of our growing use of information and communications technologies.

They included Ian White discussing the challenges of building ever faster networks, Frank Stajano arguing for computers that are as invisible as electric motors, Joan Lasenby enhancing motion capture systems with machine learning, and Simon Maskell building guidance systems for aircraft, as the day's presenters all made it clear that no area of academic computer research stands alone.

One of the most radical was Steven Hand from the Systems Research Group, who introduced the Xenoserver, a market-based approach to the provision of computing power that provides resources whenever and wherever they are needed, and can do so on a commercial basis.

Having heard about ways to build faster networks and more powerful computers, Andy Hopper, Professor of Communications Engineering and one of the key figures straddling the industrial/academic worlds in Cambridge, talked about the way computers are becoming ubiquitous, and how we can best use all the available computing power.

If Ian Leslie's team is building powerful systems, Andy Hopper wants to connect them to the real world by putting motion sensors, video cameras, voice recorders and any other sensor you can think of in

our homes, offices and streets and creating 'sentient' computers.
This will stretch to our private aircraft too, it seems, since one of his dreams is to have an automatic log created of every flight he makes.

One reason Andy Hopper's speculations are more than just science fiction is that more and more of the devices we build are coming with computers built in, as Dr Frank Stajano demonstrated in his entertaining talk. He had brought his 'intelligent' bathroom scales with him, and described - but thankfully did not demonstrate - a Japanese toilet that comes with an infrared control for its many and various cleaning functions.

Over a buffet lunch the presenters mixed with those attending. Some slipped away to attend a talk on wireless technologies given by Qinetiq's James McQuillan, and had to be dragged from the seminar room in time for the afternoon's presentations, while the rest took the opportunity to chat with other delegates. As Russell Haggar from Prelude Ventures put it: "I haven't really had a chance to catch up with what the lab is doing research-wise for a couple of years...this is a great chance." His view was endorsed by Accelerate's Daniel Dearing, who said: "I enjoy rubbing noses with people who are also interested in technology."

Throughout the talks there had been a lot of furious note-taking, and some interesting concept maps had taken shape on notepads around me. One of the note takers was Clive Thomson from Blueprint Programming, who told me "I think they've pitched it well. It's not too academic - it gives you a flavour of what they are doing"

If the morning belonged to ubiquitous computing, then the afternoon was dominated by the work of Thomas Bayes, a mathematician who died in 1761. Bayes worked in the area of conditional probability, asking the question 'what is the chance of an event happening if we know that some other event has already occurred?'

Professor Bill Fitzgerald, an accomplished speaker with the style and approach of a charismatic A level maths teacher, was the perfect choice for the post-lunch dead zone, keeping us all on our intellectual toes as he explained how hard maths sit beneath the computer models that we use every day.

He and his team of researchers from the Engineering Department took us on what can only be described as a rapid canter through the basics of Bayesian statistics and the ways in which it is used in computing. They range from target finding in defence systems to Dr Joan Lasenby's work improving the efficiency of the video motion capture systems used in sports medicine.

The final session considered the ways humans and computers interact with each other. Despite the fact that the keyboard/mouse/screen combination still dominates, as ubiquitous computing services become more common we will inevitably abandon them for most tasks. Professor Steve Young, who introduced the session, argued that we need to develop human-centred protocols, not least because there are many people who cannot use existing technologies.

The threads of the day came together in the demonstrations given by Young and his team, Professor Roberto Cipolla, Dr Tom Drummond, Dr Pat Langdon and Chris Hall. The alternative approaches they have developed for interacting with our computer systems all rely on the faster, more powerful computers and programs that come out of Ian Leslie's research; they use the sensor technologies that Andy Hopper has worked so hard to deploy; and they require internal models and machine learning that would not be possible without the mathematical breakthroughs outlined by Bill Fitzgerald.

So we saw commercially deployed speech recognition systems, face tracking and gesture recognition tools, force-feedback devices that can make computers usable even by those with extreme tremor, and an augmented reality system that overlays machine-generated diagrams and labels onto a scene and could make servicing printers and photocopiers a lot easier for even the untrained user.

We even saw Dasher, which turned out to be a text-entry system for devices without keyboards that is almost impossible to describe and simply obvious when you see it used. Like the best user interfaces, once you are told what to do - move your mouse or pointer towards the letter you want to select - it just works. And like the best computer science, it will rapidly become invisible, ubiquitous and effective.

The seminar closed with a question and answer session led by Steve Young, and it was clear from the range of issues raised that the day had managed to hit the right buttons. Reflecting on one researcher's unwillingness to claim that their system was ready for commercial exploitation, the BBC's Richard Marsden pointed out that 'sometimes ninety-five per cent is enough for a commercially useful application', since a speech recognition system which could keep a teleprompter synchronised with a newsreader would not have to understand every word spoken.

It was a good metaphor for the day, where those of us listening may not have understood every word, but came away with a much greater understanding of the work being done and its important commercial and industrial applications.

LATEST RESEARCH IN THE LABORATORY

A talk to the Cambridge Computer Lab Ring by Dr. Simon Moore and Professor Robin Milner

15 March 2004
Meeting report by Stephen Allott
Council Member, Cambridge Computer Lab Ring

INTRODUCTION

Association members gathered in Lecture Theatre 2 in the William Gates Building for an update on recent Lab research. Dr. Peter Robinson, Deputy Head of Department, introduced the talks, quipping that the department had met the Government target for admissions from State Schools whereas the University, as a whole, had not. Reflecting the balance of research in the Lab, one talk was to cover a very practical topic whilst the other was to be theoretical.

DR. SIMON MOORE: ELECTRONIC CONSUMER SECURITY DEVICES

Individual research projects can span multiple areas within computer science. Simon Moore likes this very much. One of the Lab's strengths is a wide range of skills and this consumer security project would not have been possible without this skill base. The project started from a casual conversation in the Lab tea room between Simon and Dr. Ross Anderson. A patent was filed and the project was started.

