

FLASHES

A MONTHLY MAGAZINE ON KNOWLEDGE AND DEVELOPMENT BY THE
MOHAMMED BIN RASHID AL MAKTOUM KNOWLEDGE FOUNDATION

 JANUARY 2018
ISSUE 37

#YearOfZayed

Noura Al Kaabi

Capitalising on the
Digital Revolution

GM CROPS

DELIVERING ON
THEIR PROMISE?

BIOELECTRONICS

A NEW FRONTIER
IN MEDICINE

NET NEUTRALITY

THE END OF AN ERA



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FOREWORD

Dear readers,

On behalf of the Sheikh Mohammed Bin Rashid Al Maktoum Knowledge Foundation I would like to wish all of you a happy and prosperous New Year. This year will once again be marked by rapid exponential change as technology affects and disrupts every sphere of our lives.

In 1964 the world's first supercomputer was introduced to the world. The Control Data Corporation 6600, built by the legendary Seymour Cray, had one 60-bit CPU, a 128k memory and 2MB of extended core storage. China's Tianhe-2 - which was the world's fastest supercomputer from 2014 to 2016 - runs at 33.86 petaflops (quadrillions of calculations per second) and its CPU plus coprocessor memory is 1,375 TiB. Such is the rate of technological change.

One of the most watched stories of 2017 was the rise of cryptocurrency Bitcoin, whose value climbed from below \$1,000 in January to nearly \$20,000 by the year end. The jury is still out whether Bitcoin is a bubble waiting to burst, but with more than 1,300 cryptocurrencies currently in circulation, it seems they are here to stay. The core reason behind the phenomenal success of Bitcoin is the blockchain - an encryption-based digital ledger that secures the currency and

eliminates third parties such as banks.

Now while Bitcoins can't be hacked, the exchanges that trade them can. The most recent example was on December 28 when South Korean Bitcoin exchange Yobit was forced to declare bankruptcy after having 17 per cent of its total assets stolen. According to the US Department of Homeland Security (DHS) and the FBI foreign governments have been implicated in hacking attacks.

This brings us to the WannaCry ransomware that made headlines last year by encrypting files on its victims' computers and forcing them to pay in Bitcoin to get their information back. Hacking and cybercrime are nothing new, but what was new is that WannaCry was a new form of cyberweapon stolen from a US-based National Security Agency-linked spy group. This proves that cyberwar is now being fought on a national level.

You can read the above stories, as well as many others, in more detail in this issue of *Flashes*. As this year progresses, we can be sure there will be plenty more groundbreaking events to write about.

Jamal Bin Huwareb

CEO of Mohammed bin Rashid
Al Maktoum Knowledge Foundation



Mohammed bin Rashid Centre for Future Research Launched

His Highness Sheikh Mohammed bin Rashid Al Maktoum, Vice President and Prime Minister of the UAE and Ruler of Dubai, has launched the Mohammed bin Rashid Centre for Future Research.

The Centre will openly publish its research and findings to global academic and research communities and will adopt a new concept based on open and participatory international research among scientists. Its first series of research initiatives will include the financing of a research community of 3,000 scientists, to conduct new studies on space science and technology.

“Our future plans require a solid foundation of scientific research, which comply with our aspirations. Our goal is to create the means of communication between our young scientists and scientists from around the world, to exchange knowledge, transfer experiences and build our national research capacities,” His Highness Sheikh Mohammed bin Rashid stated.

During the Centre’s launch, in the presence of HE Mohammad bin Abdullah Al Gergawi, Minister of Cabinet Affairs and The Future, HE Sarah bin Youssef Al Amiri, Minister of State, and HE Omar bin Sultan Al Olama, Minister of State for Artificial Intelligence, HH Sheikh

Mohammed said, “We are seeking to make the UAE an efficient and influential part of the international academic and research community.”

He also highlighted the vital role of the UAE’s scientific community and added that the Dubai Future Foundation, the scientific community and the ministers of advanced sciences and artificial intelligence are an able part of the nation’s future scientific endeavours.

The Centre aims to support the UAE’s scientific research sector in a variety of areas, as well to raise the country’s position in scientific performance indicators. It also aims to support the efforts to link Emirati research projects to international academic institutions, as part of the UAE’s goal to become an incubator for scientific inventions, which will serve the strategy of the UAE Centennial 2071, based on prioritising space sciences and the advanced science sector.

The Mohammed bin Rashid Centre for Future Research has taken on a range of challenges that include specialised research on space science, by involving scientists and researchers from a variety of scientific and academic institutions in the UAE and around the world, to nominate their research projects on space science, space colonisation and the exploration of various aspects of human life. †



UAE Astronaut Programme Lifts Off

Following the announcement from HH Sheikh Mohammed bin Rashid Al Maktoum, Vice President and Prime Minister of the UAE and Ruler of Dubai, the Mohammed bin Rashid Space Center has begun accepting entries for the UAE Astronaut Programme. At the end of 2018, four carefully selected Emirati candidates will be chosen to form the UAE Astronaut team and undergo a three-year long intensive training programme to enable them to board the International Space Station (ISS).

The UAE Astronaut Programme had received more than 1,000 applications only a few days after the announcement. Young Emiratis from fields including ex-pilots, doctors,

scientists, teachers and others can register at www.mbrsc.ae/astronauts. Finalists will go through training in theory and science, as well as specialty qualification courses, over several months in accordance with the highest international standards and requirements. The team of four young Emirati astronauts will be sent to space as part of the country's growing space exploration programme that integrates advanced sciences into its national growth matrix.

The UAE Astronaut Program provides Emirati youth with a unique opportunity to make a significant contribution to the advancement of UAE's space exploration and innovation industry. †

Sheikh Mohammed Thanks 'UAE Team' in New Year Message

HH Sheikh Mohammed bin Rashid Al Maktoum, Vice President and Prime Minister of the UAE and Ruler of Dubai, wished Emiratis and residents a happy New Year and thanked those who made the world a 'better and happier' place.

