



Focus IT security

Safely into the net-worked world

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Dual effort for geothermics Page 40



Open Systems gehört mit seinen Mission Control Security Services im Bereich IT-Sicherheit zu den europaweit anerkannten Anbietern. Wir arbeiten von Zürich und Sydney aus in einem dynamischen Umfeld in über 175 Ländern. Bei uns kannst Du Dein Wissen in einem jungen Team in die Praxis umsetzen und rasch Verantwortung übernehmen. Infos über Einstiegs- und Karrieremöglichkeiten sowie Videos findest Du auf unserer Website. www.open.ch

Dear readers

Accessing information everywhere and at any time: the internet and mobile devices like smartphones and tablet computers have radically changed our daily lives. Every day we answer dozens, if not hundreds, of emails – and often quickly in the evening, too. We work with colleagues on the other side of the globe almost as if they were right next to us in the office. Experts can access critical information around the clock – be it patient data or business or construction plans. Engineers control plants and power stations by computer. Our increasingly interconnected world offers undreamt-of possibilities and makes our lives simpler, faster and more comfortable. With one mouse-click or a simple touch, we can bring the knowledge of the world into our homes. However, this is not without its risks. The number of internet crimes has spiralled and it is becoming increasingly difficult for individuals to retain control over their data. This issue focuses on the dark side of our networked world – and on combating it.

Guaranteeing IT security is a challenge for the economy and society in equal measure – and thus also a challenge for researchers. With concrete issues derived from practical experience at the heart of what they do, scientists from ETH Zurich are working under high pressure with partners from industry at the Zurich Information and Privacy Center (ZISC) to make information systems more secure. The ZISC makes current research results accessible to IT experts via regular workshops.



In its teaching, the Department of Computer Science offers one of the most comprehensive programmes in the world with the Master Track in Information Security. The programme comprises fifteen modules on security for computer systems, networks and applications. The degree is conducted in close collaboration with the ZISC and the lecturers include both leading international researchers from ETH Zurich and experts from industry.

In light of the increasing importance of security issues, ETH Zurich is expanding its competencies in this field. In appointing Adrian Perrig from Cylab at Carnegie Mellon University, Pittsburgh, USA, we have gained one of the world's leading scientists for system security. With his work on redesigning central internet components he will join professors David Basin and Srdjan Capkun at the recently founded Institute of Information Security.

The new technical possibilities have not by-passed Globe, either: now you can access our magazine anywhere and anytime. The Globe iPad app is already available for download in German and English from the iTunes store, with additional picture galleries and films on individual articles. As of next year, there will also be a version for Android devices. And so I wish you happy reading – be it on paper or your tablet.

Ralph Eichler
President of ETH Zurich

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Dances with robots



When over 100 secondary school students from all over Switzerland roam ETH Zurich hungry for knowledge, you know it's study week – a one-off opportunity for pupils to get to know the university and realise their first ETH Zurich project. This year, twenty of them hobnobbed with robots.



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Crime scene cyber-space

The number of crimes on the net has skyrocketed in recent years. And the culprits are becoming increasingly shrewd. Their attacks are not only aimed at private individuals; the state and businesses are also increasingly being targeted.

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Our tracks on the net

Federal Data Protection and Information Commissioner Hanspeter Thür, ETH Zurich professor Bernhard Plattner and Marcel Zumbühl, head of security at Swisscom Schweiz, discuss whether and how we can protect ourselves against data abuse.

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The latest films, hits or audio books: with a few clicks, they can be copied from the internet and used unrestrictedly. However, the interests of the artists get left by the wayside. How can copyright be guaranteed in the cyber world?

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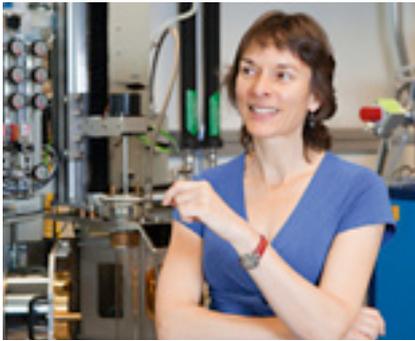
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Sought: materials that don't even exist yet



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Between drones and D flat



Alumnus Christoph Eck is passionate about flying: he scales dizzy heights both in his music with the ETH Big Band and in his career with helicopter drones.

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ETH Zurich's first crèche turns forty. What began as a democratic, grassroots parents' association has blossomed into a professionally run business.

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Imprint

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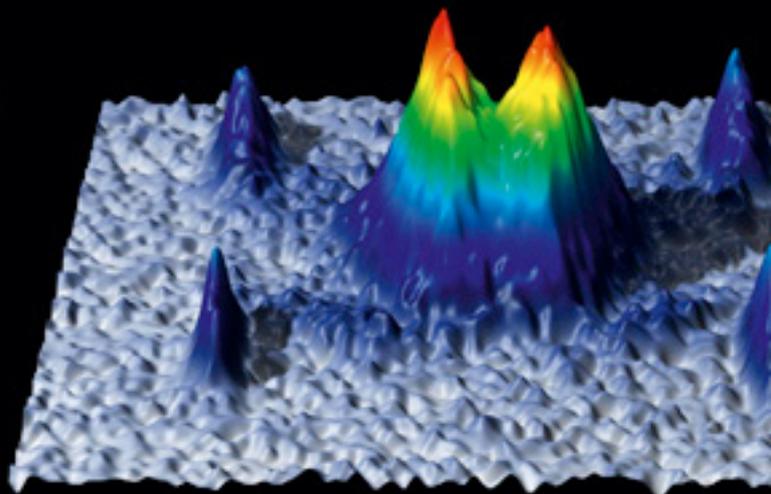
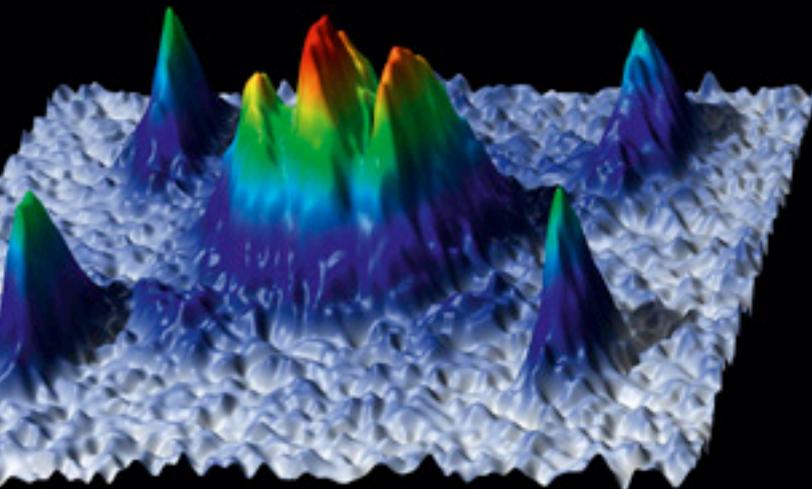
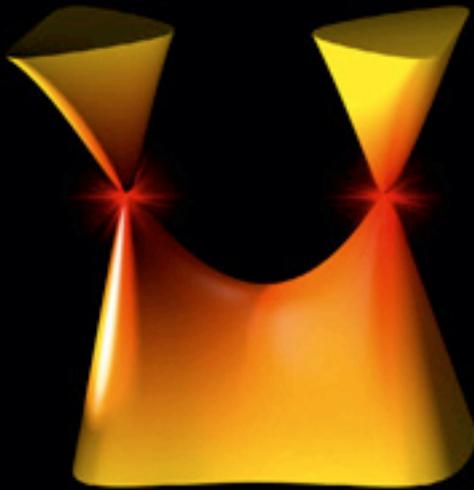
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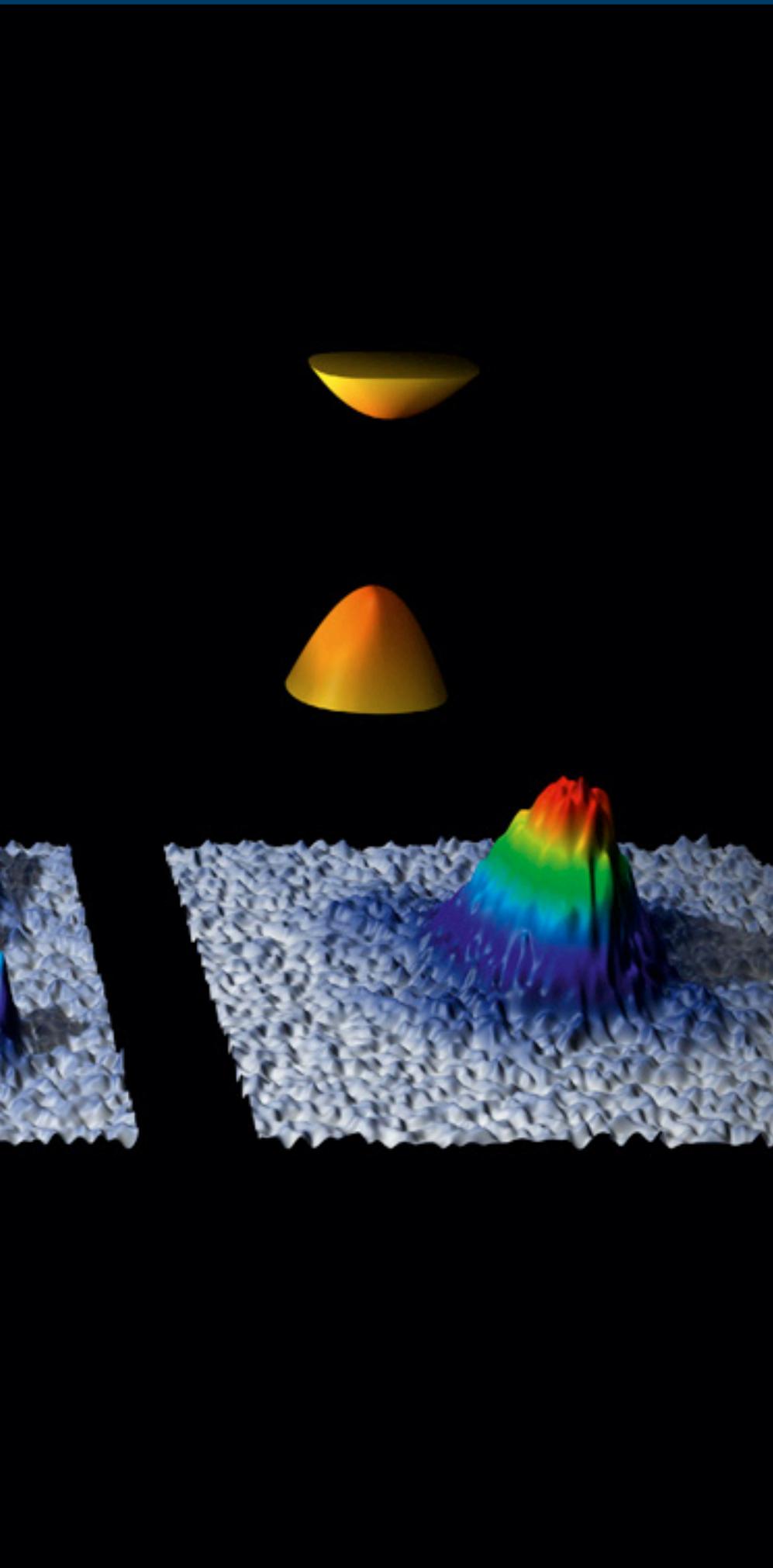
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Flashlight



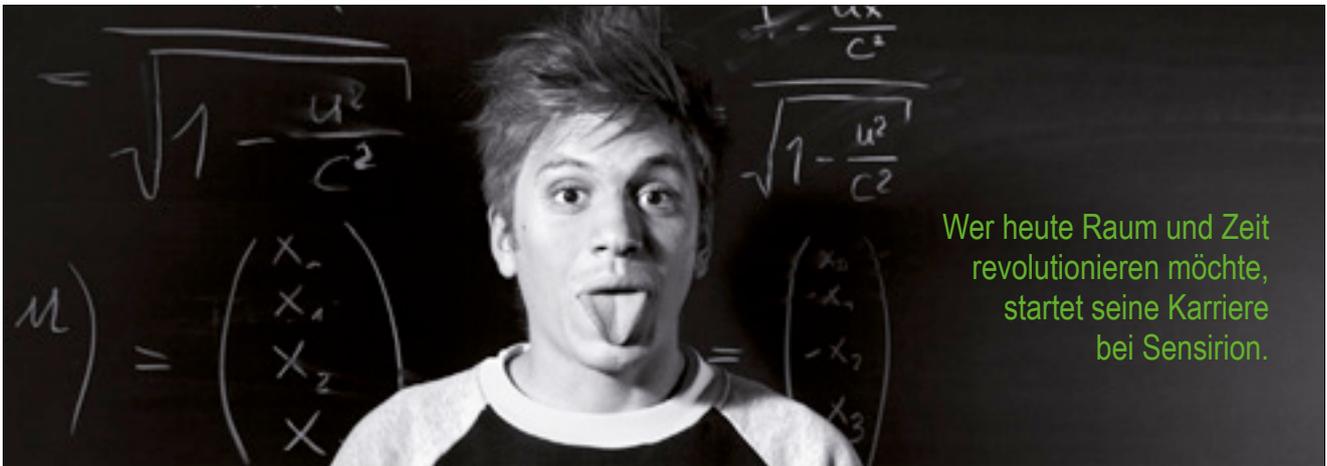


Cold atoms simulate graphene

What looks more like the fantasy world of an abstract surrealist is actually rigorous science: researchers from ETH Zurich are simulating the electronic properties of graphene. Only discovered in 2004, graphene is especially interesting – such as for new computer chips – on account of its good conductivity of electricity and heat.

