The Ring

The journal of the Cambridge Computer Lab Ring

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Aircloak

Co–founder Sebastian Probst Eide explains how Aircloak provides a technological solution for privacy.

TR: Ed Snowden's revelations on secret NSA surveillance have fuelled debate over privacy and increasing the control that individuals have over the data that is collected about them. Your website states that Aircloak Analytics is the first system to combine high accuracy analytics with strong anonymity. Can you explain this? How does Aircloak remove the need for people to put their trust in a data collector?

SPE: The secret to how we can provide high accuracy analytics with strong anonymity comes from the incredibly powerful black box anonymizing analytics engine we have developed. We call these black boxes Cloaks. The approach taken by our Cloaks is somewhat the reverse of how one would normally anonymize data.

> The question of trust is a crucial one...We believe it should not be necessary to put blind trust in any one organisation

Anonymization has not fundamentally changed from the way it was done in the 19th century. You try to determine which attributes in your data might be personally identifiable, and then either coarsen or remove them in such a way as to hide individuals, while still providing enough granularity in the dataset to be able to perform meaningful analyses. This is a cumbersome process, requires skilled labour, yields a static snapshot of a dataset, but worse still, frequently goes wrong. In the past few years we have seen many cases where data that was thought to be anonymous was not anonymous at all. Examples include the NYC Taxi ride database that was released as anonymous, but where poor anonymization resulted in73 million cab rides being in the open (http://arstechnica.com/tech-policy/2014/06/poorly-anonymized-logs-reveal-nyc-cab-drivers-detailed-whereabouts/); and a medical database in Massachusetts, where a researcher was able to locate the governor in the dataset using external information not considered when performing the anonymization (http://arstechnica.com/tech-policy/2009/09/your-secrets-live-online-in-databases-of-ruin/).

Where traditional anonymization is something done before analyses are made, we allow queries and analyses to run on the unanonymized sensitive data inside our Cloaks. As a second step we anonymize the query results. This change turns out to be incredibly powerful; by it we avoid the data loss that traditionally comes with anonymization. More often than not we are poor at considering what questions we need to ask of our data before we get a chance to play around with the data itself. This conflicts with traditional anonymization where we need an understanding of what data is really needed before anonymizing it. When you don't have to give anonymization any thought ahead of time, you become free to play with your data until you find the right questions to ask. And if you later come up with even better questions, then you still have access to all the data needed. Additionally our anonymization can happen in real–time as new data is uploaded to the Cloaks.

> Our Cloaks are zero–access. From the point data is encrypted and sent to them, no one can ever see it in its raw form again.

The question of trust is a crucial one, and one to which we have given a lot of thought. We believe it should not be necessary to put blind trust in any one organisation, and so have opted to remove ourselves from the chain of trust. In many cases our process also makes it unnecessary to trust the data collector. This has been achieved by relying on a cryptographic chip called a Trusted Platform Module (TPM) that is present in all our servers. Traditionally this chip was used in Digital Rights Management, to allow corporations to control how we consume our media. In our system we turn this relationship on its head, and instead of controlling individual clients, give the public the ability to audit and verify that our systems do exactly as we claim.

The TPM chip monitors all software running on the servers. It does so from the earliest boot stages, when the server starts, up through the booting of the operating system and the software and configurations we have provided on top of it. Using a feature called remote attestation, the TPM can give anyone a cryptographic proof of what software is running on the system. This way you never have to trust that the system does what we say it does, instead you can verify it yourself.

Our Cloaks are zero–access. From the point data is encrypted and sent to them, no one can ever see it in its raw form again. This includes both us as the creators of the system, and the system administrators, analysts, or techies in the datacentre. This setup satisfies the German definition of privacy which states that data is considered anonymous if the effort required to get from an anonymous result back to an individual is so prohibitively high that the cost far outweighs the value of the data itself.

The combination of our Cloaks being exceptionally well hardened, the ability to control and ensure that queries only return anonymous results, and the fact that Cloaks are auditable and verifiable by everyone who so desires, removes all need for trust. The sensitive data in the system is protected against everything from data handling mistakes, where sensitive data gets accidentally leaked, through to malicious employees or analysts trying to target or attack an individual.

TR:You've said that Aircloak has 'no direct rivals'.Why do you think others have shied away from finding a technological solution for privacy? What prompted you to confront this challenge?