"Brothers and sisters," he tweeted. "As 2017 comes to

an end, we proudly look back on the accomplishments we achieved and the challenges we overcame; thank you to everyone who was part of our success. We say thanks to everyone who was a part of these achievements and who was a part of the UAE team. We thank all who contributed to making our world better and happier." †



MBRF Establishes Itself as a Leader in Global Knowledge Production and Transfer

The Mohammed bin Rashid Al Maktoum Knowledge Foundation, a member of Mohammed Bin Rashid Al Maktoum's global initiatives, has established itself as one of the most important foundations that produces, transfers and disseminates knowledge in the region and the world through its diverse and innovative initiatives in 2017.

The events helped activate knowledge sharing as well as the development of new methods and tools to measure knowledge in addition to developing mechanisms and formulating proposals that contributed to the advancement of knowledge around the world.

The launch of the Global Knowledge Index, the first of its kind in the world, as part of the Foundation's strategic partnership with the United Nations Development Program (UNDP) and the Arab Knowledge Project, was one of the most important global initiatives. The Index highlighted knowledge as a comprehensive concept covering various aspects of human life and social, economic and cultural activities. It currently plays a key role in measuring and driving comprehensive and sustainable human development.

The announcement of the results of the index, which

To promote knowledge at the Arab and global levels, the Foundation also launched the Literacy in the Arab World project at the Knowledge Summit 2017, which aimed at providing people with the necessary skills and knowledge in response to the increasing challenges of new technologies. The goal was to help ensure the right to education for 30 million Arabs under the age of 18 by 2030 in the Arab world.

included data from 131 countries from all regions of the world, was made during the Knowledge Summit 2017, organised by the Foundation under the theme, 'Knowledge and the Fourth Industrial Revolution.' The event aimed to open new global horizons to optimize investment in intelligent technologies and the Fourth Industrial Revolution, to promote knowledge and stimulate its production to build knowledge societies globally.

To promote knowledge at the Arab and global levels, the Foundation also launched the Literacy in the Arab World project at the Knowledge Summit 2017, which aimed at providing people with the necessary skills and knowledge in response to the increasing challenges of new technologies. The goal was to help ensure the right to education for 30 million Arabs under the age of 18 by 2030 in the Arab world.

For the third consecutive year, the Foundation organized the Nobel Museum 2017 in Dubai under the theme, "The Nobel Prize in Physics: Understanding Matter". The Foundation is the first Arab organisation to conduct this prestigious knowledge event in the world having signed an exclusive partnership agreement with the Nobel Foundation.

As part of its efforts to promote the dissemination and production of knowledge in the region and the world, the Foundation launched masmoou.com, the region's largest audio book project through Qindeel Educational, MBRF's educational arm, to deliver a vast collection of e-books in all fields and in all languages.

Underlining its commitment to the community and contributing to the implementation of the directives of the wise leadership that support People with Determination, the Foundation also launched the Paralympic Summer Games' Rulebook in Arabic in collaboration with the International Paralympic Committee and the Dubai Club.

The Bil Arabi initiative, launched by the Mohammed bin Rashid Al Maktoum Knowledge Foundation, witnessed a wide spread of social networking sites across the world in its fifth year, with more than 2.4 billion views and interactions, in conjunction with the events organised by the Foundation to celebrate the International Day of the Arabic Language, which is set by the United Nations to be marked on 18 December each year. Its goal is to enhance the status of the Arabic language among the languages of the world and encouraging its use in social media channels.

More Training Workshops for Dubai International Writing Program

The Mohammed bin Rashid Al Maktoum Knowledge Foundation has announced the launch of a series of training workshops for 2018 as part of the Dubai International Writing Program to develop young talent in the fields of translation, short story, literature, novel and other creative writing.

The Foundation has signed a series of contracts with qualified trainers to conduct the workshops and share knowledge, expertise and skills.

The workshops first started in 2014 with a focus on enriching the Arab cultural scene. It has resulted in over 40 books including novels, translated works, children's literature and other creative writing.

More than 40 writers attended these workshops gaining skills in professional writing based on the right linguistic principles and approaches.



Salem Al Owais, Chairman of the Dubai International Writing Program, said: "The programme aims to support authors in all fields of knowledge – from science and research to literature – to nurture their talent and provide total support to strengthen content creation in Arabic. Our goal is to enhance Arabic literature, and elevate it globally with the support of reliable publishing houses inside and outside the UAE."

The Mohammed bin Rashid Knowledge Foundation has invited talented individuals who wish to develop their writing skills to enrol in the workshops being held this year by registering at: Dipw@mbmf.ae

The submissions will be evaluated and based on the individual's specialisation, they will be enrolled for appropriate training courses that will be launched in mid-January 2018.



COUNTRY PROFILE: UNITED ARAB EMIRATES

GDP US\$348.74 BN

POPULATION 9,154,302

HDI 0.84

SECTORIAL INDICES



PRE-UNIVERSITY EDUCATION (PUE)

RANK **16**
VALUE **70.3**



TECHNICAL VOCATIONAL EDUCATION & TRAINING (TVET)

RANK **24**
VALUE **61**



HIGHER EDUCATION (HE)

RANK **27**
VALUE **50**



RESEARCH, DEVELOPMENT & INNOVATION (RDI)

RANK **37**
VALUE **28.7**



INFORMATION AND COMMUNICATIONS TECHNOLOGY (ICT)

RANK **23**
VALUE **71.3**



ECONOMY

RANK **2**
VALUE **66.9**

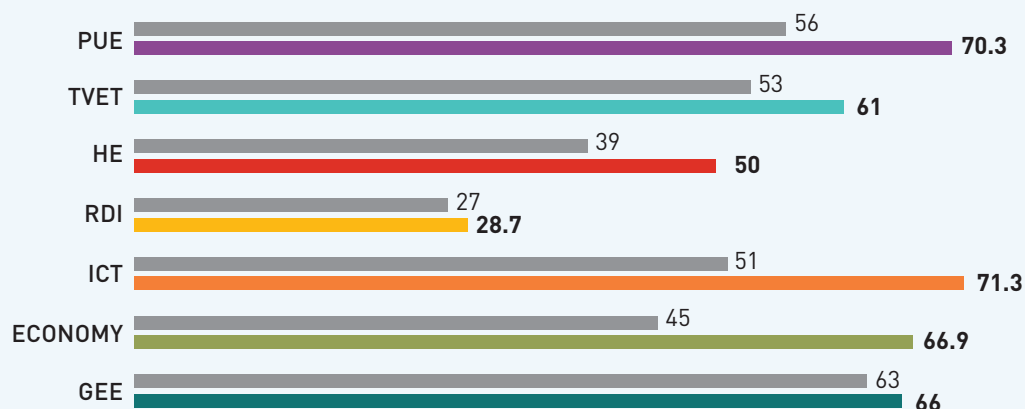


GENERAL ENABLING ENVIRONMENT (GEE)