Tilman Esslinger and his colleagues from the Institute of Quantum Electronics can now demonstrate how these properties materialise. To do so, they produce a honeycomb structure with laser beams that resembles the crystal lattice of graphene. By capturing ultra-cold potassium atoms in this lattice they can simulate the electronic properties of graphene in the model, for the potassium atoms behave in the laser lattice in a similar fashion to electrons in graphene.

The behaviour of the electrons near the so-called Dirac points (charge-neutral points) is also crucial to graphene's special properties. In their experimental design, the researchers were able to move these Dirac points. The series of images shows two Dirac points fusing together as they shift before ultimately disappearing. The bottom series depicts the impulse distribution of the atoms in the laser lattice, while the top series shows the related band structure with the Dirac points.



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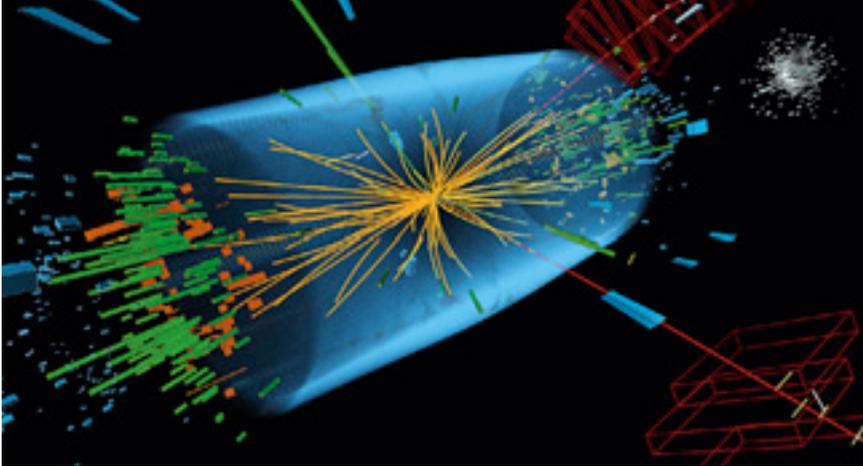


Image of a proton-proton collision recorded with the CMS detector, providing indirect evidence of the existence of a new Boson.

New particle

Perhaps the Higgs boson

In July, a consortium of researchers at Cern discovered a new particle and made scientific history.

In all probability, the particle is a boson; possibly even the Higgs boson, the last missing particle in the standard model of particle physics. It is still not entirely clear whether the new particle with a mass of 125 GeV is actually the elusive Higgs boson.

The researchers are currently working on garnering more data about the particle and describing its properties.

The search for the Higgs boson and other potentially new particles is one of the largest scientific experiments in the world – and researchers from ETH Zurich are also heavily involved. A team of scientists from the Institute of Particle Physics headed by professors Felicitas Pauss, Günther Dissertori, Christoph Grab and Rainer Wallny played a major role in building one of the two particle detectors and analysing the data.

Diarrhoeal disease

Poison targeted instead of bacteria

Researchers from the Institute of Pharmaceutical Sciences have developed a new agent to combat the dangerous intestinal bacteria *Clostridium difficile*.

In contrast to traditional therapies, the treatment does not target the bacterium itself, but rather the poison it

secretes. The major advantage: the new approach does not require any antibiotics. The patent is pending. *Clostridium difficile*, which causes diarrhoea and sometimes serious intestinal inflammation, often appears after antibiotic treatments and mostly in hospitals, but it is also beginning to spread outside. Its robust spores survive conventional disinfectants. In the USA, around half a million people are taken ill with it each year and as many as 20,000 die.

Smoke

All-clear for surgeons

During surgical interventions, such as in the abdomen, smoke containing various toxins can develop. For the first time, researchers headed by physics professor Markus Sigrist have now investigated these substances qualitatively and quantitatively under real conditions in the operating theatre and analysed them chemically with laser methods. The result of the study should reassure both surgeons and patients alike: the measurements of thirty-three samples from six different operations did not show any evidence of excessive concentrations of gaseous pollutants.



Award-winners

Favelas as research objects

Urban planners and architects from ETH Zurich are developing building types and technologies for Brazilian slums that enable sustainable housing development. They are conducting the project in conjunction with the local population and authorities – especially with the 2014 World Cup and the 2016 Olympics in mind. Together with their team, Hubert Klumpner and Alfredo Brillenbourg, professors at the Institute of Urban Development, have received the silver Global Holcim Award for their community centre design.

Ticker



President of ETH Zurich Ralph Eichler and Peter Kamm, CEO and President of the Administrative Board of Philips Schweiz.

Medical engineering

Philips partnership

The longstanding partnership between Philips and ETH Zurich has entered a new phase. The healthcare company is promoting medical engineering at ETH Zurich with a donation of CHF 10 million to the ETH Zurich Foundation. It is intended to boost collaboration in the fields of medical imaging procedures and imaging-based modelling and simulation. The two partners are thus making a key contribution towards better diagnostics and treatment of cardiovascular diseases, psychiatric disorders such as Alzheimer's or schizophrenia, and orthopaedic illnesses. The funding from Philips will be channelled into research projects, promoting talent and establishing new research groups or additional professorships in the field of health research. Moreover, the money can also be used for new research equipment, especially at the Institute of Biomedical Engineering (IBT) of ETH Zurich and the University of Zurich.



The bacterium GFA J-1 was discovered in the mud of Mono Lake in California, which contains extremely high levels of salt and arsenic.

Life in outer space

Extra-terrestrial life remains terrestrial

A team of researchers at ETH Zurich has proven that the "arsenic bacterium" GFAJ-1, hailed as a spectacular new life form by NASA in 2010, cannot do without phosphorus after all. A central dogma of biology thus remains intact – namely that all organic life on Earth is built from six basic building blocks, one of which is phosphorus.

With the aid of high-resolution mass spectrometry and a newly developed, computer-based analysis, the researchers looked specifically for arsenic compounds inside the cells of the bacteria. Sure enough, they found some arsenical sugar molecules. However, contrary to the assumptions of the NASA scientists, the arsenic sugar is not actively formed by the bacterium itself, but spontaneously.

Furthermore, the ETH Zurich team was able to prove that GFAJ-1 does

not grow with the aid of biomolecules that contain arsenic, nor uses them as a cell component. Moreover, the microbes can evidently absorb traces of phosphate from the environment extremely efficiently. This enables them to have enough phosphate at the ready – despite the high arsenic concentrations – to synthesise the most important building blocks for life.

Finally, the scientists examined the NASA data again and found that traces of phosphate were also present in the nutrient medium during the original isolation of the bacteria. Evidently, these were underestimated by the NASA researchers.

Around 130,000

... assessments are conducted by lecturers at ETH Zurich every year to gauge their students' progress. Computers are increasingly being used in written exams, which greatly simplifies the process and marking.

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Die nahe Bank



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Ticker

Astrophysics

Dark galaxies observed

Dark galaxies are small, gas-rich galaxies that hardly contain any stars and are thus basically invisible. They are thought to be the original building blocks of today's bright, shining galaxies. A team involving ETH Zurich has succeeded in observing dark galaxies directly for the first time. Previously, science was unable to prove that these mysterious galaxies actually exist.



Kuparuk oil field in Prudoe Bay, northern Alaska.

Arctic

Beneficiaries of climate change

The rush for the Arctic's natural resources has begun. As the ice melts at an increasingly rapid rate, large oil and gas fields are becoming accessible for the first time. Several countries bordering on the Arctic are concurrently showing an increasing readiness to mine new fossil resources, even under difficult conditions. Rus-

Hönggerberg campus

Underground heat store awarded

ETH Zurich is building a dynamic underground heat store on the Hönggerberg campus with a goal of making it largely CO₂-free by 2025. ETH Zurich received the International Sustainable Campus Network (ISCN) award in the "Excellence in Building" category for this pioneering feat. The ISCN brings together more than thirty universities from all over the world.



The combination of genetic data and protein measurements in patient samples speeds up the detection of cancer biomarkers.

Cancer research

Biomarkers evaluated

Protein biomarkers that can be obtained in blood plasma or urine without major interventions are very useful for the early diagnosis of cancer. Using a new procedure, potential biomarkers can be measured quickly and on a large scale and their clinical usefulness verified. This method is based on mass spectrometry and could shorten the path from the lab to usage in practice.

Protein research and genetic research have found over a thousand potential protein biomarkers in recent years. However, it is still unclear whether many of them are actually clinically relevant, since no efficient verification procedure exists. Researchers from ETH Zurich have developed mass spectrometric coordinates for 1,157 potential biomarkers in their study, storing them in a publicly accessible database. These coordinates can help to detect the biomarkers in patient samples. A case study on ovarian cancer has confirmed the rightness of their approach.

sia stands to profit the most from the new realities in the Arctic, as an analysis conducted by ETH Zurich's Center for Security Studies (CSS) reveals. Seventy percent of Arctic natural gas deposits are thought to be in Russian territory.

The melting of the ice will also open up trade routes that have been difficult to access until now, such as the North East Passage. Whether this is an international waterway or Russian territory is already the subject of geopolitical debate.

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Report



NAO robots with their programmers: Secondary school students proudly show off their project work in ETH Zurich's main hall.

Dances with robots

Alice Werner

Over 100 secondary school students from all over Switzerland visited ETH Zurich at the beginning of June to get an inside view of the university. Full of expectation and ready for action, they spent a week in various departments and realised their first project for ETH Zurich. We joined the participants at the Department of Information Technology and Electrical Engineering as they worked on the NAO robot.

It is shortly after eight o'clock, one morning in June. Bravin holds the robot around the waist then gingerly lets go. "Okay, start." His teammates stop him with a wave of the hand. Just a moment; something is wrong with the programming code. Has the connection between the robot and the computer been interrupted? Marc, who is frowning at the monitor, scrolls down the list of commands. Behind him, five pairs of eyes scour the graphic user interface for errors. The pupils are annoyed that they have been unable to locate the problem straightaway. After all, the programming language used is "far too easy" for them, really. Really. As a precaution, the project leader tilts the window open; a spot of fresh air can't hurt. Outside, the sun is rising above the roofs of Zurich. Undeterred, Marc taps around on the keyboard and grins like a Cheshire cat. The problem seems to have been solved and the first attempt can proceed. Bravin raises his eyebrows.

The robot twitches. So does Nirushan. He is playing the robot's rap partner and cranks the Indian song up to full volume: "Hey Robo, let's dance!" Robo flexes his knees, teeters, bends his torso and almost topples over when he

swings his hips. The timing is off. The robot is still not displaying much sense of rhythm, but the excitement mounts. Six boys dance around their staggering "rapbot" with glee.

Curiosity for the world of science

The six belong to a group of nineteen boys and one girl who for a week are gaining in-depth insights into the Department of Information Technology and Electrical Engineering (D-ITET). The letters of motivation they submitted told of their determination and of their great curiosity about the world of science. Now they want to experience what a university like ETH Zurich can offer them. Since 2003 five departments at ETH Zurich have been taking it in turns to host a study week in the summer, at the end of the school year. This year, the participants tackled issues from the fields of architecture, information technology and electrical engineering, materials science, mathematics and physics. This opportunity to find out about ETH Zurich's activities and about specific degree courses is highly coveted: out of the 150 applications this year, only 112 could be accommodated.

Of the budding students who made it to the D-ITET, the eldest will be 20 this year and the youngest have just turned 16. Aurelio is here; he will be doing his Matura (school leaving exams) in a few weeks' time but did not want to pass up the chance to meet some "mad scientists" and lots of nice people too. Then there is Fabian from the Canton of Bern; he has got a soft spot for electrical engineering and wants to see whether ETH Zurich is the right university for him. Pascal travelled up from Aargau for the study week because he fancies "working on a project with

Report



Full of beans, the school children have taught the NAO robots to talk, dance and do sports. Their enthusiasm for the robots spilled over into the audience at their final presentation.

like-minded young people." And Ramona is here; the only girl. "I don't mind. I'm used to it", she says confidently and shrugs. "I just find information technology exciting, that's all." They all have experience in programming languages, an interest in technology, and a fascination with robots.

Heavier than a giant baby: the NAO robot

The department has had the slogan "Electrical engineering is everywhere" printed on white T-shirts – a uniform look to foster a sense of togetherness. On Monday, the first day of the study week, friendships are already blossoming. Under the expert supervision of Khoa Nguyen, the project leader for the study week at the D-ITET and a doctoral student at the Automatic Control Laboratory, the pupils learn about the multi-functionality of the humanoid NAO robot in the course of the week.

57 centimetres tall, 12 kilos heavy. As the first robot does the rounds, passed from one person to the next like a giant baby, there is a lot of giggling. Then, the questions come in thick and fast: how many cameras has the NAO been fitted with? Can he move his feet sideways? How difficult is it for him to recognise his own position in the room? Enthusiastic, inquisitive faces. The project manager, who is noticeably enjoying the whole experience, is put through his paces: "Now think about what you want to teach the robot." Question and answer session over. The pupils organise themselves into four teams, according to their respective interests. At the end of the week they have to present their results for all to see. Khoa Nguyen has visions of a football match or an actual play, a human-robot interaction in four acts – an unusual number for an unusual drama.

Experimenting and working creatively

Over the next few days, Ramona's team focuses on motor control. With its 21 joints, the NAO can perform complex movement sequences and choreographies. The work group's goal is to program the robot so that he can complete a course faultlessly, avoid obstacles and pass balls accurately. It is going well, even if they do have to "tinker about" for a while: their robot keeps losing its balance. Then, there is the small matter of voice recognition. The robot does not always respond to commands. And sometimes its inappropriate answers are met with hoots of laughter.

This autonomous, creative style of working goes down a treat with all four teams and the pupils have revelled in the level of trust placed in them. Some, however, would love to go into the material in even more depth: "Schematic programming with predefined blocks is not all that difficult", says Ramona, speaking on behalf of her peers. "The source codes would be interesting – the algorithms behind the blocks." Khoa Nguyen can see what the pupils mean. "Of course they want to find out exactly how a robot is programmed on all levels. Anyone who is interested in electronic engineering and information science doesn't just want to be a user later on, but also wants to develop the programming further. But in such a short space of time it is just not possible to deal with more complex systems and still see a project through to the end."