The design motivation is that security systems can be designed in smaller and smaller spaces. Simon showed an example of an older security system: an IBM 4758 PCI crypto controller which provided security against a bank's own staff. This device does a good job at the physical layer. Mike Bond, in the Lab's Security Group, however, found a number of vulnerabilities and informed IBM, giving them 6 months to make changes before a resulting paper was to be published. IBM then sought an injunction against publication. The sort of functionality in the IBM controller is now found in a SIM card. A bank has an ATM which is accessed by a card with a chip in it. Using a smart card, one can have end to end secure crypto. These chips do not bend well which limits their size to a 5mm by 5 mm form factor.

Another example is pay TV which has one way communications. It is hard to identify duplicate cards which, in some countries such as Germany, were not illegal. These types of cryptographic devices are used in a wide range of areas including ID cards and chipped inkjet print cartridges which protect market share against competitors.

There are a number of design challenges for cryptographic devices in order to protect them from attack. One category of attacks is "invasive". Optical Reverse Engineering uses confocal microscopy to map the various features in a chip. One can also use a Focused Ion Beam work station which is now much cheaper. They cost less than £100,000 each. Using the work station, one can find the blown fuse which was used for production testing the chip. Repairing the fuse enables the attacker to read out the values from the production tests. Simon's slide showed a clear picture of the blown fuse on a chip. Another type of invasive attack is using a laser to read out SRAM values. Simon showed an example. Finally, lasers can be used to reset register values.

A second category of attacks are "non-invasive." The litigation attack involves suing a competitor in court and using the legal process of discovery of documents to extract information which compromises the security of a chip. Simon explained that Kerckhoff's Principle applies in this case. Security must not depend on keeping the crypto-algorithm secret. Security depends on keeping the key secret. Further non-invasive attacks include looking at power consumption patterns and electromagnetic emissions. One can apply different operations to a chip, monitor the emissions, subtract one trace from another and thereby reveal the differences.

So, how can one defend a security chip from these attacks? Reduce data dependent power emissions. Desynchronise the circuit from the outside world. Use dual rail asynchronous circuits. One can use memory protection. One can use random execution ordering and timing. One can use polysilicon transistors on polymer substrates. The Lab has built a demonstrator chip, called Springbank to show how some of these techniques would work.

In conclusion, Simon said that the smart card must keep the key secret. The industry will have to move to open platforms because keeping the algorithm secret is not robust. An open approach would enable the technology to be improved significantly.

PROFESSOR ROBIN MILNER: GRAND CHALLENGES FOR COMPUTER SCIENCE

Robin Milner, a leading computer science theorist, opened his remarks with a joke. He has been wondering when theory would catch up with technology. In an inspiring talk, he explained that the Grand Challenges for Research in Computing is a grass roots movement to identify what the UK experts in the field want to do. The whole UK academic community has been consulted and its votes distilled into 7 challenges:

1. Modelling vivo in silico
2. Memories (of a person) for life
3. Architecture of the brain and mind
4. Dependable computing evolution
5. Journeys in non-standard computation
6. Science (theory) for Global Ubiquitous Computing
7. Engineering for Global Ubiquitous Computing

Each grand challenge is a 15 year project with clear goals and failure criteria. Participation is worldwide but all are led by the UK. The whole approach has been attracting attention from the rest of Europe. There is a conference in late March 2004 to review progress.

Overall the Grand Challenge exercise is one in which the community examines and adopts long term goals from within computer science, not outside it, in order to develop and refine a portfolio of proposals to show the public - and funders - what the community aspires to. See more at www.nesc.ac.uk/esi/events/Grand_Challenges.

The 2 grand challenges for the Global Ubiquitous Computer are led from the Computer Lab. Professor Jon Crowcroft is leading the Engineering challenge; Professor Milner the Science challenge.

The Global Computer will be a thing, like a global organism. It will be partly designed and partly a natural phenomenon. Shall we understand it? No. But we should understand it before we build it. Professor Milner's Science Challenge is to

> "Develop an informatic science whose concepts, calculi, theories and automated tools allow descriptive and predictive analysis of the Global Ubiquitous Computer ("GUC") at each level of abstraction. Every system and software construction, including languages, for the GUC shall employ only these concepts and calculi and be analysed and justified by these theories and tools."

This is an idealistic goal but success is still a possibility at least !
There is a long list of concepts to consider. Provenance of information is important. When should one trust data published on the web. Searching for the figure for the population of Monaco on the web yields figures which can vary by 10%. Beliefs, security and authenticity are all important.

Locality, mobility and connectivity are 3 particularly key concepts to think about. Robin Milner has worked extensively on models of distributed processes.

This leads to an emerging subject of Structural Dynamics. GUC systems reconfigure both their topography and their connectivity, both physical and virtual. Ordinary programming languages use location as a metaphor. Mobile processes can be both modelled and programmed using Process Calculi such as pi-calculus and mobile ambients. These are already widely used from plants to business processes. Robin Milner suggests using Bigraphs which generalise these processes. Then one should extend them to a stochastic model with continuous time and space.

Professor Milner showed how one can represent a system reconfiguring following a “reaction rule”. Showing an example of a bigraph which represented multiple people doing a conference call from multiple buildings, we saw how interactions in a built environment can be represented. Systems are hierarchically nested. A person may leave one room and rejoin the conference call on their mobile phone. Another may change room. Many different types of changes can occur, each of which needs to be modelled.

The overall challenge is to devise computational theories for GUC systems alongside the *engineering* of those systems and the sub-challenge is to establish dialogue between the theorists and engineers.

After some questions we adjourned to Churchill College for dinner.

(*A list of members who attended the dinner can be found on the Events page of the website. See the Photogallery for the dinner photos. (www.camring.ucam.org)*

Career Changes: Moving From R&D to Founding a Startup

Adam Martin, CAI BA01

"The man who makes no mistakes does not usually make anything", Edward Phelps.