RANK **46**
VALUE **66**

SECTORIAL INDICES IN COMPARISON WITH WORLD AVERAGE

● World Average ● Sectorial Indices



WORLD RANK 25/131

NZ
22

Estonia
23

Malta
24

UAE
25

Canada
26

Portugal
27

Czech
Republic
28

GENERAL ENABLING ENVIRONMENT

46 RANK 66 VALUE

POLITICAL AND INSTITUTIONAL

29 RANK 74 VALUE

SOCIO-ECONOMIC

59 RANK 60 VALUE

HEALTH AND ENVIRONMENT

112 RANK 67 VALUE

PRE-UNIVERSITY EDUCATION

16 RANK 70.3 VALUE

KNOWLEDGE CAPITAL

20 RANK 68.3 VALUE

EDUCATIONAL ENABLING ENVIRONMENT

20 RANK 73.4 VALUE

TECHNICAL VOCATIONAL EDUCATION AND TRAINING

24 RANK 61 VALUE

FORMATION AND PROFESSIONAL TRAINING

33 RANK 58.7 VALUE

FEATURES OF THE LABOUR MARKET

33 RANK 64.4 VALUE

HIGHER EDUCATION

27 RANK 50 VALUE

HIGHER EDUCATION INPUTS

27 RANK 51 VALUE

HIGHER EDUCATION OUTPUTS AND QUALITY

30 RANK 49.3 VALUE

RESEARCH, DEVELOPMENT AND INNOVATION

37 RANK 28.7 VALUE

RESEARCH AND DEVELOPMENT

55 RANK 21.6 VALUE

INNOVATION IN PRODUCTION

24 RANK 44.2 VALUE

SOCIAL INNOVATION

53 RANK 34.5 VALUE

INFORMATION AND COMMUNICATIONS TECHNOLOGY

23 RANK 71.3 VALUE

ICT INPUTS

39 RANK 68.2 VALUE

ICT OUTPUTS

14 RANK 72.6 VALUE

ECONOMY

2 RANK 66.9 VALUE

KNOWLEDGE COMPETITIVENESS

11 RANK 64.6 VALUE

ECONOMIC OPENNESS

1 RANK 78.5 VALUE

FINANCING AND VALUE ADDED

11 RANK 59.7 VALUE

EXPLORE



THE PROBLEM OF CYBERWEAPONS

What happens when governments create sophisticated cyberweapons and they fall in the wrong hands? The recent WannaCry attack is one such example.

As Santa Ana, California resident Luis Mijangos went to open his front door on March 10, 2010, he had just the one thought: a surprise party. He figured the commotion outside his front door was just his friends and extended family trying to catch him off guard on his 31st birthday. Imagine his disappointment when a team of FBI agents walked through the door with a warrant to search his home. The agents ransacked the place and walked out with four laptops, scattered thumb drives and memory sticks, and a BlackBerry.

Mijangos showed a lot of promise as a young kid. He played as a forward for his football team with the chance of going pro growing with every passing year. Unfortunately, he was caught in a gang war crossfire at the age of 16; a bullet had severed his spinal cord rendering him paralyzed from the waist down. Broken, Mijangos dropped out of school and hid from the world. When he was ready, he would enrol himself for a computer programming course and teach himself to code. A few clicks later, he was hacking. What started with credit card theft – that paid for his \$5,000 titanium wheelchair – led to hacking into victims' computers, controlling their webcam, and extorting them. By the time the FBI got wind of his activities, he had already victimized about 186 women and 44 girls.

At the same time Mijangos was apprehended, the world had been introduced to its first digital weapon: Stuxnet. The

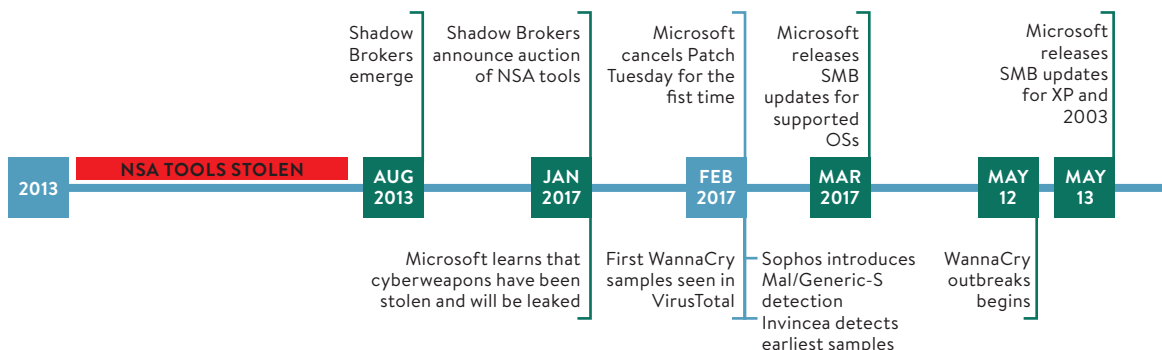
virus' attack on Iran's nuclear facility at Natanz in 2009 was sophisticated for its time. It caused uranium centrifuges to slowly fail by modulating their speed, all the while hiding the effects from Iranian engineers. It quickly spread outside Iran, ultimately infecting over 100,000 computers in India, Indonesia, and elsewhere. That's what makes Mijangos' case scarier. The Stuxnet worm was expensive to create and took 8 to 10 people six months to write. Mijangos just needed a computer and access to the internet.