Besides, the study programme includes more: visits to various research groups in the department are also on the agenda. For many, the High-Voltage Laboratory and the Wearable Computing Lab were personal highlights. And Felix was extremely excited when he spoke about the



“model aircraft control” project. For Ramona, her two lunch appointments with female students in electrical engineering were highly illuminating: “The conversations opened my eyes. Now I can see what the degree is really all about.”

Rap battle with robots

Friday lunchtime: it's time for the final presentation of the five project groups in this year's study weeks. The audience spreads out on the narrow rows of seats – pupils, parents, teachers, friends and lecturers. It is loud; the excited pupils need a last-minute discussion on the main points. The microphone screeches. Rector Heidi Wunderli-Allenspach lauds the courage the school students have shown in the face of new challenges.

First up are the architects. They have realised realistic structures in small groups. Applause. Then it is the robot team's turn. The play proves to be an entertaining video collage. The 20 youths have filmed each other interacting with an NAO robot during more or less philosophical dialogues, an imaginary walk in the park or an Indian rap battle. Finally, they treat the audience to a demonstration of the live-action robot to rapturous applause and cheers.

An important orientation aid in the subject jungle

A few days later, when asked to sum up this year's study weeks, Gaby Kläy, the project leader in the Orientation and Coaching for Students unit, did not have to think for long: “In a word: enthusiasm. Some completely flabbergasted parents told me after the final presentation that they had never seen their child so enthusiastic.”

Sometimes, however, the study week has the opposite effect, such as when unrealistic bubbles are burst after get-

ting in-depth insights into a subject. Some might be disappointed. Or disillusioned. This year, too, some future school-leavers spoke to Kläy about misconceptions concerning the degree they had been considering. “Most were glad to have found out in time”, she says. “At least they now know they will be happier in another subject.”

And Ramona, Bravin, Felix and Co.? None of them “will forget this week together soon”; a week they describe as “very useful” and “helpful for the future”, not least because they are now “better oriented” in the jungle of subjects. Finally, Pascal says: “This week showed me that you are not alone as a technology enthusiast, but that there are many other school students out there who are interested in this kind of thing.” ■

ETH Zurich's study weeks are organised by the Orientation and Coaching for Students unit (SoC), a department of the Rector. The SoC supports future students in their choice of degree, prepares them for the reality of the course they have selected and eases them into the initial degree phase with a coaching service. Besides the study weeks, the SoC also offers secondary school children additional opportunities to get to know ETH Zurich as a place of study and research: it organises degree information days and visits various cantonal schools all over Switzerland with an exhibition as part of the project “ETH on the road”. It also has a broad range of individual consultation services for Bachelor's students and people interested in doing a degree.

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Safely into the networked world

Our everyday lives are increasingly shifting onto the internet. In this cyber world we meet people, conduct business and even transport extremely sensitive data from one side of the globe to the other. Criminals are also increasingly exploiting this boundless freedom. In order to stay one step ahead of them, security experts toil away at ingenious encryption methods and improved operating systems. However, each and every one of us can forearm ourselves against cyber hazards.

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Focus IT security



Crime scene cyberspace

Boundless freedom of communication does not only open up undreamt-of possibilities for honest internet users: for criminals, too, the cyber world is a goldmine. The number of crimes on the net has skyrocketed in recent years. And the culprits are becoming increasingly shrewd. Their attacks are not only aimed at private individuals; the state and businesses are also increasingly being targeted.

It can happen now, at any moment. Perhaps you have found a USB stick bearing your company's logo in the underground car park and take a quick look at what is on it, to see who might have mislaid it. Or a call comes in that you recognise as internal. A voice claiming to be a colleague of someone you know from the IT department tells you that there is a problem with your computer. He just needs to know your username and password so he can sort it out. And moments later there it is: a malicious program, otherwise known as malware.

They often come concealed as a "Trojan horse", where a seemingly useful program smuggles in its undesirable counterpart. In the most harmless cases, it's spyware – software that enables companies to snoop on a user's internet behaviour so that they can target their advertising messages. Or worse, a program referred to as a "backdoor", which affords criminals access to other people's computers undetected. This allows them to steal passwords or sensitive company data such as business or construction plans – or, in a worst-case scenario, manipulate or sabotage entire systems.

Like the real world, the cyber world also has its dark side. It's been a long time since the internet was a place where users could surf, shop, exchange information and do business with peace of mind. It is increasingly turning into a crime scene. Every day we receive fresh reports of viruses, worms, Trojans and Co. The fear of attacks with grave consequences is mounting, and with it the cry for more security – both in the private and public spheres. Guaranteeing this is a challenge for both the state and for business. However, scientists like Srdjan Capkun are working under pressure to make the data network safer.

Easier for criminals

"The opportunities for attackers to zero in on someone else's systems have increased enormously", says Capkun, a professor from ETH Zurich's Institute of Information Security and director of the Zurich Information Security and Privacy Center (ZISC), which is also located at ETH Zurich. The reason for this is the increasing networking of computer systems. They have become more and more complex as a result, and thus more difficult to monitor. Consequently, criminals can often operate unnoticed for quite some time – if they are ever discovered at all.

Regardless of whether we are talking about maintaining power stations, managing sensitive data or controlling rail or air traffic: "All systems have got security flaws and a lot more could happen", warns Capkun. Besides, people are hacking less and less for the fun of it. "Meanwhile, there is a whole industry behind it."

On the other hand, says the expert, hacker equipment is easy to get hold of these days. Whether it is a WLAN base station or programs which virtually anyone can use to generate viruses in a few mouse clicks: it has never been easier to harm others. Furthermore, criminals are constantly looking for new niches and are becoming faster and shrewder. "By the time you're onto them, they have already discovered a new weak point and developed new malware." Zero-day exploits, where criminals have already taken advantage of a security loophole before developers or users even discover them, are constantly on the rise. The manufacturers of protective software and malicious software are racing at full speed, neck and neck.

Not even pacemakers are safe

Incredibly, even pacemakers and air-pressure sensors can be hacked and manipulated, reports Capkun, who becomes a wily IT criminal himself almost every single day – for research purposes, of course. Together with his colleagues he wants to find out which computer systems are especially vulnerable to attack and where, and then how they can be protected. In their interdisciplinary collaboration at the ZISC, the ETH Zurich security experts also examine the needs of different industries. The specialist centre for IT security is currently funded by Credit Suisse, Google, the federal authority ArmaSuisse and security technology provider Kaba.

Capkun is fairly unflappable when it comes to cybercrime. "However, Stuxnet took even me by surprise." The Stuxnet virus, discovered in 2010, reignited the debate on cyber security. Even though experts already started talking about IT security back in the 1980s, Stuxnet was like a wake-up call.

The virus had been painstakingly developed by the USA for importation into the Iranian nuclear plant Natanz via USB sticks. During its last attack, the computer worm is supposed to have rendered about 1,000 of the then 5,000 centrifuges for uranium enrichment temporarily inoperative – while reporting to the control personnel that everything was functioning properly. However, this dangerous virus was also discovered in the systems of gas, electricity and water companies in other countries. Above all, Capkun is impressed with the "enormous amount of expertise necessary to develop such a virus with thousands of functions." Although he is convinced that such an elaborate and targeted attack on companies and sensitive infrastructures will not remain an isolated incident, there is no need for paranoia in this respect.

Stuxnet was sabotage

Myriam Dunn Cavelty from ETH Zurich's Center for Security Studies also warns against excessive scaremongering.

And she hesitates to use the word "cyberwar", which has been bandied about more and more frequently since Stuxnet, for it she claims it is too vague. While this was admittedly the first major incidence of a country being behind a cyber attack, for the ETH Zurich scientist the Stuxnet attacks were acts of sabotage, not war: "The demand for armament and defence in this respect is a Cold-War philosophy and a step in the wrong direction."

Nonetheless, the worry that the conventional balance of power in the world could shift via the cyber dimension in the not-too-distant future is not entirely unjustified – something which a superpower like the USA is especially afraid of. But at least in terms of critical infrastructures, says the researcher, the state is unable to do very much anyway: around ninety-five percent of these facilities, including the power supply, are in private hands.

Dunn Cavelti primarily advises the Swiss Military Department on cyber security on behalf of the Federal Office for Civil Protection. She searches for trends, compares the cyber strategies of different countries and gives talks on the topic – including at reinsurer Swiss Re recently. "The insurance industry has been extremely interested in cyber risks for some time now. On the one hand it sees a possible market here, but on the other it is afraid of being attacked itself."

However, in order to be able to calculate premiums, insurers need reliable figures. How great is the danger of a company falling victim to a cyber attack? How many attacks have there been on similar industries in the past? And what does it cost to repair the damage? This data is lacking, complains the expert from ETH Zurich. "The few figures that exist hail almost exclusively from the antivirus industry." In other words, from an industry that profits from a high cybercrime rate.

However, many companies are not just scared of losing money; they also fear for their reputations. If sensitive data falls into the hands of third parties, not only is it embarrassing; the customers also lose trust. This, coupled with the worry that the state could regulate the protection of the security system in future, is responsible for many attacks going unreported. And a large proportion is never even discovered in the first place. Naturally, companies have the latest protective measures, such as firewalls or antivirus software. "However, most of them are unarmed against sophisticated industrial espionage or sabotage attacks", says Dunn Cavelti. These complex APT (Advanced Persistent Threat) attacks currently make up an estimated three per cent of all attacks. And their number is rising.

"A country's entire economy could be crippled by such attacks", says Capkun. Apparently, many companies are not

even aware of this and either neglect to protect their IT systems or play down the threat. However, Capkun says that it is precisely the increasing complexity of the systems that means caution should be exercised: "You only need think of smart grids: intelligent electricity systems that won't only be able to transport power, but also data and information in future." If they were to be manipulated, overloads could be faked and power cuts provoked.

But how can such massive encroachments into networks be prevented? First of all, the ETH Zurich specialists agree, the threat needs to be recognised and taken seriously. The "National strategy to protect Switzerland from cyber risks" ("Nationale Strategie zum Schutz der Schweiz vor Cyberisiken"), recently passed by the Swiss Federal Council, was a step in the right direction. Furthermore, says Dunn Cavelti, there need to be incentives – perhaps tax-wise – for companies to invest more in security. Internationally uniform standards and legal foundations could stem the threat further. And last but not least, scientists are called for.

Coping, not resisting

For Dunn Cavelti, an efficient collaboration between politicians, entrepreneurs and researchers is essential to combat the threat from the cyber world. Moreover, she observes a trend from the USA that is increasingly taking hold in Europe: the notion of resilience, the ability to cope. Here, the assumption is that certain attacks or failures cannot be prevented and thus it makes more sense to focus on coping with them rather than fending them off.

"If we want to find out how resilient a society is towards cyber attacks, first we need reliable data", says Dunn Cavelti. How fault-tolerant are the networks of sensitive infrastructures? How well prepared is the population for an act of cyber sabotage, such as a power failure? Do citizens know how to get water in an emergency? Creating a corresponding resilience index is one of the main challenges for research.

Ultimately, say the ETH Zurich experts, it is its uncontrollable aspect that makes the cyber world so threatening. The malevolence is diffuse and acts covertly. There is no longer a visible adversary. And there is not much time to think and act – of that, Srdjan Capkun is certain: "In the cyber world, everything happens in a flash." Consequently, he wants to delve as deeply into the thick of the action as possible with his team: "The more intensively we work with those affected, the more we know about their problems and the more efficiently and quickly we can develop suitable solutions." ■

www.zisc.ethz.ch →

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Gaps in the standard

Felix Würsten

How do I know that the person I am communicating with on the internet is actually who he claims to be? And how do I know if the data he is conveying is actually what he wanted to send me? Such questions are inevitable when confidential information is to be transferred through the internet. And thus it goes without saying that sensitive transactions require a secure and reliable authentication of the partners involved.

Consequently, a whole series of protocols has been devised in recent years based on different approaches. Every bank, for instance, uses its own protocol. Nevertheless, many of these protocols have a common basis: they orient themselves by the ISO/IEC-9798 standard, which lays down the fundamental principles as to how such protocols should be composed.