SPE: There is no shortage of academic and technological solutions to privacy. Unfortunately what tends to be the case is that most academics are on the quest for a holy grail of 100% bulletproof anonymization. In the process they have so far ended up with solutions that are not practical in reality. There are numerous specialized technologies used by businesses today. More often than not these tend to be very specific to narrowly defined legal problems (for example HIPAA in the US), or designed in an ad–hoc fashion for a single use case. We see companies re–inventing the wheel again and again, each time having to go through a long and costly validation and certification process.

From our experience the problems of dealing with sensitive data holds back European businesses, especially compared with their American counterparts that work in a very relaxed legal environment. As a result businesses frequently end up in a situation where they have to choose between the two evils of employing anonymization technology that are cumbersome and restrictive, or ignoring the problem altogether.

The realisation that there was an immediate and impactful solution to this problem — that we knew we had the knowledge and capabilities to solve — led us to founding Aircloak.

Aircloak has its roots in academia. Before Felix [Bauer] and I joined him, our third co–founder, Paul Francis, had spent years researching how to provide value to enterprises while not violating the privacy of individuals. The resulting approach we have taken is more pragmatic than is common in academia. We do not provide absolute mathematical guarantees, but can show that by using our system the cost of getting at individual user data is so prohibitively high that it is no longer cost effective. Our solution was designed to comply with the German definition of anonymity, which is one of the strictest in the world. By making compliance a non–issue, we allow companies to focus on their core business values, rather than be side–tracked and hindered by privacy legislation.

There are a few other start–ups operating in the field of anonymization, but from what we see they are either oriented towards more traditional anonymization or are significantly less advanced. There are other companies focusing on providing end–users with more control over how their data is being used. The Hub of All Things, run amongst others by a good friend and fellow Cambridge alumnus (Andrius Aucinas), is a great example of that approach.

TR: I read that Aircloak is also working with clients involved in geolocation including a business that wants to trace the movements of its employees via wireless tags. Can you tell me about this work?

SPE: Analytics based on location data has turned out to be a very common use case. We have been involved in cases ranging from analyzing movement patterns in public spaces to how vehicles move on larger road networks.

It is common to assume we cannot easily be identified by our location data alone, but this is far from the truth. In a paper published in Nature, titled "Unique in the Crowd: The privacy bounds of human mobility" (http://www.nature.com/articles/srep01376), they show that in a dataset containing course grained location data updated once an hour, recorded for one million persons over a period of a month, they could uniquely identify 95% of people in the dataset given only four spatio–temporal data points!

Whether location data is used to improve the infrastructure in a city, to avert disasters at large–scale events, or to determine where to place a new retail store, it is important that no individual's privacy is violated.

In no cases do we ourselves provide the data that is being used for analyses. What we at Aircloak provide is the technology used to analyse the data a customer already has the ability to collect. When it comes to location data, this might be data from WiFi access points, data collected by a network operator, or other tracking systems used internally in an organisation.

The cloaks have the ability to both perform historical analyses over such data, and to process data in real–time as it is generated. The real–time aspect is particularly useful when you want to perform crowd management.

Since our Cloaks have the ability to internally hold onto the raw unanonymized data, we can also easily enrich location data with other data sources available, be it socio–economic data, healthcare information, or transactional data from payment providers.

TR:You co–founded the company with fellow Cambridge graduate Felix Bauer and Paul Francis, Director at The Max-Planck Institute for Software Systems. Do you see differences in the relationship between universities and businesses in Germany compared with the UK?

SPE: My experience with the relationship between universities and businesses is rather limited. I imagine that it might very well depend on the institution you are coming from, rather than the country. Having the names of the University of Cambridge and the Max-Planck Institute, both well renowned powerhouses, behind us has turned out to be incredibly beneficial and has opened a lot of doors for us.

The German government has a very generous grant system aimed at commercialising research. It has been a crucial factor in our success to date.

TR:What are the next milestones for Aircloak?

We are still a very young company with a current team of only seven. While we have been working on the Aircloak project for over three years, the legal entity Aircloak GmbH has only existed a year. We have almost reached break even, but attaining full financial stability will certainly be a significant milestone for us. We hope to reach this milestone in the not–too–distant future. .

Just the other week we got our system certified by the German auditor TÜViT. The auditor certified both the system security as well as the anonymization we provide. This is a major milestone for us as it makes it significantly easier to sell our technology to larger European enterprises.