The panic around hacking and its threat to global security hit an all-time high last year with the WannaCry attack that infected more than 300,000 computers across 150 countries including hospitals in the United Kingdom. WannaCry is a ransomware that spreads through a flawed protocol used by Windows machines to communicate with file systems over a network. Once the ransomware infects a system, it takes control of every file on the victim's computer and leaves just two files: one that contains instructions on what has happened and one explaining how to pay to get your own files back – via Bitcoin, of course.

The attack was thwarted just five days after the initial outbreak, but not before total damages ranging from hundreds of millions to billions of dollars. The man who saved the world was 22-year-old self-taught IT-whizz, Marcus Hutchins. The man better known on the internet as



WANNACRY TIMELINE



Countries initially affected in WannaCry ransomware attack



Malware Tech admitted that he managed to stop the outbreak by pure luck. Nevertheless, he did what tech honchos around the world couldn't.

Months before anyone had ever heard about the WannaCry ransomware, a group of hackers called the Shadow Brokers stole a collection of files that belonged to a National Security Agency-linked spy group, and tried to auction those files off to the highest bidder. In that trove of stolen NSA code was an NSA-created hacking technique known as Eternal-Blue, which exploits flaws in a Windows protocol known as Server Message Block to remotely take over any vulnerable computer.

WannaCry was a ransomware built out of this NSA cyberweapon. It was proof that not only could the United States' intelligence agency create cyberweapons that the rest of the world couldn't even fathom, they also had no way of containing their creations if and when they fell into the wrong hands.

Attackers further retrofitted the NSA's cyberweapons to steal credentials from American companies. Cybercriminals have used them to pilfer digital currency. North Korean hackers are believed to have used them to obtain badly needed currency from easy hacking targets like hospitals in England and

manufacturing plants in Japan.

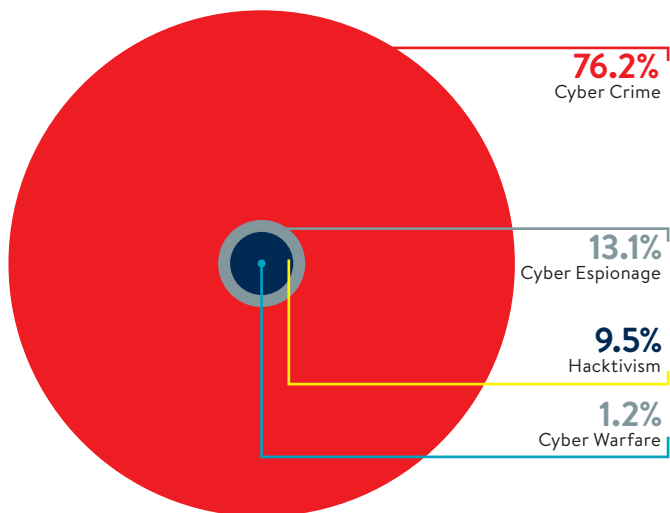
In 2017 on Ukraine's Constitution Day – which commemorates the country's first constitution after breaking away from the Soviet Union – attackers used NSA-developed techniques to freeze computers in Ukrainian hospitals, supermarkets, and even the systems for radiation monitoring at the old Chernobyl nuclear plant. The attacks inflicted enormous collateral damage, taking down some 2,000 global targets in more than 65 countries, including Merck, the American drug giant, Maersk, the Danish shipping company, and Rosneft, the Russian state owned energy giant. The attack so crippled operations at a subsidiary of Federal Express that trading had to be briefly halted for FedEx stock.

In December last year, the United States pinned the digital epidemic, WannaCry on North Korea. The announcement came in the form of an op-ed in *The Wall Street Journal* authored by Trump's Homeland Security Advisor, Thomas Bossert. While it was previously reported that the US National Security Agency was in possession of evidence that pointed to North Korea, Bossert's op-ed publicly confirmed the NSA's findings with support from evidence gathered by foreign governments, independent cybersecurity firms, and corporations directly hit by the attack.

This isn't the first time North Korea has been accused of cyberattacks. In fact, many experts believe that cyber capabilities have become a key asset in North Korea's war chest that has been used to hack into banks around the world, leak Sony Pictures' scripts and emails, and revealing South Korea's confidential military information. To make matters worse, in October last year, Russia provided North Korea with a better internet connection that not only boosts the country's cybersecurity strengths but also improves its hacking capabilities. The Russians have been accused of many cyberattacks as well: from the hacking of the US Democratic Party's servers to Donald Trump's election.

MOTIVATION BEHIND ATTACKS

Source: hackmageddon.com



Currently, the United States, Britain, Germany, Norway, Spain, Denmark and the Netherlands are drawing up cyber warfare principles to guide their militaries on what justifies deploying cyber attack weapons more broadly, aiming for agreement by early 2019. The 29-nation NATO alliance had recognised cyber as a domain of warfare, along with land, air and sea, in 2014, but has not outlined in detail what that entails.

In Europe, the issue of deploying malware is sensitive as democratic governments do not want to be

seen to be using the same tactics as an authoritarian regime. Commanders and experts have focused on defending their networks and blocking attempts at malicious manipulation of data. Senior Baltic and British security officials say they have intelligence showing persistent Russian cyber hacks to try to bring down European energy and telecommunications networks, coupled with Internet disinformation campaigns.

What is clear is that we're still horribly underprepared for a cyberwar. Cyberattacks are damaging when orchestrated by lone criminals and hacktivists with a point to prove, but take on a more sinister and potentially catastrophic significance when carried out or supported by government-funded military or intelligence units. State-sponsored espionage has been growing so much that we're now at a point where everything we do online can be tracked by another country. The situation is so grave that there are calls to establish agreed rules on the use of cyber weapons against the critical national infrastructure (CNI) of individual countries. The need for a cyberweapon treaty cannot be stated enough. A cyberattack is hard to detect, can have a devastating effect and is far easier – logistically – to carry out compared to air strikes, bombings or military action.

So long as flaws in computer code exist to create openings for digital weapons and spy tools, security experts say the NSA and other governmental organisations are not likely to stop hoarding software vulnerabilities any time soon. ↑

Below: South Korea traced a number of WannaCry attacks back to North Korea.



SECURING THE FUTURE

Pablos Holman is a futurist, inventor, and notorious hacker with a unique view into breaking and building new technologies.