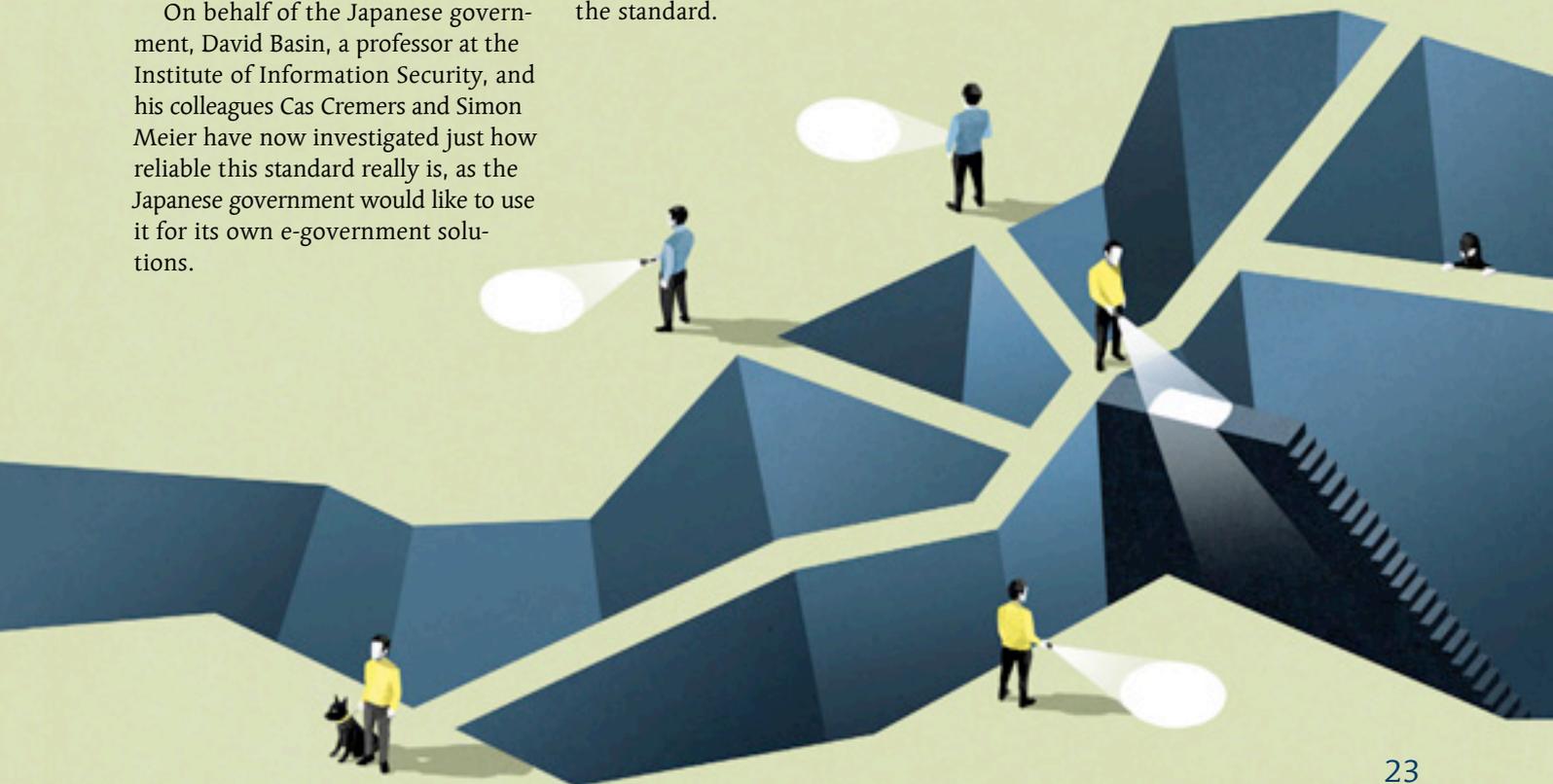
On behalf of the Japanese government, David Basin, a professor at the Institute of Information Security, and his colleagues Cas Cremers and Simon Meier have now investigated just how reliable this standard really is, as the Japanese government would like to use it for its own e-government solutions.

If you want to check whether a protocol is secure, first you need to define what features it should have. Is it only supposed to prevent outsiders from receiving information through observation? Or should it offer protection from active attacks? The scientists from ETH Zurich discovered that many protocols described in the ISO standard do not actually have the features they are supposed to.

"Really, we thought the ISO standard would be a solid basis. It has already been used for a long time and refined constantly", reports Cremers. Admittedly, they only discovered subtle weaknesses. "But these can still be exploited by attackers." With his team, he has now put together a series of recommendations as to how the ISO standard can be improved. These have already been adopted by the ISO Committee in a new version of the standard.

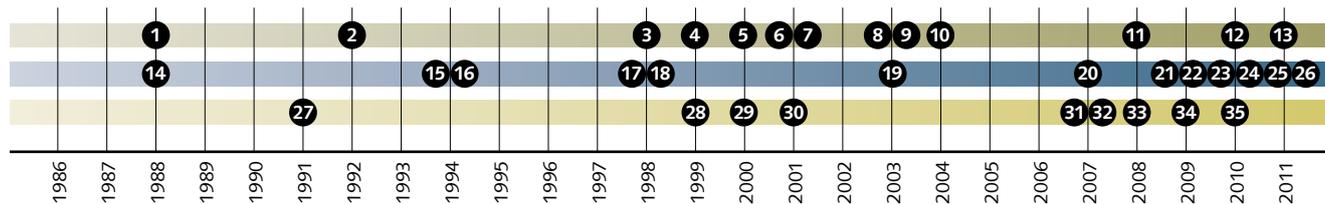
The researchers conducted their study with the aid of tools that Basin's group had developed in recent years. "These tools provide mathematical proof that a particular protocol has got the features it should have", explains Basin. "Not only did we find the aforementioned weaknesses in the ISO standard; we were also able to demonstrate that our recommendations can actually remedy these shortcomings." ■

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Focus IT security

Timeline: Major known cyber incidents



Malware

- 1 Morris Worm:** Slowed down machines in the Cyber ARPANET until they became unusable. Huge impact on the general awareness of insecurity.
- 2 Michelangelo:** Overwrote the first hundred sectors of the hard disk with nulls. Caused first digital mass hysteria.
- 3 Back Orifice:** Tool for remote system administration (Trojan horse).
- 4 Melissa:** Shut down Internet mail, clogged systems with infected e-mails.
- 5 I Love You:** Overwrote files with copy of itself, sent itself to the first fifty people in the Windows Address Book.
- 6 Code Red:** Defaced websites, used machines for DDoS-attacks.
- 7 Nimda:** Allowed external control over infected computers.
- 8 Blaster:** DDoS-attacks against "windows-update.com". System crash as a side effect. Was suspected to have caused black-out in US (could not be confirmed).
- 9 Slammer:** DDoS-attacks, slowed down Internet traffic worldwide.
- 10 Sasser:** Internet traffic slow down, system crash.
- 11 Conficker:** Forms botnets.
- 12 Stuxnet:** Spies on and subverts industrial systems (see also incident 35).
- 13 Duqu:** Looks for information useful in attacking industrial control systems. Code almost identical to Stuxnet (copy-cat software).

Cyber crime/espionage

- 14 Hannover Hackers (Cuckoo's Egg):** Break-ins into high-profile computer systems in the US.
- 15 Rome Lab incident:** Break-ins into high-profile computer systems in the US.
- 16 Citibank incident:** US\$ 10 m siphoned from Citibank and transferred the money to bank accounts around the world.
- 17 Solar Sunrise:** Series of attacks on DoD computer networks.
- 18 Moonlight Maze:** Pattern of probing of high-profile computer systems.
- 19 Titan Rain:** Access to high-profile computer systems in the US.
- 20 Zeus Botnet:** Trojan horse "Zeus", controlled millions of machines in 196 countries.
- 21 GhostNet:** Cyber-spying operation, infiltration of high-value political, economic, and media locations in 103 countries.
- 22 Operation Aurora:** Attacks against Google and other companies to gain access to and potentially modify source code repositories at these high-tech, security, and defence contractor companies.
- 23 Wikileaks Cablegate:** 251,287 leaked confidential diplomatic cables from 274 US embassies around the world, dated from 28 December 1966 to 28 February 2010.
- 24 Operations Payback and Avenge Assange:** Coordinated, decentralised attacks on opponents of Internet piracy and companies with perceived anti-WikiLeaks behaviour.
- 25 Sony and other attacks:** Highly publicised hacktivist operations.
- 26 Theft of Co₂-Emission Papers:** Theft of 475,000 carbon dioxide emissions allowances worth € 6.9 m, or US\$ 9.3 m.

Main incidents dubbed as "cyber war"

- 27 Dutch hacker incident:** Intrusions into Pentagon computers during Gulf War. Access to unclassified, sensitive information.
- 28 Operation «Allied Force»:** "The first Internet War". Sustained use of the full-spectrum of information warfare components in combat. Numerous hacktivism incidents.
- 29 «Cyber-Intifada»:** Email flooding and Denial-of-Service (DoS) attacks against government and partisan websites during the second Intifada.
- 30 «Cyber World-War I»:** Defacement of Chinese and US websites and waves of DDoS-attacks after US reconnaissance and surveillance plane was forced to land on Chinese territory.
- 31 Irak:** Cyber-attack on cell phones, computers, and other communication devices that terrorists were using to plan and carry out roadside bombs.
- 32 Estonia DDoS-attacks:** DDoS-attacks against web sites of the Estonian parliament, banks, ministries, newspapers, and broadcasters.
- 33 Georgia DDoS-attacks:** DDoS-attacks against numerous Georgian websites.
- 34 GhostNet infiltrations:** GhostNet related infiltrations of computers belonging to Tibetan exile groups.
- 35 Stuxnet:** Computer worm that might have been deliberately released to slow down Iranian nuclear program.

Beste Aussichten für meine Zukunft.

Michael Bättscher, Bauingenieur, Axpo Mitarbeiter

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Our tracks on the net

Surfing on the internet, posting pictures on Facebook or downloading the latest app – we leave our digital fingerprints everywhere. Federal Data Protection and Information Commissioner Hanspeter Thür, ETH Zurich professor Bernhard Plattner and Marcel Zumbühl, the head of security at Swisscom Switzerland, discuss whether and how we can protect ourselves against data abuse.

Interview: Martina Märki and Roland Baumann

Surfing on the net can be dangerous. You can easily receive uninvited guests in the form of viruses or unwanted programme add-ons. As a surfer, how do I know whether I am moving in a safe environment?

Marcel Zumbühl: With certain browsers, the address bar is marked in green or red. This tells me whether the system classifies the page as secure or not. However, this mostly only applies to part of the content. If I have installed a firewall on my PC that registers which connections are being established, I can see fairly quickly whether a page contains adware, for instance. This enables data to be collected that is then used for advertising purposes. Nowadays, many websites have these or similar add-ons.

Bernhard Plattner: Certificates enable corresponding security checks. In theory, this works very well. In practice, however, it is evident that dealing with certificates is tricky for users. Plus there have been cases of forged certificates.

That sounds very complicated for laymen. Do we all need a course to use the internet?

Plattner: Actually, we do need to become more aware of the fact that surfing is something that has to be learned. A certain amount of training is necessary if we want to make the most of the opportunities that the internet and communication technologies can offer us today.

Hanspeter Thür: The FDPIC is trying to pave the way with training schemes. We are focusing on school children of all age groups, as the majority of parents are out of their depth and the teachers are also glad of some support. We provide them with course modules for media lessons, which include programmes that are even geared towards five-year-olds.

Zumbühl: Swisscom is also active in this respect, often in conjunction with the public sector – with campaigns like “Schulen ans Internet” (“Schools into the internet”) or special courses for seniors, for instance.

Can providers also help by giving their internet subscribers or mobile phone customers tips on using them more securely?

Zumbühl: We actually try to point out security aspects to people who buy new devices, such as the fact that they should protect Android devices with antivirus software. We are currently discussing whether we should install such programmes in advance. We already configure the

Interviewees:

Bernhard Plattner, a professor at ETH Zurich's Computer Engineering and Networks Laboratory (TIK)

Hanspeter Thür, Federal Data Protection and Information Commissioner (FDPIC)

Marcel Zumbühl, head of security at Swisscom (Switzerland) Ltd



Marcel Zumbühl, head of security at Swisscom, ETH Zurich professor Bernhard Plattner and Federal Data Protection and Information Commissioner Hanspeter Thür see a danger in combining large data sets.

security settings as we deem optimal when supplying the devices. However, the customer can change these settings afterwards, of course.

Thür: That's one of our theories. We say the manufacturer should supply his products in such a way that all the security and data protection settings are optimal. If the customer doesn't want that, he should have to take action, which mostly requires a certain amount of knowledge, too. The average customer, however, should be able to bank on the fact that he has got maximum protection without requiring any special assistance.

Purely from a technical perspective, how much protection can actually be guaranteed?

Plattner: You can't guarantee one-hundred-percent protection, regardless of what platform we're talking about – no matter whether it's a PC, tablet or smartphone. And don't forget that such a device never stays in the condition in which it was supplied. As soon as the user installs the first new app, it can already become unsafe.

Zumbühl: Especially if the app hasn't been checked. App-store providers have different standards in this respect. Some vet apps extremely meticulously, others less so. You also have to bear in mind the fact that things develop very quickly in purely technical terms. Every day, there are about two gigabytes of malicious codes that hit the market. It takes hours, if not days, to analyse all this and incorporate it into the antivirus software. So even a decent antivirus program is only about sixty percent effective.

How close is research to tracking down the "pests"?

Plattner: It's up to industry to trace the pests promptly, not researchers. However, we know that careless programming is often responsible for software weaknesses that attackers exploit. That's where we come in to provide sound methodological foundations. For instance, we can say how a website should be designed to display as few weaknesses as possible. Incidentally, nowadays the threat no longer comes from individual hackers, but from extremely well-organised cybercriminals who effectively form their own industry.

Constructed security

Felix Würsten

Nowadays, it is impossible to imagine many IT applications without cryptography anymore, especially where those involved need to be identified reliably and data transferred safely and unaltered. This is where the use of extensive protocols comes in that guarantee the security of transactions. However, these protocols have one major drawback: they are sometimes so complex that they can no longer be controlled correctly and repeatedly facilitate fresh attacks, as Ueli Maurer, a professor of theoretical computer science, explains.

According to Maurer, the efforts to render these protocols more secure through continual improvements are falling short.

As far as he is concerned, they do not solve the basic problem, namely that the manner in which such protocols are designed is simply outdated. He is convinced that "we need a paradigm shift in building cryptographic systems."

"Cryptography should become a constructive discipline like many other engineering disciplines, such as automobile manufacturing." A constructive discipline based on the principle that a complex entity can be built from simpler parts that all have particular specifications. These days, it is not only cars that are built according to this principle, but also normal software: one divides the project into clearly defined modules and then pieces them together.

However, there is a compelling reason why this approach has not yet been used in cryptography. There is a hypothetical entity that is difficult to grasp and is only posited for the security analysis: the attacker. As the attacker does not really exist, it is fundamentally impossible to test whether the individual components have the desired characteristics. "In cryptography, you have to prove that the specifications have been adhered to", explains Maurer. "This leads to a whole new mathematical complexity."