The privacy community in Europe is not all that large, and we have thankfully already managed to build a name for ourselves. We have spoken at policy maker events in Brussels and our long term goal is to have a system like the one we are providing as an EU wide recommendation, if not a requirement, for all who deal with sensitive data about individuals. We are at a turning point in history where we have an incredible wealth of data about customers and citizens that far exceeds what was imaginable only a few years back. As a society we have to quickly learn how to deal with this data in a way that does not violate individual privacy, nor can we afford to give up on privacy altogether. We cannot be the only provider of such technology, so I am very happy to see that awareness of the need for privacy is ever growing. I hope this leads to innovation that can benefit us all. Aircloak will certainly be an important piece in this puzzle, but the market is more than big enough for other players as well. I hope we can show that it is possible to operate profitable businesses in Europe without violating our basic rights.

Go to https://www.aircloak.com/ for more information about Aircloak

Graduate Story

Raphael Scheps (K MA14), who co–founded Converge to transform heavy industries, plans to deploy their wireless sensor networks on 10,000 sites within five years.

After having spent four years at Cambridge studying theoretical physics at the Cavendish and DAMTP, little did I know that a year later, I would find myself visiting construction sites, oil fields or chocolate factories, with the aim of making wireless sensor networks ubiquitous in some of the world's most traditional industries.

During my time at Cambridge, I largely spent my days studying abstract topics — quantum field theory, cosmology, or string theory — that attempt to explain how and why the universe functions. Cambridge also offered ample time to reinforce my fascination for technology and its potential for positive impact in the world. Cambridge's entrepreneurial community was full of inspiring success stories — Cambridge Consultants, Acorn/ARM, FORE, CSR or Solexa to name just a few, and societies such as Cambridge University Entrepreneurs. This "Cambridge Cluster" of companies offered an invaluable source of knowledge, experience and advice on how to build successful companies from some of the world's best entrepreneurs and investors.

When I graduated in 2014, I co-founded Converge, where we build low-power, wireless sensor networks and data analytics software for the heavy industries. At Converge, we believe that manual monitoring is a systemic problem across the world's most important industries — construction, energy, mining, manufacturing. Engineers waste valuable time monitoring sensors by hand when automatic collection and analysis has the potential to massively optimise efficiency of critical processes. We decided to increase efficiency in Industry by bringing data driven decision making to the worksite.

What sparked this journey — from theoretical physicist to startup founder — was meeting my very good friend and co-founder, Gideon Farrell, who matriculated with me in 2010. Gideon and I met during fresher's week at King's. When we both graduated, we joined Entrepreneur First (EF) which has become Europe's leading pre–seed investment programme for technical founders. At the time, EF, co–founded by Alice Bentinck and Matt Clifford, had only been running for two years. Without much data to prove what the programme was worth at the time, we took a leap of faith, mainly thanks to Matt and Alice, who convinced us of its potential. Today, I can safely say it was one of the best decisions we could have made.

Spending six months in an environment where teams form and reform and ideas are constantly cycling, and the clock is ticking all the while to prove that you can build a real business is a unique experience. This pushed us to just get on with it; to hustle and ship a product that people actually want.

The cohort, a group of ~50 incredibly smart and driven people, and the 'EF family' have been and still are invaluable — from technical discussions, to sharing their network, hiring, or discussing solutions to common problems.

Converge started out as a tool for connected hardware makers to monitor their devices. Our thesis was that the Internet of Things would grow exponentially, and that makers would need better ways of monitoring the performance and usage of their connected hardware. We quickly realised that hardware monitoring would become a serious problem once IoT had really taken off, but that we would have to wait a few years before the market got there, and Converge would not survive that long.

That's when we metTom [Gilpin], who worked at Laing O'Rourke, one of Europe's largest construction companies. He told us about the challenges engineers faced on construction sites. How monitoring processes were still largely manual, and data were still being collected on clipboards, and transcribed to spreadsheets by hand. Laing O'Rourke was willing to spend money to try and increase efficiency on site, and the more we learnt about the construction industry, the more we realised it had been largely left behind by the startup community. It is one of the only industries where net labour productivity has decreased over time; a shocking fact for an industry that accounts for nearly 10% of the UK's GDP. Beyond construction, we realised that sensor monitoring was also mostly manual in mining, energy, agriculture, manufacturing and that the convergence of low–cost and low–power hardware, wireless technology and cheap computing had made it possible to build solutions that would provide huge amounts of valuable data, and also had a massive return on investment for the end customer.