Holman earned his early fame as a white hat hacker by doing parlour tricks where he stole audience member's passwords and broke into their phones on stage. Another favourite was to remotely scan credit card details without physically touching the card. Why? To highlight the flaws in cybersecurity and how vulnerable we all are.

According to Holman, cyber criminals will always be one step ahead. On the side line of last year's Knowledge Summit 2017, which was organised by the Mohammed Bin Rashid Al Maktoum Knowledge Foundation, he pointed out that we can never make things perfectly secure and that it is impossible to anticipate everything that can go wrong.

"Attackers have more time and attention to waste on messing with your stuff than you do," said Holman. "Change your perspective. It's a risk management problem, assume you've been compromised and act accordingly. What I worry about is people getting paralysed by these fears around security."

As we become more connected through

technology the opportunity for hackers to exploit security flaws increases exponentially.

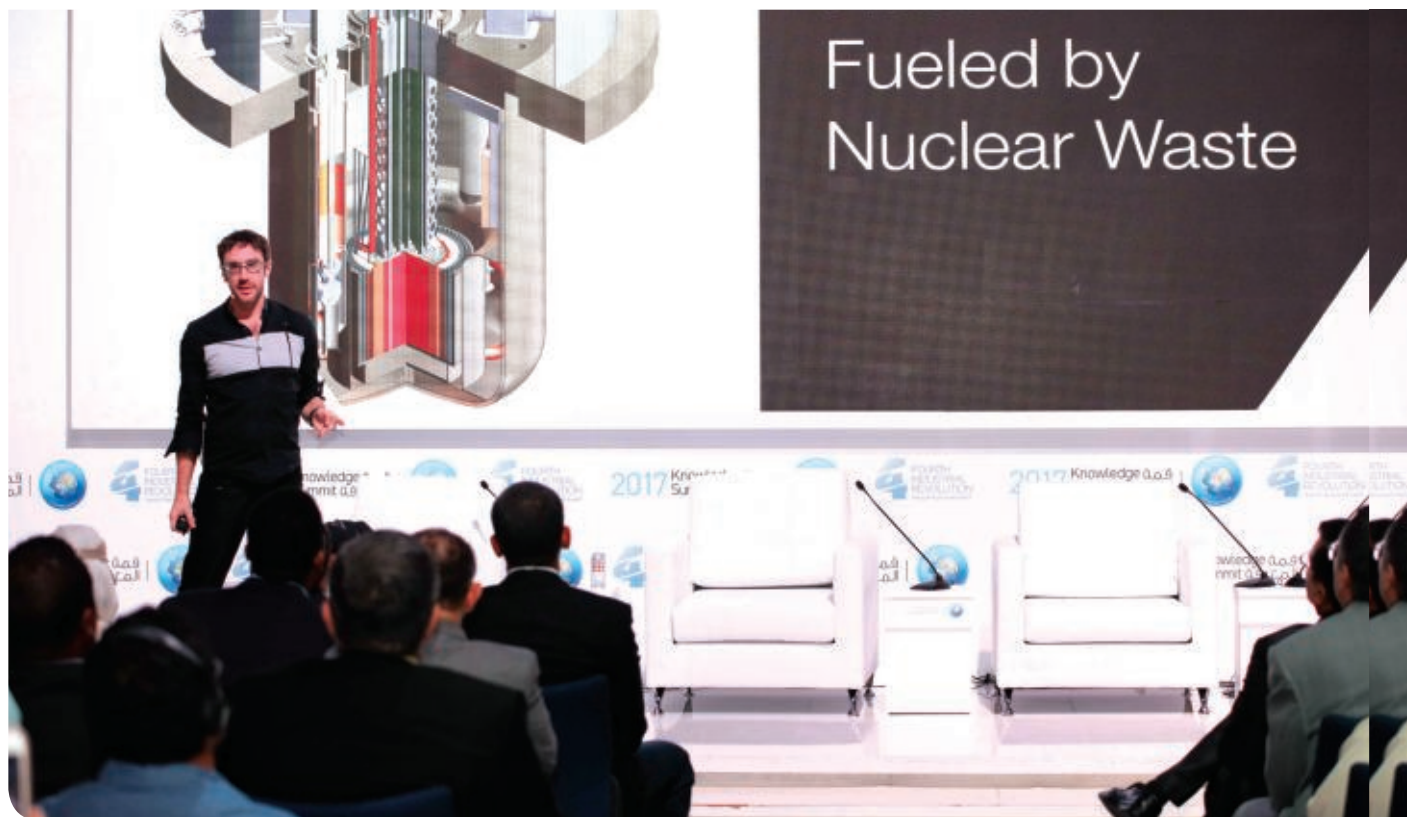
"Whether you're talking about a computer, phone, car, or plane – they're all using the same kinds of operating systems and chips, so they're all susceptible to the same types of attacks. And we don't really know how to fix this. I worked in computer security for a long time before I realised we security experts were never going to win."

So in a world dominated by technology, are we heading for a catastrophic cyberattack? Holman doesn't think so.

"If I'm a sophisticated hacker and I get into your computer, am I going to shut down the power grid. Why? You are just going to reboot, kick me out, and six minutes later the country would be back to normal.

"Catastrophic failures are improbable from an attacker's perspective. What I would do instead is, if I get into your machine, your power system, your company, I'm going to hide, and sit and watch and find something I can trade on. This is what is going on, this is what we need to worry about." >





However, the world of hacking is not all bad, as the skills and talents of hackers can be harnessed and, when bolstered with big data, artificial intelligence and other technological advances, can achieve positive outcomes.

That is why Holman has changed job direction and now works as an inventor at Intellectual Ventures Laboratory headquartered in Bellevue, Washington. According to Holman the Bill Gates-backed lab files the largest number of patents yearly in new inventions and has, to date, filed the most patents in history.

Holman himself is consulting worldwide on invention and design projects that assimilate new technologies - making wild ideas a bit more practical and vice versa. He helped create the world's smallest PC; 3D printers at Makerbot; spaceships with Jeff Bezos; artificial intelligence agent systems; and the Hackerbot, a Wi-Fi seeking robot.