After a year in IBM's main UK research lab at Hursley, I came to Cambridge with a rough career plan. I expected to mix academic study with internships at IBM - possibly a sponsored project - before going back to IBM to do some interesting research, go on many more training courses, and get a lot more experience. I had some great mentors, including someone who sat on IBM's “Worldwide Technical Committee”, as well as one of the youngest ever senior managers. Expectations and advice ranged from “after two years, do an IBM-sponsored MBA, then come back to do a stint in management” to “don't bother doing an MBA, you'll learn everything on the course in less time just by moving around within IBM”.
Within a year of graduating, I told IBM I wasn't going back, founded a start-up, and was doing cutting-edge research alongside the hard slog to gain equity funding. This article is about making the decision to walk away from commercial research within a large corporation, opting rather for the extreme risks and rewards of running my own company.

For those who don't know IBM (and similar companies) I ought to explain that everyone in the company has a career path. You can see how to get from bottom to top, in any aspect that interests you, worldwide. To reach particularly high levels, there are mandatory stages and checklists, but in-between there are very broad requirements allowing you to take whatever path interests you. This means that no-one can reach seniority without extensive experience and training in both management and technology. So it's not unusual for the head of a research lab to have considerable management experience, or for a head of marketing to be a competent (if not skilled) programmer.

By sheer co-incidence, IBM has entered my company's niche - we identified this “threat” in the original business plan, but never thought it would actually happen! This, through my contact with former colleagues, has provided an interesting opportunity to compare what I would be doing had I not started a company but rather moved to IBM. In short, my expectations have mostly proved correct – I've learnt more about management and running a business in the last 3 years than I would have done in twice as long at IBM. Granted, I would have had a lot more training at IBM, but I prefer to learn by experience. IBM would not have taught me how to persuade a customer to sign a cheque or to become so adept at finding cash. Working for myself has taught me both albeit likely born from simple desperation!

At the end of the day, my main reason for spurning IBM was that I knew it would take me at least 5 years to do the work I wanted to. This is not down to checklists and career plans (although I'd looked at the “previous experience” requirements, and they were well ahead of what I could realistically achieve in IBM), but simple ageism. I already knew of candidates seeking promotion who were excellent on paper (to the extent of being told they'd probably got the position) but who were turned down at interview – apparently because of their age (or lack thereof).
In practical terms, it was only a chance meeting at the Cambridge Entrepreneurship Conference that gave me the courage to go ahead. At lunch I sat next to an investment banker who asked why I was there I said that I really wanted to start a company, but doubted the wisdom of it - I was aware of the huge risks and the chance of no reward for years of extremely hard work. He pointed out that, whatever the outcome, I'd be at least as employable at the end of it, and that the experience alone would be worth every ounce of blood and sweat.

For me, Phelps's quote encapsulates one of the most important criteria when deciding whether you’re suited to founding a start-up based upon your own research - you have to possess a realistic and non-judgemental view of mistakes, no matter how large, and be capable of picking yourself up and carrying on no matter what happens. There are other ways to start a company, but most do not exact such a heavy emotional investment. If it turns out that your

research is not as commercially viable as you thought, you may have to throw it away. By contrast, large companies, as part of their ongoing investment in potentially viable IP, are usually able to absorb the ongoing costs of research that might have no commercial use for many years to come. Sir Alec Broers (himself ex-IBM) once told me that it is normal for a large corporate to undertake research that bears no commercial fruit for up to 25 years. Indeed, he felt that a number of companies should look this far ahead. It's a game of percentages. A company knows that much of the research will be worthless but hopes one project will hit the jackpot covering the cost of all the rest – and more. IBM's CopperMine processor technologies are an example of this. When news of the success of the copper manufacturing processes hit the press, IBM sent round internal brochures explaining how close they came to closing down the project. After years of investment and research the large team (in excess of 40 people, IIRC), having produced nothing of value to IBM, were only weeks away from having the project canned. The breakthrough came in the nick of time. Clearly, commercial research is not quite as hard-nosed as it's often rumoured to be.

There is one thing I would do differently if I had my time again. I would have read for a PhD before starting a company. Admittedly, there would have been a massive opportunity cost - in the last 3 years, Grexgames has become one of the leading players in the field. However, the support networks for entrepreneurs in the UK are still in their infancy, and a government-backed academic qualification goes a very long way to securing government support. A PhD also adds a genuine legitimacy in the eyes of potential investors who often have neither the resources nor the expertise to check whether you really know what you're doing. Incidentally, I believe it is for similar reasons that IBM very strongly encourages PhD students to complete despite cold feet.

I founded a start-up with my eyes wide open. In my last two years at the University, I spent more than a year helping to run the CU Entrepreneurs Society, and even entered the £50,000 competition (making it to the final, but alas no further). One of the original aims of this society was to be a surrogate "Dept of Entrepreneurship", providing resources and encouragement for students who either knew they wanted to start a company, or who weren't sure but with guidance and encouragement might choose to do so. In that respect, both CUE and the Cambridge Entrepreneurship Centre seem to be doing a great job; they should certainly be the very first port of call for anyone who thinks they might be even remotely interested in starting a company. They provide a huge variety of resources, from courses to networking to mentors - and of course more than £50,000 each year in prize money to the best business plans and new start-up teams from the University.

However, in my day, there were several things that CUE/CEC didn't teach well – in particular, how to market ground-breaking technologies, how to recruit the right staff, and "closing the sale". I haven't seen the current teaching syllabus, but you may find it worthwhile looking elsewhere to complete your entrepreneurial education.

Assuming you get the help you want, learn what you need, and produce an excellent business plan, for most academically-minded people the really big challenges are only just beginning. Historically, University spin-out companies in "Silicon Fen" have faced a particular accusation: great technology, great invention, crap marketing, no business acumen. A number of companies are guilty of this charge however generalized. They range from those who have never quite worked out who their customers are, to those who have refused to compromise on R&D budgets and strategy. Some have founders who have looked to do whatever they want on the development side, assuming that once the "hard bit" (technology development) is cracked, the business 'stuff' will follow easily – or else be looked after by someone else.