If cryptography is to become a constructive discipline as Maurer suggests, then this does not just need a change of thinking in the community, but also a lot of theoretical groundwork. What is cryptography? What exactly does "construct" mean? Which parts make up a cryptographic system? And how can they be assembled successfully? These are the kind of questions Maurer is tackling in his work. At the moment, he is not merely interested in concrete applications, but also in a fundamental way of thinking: how do we build a system that is really secure? Maurer is convinced that his groundwork is important for practical applications: "Cryptography is a gratifying field for us theorists. After all, without theoretical foundations, you can't even begin to build a secure system." ■

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Listening to you reminds me of the race between the tortoise and the hare...

Zumbühl: Actually, it's a bit like cops and robbers. As a provider, we want to offer as secure a service as possible. We constantly look for the best solutions on the market for us to improve our networks, such as effective antivirus software or spam filters. If a customer has received a phishing email, we evaluate exactly what the attack looks like, whether and how we can block it, and whether other customers have been affected. So we're trying to break the chain between the attack and its consequences. And we consider how to get in touch with our customers and how to keep them informed as best as we can.

"If I don't pay with money on the internet, I pay with data."

Hanspeter Thür

Plattner: It's a balancing act. If, as a user, I notice that my provider has seen me fall into a trap, I might be glad at first. However, the next moment I'll start wondering whether I am being watched the whole time. What else does the provider know about me?

That brings us to the issue of data protection.

Thür: It really depends on the purpose of gathering data. If I do business with a company, the firm I am entering into the contract with may collect my data to serve me as a customer. They might even be allowed to send me advertisements for their own products. As a customer, however, I certainly don't want the company to sell or pass on the information I have entrusted to them in the course of our business. So as a customer you should be critical in your choice of provider. For example, I wouldn't necessarily choose a provider that is affiliated to a company that procures data on a grand scale. You should always have a look at the business model. If a provider offered me a lot of memory for free, I'd ask myself what it did with the information about me to which it has access.

Plattner: As a user, I also have the option of paying for a service. In return, the service provider gives me a guarantee that my data won't be passed on to others.

Thür: Yes, it's simple in principle: nothing's for free – not even on the net. In other words, if I don't pay with money, I pay with data. And every address becomes more valuable with additional attributes. If I enter a competition, if I indi-

cate my "likes", if I read certain articles on the net – I am always disclosing information about myself, my behaviour and my interests, which can be collected and used for marketing purposes.

So does that mean we're effectively powerless as users, left at the mercy of the data collectors?

Plattner: It has truly become difficult to retain control over your own data these days. First of all, you should always think long and hard about what personal information you make public. Moreover, you should effectively behave as chaotically and freakishly as possible – in other words, not act predictably – if you really want to make it hard for data collectors to do their handiwork.

Thür: Practically speaking, you can use different search engines and browsers, for instance, or keep changing them every so often. You should change passwords from time to time anyway. And exercise caution in choosing the service provider, too.

Cybercriminals conceal their identity on the net. Couldn't I use similar techniques as a surfer to remain anonymous, too?

Plattner: Yes, there are so-called Tor networks, which encrypt our actions as users in one or several steps so that they appear as the actions of an anonymous server. The problem is that many of the services we use only work if we authenticate ourselves, such as payment or localisation services. Consequently, anonymisation techniques are only of limited use.

"Technically speaking, you can't guarantee one-hundred-percent protection."

Bernhard Plattner

Zumbühl: There is also the fact that every one of your devices has been highly personalised. How likely is it that someone else will have exactly the same apps as me on his smartphone? I am effectively using something unique, which means I am already recognisable from the profile I have got on my little machine.

Plattner: Scientists have shown that every user has his own highly specific user behaviour. We have all got a digital fingerprint that clearly distinguishes us from others.

Zumbühl: This especially becomes problematic if the data I produce with different uses can be correlated. This is

Focus | IT security

illegal in Switzerland, but may well not be in other countries.

Plattner: Yes, I see this as a great threat that we will be facing in the near future. You might have carried out anonymisations on a data set in order to protect your data, but they can still be reversed. In my opinion, however, the more obvious threat at present is the careless use of Twitter, Facebook and similar platforms by many people. The information I voluntarily disclose about myself via Facebook can easily be misused by organised criminals, such as for personalised phishing emails.

How exactly does that work?

Zumbühl: It's very easy. You write on Facebook or Twitter that you went hiking in the mountains at the weekend, for example, and on Monday you receive a bogus message, supposedly from a friend, saying "thanks for the great walk; here are some photos I took." You click on them and you've already fallen into the trap.

"Around two gigabytes of malicious codes hit the market every day."

Marcel Zumbühl

And what does the future hold? What are you currently working on and what challenges lie ahead for you?

Zumbühl: At the moment, I'm mainly focusing on phishing attacks against customers. We are looking into how we can stop the mechanism earlier and how we can make the net we provide as unattractive as possible to attackers. As regards the spam curve, we're in a pretty good position with our service compared to the rest of the world. In the future, the "Internet of Things" will present fresh challenges. If my fridge shops for me and the tablets I swallow immediately register my state of health, I ask myself how we want to keep this data under control.

Thür: In the last few months, we've been focusing intensively on Google Street View, where we're on the right track with the federal court decision and negotiations for the blanking-out of faces and the protection against recordings of private locations. As for the future, I'm worried about Smart Grid. I think the idea of an intelligent power grid to use energy as efficiently as possible is good in principle. From a data protection perspective, however, there are a

few problems. Once again, it's a huge data set that provides very precise information about my lifestyle in that my energy consumption is recorded constantly and in detail. I haven't got a problem with that under the terms of a functioning, democratic, constitutional state. But under different circumstances, it soon becomes problematic. The increasing size of databases and the expanding numbers of link-up and analysis possibilities can also be exploited for political purposes.

Plattner: As researchers, we're now intensely involved in addressing how you can disclose data from large data sets without third parties being able to extract more information than was originally intended. And we're still looking into the problem of software weaknesses. Between 2000 and 2008, over 30,000 serious software weaknesses came to light. We made a statistical analysis of when and how they became apparent and what happened next. After all, depending on who finds the weakness and how it comes to light, it can either be remedied quickly or exploited. We have developed a measuring rod to gauge whether industry is on the right track or not. We'd like to repeat this study annually to create a quality barometer for the software industry. ■



Deleting data without a trace

Felix Würsten

Private pictures, contact data, confidential emails and business memos – we store a myriad of sensitive data on our smartphones. And naturally we assume that it is deleted safely again when we no longer need it. After all, it is precisely this data that we want to prevent from falling into the wrong hands.

However, deleting information on smartphones is nowhere near as reliable as users would like to believe. According to Joel Reardon and his colleagues from ETH Zurich's Institute of Information Security, data believed to have been deleted safely can on average remain intact and relatively easily readable by third parties for several days, depending on how often the smartphone is used. The reason is that data stored on flash memories, which are a standard feature on smartphones these days, takes a relatively long time to delete compared to conventional storage devices, where sensitive data can be overwritten selectively.

The researchers from ETH Zurich investigated how data on mobile devices can be deleted safely using the example of the Android Smartphones, which are based upon the openly accessible Linux operating system. "The problem isn't limited to Android phones, however. It basically affects all mobile devices that work with flash memory", says Reardon. "This includes iPhones, tablets, laptops and cameras."

Consequently, the scientists developed two approaches towards solving the problem. One of them offers pragmatic assistance: the owners of Android devices can download a special app that removes the data safely. The app not only forces the device to overwrite the data in question on the storage device, but also on external storage media such as SD cards.

The second approach, however, is more fundamental and thus delves deeper into the operating system. Reardon and his colleagues suggest that the data on flash memory devices be saved in an encoded form in

future, and the keys stored at a central location. The aim of the encryption is not to protect data that is still being used, but rather to facilitate rapid and secure deletion.

With this approach, the operating system no longer needs to overwrite the data itself, just the corresponding key. As the section with the keys only takes up a small part of the entire memory, the mobile device can thus be protected in a short space of time. ■

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Legal uncertainty in the global village

Roland Baumann

Not just the film and music industries, but publishing houses too are desperately seeking answers to the challenges that the internet has brought with it. Legal experts are also dealing with fundamental questions surrounding copyright law.

Whether it's the latest film from Quentin Tarantino, Lady Gaga's current single or a bestselling audio book from Stephen King, it just takes a few mouse-clicks to copy files from the internet, save them on your hard drive and use them without restriction. A whole generation of young people is growing up in a world where the predominant perception is that content is available for free. File-sharing platforms such as BitTorrent leave virtually no wishes unanswered. Somewhere in the world, a file is uploaded and it can then be used free of charge by all users. It's a real El Dorado of information.

But the artists no longer receive any royalties, and their interests get left behind. The situation is even more dramatic for music firms, film distributors and publishing houses, whose entire existence is called into question. As representatives for the interests of the creative industry, they have not yet found any solutions for the infringements of copyright law that take place every time a file is copied. Legal experts are also put on the spot here. Intellectual property law, which includes copyright law, has to

be re-written. In the past 20 years, this branch of law has grown enormously in popularity, having been all but forgotten in the previous decades.

It is not just specific issues of infringements of the law that are being ruled on by the judges. In fact, a heated debate is taking place about fundamental questions.

Enforcing the law is expensive and difficult

Stefan Bechtold, Professor for Intellectual Property at ETH Zurich, has been following these debates for years now and sees one of the main problems for copyright law in the fact that it is always enforced territorially: "Although copyright law was harmonised at an early stage using international treaties, enforcement takes place in individual countries. This makes it not only expensive but also difficult to enforce the law." For example, if a Swiss company wants to take action against legal infringements in America, China and Russia, it has to go before the courts in each of these countries. Not only can the judges pass different rulings in the different countries, but the rulings can also be enforced in entirely different ways. In addition, most elements of copyright law came into being in the nineteenth century, and there are always difficulties in addressing new technological possibilities. For example, to what extent are individual users liable if they upload files to a file-sharing site, and to what extent does the liability rest with the operator of the site?

According to Bechtold, however, the example of the file-sharing sites has a whole other dimension: "If certain behaviour that is far removed from applicable law is accepted by an entire generation, society has to weigh up the different interests: does it make sense to mobilise huge amounts of resources to enforce this law? Or does the legal system have to adjust to the new circumstances?" These are the questions that lie at the heart of the copyright debate.

How much copyright?

In traditional economics, information – for example, in the form of a book or song – is a public good that can be used free of charge by everybody. If the legal system did not provide for intellectual property rights, everyone would have an interest in consuming such public goods but no one would have an incentive to produce them. Thus, from a legal economics perspective, copyright law aims to create incentives for people to undertake creative tasks.

The internet has triggered a huge industrial change, allowing information to be disseminated and made accessible much faster and much more efficiently. However, this in turn has an impact on creative artists and copyright associations. If authors do not find new ways to transform their creative works into cash, this could also have negative consequences for society as a whole. As the social scientist Stefan Bechtold agrees, this is difficult to assess: "It is hard to make statements on how the economy would develop if we added or removed certain cases of state intervention. The relationship between intellectual property rights and dynamic innovation processes is a huge research area that is wide open."

No hidden payments

Felix Würsten

An uncomplicated, electronic payment system that offers the same advantages as cash – this is exactly what everyone has been dreaming of who has been fighting for more freedom on the internet and against the might of the banks. Precisely one such system was created in 2009: the internet currency Bitcoin. Despite all the prophecies of doom that the system would soon burst like a bubble, and despite all the warnings that Bitcoin promotes trading in illegal goods, the new electronic currency has an increasing number of supporters.

The virtual money was made possible by modern encryption technology. Every Bitcoin is secured by a key; every transaction that the (anonymous) users perform is registered so that the same coin cannot be used twice. However, the verification of a payment usually takes ten whole minutes. Sometimes, the seller even has to wait for an hour before he can be sure that the money transferred is actually his. For online traders who sell books on the internet, this amount of time is not a problem. For quicker transactions, such as purchasing a hamburger at a snack bar, however, it is a major obstacle. If the buyer is not to wait unnecessarily long, the seller has to hand over the goods without any definitive confirmation.



Together with Ghassan Karame and Srdjan Capkun, Elli Androulaki, a postdoc at the Institute of Information Security, managed to demonstrate that there is actually a security loophole here, even if it has never been exploited in concrete daily life. With an elaborate configuration, the buyer can actually spend his electronic coins twice: first, he buys the goods he desires; then he transfers the same amount to his own account. As the transactions are verified via a complex process in the Bitcoin network and not by a central office, the buyer can perform an exchange manoeuvre: the seller sees that the Bitcoins have been transferred to his account, so he is willing to dispatch the goods. However, if the buyer is clever enough, the network only registers the second illegal transaction instead of the first legal one, and the buyer ends up with both: the goods and the money.

If Bitcoin is to establish itself as an everyday, viable alternative, this gap needs to be plugged, confirms Capkun, in whose group the study was conducted. "We are already in talks with the operators of the Bitcoin network and have proposed a concrete solution, which is now due to be implemented." ■

www.syssec.ethz.ch/research/index →

Focus IT security



IT security solutions

One way of intervening to enforce the law on the internet could involve IT security measures. In the 1990s there was a vision of what was referred to as Digital Rights Management. Unsettled by file-sharing sites such as Napster, the industry made attempts to create an infrastructure that was to guarantee complete security and enforce rights. In certain areas like pay TV and DVDs, these technologies are in use today, and mobile communication is also moving partly in this direction. "However, there is no longer any talk of a big vision of a comprehensive rights management system", says Bechtold. "In addition to huge technical challenges and data protection issues, such systems can also be problematic from a legal perspective because they can unilaterally protect the legal position of just one party." Ultimately, though, the main issue is that there would be a high price to pay for all-encompassing Digital Rights Management: "It clashes with one of the main principles for the success of the internet,

namely its open architecture that does not allow any control over who adds which applications."