"The most challenging aspect of invention is simply the lack of time," explained Holman. "I always dream of applying all of my time to the right ideas or inventions. But mystically I have no way of knowing whether an idea or invention is the right thing. Since I am always working on

the five-to-ten-year horizon, some of my futuristic ideas can be off the mark - I can be wrong about what will happen in the next decade. All of this means that I can waste far too much time inventing one thing. And that can be nerve-wracking!"

Holman believes that the hacker mentality drives innovation that is good for the invention progress.

"You need that discovery process to get every new technology," he said, noting hackers' propensity to disassemble new gadgets immediately. "They flip it over, take out all the screws, break it into a lot of little pieces - but then figure out what can we build from that rubble."

"It's that discovery process that starts every new invention, every new innovation," Holman pointed out. "You can't get a new invention by reading the directions. That's never happened before. That never will happen. The mind of a hacker is really important for figuring out what's possible for new technology."

Holman said he's enlisted hackers to work with him at Intellectual Ventures Laboratory, where ideas include a machine to suppress hurricanes, a system to reverse global warming, a fission reactor

Above: Holman at the Knowledge Summit 2017.

powered by nuclear waste, and a mosquito-targeting laser system to eliminate malaria.

“We basically bought one of every tool in the world, hired one of every kind of scientist, put them all on the same team and tried to start going after the biggest problems we can find,” he explained.

As far as Holman is concerned, the biggest threat to humanity is not hacking and cyber-crime, but the disruptive potential and power of new technology.

He pointed to the arrival of supercomputers and the ways they are transforming the world.

“Our computational ability, for the first time in history, has surpassed our imagination. We are at the beginning, right now, of figuring out what computers are good for.

“Big data, artificial intelligence, computational modelling - all these things together mean we are going to flip our relationship between causations and correlation.”

At the Knowledge Summit 2017, he showed a video of a prototype self-sewing machine that can make clothing without human operation. It has the ability to adversely affect clothing factories across major centres in Asia where cheap labour dominates the textile and fashion production industry.

Holman outlined that the “\$2 trillion industry will be disrupted. We will recreate that industry.”

According to Holman, the clothing industry was an example of gross inefficiency. “Consider a simple t-shirt, your lowest common denominator product. First you grow cotton in one country and then ship it to another country to be beaten down and bleached into something sort of white. Then it’s sent to another country to be spun into yarn, and then shipped to another country to be knit or woven into fabric. Then it’s shipped off to another country to be sewn into t-shirts, and then shipped somewhere to be sold.”

That is the reason why Holman founded Bombsheller, a made-to-order system that has only recently become possible due to the new technologies transforming the apparel landscape. The Seattle-based company makes performance-grade graphic leggings for men and women in real time, using customized software that controls an in-house dye-sublimation printer. What makes Bombsheller unique for the clothing industry is that they don’t spend a dime until a pair of leggings are sold. That means there’s no waste since they’re not taking on any inventory risk or guessing about market demand. That is why concepts such as 3D printing are so important to Holman.

“3D printers are programmable factories. It

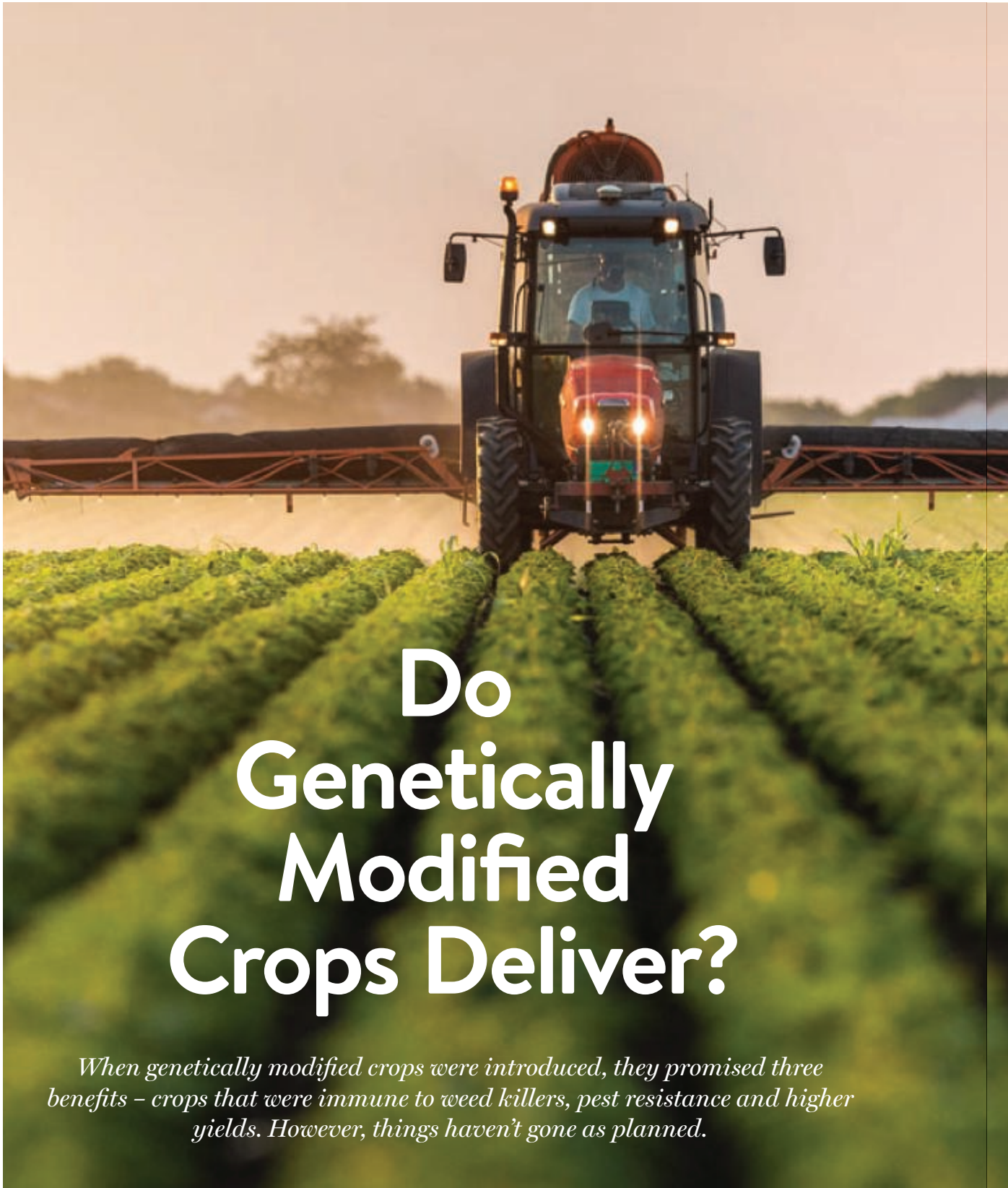
doesn’t care if I make the same thing twice, since it’s just using code. That programmability will allow us to change everything about the way we make things.”