To be fair, from what I saw at CUE, today's entrepreneurs-in-waiting are aware of many of the problems and have addressed them before putting pen to business plan. However, marketing still remains an issue for many fledgling start-ups.

Just how do you talk to people about your technology? The longer you spend in a non-commercial environment, the more difficult it is. When you work with people genuinely interested in what they do, who understand what is going on, you expect everyone to have the same interest and level of knowledge. I thought I was pretty good at explaining things to people in a clear, concise manner. At IBM I'd been a technical consultant on non-technical issues. Also I'd run a small online service and had learnt how to attract people with imaginative marketing. However, in reality, I was totally unprepared. Sure, I could write great brochures for our technical target market. But, in any major market you need to reach out further than just the product users. For instance, an accountant will need to sign off on any expensive product (licensing costs for our product are in the 6 figure range). If that person cannot be convinced of its value, it's usually a no-go - even if they hear the magic "...it'll save you THIS MUCH money!".

Here I am indebted to Adam Twiss (co-founder of Zeus and Saviso, and a CompSci grad from Churchill) who has an excellent grasp of marketing, especially the phrasing, plot, and vocabulary needed to excite people who don't really want to know about your product. In the early days of Saviso, Adam (and Co-Directors Bryan and Andy) gave me a lot of time and advice on attracting funding. Now I'm glad to say I can write a pretty good sales brochure, one-page flyer, or even a press release. I hasten to add that nowadays we have a professional Marketing Director with over a decade of experience in Sales and Marketing. This makes things much easier.

Interestingly, when it comes to talking to people face-to-face, this "marketing speak" is neither an issue nor a requirement. Both potential investors and customers comment that our knowledge and enthusiasm shine through, while the ability to intelligently answer any question on our product or market pays instant dividends. However, whether you are talking to investors, customers, or even partners, it is important to have marketing literature to hand. If these are instantly available and of a high standard, it's easier to keep the momentum going.

If you would like advice on marketing, why not contact lab grad Nicky Dibben (CTH93). Her company – Invention Marketing – provides a range of marketing services specialising in the technology sector. Nicky's contact details can be found in the Who's Who. If you have mislaid your username and password please contact the Ring office at jan.samols@cl.cam.ac.uk

THE "CAMBRIDGE COMPUTER LAB RING"

Progress Report to the Faculty Staff Meeting by Stephen Allott, 3 December 2003

I am going to give you a progress report on the Cambridge Computer Lab Ring, the Department's Graduate Association.

This is an important topic because the Ring is there for you to make use of. It's an important topic because you can shape the Ring to adapt it to your needs. It's important because the Ring will be a valuable asset for the department in the future.

This progress report is in 3 parts:

1 What have we done since work started in October 2001?

2 Where have we got to today?

3 What is the vision for the future?

SO LET'S START WITH "PROGESS SINCE WORK STARTED"

When I turned up for work at the start of October 2001, I asked Ian [Leslie] to tell me what would be the most helpful thing I could work on for the department. He replied:

"Set up an alumni association."

So, I started to research what members would want from it, what we could learn from other similar organisations and what already existed in Cambridge. In effect, we were looking for the gap in the market and how to do a good job filling that gap.

The University does help students find a job or set up a company. It energetically stays in touch with business. It definitely wants your money if you end up rich.

The un-served gap in the market then became clear. There is nothing to help you succeed in the 40 years between leaving here and retiring. There isn't a way of accessing the Cambridge graduate community. The network isn't real. So that is what we set out to build; the infrastructure necessary to derive a lifetime benefit from a Cambridge Computer Science degree.

One of the first things we did was to recruit someone to run the Association, the Director General. A lot of energy went into finding a good person. After 3 months of effort and interviews with Ian, Margaret [Levitt] and myself, Jan Samols was appointed and she started work in March 2002. I'm really pleased with the results. We are lucky to have her.

A good brand name is important. Early feedback suggested that using the word "Alumni" would be a bad idea. It suggested a fund raising mission which isn't the goal. It would cause confusion with the Development Office's University Alumni Relations activities. I also wanted it to be clearly home grown. Hence we are called a "Graduate Association". This makes clear that it's the graduates' own association. I am always explaining that we are a graduate association not an alumni activity.

For a while, we collected naming suggestions on the whiteboard in my office. "Network" was too hackneyed. We toyed with Latin names. Nothing was quite right. In desperation, I sent an email around asking for suggestions. Maurice mentioned the "Cambridge Ring". A very clever suggestion. We broadened this to "Cambridge Computer Lab Ring" and this is the official name of the Cambridge University Computer Laboratory Graduate Association.

Now we had a name, Jan was able to incorporate a legal entity, a company limited by guarantee, to give the association legal personality. A bank account was opened and the initial endowment paid in. The service offering to members was researched and finalised. Software was bought. A web site set up. The first Newsletter was written. Speakers were booked for the events programme. Stationery was designed with help from Chris Hadley and printed. We sent a mailshot to 1,800 graduates inviting them to the launch event which took place on 10 October 2002. So, in the first year, we had built and launched the Association.

The meetings that autumn and winter were well attended. In March 2003, we held the first Annual Dinner. After a Laboratory Update in this building, we walked over to Churchill for drinks and dinner. Maurice gave an excellent after dinner speech. 45 people came. Their feedback was very positive. One of the highlights of the first year's events programme was the talk by Queens graduate Demis Hassabis on challenges for computer science from the games industry. 150 people came and it was a great success. The month after, in May over 40 people came to the London drinks party. During this time, I briefed many of you individually and asked for suggestions. In total I had 22 faculty syndication meetings.