We presented Converge at EF demo day, in front of 250 of the best investors in the UK, hoping to quickly raise our first round to build a team and get our product deployed in the field. Raising investment for a hardware startup addressing the construction industry was much harder than we had ever expected. Most investors didn't understand our market, and we spent the first 3 months speaking to the wrong people. Eventually, we made it back to Cambridge, where we had the opportunity to present to the Cambridge Angels. There, we met [Ring member] Peter Cowley. Peter believed in us and agreed to lead the round. Peter, who brings what he likes to call 'grey–hair' governance, expertise and contacts to the table helped syndicate a round with some of the smartest investors in the UK, and guide us through the challenges of closing an angel round and more importantly, provides daily advice on how to build a sustainable, scalable business.

Our team, Oliver [Spragg], Andrew [Brannan] and Isaac [Seymour] have been an invaluable part of the Converge story so far — we wouldn't be where we are today without them. We have deployed our wireless sensor networks on several worksites across the UK and are on track to deploy many more in the next few months. The plan has always been to deploy on 30 sites within 18 months, 1000 within 3 years, and 10,000 within 5 years. An ambitious target that we believe we can achieve!

We're still at the beginning of the journey, and there are many challenges ahead, but I can't wait to see where Converge will bring us in the next few years.

I would love to hear your thoughts, advice, or suggestions, so do get in touch at raphael@converge.io (We are also always on the lookout for great developers and engineers so if you want to help disrupt some of the world's largest industries, let me know!).

Who's Who

David Carter (PhD85) recently joined Microsoft Research as a senior research software development engineer.

Chris Charlton (BA94, PhD99) is lead engineer at Skim.it.

Peter Cowley (F MA77) has become a non–executive director of Converge.

Dan Cvrcek (RA04) has been appointed CEO of Enigma Bridge.

Paulo Ferreira de Castro (RA07) has joined Intelligent Optimisations as a senior software engineer.

Chris Galley (CHR MA87) has joined Thames Valley Business Advisors Ltd.

Jagdip Grewal (CTH BA93) has joined Hanover Housing Association as a non–executive board member.

Andrew Harter (F MA83, CC PhD90) FREng FIET FBCS has been awarded an Honorary Doctor of Science degree from Anglia Ruskin University. The award recognises Andy's distinguished contribution to computer science and engineering on the international stage. Amongst other influential technologies, it is VNC for which he is best known. The remote screen sharing technology is on over a billion different devices, and on more different kinds of computer than any other application. It is now in Intel Chips, Google Chrome and Apple products amongst many others. Along the way, he was responsible for projects which were precursors by decades of Smartphones and the Internet of Things. He is a pioneer of free software with a commercial upgrade path, the Freemium business model, and together with RealVNC co–founder Lily Bacon and others invented the idea of kick starting a business with money from the public, now called Crowdfunding. Speaking about his recent award, Andy said: "I am delighted to receive this honour from Anglia Ruskin University. It is especially fitting since ARU is the Entrepreneurial University of the Year which makes the association particularly appropriate and welcome."

Dr Andy Harter (r) receives an Honorary Dctor of Science from Professor Michael Thorne

Laura James (CC MA00, PhD05) has been appointed a technology advisory board member at The Weir Group plc.

Peter Jarvis (M Eng88) is a director at JPMorgan Chase.

Martin Kleppmann (CC MA06) has returned to the University of Cambridge Computer Laboratory as a research associate.

Jennie Lees (MA03, MPhil05) has joined Riot Games in Santa Monica as a software engineer.

Angus Lepper (BA12) is a software consultant at the University of Edinburgh.

Hui Li (G MA02) has co–founded Thunderbirds Ventures.

Joel Moss (F BA13) has joined Moss Software.

Samuel Pattuzzi (R BA13) has joined Sumdog as a software developer.

Lauri Pesonen (W PhD08) has started Moss Oak Software.

Muhammad Shahbaz (RA12) is now at Princeton University.

Diarmuid Ó Séaghdha (PhD08) recently joined Apple as a NLP researcher. He is also a Visiting Industrial Fellow at the University of Cambridge.

Matt Wiseman (T BA97 MPhil02) is now head of product at Butter Home Services in California.

David Young (JN BA90) has joined Datalytyx as head of projects and programmes.