Technology, he said, is vital for overcoming hurdles that keep humans from thriving, and will be instrumental in solving some of the resulting concerns including food, housing and employment for a growing population.

“Our job is to figure out how we will solve those problems at a scale,” he said. “We are at a point, now, where we have more computational power than we have imagination. That’s why we will solve every one of them with a new technology — not government, not religion or an election.”

Below: Holman works at the Intellectual Ventures Laboratory, which to date has filed the most patents in history.





Do Genetically Modified Crops Deliver?

When genetically modified crops were introduced, they promised three benefits – crops that were immune to weed killers, pest resistance and higher yields. However, things haven't gone as planned.

For most people, genetically modified (GM) crops present only one dilemma – whether to eat them or not. However, there are more pertinent questions that need to be addressed. While scientists did want crops that were easier to cultivate, more nutritious and aesthetically pleasing, the main aim was increasing crop yields without an increase in the use of pesticides.

Has this aim been reached? Based on data from the United Nations, a New York Times analysis shows that GM crops in the United States and Canada have not accelerated increases in yields or led to an overall reduction in the use of chemical pesticides.

Genetic modification promised crops that would not be affected by weed killers, they would require fewer doses of sprayed pesticides as they would be inherently resistant to pests, and they would grow robustly thereby becoming indispensable to feeding the world's growing population. The United States and Canada eagerly embraced GM crops, while Europe remained skeptical and largely rejected them. Comparing results on the two continents, the study has shown that GM crops have fallen short of its promise. Crop yields in the US and Canada did not show any discernible gain when measured against European countries like France and Germany, which employ modern agricultural

practices. Another study by the National Academy of Sciences also found “little evidence” that GM crops in the US yielded gains beyond those seen in conventional crops.

Despite using modified varieties of major crops like corn, soybeans and cotton, the use of herbicides has gone up. The United States has fallen behind Europe's biggest agricultural producer, France, in reducing the overall use of pesticides, which includes both herbicides and insecticides. Data from the US Geological Survey showed that since the introduction of GM crops two decades ago, the use of insecticides and fungicides had fallen by a third, but herbicide use had risen 21 per cent. On the other hand, France had successfully reduced use of insecticides and fungicides by almost 65 per cent and herbicides by 36 per cent.

ACTUAL CAUSE FOR CONCERN

While the harmful effects of GM foods remain to be proved, researchers are now drawn to the potential harm from pesticides. Pesticides are toxic by design and regular consumption can result in developmental delays and cancer. A Harvard University research attributes the loss of nearly 17 million IQ points among American children five-years old and under to one class of insecticides.

In the past two decades, herbicide use has skyrocketed in soybeans, a leading GM crop,





Above: In the past five years, developing countries have planted more GM crops than the industrial countries.

going up by two and half times while planted acreage of the crop grew less than by a third. Herbicide use was on a downward trajectory even before the introduction of the GM variety, but surprisingly doubled from the years 2002 to 2010 before leveling off. Weed herbicide resistance has pushed overall usage up.



HOW MUCH PESTICIDE DOES THE WORLD USE?

A 2014 report by research company Springer reports the worldwide consumption of pesticides is about two million tonnes per year: out of which 45 per cent is used by Europe, 25 per cent is consumed in the USA, and 25 per cent in the rest of the world. Globally, the pesticides cover only 25 per cent of the cultivated land area. These include herbicides, fungicides and insecticides.

However, the Times study is being challenged by both GM crops and pesticides manufacturers. They say the Times cherry-picked data to reflect poorly on the industry. “Every farmer is a smart businessperson, and a farmer is not going to pay for a technology if they don’t think it provides a major benefit. Biotech tools have clearly driven yield increases enormously,” said Robert T. Fraley, chief technology officer at Monsanto, the world’s largest seed company. Regarding the use of herbicides, in a statement, Monsanto said, “While overall herbicide use may be increasing in some areas where farmers are following best practices to manage emerging weed issues, farmers in other areas with different circumstances may have decreased or maintained their herbicide usage.”

Ironically, the industry is winning on both ends. The companies that make and sell GM crops also sell the pesticides. Case in point is the six-fold increase in the combined market capitalizations of Monsanto and the Swiss pesticide giant, Syngenta. Separate merger agreements have raised their new combined values to more than \$100 billion each.

But it would be unfair to write off GM crops completely. Martin Qaim, a researcher at Georg-August-University of Göttingen, Germany, notes significant yield gains from GM crops – mostly from insect-resistant varieties – in developing countries, especially India.



GENETICALLY MODIFIED CROPS ARE CONSIDERED THE FASTEST ADOPTED CROP TECHNOLOGY IN THE HISTORY OF MODERN AGRICULTURE.

Farmers with fields plagued by weeds or a particular pest or disease are obvious champions of GM crops. “It’s silly bordering on ridiculous to turn our backs on a technology that has so much to offer,” said Duane Grant, the chairman of the Amalgamated Sugar Company, a cooperative of more than 750 sugar beet farmers in the Northwest. He says crops resistant to a certain popular weed killer saved his cooperative.

However, weeds are becoming increasingly resistant to widely used pesticides around the world. This resistance is spurring manufacturers to sell more seeds and pesticides. Companies are also now manufacturing seeds that are resistant to multiple weed killers. This means farmers can now spray a wider array of poisons – manufactured by the same companies.