We staffed the Ring Governing Council which is chaired by the Head of Department. Other members are David Colver, Christ's 1980 and founder and CEO of his own company, Operis; Lorenzo Wood, Christ's 1993, who also founded his own company which is now part of Oyster. I am a member. Jan Samols attends as Director General and Margaret attends as an Observer. So the Council consists of 4 people plus 2. There are 2 vacancies which will be filled in due course. *[They have now been filled. Ed]*

Jan researched and launched the Ring Hall of Fame which lists companies founded by Lab graduates and faculty. This is accessible on the members' web site. Meanwhile, I have been giving the occasional lecture in the Engineering Department for Dr. Elizabeth Garnsey and she offered to supervise a student project to study the Hall of Fame companies. Liz Cass, the student who did the project, came to present her results here in July. The Cambridge Computer Lab Phenomenon is now documented.

We have an ambition to do a survey of Lab graduates to find out how they are doing and what they need. Last summer, Jan spent a lot of time in the Library reading the University Reporter to compile the comprehensive list of Lab graduates. We call this the Universe. The name of every single one is now

loaded into the Ring online Who's Who and members can search it by name, year, college, degree and any combination of those. I often use this to show visitors who was in their year at their college and to see if they know them.

During the year we conducted qualitative research amongst the members on careers and on social issues. We found out that:

- Summer placements are highly recommended
- The University Careers Service is highly rated but under used.
- There was little undergraduate social life at the Lab for students to remember and most undergraduates had not made any friends through the Lab.

Just recently, the Lab was featured in the latest issue of CAM magazine.

So that, in 7 minutes, is the progress over last 2 ¼ years. What are the results?

HOW IS THE RING DOING?

Membership is the key thing.

- We have 233 members in total. *[294 at time of press. Ed]*
  - 94 are paying members [*125 at time of press. Ed]*
  - 139 are recent graduates or current members of the department both of whom can join for free. *[169 at time of press. Ed]*
- The first members who joined in October 2002 have just come up for renewal. Out of the 8 who joined in that month, 7 of them have renewed which was encouraging. The 8th said they would rejoin when the Association had reached critical mass. A further 8 joined in the following month, in November 2002. Of those, 6 have paid their renewal and the other 2 have promised to do so. No rejections. Jan has done a telephone interview with each one to find out what they liked and didn't like.
- 3,509 graduates are listed in the Who's Who going all the way back to 1954.

  The top 4 colleges are:

Churchill	338
Trinity	281
St. Johns	226
Queens	184

  Examples of mid sized colleges are:

Trinity Hall	124
Jesus	119
Emmanuel	118

  Examples of small ones are:

Corpus	95
Peterhouse	86

  By degree type:

3 year Tripos	1022
Diploma	1007
PhD	487

- We need 600 members to cover the Ring's day to day running costs. Although the recruitment of new members is slower than I would have liked, the high renewal rate is encouraging. Based on our current projections, the Ring has sufficient funds to last for about 15 months. In that time we shall either have to accelerate recruitment, reduce the costs or find fresh funds or do some combination of those 3 things. Making it work through accelerating recruitment would be the ideal.

  Those are the membership numbers, actual and potential. Helping these members do better in their careers is our prime objective.

- We have established a Careers Advisory Committee, which met for the first time in November. It consists of:

  Nick Bolton (T72)
  Youssef Bouguerra (PEM98)
  Peter Cowley (F77)
  Nathan Dimmock (JE01)
  Richard Hadden (Q97)

- 70 members have volunteered for the Careers Advisory Panel who make themselves available to give careers advice to members. The Panel are listed in the on-line Who's Who. This is an impressive number and something we should trumpet.
- There are 16 jobs currently advertised on the Ring Jobs Bulletin Board where members can recruit each other for free. This is not for undergraduate jobs which should go through existing channels. Undergraduates do not have access to the Ring site.

As well as careers, the Ring also offers other benefits:

- We have sent out 4 Newsletters so far. The deadline for the next one is on Friday.
- We have held 10 events, 9 in Cambridge and 1 in London. The next one is here on 15 January 2004 when we shall hear from Library House about how the 898 technology companies in the Cambridge Cluster are doing.
- The Hall of Fame now contains 89 *[now 106. Ed]* companies; the most of any

department. Andy Hopper is the most prolific with 11 companies listed.

- ❖ We have started an Industry Legends page to list individuals in industry who have made notable contributions to the computer industry. Bjarne Stroustrup who wrote C ++ is an example. Please encourage people to send in nominations.

- ❖ We have received and answered many requests to the members' helpline.

- ❖ We have launched the Schools Visit Programme where members visit a local school or their old school to talk about computer science at Cambridge.

- ❖ Of these, the most valuable benefits, from our research, are the newsletter, events and calibrating career progress by keeping tabs on peers.

So, I've covered progress in the past 2 years and where we stand now. My third topic is the vision for the future and what the Ring can do for you:

THERE ARE 3 AREAS WHERE THE RING CAN BE USEFUL TO YOU

The first is admissions & teaching

- ❖ The Ring can help improve the quality of candidates. We encourage members to visit schools and have a powerpoint presentation, which is Neil Dodgson's with a few changes, for them to use.

- ❖ Role models can also encourage good candidates to apply. We keep a lookout for graduate role models to use in Admissions publicity.

- ❖ There is a standing invitation to graduates to suggest student projects and to act as project "clients".

As well as admissions, the Ring can be useful in research

- ❖ You can publicise your work to the graduate community through the Ring Newsletter.

- ❖ You can invite members to suggest academic seminar topics.
- ❖ You can get the Ring to host a speaker event on topics relevant to your work.

The third area the Ring can help is to promote the Lab and its community

- ❖ You can show the Ring to visitors:
    - The literature rack in the Street has copies of the Newsletter
    - I keep interesting material on the Ring notice board
    - Do pop into the Ring Office. If your visitor is a graduate introduce them to Jan.