Feng Zhou (G MPhil04) has co–founded Beijing Hooli Tech Inc.

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In memoriam: Nat Billington

Lorenzo Wood (CHR BA93) gave this eulogy for Nat Billington (Q BA92), his dear friend and colleague of 34 years, at his funeral on 14th September 2015 at the Church of the Immaculate Conception, Farm Street, London W1.

Nat was born on 6th December 1970. He and I met at school when we were ten.

In their accounts of his early life his family and friends were amazed at his cleverness. He didn't just have a very good brain. He had a powerful combination of constant curiosity about the world and the confidence to feed it. His mother, Rachel, recalls that, aged eight, he took a bicycle apart — and then put it back together and rode away on it. His uncle Michael remembers a less successful experiment: it seems that cheap Irish novels burn at the same rate as first editions of Jane Austen.

As soon as he was exposed to computers, and in spite of his literary family, he became fascinated by them. Grandmother Elizabeth bought him a BBC computer when he was ten. He put his knowledge to immediate entrepreneurial use: as a teenager, he did a decent trade in setting up computers for friends and family, but not before we had signed up one of our prep school teachers each for computer lessons.

In these days before widespread availability of the Internet, you could connect to other computers by dialling them up over the phone. Rachel recalls the elevated phone bills as Nat tried out the Multi–User Dungeon, a game running in spare time on a minicomputer at Essex University in the small hours. We decided with some friends to make our own, persuading our much smaller computers to do much the same things, because although he found them interesting Nat couldn't be bothered with actually playing the games.

Nat followed his father Kevin to Queens' College Cambridge, in his case to study Computer Science. It was there he showed his intense way of making friends of people who impressed him. You would hear a new name constantly for days or weeks — Roger, Amir, Sandy, Azeem, Mark, George, Tamara, and later Mike and Steve — as Nat told you all the ways in which that person was amazing. The repetition would fade only because Nat had internalised his friendship with that person.

From University we started KBW Consulting, and after five years combined it with another company to form Oyster Partners. Nat honed his skills of identifying promising people: Stuart Dean at Cognifide and Jonny LeRoy at Thoughtworks are just two of many successful technologists who remember the start Nat gave them. "Finding people with no experience that would make a rock star tech team," is how one describes it. Nat also showed himself to be a brilliant negotiator. When we had built ba.com — twenty years old this Christmas — we were in an agitated debate with the introducer, who was claiming a percentage of our on–going billings. Nat calmly asked him how much he reasonably expected to get in total out of such a deal; off–balance, he quoted a figure. "Let's see what deal we can come to that gets you that," said Nat. One of many of his excellent patterns that I have used since.

As the Web became more about marketing, it began to leave Nat wanting for a sense of purpose. He met Mike Stein who had the vision for a system to make the latest medical research available to doctors concisely at the point of need. Nat persuaded the rest of us to extend generous terms to Mike's start–up company; he led the design and build of the product; was seconded as its Chief Technology Officer and, after a new investor acquired it, eventually left our business to become full-time managing director of what had become the Map of Medicine.

During his tenure, Nat matured into an impressive leader. Colleagues from that time marvel at his ability to find solutions quickly and get the most out of his people. They say, "[we] desperately wanted to work with him," and describe him as a "Jedi master." And under his leadership the business achieved some major successes with the NHS, in Australia and with the World Health Organisation in Africa. It changed attitudes and is driving quality and safety in healthcare across the world.

At the age of 28, Nat again revealed laser–like focus. He announced to Rachel that he wanted to marry and have children. Always one to have a plan, he did the obvious thing: sign up for Spanish classes, which he had on good authority was a great way to meet girls. And as with most of his plans, this one worked beautifully: he met and then married Hannah, who I think had a profound effect on him. All of his intellect, curiosity and focus remained, but added to them were even greater empathy and the wish to involve himself with others. Many people who worked for us at KBW and Oyster and went on to do other things counted on him as a mentor, a role which he relished.

The arrival of his sons Phin and Jacob only continued this development. A family friend described the eight-year-old Nat helping her with a television over the phone in a “weary talking-to-imbecilic-adults voice”. The twenty–odd years since then were, for me, the most impressive aspect of Nat’s development as a person. He would talk with anyone, old or young, with equal interest and respect — whether they were elderly relatives of friends, the local people he met on reconnaissance trips to Africa, other people’s children, or, eventually, his own.