Human behaviour is decisive for the future

In light of this situation, there are still many unanswered questions today. Will copyright law be relaxed and adjusted to the changed framework conditions? Or will there be attempts to change the social norms by imposing more and higher penalties for small but widespread transgressions of the law? Ultimately, the answers to these questions will depend on human behaviour. Business models such as Apple's iTunes show that users are indeed willing to pay for security and convenience. Maybe this also has something to do with a preference for fairness. Modern economics knows that people are perfectly willing to make a contribution for a public good. As a result, the open internet has brought forth a large community that waives the right to payment for its copyright. With products like Wikiped-

ia or open source software, people are contributing to the welfare of society as a whole.

At the end of the day, the central question is whether we will adhere less to laws on the internet if these laws are not enforced. Bechtold is carrying out research into this question on the basis of open source licenses, which are sometimes infringed upon but seldom legally enforced. Do the programmers stick to the rules even though they know that they do not have to fear any consequences if they break them? Using a database with several tens of thousands of software projects, Bechtold – together with his post-doctoral student Dr Thomas Maillart – is carrying out an empirical study of how often and under what conditions licenses are infringed upon. "We hope that this project will give us a detailed insight into the relationship between human behaviour, social norms and legal institutions in complex networks like the internet." ■



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Glossary

Viruses, worms, Trojans and Co.

Adware

A malicious program that, unlike spyware (see below), does not target the user's personal data, but rather serves advertising or market research purposes. It is often installed unbeknown to the user along with useful software or through web access.

APT**(Advanced persistent threats)**

Sophisticated, complex, generally more prolonged cyber attacks for the purposes of spying or sabotage.

Backdoor

A malicious program that criminals use to gain access to someone else's computer through the "backdoor" – usually via Trojan horses, viruses or worms.

Botnet

A remote-controlled network of computers that criminals use to carry out DDoS attacks, for instance (see below).

DDoS**(Distributed Denial of Service)**

Coordinated DoS attacks (see below) on a larger scale with several aggressive systems.

DoS**(Denial of Service)**

Attacks that prevent computers or networks from being available, that "deny service." By being inundated with e-mails, for instance.

Firewall

A system that limits access to a network based on particular rules to protect the computer against attacks from the internet.

Cryptography

A branch of mathematics concerned with information systems that are resistant to unauthorised reading and modification. In cryptography, processes are developed that can be used to identify IT users reliably and transfer data securely (i.e. secretly and unaltered).

Malware

Umbrella term for unwelcome, often malicious software.

Phishing e-mails

Bogus e-mails designed to coax the IT user into surrendering sensitive data such as passwords.

Protocol

Set of rules that describe how data packets are transported from a sender to a recipient on the internet. Security protocols, such as for web-based transactions, run in the background and serve to make communication more secure.

Spyware

Malware that spies on users without their knowledge and sends personal data such as passwords, account details or surfing behaviour on the internet to software producers or third parties.

Tor network

A network that encrypts a user's connections on the internet in such a way that they appear as actions of an anonymous server. Using Tor protects the user from data traffic analyses.

Trojan horse

A seemingly useful program that conceals a malicious one – such as spyware – and sneaks it into computer systems.

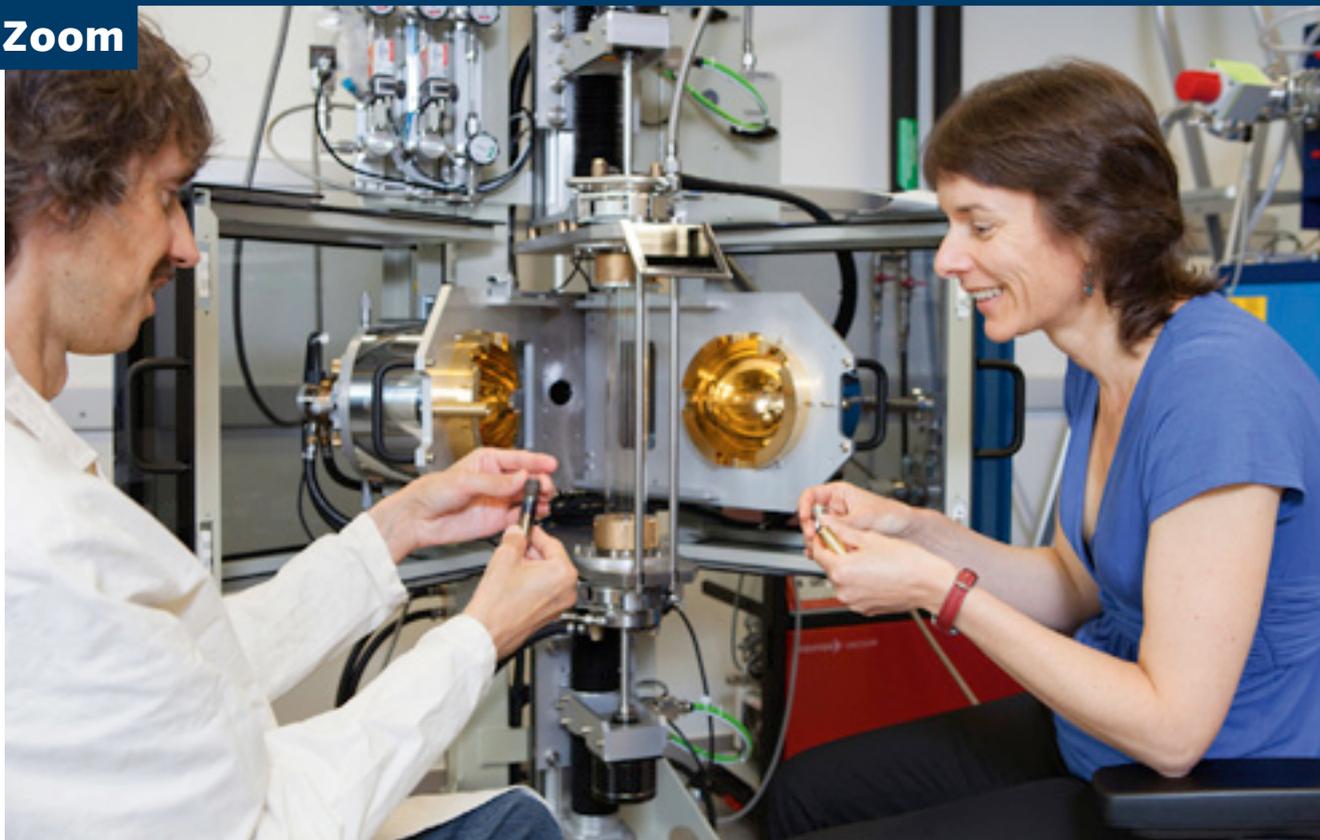
Viruses / Worms

Computer programs that duplicate themselves and primarily spread in networks. Viruses need another program to attach themselves to; worms spread independently.

Zero-day exploit

A security flaw that has already been exploited by criminals before developers discover them, i.e. before day "zero."

Zoom



Nicola Spaldin (right) with team member Frank Lichtenberg in the new lab.

Max Rössler Prize 2012

In search of materials that don't even exist yet

Martina Märki

Is there a material that is both magnetically and electrically polarised? Not by nature. However, professor of materials theory Nicola Spaldin and her team are working on it. This ETH Zurich researcher recently won the Max Rössler Prize for her pioneering research.

A minimalistic office; in a plain, hand-blown glass vase there is a seemingly random jumble of thick plastic name tags, laminated simply, with clips, on a ribbon, some with the logos of events and institutions, others without. Only the name is always the same: Nicola Spaldin. No doubt this young scientist is either extremely

hard-working or very popular at conferences – and probably both. And in her own way, she's well organised: there on her meeting table, surrounded by all kinds of scientific documents and notes, lies music for clarinet and flute. "A colleague and I were practising a little during the lunch hour", she explains matter-of-factly. Chamber music is one of her passions. Another is science. Solid-state chemistry, to be precise.

Nicola Spaldin and her team are looking to develop new materials that combine special properties, such as a material that is both magnetically and electrically polarised. From a technical standpoint, there would be no shortage of applications for it. "It would be extremely useful in any lap-

top or in any car", says Spaldin. A vehicle, for instance, has over 200 magnets in electric motors, sensors and other instruments. At present, magnets can only be controlled via electrically generated magnetic fields, which are formed using a wire coil with electricity flowing through it. This takes up space, adds weight and unnecessary heat – and ultimately uses up lots of energy. So-called magnetoelectric materials, on the other hand, would constitute a magnet and control system all rolled into one. In a nutshell: "The combination of both properties would enable us to make great headway in energy efficiency and miniaturisation."

It's a nice idea. The only snag is that no such material exists that com-

bines these properties. Materials with good magnetic properties, such as iron or nickel, are usually poor conductors and thus not electrically polarised. Conversely, oxides, which Nicola Spaldin likes working with because they have a good electrical polarisation, are useless as magnets, explains the chemist.

A matchmaker for difficult couples

"We have to look in two completely different areas of the periodic table if we want to marry these properties." And this means that the atoms to be combined tend to be foreign by nature. "We have to come up with unusual methods to pair up the right partners", says Spaldin.

First of all, it is important to understand the exact properties and bonding patterns of potential partners before a partnership can even be considered. Oxides, says Nicola Spaldin, have extremely appealing characteristics. Their bonds are neither too ionic nor too covalent, as they say in chemistry circles. And they react easily to electrical or magnetic fields. Consequently, they are Spaldin's preferred candidates for difficult magnetic partners. However, before they get a reality shock, the scientists check on the computer whether the contender qualifies for a partnership and will produce useful results. Not infrequently, the computer operations this entails are so complicated that a supercomputer needs to be brought in. In doing so, it is not a matter of checking through thousands of material combinations, as with so-called screening methods; no, Nicola Spaldin and her team prefer to focus on a precise individual understanding rather than chemical speed-dating. "We only test our understanding with a computer simulation when we are

convinced from a theoretical point of view that a partnership between the materials is possible, perhaps with one or two small modifications, and can give us precisely the properties we are looking for."

From simulation to the lab

Then it gets serious. Potential partners need to be combined in reality – in other words, in an experiment. "Previously, I always had to look for someone who was willing to create the material in the lab. Now we'll be able to do it ourselves", Spaldin beams. After all, for the first time she will have her own specialised lab at her disposal here at ETH Zurich. The boxes of equipment have just arrived. She is delighted with this – and the fact that she will have plenty of freedom to focus on basic research at ETH Zurich. "We mustn't forget that we are inventing materials that have never existed before", she says. Before the lab experiments, no one can say for sure whether they will actually behave in reality exactly how the scientists had hoped, based on their theoretical considerations and computer simulations. After all, as the saying goes, the whole is greater than the sum of its parts, and chemistry is no exception.

This also concerns extremely fundamental questions: "We have a fairly accurate idea of how a single electron behaves and why, or even how two electrons react. But why, when great numbers of them meet in a solid body, do electrons interact in such a way as to make exotic properties like superconductivity or new kinds of magnetism possible? We still have no idea", says Spaldin. Together with high-energy physicists, she is currently designing magnetoelectric materials that can help research the fundamental properties of electrons. And another of her test materials could even

help investigate more precisely what happened in the early period of the universe after the big bang. Along with cosmologists, she is currently working on developing appropriate lab experiments.

From materials research to cosmology, interdisciplinary collaboration is a matter of course for Nicola Spaldin. Her research group includes materials scientists, physicists, chemists and one mathematician. And she loves to delve deep into things that interest her: "I'm always drawn to whatever I find exciting." She recently won the Max Rössler Prize (see box) for her work. She plans to use the prize money as a "rapid response fund to enable us to head in new directions spontaneously if something particularly interests us." ■

Max Rössler Prize

In 2007 the mathematician and ETH Zurich graduate Dr Max Rössler donated CHF 10 million to the ETH Zurich Foundation. The prize is intended to honour and encourage particularly promising young ETH Zurich professors and includes CHF 200,000 in prize money. This year, it was awarded for the fourth time.

The British scientist Nicola Spaldin had already won many awards before joining ETH Zurich in 2011. At the beginning of 2012, she was also awarded a research grant from the European Research Council for her promising research.

www.ethz-foundation.ch →

www.globe.ethz.ch/spaldin_EN →

Inside



Accessing deep geothermics is a tricky business, as a pilot project near Basel demonstrated a few years ago. If there are no aquiferous layers in the subsoil, the heat deep down cannot be used routinely with today's technology.

Strategic initiative

Using the Earth's heat

Felix Würsten

In theory, deep geothermics could make a key contribution to our future energy supply. Whether this potential can also be exploited in practice, however, remains to be seen. With two new professorships, ETH Zurich is looking to help this technology make a breakthrough.

The heat resources inside the earth are thought to be almost inexhaustible. No wonder that geothermics is regarded as one of the most promising options for our future energy supply. In a number of countries, subterranean heat has already long been used to generate electricity and warmth, in-

cluding the USA, but also Indonesia, New Zealand, Iceland and Italy.

No big breakthrough

In Switzerland there is nothing of the sort yet. Admittedly, near-surface geothermal heat supplies numerous buildings with heat and warm water today. However, whether the energy from the earth's interior can be used to generate larger amounts of electricity is still unclear. Unlike the aforementioned countries, where active volcanoes conduct the heat near to the earth's surface, in Switzerland the heat source has to be accessed at a depth of three to six kilometres. Only down there are the rocks hot enough for power production to make economic sense.

Previous attempts to use deep geothermics in Switzerland, however, were not particularly encouraging. There was a pilot project in Basel in which the hot dry rock process was to be used to turn heat from non-aquiferous rocks into electricity, but it had to be abandoned. When the underground rock had to be loosened to increase permeability, it caused palpable shocks on the earth's surface. And in Zurich the drilling in a pilot project at Triemli Hospital did not yield as much hot water as had originally been hoped. Only in St. Gallen do the prospects look somewhat rosier: the project managers there are hopeful that the forthcoming deep drilling will produce sufficient hot water to generate electricity and heat.

This would enable an especially favourable geological situation in Eastern Switzerland to be exploited that has also triggered a veritable geothermics boom in Bavaria.