- ❖ You can promote the willingness of faculty to do commercial consultancy by publishing a case study in the Newsletter. If your client is publicity shy, make the case study anonymous.

- ❖ When former students contact you, you can mention the Ring jobs board (for both finding and publicising jobs) and mention the Careers Advisory Panel where they can get advice from the 70 advisers.

So that is how the Ring can be useful in teaching, in research and in promoting the Lab generally.

THE RING WILL BE MOST VALUABLE AFTER IT REACHES SCALE

I have a vision of how it will work, benefiting individual graduates, their companies and you, the faculty.

Individual graduates will use summer placements, the Supporters Club and the Careers Service to find the best job for them, the job that matches their ability and aspirations. Later on, they will make good career moves, getting advice from the Ring Advisory Panel and finding jobs on the Ring jobs board. Social contact will make them happier. Events will make them more knowledgeable. The Annual Dinner will be well attended with student prizes being presented, academic successes being recognised and business successes such as flotations being celebrated.

Hall of Fame companies, founded by Lab graduates, will get help finding customers through the Ring Who's Who, through the Ring Newsletter and through Ring events. Recruiting technical staff will be easy through the jobs board.

Faculty will be getting more consultancy and student project suggestions. This will help identify fertile areas for research which can be publicised to industry through the Ring Newsletter. Students can be placed into relevant companies. Ring events will bring together people interested in particular areas. Overall the Ring will help to enrich research and find outlets for it.

So at scale, the Ring will help attract students and faculty to the department.

THE FUTURE MEASURES OF SUCCESS ARE CLEAR

<u>Graduates</u>

- ❖ Average salary

- ❖ Continued employment in computing

- ❖ Ring membership number

Hall of Fame Companies

- Company turnover
- Company Employment
- Company Market capitalisation

Laboratory

- Admissions quality
- Competition for faculty positions
- Reputation and buzz

WE SHALL NEED YOUR HELP TO SUCCEED: SO

- If a graduate contacts you for a reference, please recommend that they join the Ring
- Please suggest to graduates that they visit a school using the Ring School Visit Programme.
- If there is a specific individual you wish to stay in touch with, invite them to join you at the Ring Annual Dinner next March.

TO SUMMARISE

In 2 ¼ years we have built a strong well founded organisation. It is now ready for growth. It will be a distinctive and valuable asset for this department and for each of you personally.

My hope is that by mobilising the 3,500 strong graduate community, we can help them reach their personal potential, we can help their companies be much more successful and we can enable the department to grow for another 50 years, attracting great students and great faculty members.

The Ring connects People, Companies and the Department.

Thank you very much.

Now let me ask you, what are your impressions of the Ring? Give me some feedback.

If you have feedback on the association, the editor would like to hear from you. Comments can be submitted via the home page of the website (www.camring.ucam.org) or by email to jan.samols@cl.cam.ac.uk.

Business Hall of Fame

Thank you to all those who contacted us to add a company to the list. They are as follows. The full list of 106 companies can be found on www.camring.ucam.org.

Faisal Ahmed *HH* Dip90
UK Broadband Ltd (f.2002)
Wireless broadband operator. Provides fixed wireless Broadband services to residential consumers and businesses. Sold to PCCW (the incumbent telco in Hong Kong) in September 2003.

Kona Andrews (nee Macphee) *PEM* MSc00
break-step productions (f.2001)
Developer of Foveola, a new machine version technology based on neurophysiology. Winner of DTI Smart Award 2003-4.

Paul Beard *JE* BA76
Bid Management Ltd (f.2002)
Primarily focussed on providing major bid support and bid and sales performance improvement for Carriers and Technology companies.

Ian Benson *K* **BA67**
Sociality (f.1999)
Commercialises validation techniques for distributed systems using temporal logic.
It has two products: Labourdotdonor(tm) for recording political donations and reporting to the Electoral Commission, and Guildhall Radio (tm), a low bandwidth subscription radio station used by schools and the British Council.

Jeff Fenton *CL* Dip70
GST Technologies Ltd (f.1979)
Software developer – developed the original budget desktop publishing program Timeworks Publisher. GST operates under its new name Greenstreet Software Ltd, which was formed from the merger of eGames Europe and GST in 2001.

Global Software Publishing (f.1985)
One of the UK's leading consumer software publishers. Acquired in 2000 by the European EMME group.

Samir-Ali Feroze *G* Dip01
VeriQual (f.2003)
Provides dual shore testing services from its offshore testing laboratory by partnering with UK software testing companies.

Chris Galley *CHR* BA87
Cedalion Ltd (f.1995)
Leading Microsoft Gold partner, Systems Integrator, develops risk management solutions for the Finance Industry through FI division and Infrastructure solutions through Advanced Microsoft Consulting division.

Jochen Leidner ***PET*** **MPhil02**
Linguit GmbH (f.2001)
Linguit GmbH is an award-winning European startup with focus on human language technology (processing of natural language using computers with the aim of making information more accessible).

Richard Marsh ***JN*** **Dip93**
Datanomic Ltd (f.2001)
Provides a software solution to overcome the problems caused by poor quality or inconsistent data.

Richard Mason ***JN*** **Dip93**
Mitcham Technologies (f.1996)
Provides IT-related management consulting services, including temporary IT executive staffing

Xandera (f. 2000)
Provides IT-related consulting services, focussed on the health insurance sector. Sold in 2002.
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Rurik Turton ***PEM*** **Dip85**
Xynchron (f.2002)
Develops software for managing data through the process engineering project lifecycle.

Computer Laboratory News

Pro-Vice-Chancellor

Head of Department, Professor Ian Leslie, has been appointed Pro-Vice-Chancellor with responsibility for research. His appointment runs for 3 years from January 1st 2004.

Deputy Head of Department

Dr Peter Robinson has been appointed Deputy Head of Department.