When he had successfully sold the Map of Medicine a second time to Hearst, and had spent some time observing corporate America from the inside, Nat felt ready to move on to the third big phase of his life. Moving from health to energy, with his great friend Steve Brooks he set up Synergy Energy. There he finally achieved his ambition of a true portfolio career, managing Synergy’s investments, acting as an adviser and mentor to those businesses, and doing the same in his work with the Longford Trust. He also found time to create a new company, based originally on some research from Oxford University about monitoring batteries. He saw enormous potential here, and repositioned the business as Product Health, whose mission is to give products longer useful lives. An amazing aspiration.

As a mentor and investor, Nat became particularly good at balanced decision-making, building on his innate talent with real analytical rigour. Remarkably, after a lifetime of fast cars and some helicopter lessons, he calculated that he would henceforth drive exactly at the speed limit — because not worrying about the road or the law would give him the mental capacity to spend his journey time more constructively.

When he received his first diagnosis of lymphoma, he tackled it with the same rigour and focus and calm optimism he had demonstrated in the rest of his life. I have not met anyone who knew him when he was ill who wasn’t struck by how upbeat he was; how expert he became in his disease and its treatment; and how he remained thoroughly interested in how everyone else was doing, continuing to be a networker, a mentor and a loving husband and father throughout.

Nat fought his disease and achieved such remission that at the start of this year he was able to travel to the West Coast on business and take his family on holiday to the Maldives. Sadly, the disease returned in a different form and finally took his life on 1st September.

I can think of no better way to end than with some words of Nat’s from that period of respite that very few other people could say:

“Some people in my situation would be rushing around trying to change things, to fix things in the time they have left. I don’t need to do that. I’m living the life I want to live now. My family is secure. I’m getting to spend all time with them I want. I’m only doing work I want to do, and I’m only working with people I like. Right now I wouldn’t change a thing.”

Hall of fame news

ARM

ARM reported that third quarter sales were up 24% to £243.1m and that pre–tax profit increased 27% to £128.4m. ARM's royalty business was the biggest engine of growth, up 46% in the period to £131.7m. Licensing saw sales up by 6% to £93.8m. Fourth quarter results should reveal the boost royalties receive from the launch of Apple's iPhone 6S.

Bango

Bango saw off stiff competition to win Medium Employer of the Year, in the East of England final of the National Apprenticeship Awards 2015.

The awards are run by the National Apprenticeship Service and recognise excellence both in businesses that grow their own talent with apprentices, and apprentices who have made a significant contribution to their workplaces.

Bango will now go through to national judging in the hope of becoming a national winner.

Cambridge Coding Academy

Cambridge Coding Academy recently announced its collaboration with iDEA, the Inspiring Digital Enterprise Award founded by HRH The Duke of York to support young people in developing digital skills.

CCA co–founder Raoul Urma (R) shows HRH The Duke of York the Cambridge Coding platform

In December 2015, Cambridge schools took part in Cambridge Coding Academy iDEA 2015, hosted at the University of Cambridge Computer Laboratory. The event gave over 60 students the opportunity to get started coding using the interactive Cambridge Coding online platform.

Embecosm

Embecosm founder Jeremy Bennett recently compered 'Open for Business', a one–day conference aimed at anyone who is in, or who wishes to start, an open source business.

Recordings of the talks can be found on the Embecosm website (http://www.embecosm.com/2015/11/17/how-to-start-your-own-open-source-business/)

Jagex

Jagex has launched a new game, DarkScape. It is free–to–play and includes areas of the RuneScape game world usually reserved for members in the main Runescape game.

Masabi

Masabi and Arriva Trains Wales (ATW) announced that more than 350k mobile tickets have been sold for travel across Wales. The ATW app, provided by Masabi, enables passengers to purchase, download and display tickets on their smartphones, while Masabi's Inspect app allows ATW staff to quickly and securely validate tickets using standard Android and iOS phones.

Over the pond, Masabi and Transdev have deployed mobile ticketing in New Orleans across bus, ferry and streetcar services. The deployment will let riders use their smartphones to purchase, store and display tickets for immediate and future travel so that passengers in New Orleans will no longer need to wait in queues for tickets at vending machines or ticket offices.

ObjectSecurity

ObjectSecurity has won a NIST SBIR phase 1 contract to commercialise NIST's Access Control Policy Testing (ACPT) technology. ObjectSecurity will commercialise a first version of the technology by the end of Q1 2016.