In the medium to long term, however, the question is not whether deep geothermics is actually viable for power generation, but rather whether it is capable of making a relevant contribution to the Swiss power supply – or, as Domenico Giardini, a professor of seismology and geodynamics at ETH Zurich, succinctly puts it: “Can deep geothermics replace a nuclear power station?”

Since the nuclear disaster in Fukushima and the nuclear phase-out decided by the Federal Council and Parliament, the issue has become more pressing. After all, deep geothermics is one of the energy forms in which the Federal Council has placed great hopes in its new Energy Strategy 2050. And the “Action plan for coordinated energy research in Switzerland” (Aktionsplan koordinierte Energieforschung Schweiz) published by the interdepartmental workgroup Energy in April 2012 also banks on geothermal energy. Not only does the workgroup propose a national support programme for deep geothermics; it also recommends coordinating future research in a national competence centre.

Insufficient capacity

For Giardini it is also clear that a nationally coordinated effort is now required and that the state should thus be involved more closely. “The previous pilot projects were primarily local initiatives”, he explains. “If we want to achieve our ambitious goals in twenty to thirty years, such isolated projects will not be enough.” For Giardini, it goes without saying that ETH Zurich should assume a leading role here: “We have a series of professorships

that can make a contribution in one way or another. Besides earth scientists, scientists from the fields of process engineering and energy technology also deal with geothermics. And finally there are also professors at ETH Zurich addressing issues of risk financing and the social acceptance of this energy form.”

However, the capacities of these professorships are insufficient – of that Giardini is convinced, for none of them has geothermics at the top of the agenda.” So far, ETH Zurich hasn't really exploited its potential to the full”, he explains. Consequently, the university has now launched a new strategic initiative with a view to establishing two new professorships very quickly thanks to support from private sponsors. One of the new professorships at the Department of Earth Sciences will focus on accessing deep heat sources, while the other will examine issues of technology development at the Department of Mechanical and Process Engineering.

Talking to Giardini, it soon becomes clear that there is no shortage of concrete research topics. “The main problem is that no deep geothermal plant has ever produced electricity over extended periods of time”, he explains. “The pilot project in Soultz-sous-Forêts (Alsace), which is also based on the hot dry rock process, is running satisfactorily. However, it only produces an electrical output of about one megawatt. If deep geothermics is really going to make a relevant contribution to the power supply, we need plants with an electrical output of at least twenty to fifty megawatts.”

How a big enough reservoir for such plants can be created underground and managed for decades, however, is still largely unclear. “We need to have a better understanding of what actually happens deep down

when the rock is loosened”, explains Giardini. “We have to reach a point where we can gauge a project's prospects of success fairly reliably before the construction work gets underway. This is the only way investors can make a reliable risk assessment.”

How reliable are the forecasts?

Besides geological issues, technical aspects also need to be clarified. The oil and gas industries already have technologies for drilling into rock at great depths and breaking it up. However, unlike oil and gas drilling, geothermal drillings are not conducted away from civilisation, but close to towns to enable the residual heat to be utilised. Therefore, the technologies now have to be refined in such a way that they no longer trigger any noticeable tremors at the Earth's surface. Last but not least, the costs need to be reduced that are incurred while exploring possible locations, accessing the heat reservoirs through drilling and running the plants.

“All current energy forecasts predict a rapid rise in deep geothermics in the years to come”, explains Giardini. “Now we have to show whether these prognoses are actually realistic and, if so, which technological prerequisites need to be fulfilled.” ■

Inside



ETH Zurich President Ralph Eichler and Jean-Marc Joerin, President of the Misrock Foundation, inaugurate the S. Leslie Misrock Lecture Hall in the D-BSSE.

Donations

Giving a boost

Roland Baumann

Thanks to donations from private donors, ETH Zurich has been able to set up various new professorships very quickly in recent years. One topic that keeps arising as a result of these contributions is the university's research freedom.

In the last decade, ETH Zurich has established around 100 additional professorships and thus set the course for the future. Around a fifth of these professorships was established quickly because the university was able to count on the support of donors. Various companies and organisations helped to fund a professorship for five or ten years with substantial donations to the ETH Zurich Foundation. The latest examples are the "Sustainable Building" professorship supported by Holcim and the professorship in the field of information security, in which Swisscom is involved.

It is pivotal that these contributions do not affect ETH Zurich's research freedom, as ETH President Ralph Eichler stresses: "A donation

must make sense for both sides. The companies expect new, fundamental knowledge and novel processes in their particular fields. At the same time, ETH Zurich plays a major role in the education of people who will hold positions of responsibility in companies in the future. For us, it is crucial for a new professorship to fit the strategic focus. This weighing of interests already takes place during the initial talks with potential donors."

The issue of research freedom is less pronounced in the case of contributions from foundations and private individuals. But here, too, it is all about reconciling the concerns of the contracting partners. One example of this is the start-up funding of the Biomolecular Engineering Chair at the Department of Biosystems Science (D-BSSE) in Basel by the foundation of S. Leslie Misrock, who passed away in 2001. This chemist and patent attorney from New York was so impressed by the research location on the elbow of the Rhine that he established his foundation there in 1981. It supports research in molecular biology, biotechnology and

similar fields. While the Misrock Foundation was only able to fund smaller projects in its early days, after the sale of assets from the portfolio in 2008 it became involved in larger projects.

The launch of the D-BSSE in 2007 came just at the right time: only three years after ETH Zurich had moved into its new location in Basel, the contract for start-up funding for a professorship at ETH Zurich was signed and the appointment procedure initiated. Then, in November 2011, the ETH Board appointed Sai T. Reddy as a tenure-track assistant professor of biomolecular engineering at the D-BSSE. This internationally renowned researcher from the University of Colorado in Boulder (USA) is regarded as one of the co-founders of systems immunology as a research field. ■

Research freedom

The ETH Zurich Foundation plays a pivotal role in research freedom for donations to ETH Zurich. As an independent, non-profit foundation, it conducts negotiations with potential partners and, together with ETH Zurich, is the joint contracting partner for the donors. It provides the university with funds for new professorships. ETH Zurich then conducts its ordinary appointment procedure with checks and balances: it appoints a commission, to which ETH Zurich professors in the field and experts from other universities and industry belong.

The commission evaluates the applications and draws up a recommendation for the President of ETH Zurich, who conducts the negotiations. If these go well, he puts forward a motion to the ETH Board to appoint the new professor.

www.ethz-foundation.ch →

www.facultyaffairs.ethz.ch/berufungen/index_EN →



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Scientifica 2012

Health meets with interest

This year's Scientifica on the topic of "Health" attracted huge crowds of visitors to ETH Zurich and the University of Zurich. Roughly 21,000 visitors attended the 50 exhibition stands and 40 brief lectures where they were inspired by the scientists' enthusiasm for research. The visitors included cantonal government councillor Thomas Heiniger and city councillor Claudia Nielsen, who were given a guided tour of the exhibition by Prorector Daniel Wyler from the University of Zurich (below left, centre). A humorous performance by cabaret artist Lorenz Keiser (below right) provided plenty of laughs for the guests at the opening event.



Thanksgiving at ETH Zurich

Reaching for the Stars

Under the motto "Reaching for the Stars", keynote speaker Claude Nicollier – an astronaut, pilot and lecturer in aerospace technology at EPFL and ETH Zurich – invited the roughly 130 guests at this year's mid-June "Thanksgiving" on a journey through space. This annual event is an opportunity for ETH Zurich to thank its donors for their support.

ETH Zurich's Max Rössler Prize was awarded for the fourth time at the Thanksgiving event. This year's prize was won by Nicola Spaldin (see page 38).





CSCS inauguration

New building for fast computers

The new CSCS (Centro Svizzero di Calcolo Scientifico) building was opened in Lugano-Cornaredo at the end of August in the presence of Federal Councillor Alain Berset (centre), President of the ETH Board Fritz Schiesser (left) and President of ETH Zurich Ralph Eichler (right). This new high-performance computer centre, which is one of the most energy-efficient in the world, provides ideal conditions for Switzerland to hold its own among the global high-performance computer elite in the long term.



Water talk

"Water is a human right"

Unless the human race can come up with something soon, its drinking water will run out before oil does. With this pointed statement at the "Water talk" in mid-June, Nestlé President Peter Brabeck-Letmathe advocated a more sensible approach to water as a resource. Over 500 guests attended the third edition of "ETH Talks", a series of events organised by the coordination centre "ETH Sustainability".

ETH Zurich alumnus Christoph Eck

From drones to D flat

Christine Heidemann

ETH Zurich alumnus Christoph Eck has got his feet firmly on the ground. But he's passionate about reaching for the skies – whether it's scaling dizzy heights as the long-standing director of ETH Zurich's Big Band, or working with his helicopter drones as the head of "Aeroscout", an ETH Zurich spin-off.

Although he is only 43, for long-serving staff at ETH Zurich, Christoph Eck has already been around as long as they can remember. After all, he has been head of ETH Zurich's Big Band for nearly 20 years now and has already performed with the band at almost all of the major events at the university – from doctoral celebrations and congresses to Nobel Prize celebrations and openings of new institutes and buildings. Christoph Eck and his 20 musicians are also sought after as ambassadors for ETH Zurich. In 2011, for example, the band toured for ten days through Brazil, entertaining partner universities and various Swiss institutions with their jazz grooves.

But Christoph Eck's close links to ETH Zurich extend beyond his music. After his postgraduate, doctoral and postdoctoral studies in Zurich, German-born Eck founded two spin-offs that were based on his research at what was then the Measurement and Control Laboratory (IMRT). Both of these companies represent the other side of Christoph Eck, namely the electrical engineer and expert for helicopter drones. These are unmanned helicopters that weigh around 75 kg and have an in-built autopilot. They navigate through the skies independently, for example to search for people trapped in landslides or avalanches, to inspect high-voltage wires or to map landscapes in 3D. "On the one hand, I am fascinated by dynamics and mathemat-

ics. On the other hand, I love working with the band. For me, the latter offers a human component that is often missing in the technical work I do."

Christoph Eck explains that the decision to study electrical engineering in Karlsruhe and then in Bremen in the north of Germany was not an easy one. "While I was at school, I took trumpet, piano and double bass lessons for a long time because I really wanted to do something related to music." But now he is happy that he changed his mind: "This way, I can play music without any constraints."

Tuesday is rehearsal day

But one evening in the week is blocked in his appointments diary for almost the entire year. Every Tuesday at 7 p.m. the band rehearses, turning the largest seminar room on floor H of ETH Zurich's machine laboratory into a concert hall. For the past 16 years, musicians have been using the room to perfect their pieces, try out new ideas and plan projects, CDs and concerts. Or, like just now, to plan the 20th anniversary of the band which is coming up next year.

"But recently we found out that we won't be able to rehearse there regularly any longer", says Christoph Eck. The official explanation given was that the building is to be redeveloped and that no alternative rehearsal room was available. "Personally I was very disappointed by the news", the musician admits. After almost 20 years with the Big Band, he didn't expect them suddenly to be put out on the street, as it were. Christoph Eck tells of how he has put his lifeblood into his work with the band, without any compensation or payment in return. "It is hard to imagine that this would happen to a university orchestra anywhere else."

Together with Dieter Wüest from the ETH Rectorate, he has now found a temporary solution for most of the time.



For Christoph Eck, music provides a “fantastic release.” Whenever the electrical engineer finds the time, he reaches for his trumpet. But in particular, he beats time for the ETH Big Band, whose 20th anniversary he will be celebrating next year.

Profile

Christoph Eck is not one to give up easily. After all, there was a similar situation in the early days of the band. At that time, in 1993, the only band at ETH Zurich was the Polyband. "But I didn't really feel at home musically in the band." And because this engineer had already successfully founded a big band at the University of Bremen, he decided to do the same in Zurich. It didn't take long to get the musicians together, but finding a rehearsal room was difficult even back then. Flexibility was the order of the day: "We once rehearsed in the entrance hall to the Physics Building on the Honggerberg campus, and another time we practised in a church hall", Eck recalls.

He describes music as providing a "fantastic release", even though he can only devote a small portion of his time to it. The former ETH Zurich student spends the rest of his time either teaching as a part-time lecturer for control

"It would be fantastic if drones could one day fly as reliably as manned helicopters."

Christoph Eck

technology at Lucerne University for Applied Sciences and Arts or in his spin-off company "Aeroscout."

The company was formed in 2005 from "weControl", a company founded by Christoph Eck together with three other doctoral students at ETH Zurich four years previously. "weControl" still exists today and still markets autopilots, while Aeroscout integrates the autopilots directly in the helicopters, i.e. it provides complete drones. These are used solely for non-military purposes and for research. One high-profile example of their use was after a mine collapsed in eastern Turkey in February 2011. At the time, Christoph Eck and his team travelled to the site to search for buried vehicles using his helicopters.

One major future area of application for the helicopters will involve inspection work on high-voltage wires. Performing this kind of work with manned helicopters is either too dangerous or not possible on account of regional circumstances. For this reason, the process is being automated. The drones should be able to find their way along the wires independently using the images recorded via their integrated cameras. They have to choose their flight path such that they can inspect the wires from all sides and detect even the tiniest amounts of damage. "Because both the helicopter and the camera move and turn independently of

each other, the flight path and the camera guidance have to be perfectly combined", explains Eck. And that, according to Eck, is a "complex matter" and the greatest challenge currently facing the four employees who make up the Aeroscout team.

Reliable organ transport

The 43-year-old tells us that it would be fantastic if drones could one day fly through the skies as reliably as manned helicopters. Then they could also act as messengers, for example, flying organs from one hospital to another. However, to do this they will have to become "more intelligent", meaning that they will have to be able to navigate even more reliably in order to get out of the path of other flying objects in good time and make emergency landings if necessary, for example in the event of bad weather.