IEEE Computer Society Computer Pioneer Award

Dr Martin Richards has been awarded one of the IEEE Computer Society's 2003 Computer Pioneer Awards for pioneering system software portability through the programming language BCPL, widely influential and used in academia and industry for a variety of prominent system software applications.

New Staff

Pietro Lio' joined the Lab at the beginning of 2004 as a Lecturer in Algorithms for Computational Biology. He is a Fellow and Director of Studies at Fitzwilliam College. His research covers several areas in bioinformatics and computational biology. Dr Lio' was previously with the MRC Human Genome Mapping Project.

Careers@CL

The Computer Lab's careers room was officially opened on February 25th. It is located in the Street and all Lab grads are very welcome to make use of it.

The Ring Newsletter

Previous editions of 'The Ring' are now in .pdf format on the website (www.camring.ucam.org).

BOOKS

"Computer Systems: Theory, Technology and Applications Series: Monograhps in Computer Science", edited by Andrew Herbert and Karen Spärck Jones, published by Springer-Verlag. ISBN: 0-387-20170-X

The book contains papers written in tribute to Prof Needham in recognition of his distinguished career. It can be ordered online from www.springeroline.com

LETTERS

From Akira (W PhD94) and Nobue (W Dip97) Nakamura who both flew over from Japan for the Ring's Update and Annual Dinner on March 15th.

Thank you for your great organization for the Computer Lab Ring, which is the most precious challenge of the New Computer Lab century. Akira and Nobue are so glad to meet great many graduates and share with coming innovative technologies in computer systems and sciences.

NEWS OF MEMBERS

Faisal Ahmed, *HH* Dip90, is business development director and founder of UK Broadband Ltd (see Hall of Fame entry).

Pablo Arrighi, *EM* PhD03, is a lecturer at the Institut Gaspard Monge in France. He is doing research in the field of quantum computation and cryptography.

Jonathan Ayres, *R* BA92, is Head of Finance and Client Administration at Cazenove Fund Management.

Paul Beard, *JE* BA76, is founder and managing director of Bid Management Limited (see Hall of Fame entry).

Jeremy Bennett, *EM* BA82 PhD88, is the Chief Executive of Tenison EDA.

Peter Blackburn, *CTH* BA89, is a senior consultant, developing software solutions for business. He co-authored "ADO.NET Examples and Best Practices for C# Programmers"

Timothy Bond, *CHU* BA85, is senior architect at Phio Corporation in Cambridge, MA.

Stephen Bishop, *Q* BA02, is a Research Assistant at the University of Cambridge Computer Laboratory

Andrew Bott, *CC* Dip85, is a director at Breckfoot Control Limited, a real-time embedded software development, consultancy and project management company.

Richard Boulton, *PEM* Dip99, is a director and software architect of Lemur Consulting Ltd, a company he co-founded in 2001.

Sébastien Bratières, *CHU* MPhil01, is head of project development at As An Angel.

Paula Buttery, *CHU* BA00 MPhil01, is a PHD student at the University of Cambridge Computer Laboratory.

Tim Cartledge, *W* BA95, is Managing Director and Global Head of Currency and Commodities DerivativesTrading at DRKW.

Robert Catherall, *F* BA01, is an applications engineer at ARM.

Melvin Carvalho, *CAI* Dip96, is a director of Otrader Limited, a software consultancy in Germany. He also won the Daily Telegraph's Fantasy Football competition.

Thomas Christie, *Q* MPhil01, is a research and development engineer at Softsound.

Andy Clark, *K* BA02, is a Test Manager at Smartner Ltd. He is responsible for testing mobile email software.

David Colver, *CHR* BA80, is Joint Chief Executive of Operis Group plc, a company he founded in 1997.

Giles Courtice, *CL* Dip88, is a consultant at Scientific Generics, the technology and business consultancy arm of The Generics Group.

Matt Doar, *JN* BA88 PhD93, works for Trapeze Networks in California.

Gavin Dolling, *F* BA96, is an embedded software engineer for Axxcelera Broadband Wireless, a data networking solutions company.

Vishal Doshi, *HH* MPhil01, is an embedded software engineer at the Technology Partnership.

David Dunwoody, *CHU* BA00, is a consultant at Accenture.

Nicholas Edwards, *G* BA03, is a graduate student at Columbia University. He works in the Intrusion Detections Systems group.

Jeff Fenton, *CL* Dip70, is CEO of Greenstreet Software Limited (see Hall of Fame entry).

Peter Ferne, *T* BA86, is director of Properdigital. He is also a director of Bristol Interactive Cluster, Bristol Wireless Community Co-operative Ltd and a Committee Member for Kingsdown Conservation Group.

Anthony Finbow, *DOW* MA91, is managing director at MetaSolv Software.

Richard Fuller, *EM* BA03, is a computer officer at the University of York.

Chris Galley, *CHR* BA87, is the founder and CTO of Cedalion Ltd, a leading Microsoft Gold Partner and developer of risk management solutions for the Finance Industry.

Paul Gover, *CHU* Dip75, is a WebSphere consultant at IBM UK.

Max Grender-Jones, *CL* BA02, is a systems analyst at MX Telecom.

Tom Griffiths, *JE* BA03, is doing an MSc in Informatics at the University of Edinburgh. He is specialising in machine learning.

Jim Grundy, *F* PhD94, works at Intel's Strategic CAD Labs in the US. He researches into the application of interactive mechanical reasoning systems to verification problems in computer hardware and software, and in the development of mechanical reasoning systems.

James Hall, *DAR* Dip93 *K* PhD03, is a research associate at the University of Cambridge Computer Laboratory.

Demis Hassabis, *Q* BA97, is creative director and lead designer at Elixir Studious, a company he founded in 1998.

Richard Hinchliffe, *EM* BA81, is managing director at Protechnic Exeter Limited, a company that provides solutions to the problems faced by the NHS.

Ritchie Hughes, *PEM* BA01, is a software design engineer at Microsoft in Redmond, USA.