ObjectSecurity is seeing a rise in requests for policy testing from its OpenPMF customer base, and will make the new feature available soon as a pre–release version to selected existing customers.

Raspberry Pi

Raspberry Pi has unveiled its latest device, the tiny (65mmx30mmx5mm) Raspberry Pi Zero. Priced at just 5$, the Zero is a full–featured computer and has a core that's faster than the original Pi.

Raspberry Pi Zero runs Raspbian and applications including Scratch, Minecraft and Sonic Pi. It is available in the UK from The Pi Hut and Pimoroni, and in the US from Adafruit and in–store at Micro Center.

RealVNC

RealVNC has been showcasing its latest in–car technology.

VNC Telematics™ allows connectivity and real–time interaction between vehicles and cloud–based content and applications. The technology allows automotive OEMs and dealer networks to remotely access a vehicle's dashboard display in order to deliver instant assistance to the driver.

VNC Automotive™ pairs your vehicle with your mobile device enabling your mobile phone to perform a number of different functions within the car. The technology allows multiple videos to be streamed from one handset and viewed on the rear seat entertainment screens, as well as allowing you to connect several mobile devices to the vehicle at once with the freedom to stream content from any one of them. Whilst videos and media applications are running, the driver is able to launch navigation maps without disrupting the passengers' viewing.

Sophos

Sophos has been placed in the 'Leaders' quadrant of Gartner's 2015 'Magic Quadrant for Mobile Data Protection Solutions' for the seventh consecutive year.

SwiftKey

SwiftKey has reached #4 in the UK's first ever intellectual property league. The IP League Table ranks companies based on their track record in terms of managing their IP assets and for 'promoting a culture of innovation and IP creation within the UK'.

Ubisense

Ubisense has been named the Best RFID Solution Award Winner 2015 by CNFRID. The award recognises the company which uses an innovative Radio Frequency Identification (RFID) product to offer a new solution to a user problem.

Ubisense received the Best RFID Solution for the application of its industry–leading real–time location system (RTLS) to the automotive sector, where it uses active RFID on vehicle assembly lines. The RTLS helps eliminate non–value–added tasks, improve productivity and increase product quality.

The Ubisense RTLS solution is already in operation at many of the world's largest car manufacturers.

Job listing

January 2016

DisplayLink

- *Linux kernel development engineer*
- *Senior embedded development engineer*
- *Build and test automation engineer*
- *Associate hardware engineer*

Grapeshot

- *Core software developer*

December 2015

Fospha

- *Software developer*
- *User experience designer*
- *Product analyst*
- *Front end developer*
- *Software digital designer*

Ellexus

- *Experienced C programmer*
- *Graduate C programmer*

If you have a job advert that you would like included in the weekly listiing, please send the details to cam–ring@cl.cam.ac.uk

Research Skills course

Yannick Forster: A Formal Proof of the Kepler Conjecture

In 1611 the famous astronomer and mathematician Johannes Kepler published a conjecture on an optimal packing of apples on the market in his paper "On the six–cornered snowflake". The conjecture, nowadays named after Kepler himself, states that the volume–optimal packing of apples (or any other spherical object) is the one that is usually used. Namely first packing a rectangular layer of apples, then placing the next

layer in the lowest points of the first layer and so on, until the whole construction is roughly a pyramid. In mathematical terms this means that "no packing of congruent balls in Euclidean 3–space has density greater than the face–centered cubic packing".

While the conjecture became famous, it remained unknown if it was true. In1900, David Hilbert even included it in his famous list of twenty–three unsolved problems of mathematics, as a special case of the eighteenth. It took until 1998 that the American mathematicians Thomas Hales and Samuel Ferguson announced a full proof — spread over more than 300 pages on paper and several thousand lines of computer programs, checking the side cases,

Before publication in the Annals of Mathematics [1], the proof was given to twelve reviewers who announced after four years that they were 99 percent sure that the proof was correct. Even before this announcement, Hales decided to eliminate every uncertainty by formalizing his proof in a proof checker [2]. His formalization of the Kepler conjecture and his proof took him until 2014, when he finally published a full machine–checked proof. The proof was given in the logical system HOL light, a proof assistant for classical higher order logic. HOL light was developed by Cambridge alumnus John Harrison under the main idea of providing a proof assistant with relatively simple logical foundations. Its kernel is a few hundred lines long. This means, that reviewing Hales'formalized proof is considerably easier than reviewing the original one. A reviewer now just needs to check that Hales captured the conjecture correctly in the logic of HOL light and that the few hundred lines of HOL light are a correct implementation of the underlying logic.