When asked about the characteristics that make him who he is, both a successful engineer and a musician, Christoph Eck explains: "I am very organised and structured." To the question of whether he is a strict band leader, he replies that his musicians would have to answer that. Of course, he says, there are always phases in which everyone has to be highly focused, for example in the run-up to a concert or a tour. And ultimately, the band wants to reach and maintain a certain level. But the head of the band assures us that on the whole the relationship between the musicians is extremely friendly and supportive. And finding new people to join the band is never a problem: "There are always new and talented people coming along." In his private time, however, Christoph Eck now only rarely has the chance to play music. After all, he also has a family and likes to spend as much time with them as possible. "But if I am not too tired by the time the children have gone to bed, I reach for my trumpet and play – using a mute of course!" ■

About Christoph Eck

Christoph Eck studied electrical engineering at Karlsruhe Technical University and at the University of Bremen. In the autumn of 1993 he switched to ETH Zurich, where he completed a postgraduate course in information technology and, in 1996, a doctorate at what was then the Measurement and Control Laboratory (IMRT). In 2001 he founded the ETH Zurich spin-off "weControl" along with three other postdoctoral students at ETH Zurich. In 2005 this gave rise to the spin-off "Aeroscout", which he has since managed as CEO. The 43-year-old also lectures part-time in control technology at Lucerne University for Applied Sciences and Arts. In his free time, Christoph Eck has led ETH Zurich's Big Band since 1993. Next year the band will celebrate its 20th anniversary.



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www.bkw-fmb.ch/karriere



KIKRI ETH Zentrum crèche officially opened the doors of its new-look building at Clausiusstrasse 72 on 2 April 2012.

1972

One big family

Alice Werner

ETH Zurich's first crèche is celebrating its fortieth birthday this year. What emerged out of the 1968 movement as a grassroots, democratic parents' association has blossomed into a professionally run business today. This year, KIKRI moved into a new, state-of-the-art building.

It is 1972. Students and women throughout Europe are caught up in a spirit of change. In Switzerland, however, the situation of women in society is still heavily dominated by tradition. Only one year earlier, Switzerland became one of the last countries in Europe to grant its female population full civil rights and give them the right to vote. Young working women who leave their children at crèches still face criticism in society, as they are accused of being bad mothers. At the same time, support services for working mums are few and far between.

A pioneering, emancipatory feat

Consequently, it has to be viewed as a pioneering achievement that in this same year a group of students from ETH Zurich – budding architects with leftist leanings – opens a crèche for the children of ETH Zurich members. It is one of the first crèches ever at a Swiss university. A woman's right to work and the reconciliation of career and family are issues especially close to the founders' hearts. The day centre is

christened KIKRI and run as an independent, grassroots, democratic parents' association. It is first based in an ETH Zurich building on the Zürichberg. Here, at Hochstrasse 60, on a floor the students have renovated themselves, 25 toddlers and babies can now be supervised under the watchful eyes of two kindergarten teachers and a series of apprentices and trainees. One of the first students to take advantage of the service was Rita Marusic. Back then, the pharmaceutical student told the newspaper "Züriwoche" that under no circumstances did she want to interrupt or drop out of her degree, so she started looking for infrastructural support to continue her academic education.

Crises and further development

In the early days, the founders of KIKRI propagate an anti-authoritarian style of supervision, which they also back up with educational theory. The atmosphere is free and frequently wild. However, ideological principles soon make way for a pedagogical concept that is geared more towards the daily experiences of the parents and supervisors. For instance, the independence and self-confidence of the children are to be encouraged by accepting them as individuals and taking them seriously. The philosophy is: as much freedom as possible, and as little criticism as necessary.

In 1977 KIKRI moves into an old house with a wonderful garden at Clausiusstrasse 72, near ETH Zurich's main building. In this old villa with its enchanted garden, the

children can play to their hearts' content. The main attraction is an old circus caravan. The children often go home with bags of wet clothes – filthy and exhausted but happy from playing in the mud they've made.

In 1979 the future of KIKRI hangs in the balance due to strict cost-cutting measures introduced by the federal government. Max Knus, now an emeritus professor of mathematics and ombudsman of ETH Zurich since 2011, was president of the crèche in the late 1970s. He stresses that ETH Zurich's CFO at the time did a sterling job of championing the interests of KIKRI on the Executive Board. Consequently, the university agrees to cover a proportion of the wage payments, above and beyond its commitment to the infrastructure. The rest is funded via parent contributions.

Active parents are the bedrock

The parents have been included in the conception and running of the centre from day one. The idea is to give the children a sense of security and create a second home from home. And since fathers are also involved, the youngsters are set an example of how naturally traditional gender roles can be swapped around. Max Knus recalls the time when his daughter was a KIKRI child: "At lunchtime, when it was time for the staff to have a break, parents would take it in turns to watch the children." The fact that parents are responsible for the company and help out at the crèche (a certain degree of assistance is still obligatory to this day) is what really sets KIKRI apart from municipal enterprises.

The second financial crisis comes in 1982. Once again, ETH Zurich comes to the rescue, this time with material contributions. In addition, the membership fees for parents are increased and the status of preschool support reinforced within the educational concept. This is with a view to opening KIKRI up to kindergarten children. By 1992 the situation has improved to such an extent that a crèche management is introduced and the number of staff increased – KIKRI is now a professional operation. The way people think and act in society and at the university has undergone a sea change. Day care for working parents is now regarded less as a cost factor and far more as an investment, and as an opportunity for the active advancement of women.

A new material basis opens up for ETH Zurich's crèche six years later. On 31 March 1998, ETH Zurich and the Parents' Association sign a contract with the City of Zurich, which now becomes a second subsidy provider. In return for the 28 subsidised crèche places, KIKRI introduces the municipal parental contribution regulation, which deter-

mines the contributions based on a social tier system according to the income of the parents or legal guardians.

Today, KIKRI is celebrating its fortieth birthday in a new building at its old address, and now employs 19 professional staff. However, the active involvement of parents continues to be a key element of its pedagogical concept. As the crèche's current head, Katrin Imholz, proudly says: "We're one big family." One that sticks together. Even today, after all these years, Max Knus is still friends with parents of his KIKRI generation. ■



Villa Villekulla: this old house in Clausiusstrasse has been home to KIKRI ETH Zentrum since 1977.



The dawn of a new era: student banners above Clausiusstrasse at the end of 1971.

Alumni life



As the president of the Movement Sciences alumni group, Denise Schmid wants to demonstrate to the outside world the expertise that is imparted during the degree course.

Alumni groups

Young and dynamic

Felix Würsten

ETH Alumni has really boomed in recent years: thanks to a series of new alumni groups, the alumni family has gotten bigger and bigger. As "Math Phys Alumni" and "Alumni Movement Sciences" illustrate, these groups have been extremely busy.

First the financial crisis, now the questions surrounding the safety of atomic energy – these are just some of the con-

troversial topics that the alumni group Math Phys tackles at its annual lectures. The choice of provocative themes is no coincidence: "We would like to demonstrate that mathematics and physics are relevant to the here and now", explains Michael Stadelmann.

As the president of the group, he is closely involved in organising the next lecture at the beginning of November, when the speakers will also include ETH Zurich professor Horst Prasser. "Last time, we had over 140 guests", reports

Stadelmann with visible pride. "We were delighted with the huge response, as the lectures are also an important promotional opportunity for us to draw attention to our group."

Establishing the group as a brand

Although mathematics and physics are among the more traditional subjects at ETH Zurich, there has only been a specialist alumni group for these two disciplines since 2010. The demand seems to be great: 350 alumni have already joined, along with around 350 new graduates who are automatically given free membership for one year upon completing their degrees.

Together with his Board members, Stadelmann works extremely hard to convince as many graduates as possible to join. After all, this is the only way to develop a network that is as stable as possible and is able to help its members in their day-to-day work on the one hand and to support ETH Zurich actively on the other. "For us, the contacts with the students are especially important", says Stadelmann. For instance, the alumni sponsor the VMP student association's traditional fondue dinner and attend the master's graduation ceremonies of the two departments.

The Math Phys group heralds a new generation of alumni groups that are geared more towards an exchange of ideas and experiences within a subject and less towards social get-togethers. "We also have social events, of course, such as regular informal meets or the annual wine tasting in the Department of Mathematics", says Stadelmann. "But we also want to achieve something instead of just having fun. That's why we want to establish Math Phys as a brand with

which as many alumni as possible can identify."

For this young group, the fact that it could band together relatively informally under the umbrella of ETH Alumni was a major advantage. "This keeps red tape to a minimum", explains Stadelmann. The Alumni Office actively supports the Board in its work. "It helps us personnel-wise with major events, organises name tags, posts invitations and, if need be, even produces flyers. And it takes care of our address management for us, which is extremely time-consuming", says Stadelmann. "That might not sound all that spectacular, but it certainly makes our voluntary commitment so much easier."

A sense of appreciation

The Movement Sciences group, founded in 2008, also benefits from these services. "The collaboration with the Alumni Office works like clockwork", confirms President Denise Schmid. "And we are delighted to feel that our dedication is appreciated by ETH Zurich."

Like the other groups, Alumni Movement Sciences organises regular events. Besides company visits and social events, it also holds a careers session every March where four alumni talk about their work. "We're also planning additional events geared more towards longstanding alumni", explains Schmid. "We held one in the spring, for instance, where members could learn how to communicate effectively."

One of the group's main activities involves drawing the attention of the professional world to movement sciences as a subject. "In the beginning, we found that the companies didn't really know what profile the graduates could bring to the table." Mean-

while, the situation has markedly improved, probably due in no small part to the efforts of the alumni group. "We convey the strengths of the degree to the outside world to smooth the transition into professional life for new graduates", explains Schmid. "For example, a year ago we teamed up with the department and ETH Zurich's Career Centre to issue a careers brochure."

The alumni group currently has around 300 members. And it would like to keep on growing: "We have also invited many alumni who aren't yet members to the celebration at the Scientifica on 31 August to mark ten years of the movement sciences degree", explains Schmid. After all, much like the Math Phys group, Alumni Movement Sciences is finding it hard to recruit new members from the older semesters. "We would love to welcome more graduates from the earlier movement and sports science degree. After all, precisely these alumni have extensive hands-on experience out in the workplace and they would make interesting contacts for our younger members." ■

www.alumni.ethz.ch/association/topic_groups/MathPhysAlumni →

www.bewegungswissenschaften.ch/bws/Home.html →



Greetings from the President

Dear ETH Zurich alumni

Sometimes the terms "former students" and "alumni" are still understood differently. However, it is very straightforward, really: all graduates of ETH Zurich are ETH Zurich alumni, irrespective of whether they are members of ETH Alumni or not.

ETH Alumni's wide range of services, the relationships between graduates and their former university, the international alumni network and the advantages of being a member of the ETH Alumni Association – all these topics are featured in our brochure "Our network, role and mission", which you can find on our website or obtain free of charge from the Alumni Office (info@alumni.ethz.ch) in German or English. Happy reading!

Dr. Eduard M. Brunner
President of the ETH Alumni Association

job^{up}date

Vacancies for ETH-Zurich graduates
www1.ethz.ch/career/index
EN →

Alumni life

Agenda

Exhibitions

Crossing the Greenland Ice – 100 Years of Swiss Science in Greenland

In 1912 a four-man team from Switzerland crossed Greenland's ice sheet on a 700-kilometre trek – even by today's standards, an extraordinary, pioneering feat.

Until 21 October 2012

FocusTerra, Sonneggstrasse 5, Zurich

Fossil Art

An exhibition to look at and touch

19 November 2012 – 12 May 2013

FocusTerra, Sonneggstrasse 5, Zurich

www.focusterra.ethz.ch/index_EN →

Ian Anüll – Editions

22 August – 19 October 2012

Between the Lines – Graphics Series by Louise Bourgeois

7 November 2012 – 18 January 2013

Graphics collection

ETH Zurich Main Building, E53

Wohnort Campus

Student accommodation projects for the Höggerberg and Irchel

Until 8 November 2012

ARChENA, HIL Building,

ETH Höggerberg

14 November - 5 December 2012

University Zurich, Lichthof

Arch_Tec_Lab

A house for the Institute of Technology in Architecture

26 September – 19 October 2012,

Mo. – Fr. 11 am – 3 pm

Freight container,

HIL Building, ETH Höggerberg



Like the Chinese city of Shenzhen, many metropolises are currently undergoing rapid change. The next issue of Treffpunkt Science City reveals what this development means.

Music and dance

Polyball

Scheherazade

1000 stories and one night

1 December 2012

ETH Zurich Main Building

www.polyball.ch →

Alumni Business Events

Dr David W. Syz

VR President of the Board of

Huber+Suhner

20 November 2012

Networking aperitif from 5:30 pm,
event begins at 6:45 pm,

ETH Zurich Main Building, Dozentenfoyer

Register at:

www.alumni.ethz.ch/events/business_events/anmeldung →

Alumniball 2012

The traditional Alumni Ball is already being held for the seventh time this autumn – this year with a 007 theme! This pulsating party kicks off on **6 October 2012** at 6:00 pm in the Dolder Grand Hotel Zurich.

www.alumni.ethz.ch/events →

Treffpunkt Science City

The city

In the beginning, there was the city. It is regarded as the cradle of human civilisation and culture. However, the city's success story is becoming a problem. Today, over half of the world's population already lives in cities and by the year 2050, seventy percent of humankind will be living in urban areas. The world is turning into a city. How can this development be planned and controlled? How can mega-cities be made people-friendly? How can Europe's old cities be transformed into sustainable living environments? And what should the city of the future look like? Urban planners, architects, spatial planners, engineers and social scientists show how they are tackling these issues.

21 October – 2 December 2012

ETH Zurich, Höggerberg and Zentrum

Detailed programme available at:

www.ethz.ch/news/treffpunkt/veranstaltungen/index_EN →



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CAS Biomedical Ethics
CAS Forschen in den Sozialwissenschaften
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Klimaethik / Migrationsethik
Wissenschaft und Weisheit

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MAS/DAS Ärztliche Psychotherapie
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Infoabend

Besuchen Sie uns!
Montag, 24. September 2012
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