Dan Jarvis, *CTH* BA02, is working as a software engineer for Data Connection.

Adam Jollans, *JN* BA80, is IBM's Linux strategy manager. He was named one of the leading global authorities on Linux in Linux World Magazine.

Ian Jones, *K* B83, is a partner at Apax Partners, one of the world's leading providers of private equity. Ian heads up the UK regional team and focuses on investments in the technology and IT sectors and on leveraged transactions.

Fabre Lambeau, *ED* MPhil01, is a PhD student at the Computer Laboratory

Ulrich Lang, *W* PhD03, is CEO and founder of ObjectSecurity Ltd. He is also co-author of 'Developing Secure Distributed Systems with CORBA".

Aaron Lee, *TH* PhD96, is a manager at Operis Group plc.

Andrei Legostaev, *PEM* BAD01, is working for Goldman Sachs. He is currently based in New York.

Heinz Lemke, *W* PhD71, is Professor of Computer Science, Chairman of Department of Computer Graphics and Computer Assisted Medicine at the Technical University Berlin. He is a member of numerous editorial boards including PACS and Networking News, USA and Academic Radiology. Heinz has many other involvements including founding member and member of the Executive Board of the World Academy of Biomedical Technology (UNESCO) and Member of the Information Technology Committee of the British Institute of Radiology. Heinz is the organizer of the CARS conference (Computer Assisted Radiology and Surgery). This year it will be held in Chicago, USA on June 23-26th.

Jochen Leidner, *PET* MPhil02, is founder and CEO of Linguit GmbH (see Hall of Fame entry).

Clark Lu, *Q* PhD02, is associate technical architect at Convergys EMEA.

Roger Marlow, *CHU* BA91, is a director at ThoughtWorks, a company that provides custom application development and advanced system integration services to Global 1000 companies.

Stuart McLellan, *EM* MPhil01, is a software developer at Interbase Programming Ltd.

Andrew McVitty, *Q* PhD02, is a software design engineer at Convergys EMEA.

Alan Mitchell, *CHU* BA01, is a project manager at Endis Ltd.

James Monaghan, *M* MEng02, is a systems analyst at MX Telecom.

Christopher Morgan, *JE* BA01, is an executive IT analyst with Barclays Capital. He is responsible for application development to support the convertible bond business.

David Mrva, *PET* MPhil02, is a PhD Student at the University of Cambridge Department of Engineering.

Will Muldrew, *T* Dip00, is working as a senior developer for KBC Financial Products.

Nobue Nakamura, *W* Dip97, runs the internet shops for an importer and producer of linen products in Japan.

Rob Newsome, *CC* BA01, is technical team leader at Fluency Voice Technology, a leading provider of packaged speech recognition applications.

Anna Ritchie, *NH* BA02 MPhil04, is a Research Assistant at the University of Cambridge Computer Laboratory.

Fred Roberts, *CL* BA02, is back from extensive travels in Africa and has now settled back into work in Bristol.

Kerry Rodden, *NH* PhD95, is working at Google as a Usability Analyst.

Philip Rushby, *CHU* BA80, is Technology Director at Patientline plc, the leading provider of bedside entertainment and communications systems in the UK and NL.

Alex Shipp, *R* BA83, is a senior anti-virus technologist at MessageLabs. He is the architect and lead programmer for MessageLabs' heuristic virus scanner.

Catherine Siciliano, *DAR* MPhil01, is a Research Fellow at University College London.

Jon Thorner, *TH* Dip92, is a senior technical consultant at Objective Corporation Limited, a software company that specialises in electronic document and records management.

William Tunstall-Pedoe, *CHU* MA91, works at Genius 2000 Ltd, a company he founded in 1998.

Michael Walker, *W* Dip94, is an airline pilot with British Airways. As a member of the Territorial Army Reserve he was posted in Iraq for 6 months.

Andrew Wallace, *EM* BA84, is director of Rosemount Services Ltd which provides consulting in digital TV and audio, TV software and electronics.

Tim Ward, *CHU* BA76, provides software engineering services in the Cambridge area. He is also a member of Cambridge City Council.

Andrew Watson, *SID* BA85, is Vice President and Technical Director of OMG.

Howard Wilkinson, *F* MA79, is a director at Coherent Technology.

Andy Wilson, *CHU* BA02, is a software engineer at Ingenico Fortronic in Scotland.

Chris Wilson, *M* BA01, is Head of Systems Development at MX Telecom.

Anthony Woodhouse, *CHU* MA70, is currently lecturing at the Centre for Computing and Information Systems at Anglia Polytechnic University in Business Systems Analysis.

Peter Woodsford, *JN* Dip68, is a non-executive director at Laser-Sccan Ltd, a company that produces geographic information software. currently lecturing.

Leon Wynne, *TH* BA77, is a Director of Client Services at Spirent Communication.

We would welcome news of any appointments, distinctions gained or honours and awards made to graduates of the Laboratory. Please contact the Cambridge Computer Lab Ring office.

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The Computer Lab Ring Awards

In order to publicly recognise the achievements of Ring members and to further develop a sense of community, we are pleased to announce the Computer Lab Ring Awards! The inaugural awards ceremony will take place at the 2005 Ring Dinner, and form the main focus for the evening's events.

There will be four awards categories:

1. A Student award, presented to the top Tripos student graduating in 2004.
2. The Ring Medal, awarded to the most significant peer-reviewed paper by a Ring member published in the preceding 12 months.
3. Company of the Year, open to all Hall of Fame companies
4. New Product of the Year, open to all Hall of Fame companies

The Ring Medal will be judged by a panel consisting of current and/or past Faculty members; we are now also actively seeking Ring members to act as judges for the Company of the Year and Product of the Year categories.

If you are interested in joining the judging panel and can spare the time for 3-4 meetings and some after hours preparation work over the next 12 months or so, please contact me. It should prove to be a most interesting and enjoyable process.

Richard Jebb (DAR Dip88)
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