The final report was published by 21 collaborators and Hales himself [3]. They claim that this might be the largest finished formalization project in terms of lines of code until now. One can see this as a proof that fully machine–checked proofs of huge mathematical theorems are not out of reach, although the formalization may take several years. The challenge for all proof assistants and the big open question of the field is now if this time can be reduced to a level such that all mathematics can be carried out in a formalized way.

References

[1] Thomas C. Hales, A proof of the Kepler conjecture, Annals of Mathematics , 162 (2005),10651185

[2] Flyspeck project, online at https://code.google.eom/p/flyspeck/

[3] Hales et al, A formalproofof the Kepler conjecture,online at http://21rxiv.org/ abs/1501.02155.

The best essays from the Research Skills module of the MPhil in Advanced Computer Science course 2015/2016 are being published in 'The Ring'. This is the first of these essays.

Computer Laboratory news

Annual Report of the Faculty 2014–2015 Selected Highlights

Personnel

As of October 31st 2015, there were 156 members of staff: 41 academic; 29 academic–related; 5 research fellows; and 81 post–doctoral researchers.

Honours, Awards and Competitions

- **Ross Anderson FRS FREng**, Professor of Security Engineering, was named the recipient of the 2015 BCS Lovelace Medal awarded by the British Computer Society. Ross was also named the winner of the 2015 SIGSAC Outstanding Innovation award. The award is given for outstanding and innovative technical contributions to the field of computer and communication security that have had a lasting impact in furthering or understanding the theory or development of secure systems.
- **Mark Batty** received the ACM SIGPLAN John C Reynolds Doctoral Dissertation Award.
- **Luana Bulat** was awarded a Google Anita Borg Scholarship.
- PhD student **Oliver Chick** received the Best Paper Award at APSys15.
- **John Daugman OBE FREng**, Professor of Computer Vision and Pattern Recognition, was elected a Fellow of the Royal Academy of Engineering in recognition of his outstanding contribution to engineering.
- **Anuj Dawar**, Professor of Logic and Algorithms, was awarded a prestigious Hind Rattan Award for outstanding services, achievemens and contributions in his field of research.
- **Matthew P Grosvenor** received the Best Paper Award at NSDI'15.
- MPhil in Advanced Computer Science students **Ran Guan** and **Bob Fang** were members of the team that won the Oxford Instruments Special Award at iCAN UK 2015.

Research

Research grant income in the last financial year was £6.9mio.

Teaching

Growth in undergraduate numbers steadied and the first year intake returned to 2013 levels of 90 students.

The percentage of female students rose from 13% in 2014 to 18% in 2015. The number of students obtaining a First or II.1 rose to 83% in 2015.

The full Annual Report of the Faculty 2014–2015 can be found at www.cl.cam.ac.uk

The Lab bids a fond farewell to Neil Dodgson

Professor Neil Dodgson is leaving the Computer Laboratory to return to New Zealand after 27 years in Cambridge.

Neil came from New Zealand for three years at the start of 1989 to do a PhD. He was supervised by Neil Wiseman, working on image processing. Rather than returning to New Zealand, he moved to a semi-industrial post-doc in the Lab working on the Cambridge Autostereoscopic Display project, which produced a glasses-free 3D display.

In 1995, he was appointed to a lectureship, teaching the computer graphics courses in the Lab. For the past 20 years he and Peter Robinson have jointly run the Graphics and Interaction Group (the "Rainbow Group"), joined briefly by Simon Moore before he set up the Computer Architecture Group, and then by Alan Blackwell in 2000. In 2007, Neil was awarded a Doctor of Science degree and a Pilkington Prize for Teaching. In 2010 he was promoted to professor. He has, at various times, been Head of Teaching and Deputy Head of Department. Over his 20 years, he has published over 100 papers, supervised 19 PhD students and managed 12 post-docs. Many of them have gone on to do interesting work elsewhere, some in academia and some in industry.

Neil is moving to the Victoria University of Wellington in New Zealand, where he will head their computer graphics group. He is joining a team of three other lecturing staff and a research group of 15. The group collaborates closely with Weta Digital, the visual effects company behind the Lord of the Rings and Avatar movies.