There are some farmers who are trying to make do without GM crops, but

In 2016, 185.1 million hectares of GM crops were planted by 18 million farmers in 26 countries. This marked a 110-fold increase from the initial planting of 1.7 million hectares in 1996 when the first GM crop was commercialised.

In the past five years, developing countries have planted more GM crops than the industrial countries. In 2016, 19 developing countries planted 54 per cent (99.6 million hectares) of the global biotech hectares, while seven industrialised countries took the 46 per cent (85.5 million hectares) share. The USA is the top producer of GM crops globally, planting 72.9 million hectares – 39 per cent – of the global GM crop plantings in 2016. Brazil holds the second spot, with 49.1 million hectares or 27 per cent of the global output. According to Cropnosis, the global market value of GM crops in 2016 was US\$15.8 billion.

the choice is a difficult one. While they do appreciate the ability of GM crops to reduce insecticide use, they would prefer plants with classic traits such as yield capabilities and the ability to stand well without support.

The world’s population is expected to reach nearly 10 billion by 2050 and GM crop companies cite the food demand of these added billions as their primary driver. “It’s absolutely key that we keep innovating,” said Kurt Boudonck, who manages Bayer’s sprawling North Carolina greenhouses. “With the current production practices, we are not going to be able to feed that amount of people.”

But a broad yield advantage still eludes manufacturers. Michael Owen, a weed scientist at Iowa State University, said that while the industry had long said GM crops would “save the world,” they still “haven’t found the mythical yield gene”.†

EXPLORE



BITCOIN MANIA

This peer-to-peer electronic cash system is the world's biggest cryptocurrency, but it has its detractors.

2017 closed as the year of Bitcoin. From January to December the price of Bitcoin climbed from below \$1,000 to nearly \$20,000 on the CoinDesk Bitcoin Price Index (BPI). Yet at the end of December, Bitcoin fell below \$15,000 after the cryptocurrency's biggest rally in two weeks ended a rout that wiped more than \$9,000 off the price.

As a result, this purportedly revolutionary cryptocurrency continues to be feverishly covered in the global media. The 'crypto' in its name refers to the encryption of any digital monetary asset. Cryptocurrencies are designed to work as a medium of exchange, deploying cryptography for secure transactions and allowing consumers to make electronic purchases without commercial banks as intermediaries. Bitcoin is by far the most dominant cryptocurrency and it is the one investment that everyone wishes they had made a year ago – whether they understand what Bitcoin actually is or not.

As US Senator Thomas Carper recently quipped, "Virtual currencies, most notably Bitcoin, have captured the imagination of some, struck fear among others, and confused the heck out of the rest of us."

When it was first

launched, one Bitcoin could be bought for just over one cent. The value of one Bitcoin at the time of writing is a little over \$18,000. Back in those early days a \$12 purchase would now be valued at \$18 million. If that missed opportunity stings a little, spare a thought for those who actually did make Bitcoin investments, only to lose the private digital key-code that is essential for verifying they own the virtual cash.

Campbell Simpson, an Australian tech journalist and former editor at Gizmodo, posted a painfully blunt tweet in May this year that read – "I threw away \$4.8 million in Bitcoin." In a subsequent article Simpson expanded, "Five years ago, I threw away a hard drive. An utterly generic 250GB portable hard drive, already a few years old, with a couple of dings and scratches in its shell and with the beginnings of an audible click that would have eventually killed it. It had a data file containing 1,400 Bitcoin on it. No big deal, at the time."

His \$4.8 million would actually be \$25.2 million today, but who's counting. A more extreme example is James Howells from Wales, who explained to the BBC that he thought he'd backed up everything when he threw out an old computer... which held a digital wallet file containing 7,000 bitcoins, now worth \$120 million.

Disproportionately cruel lessons about sensible tech disposal aside, is it still a shrewd investment to buy Bitcoin ➤

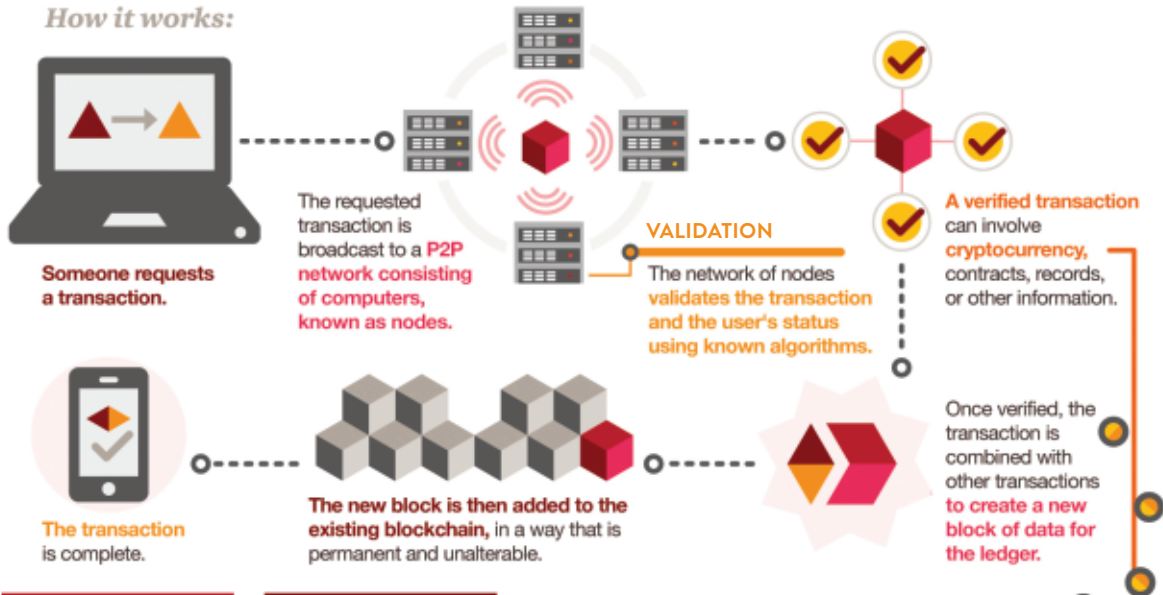


A LOOK AT BLOCKCHAIN TECHNOLOGY

WHAT IS IT?

The **blockchain** is a decentralized ledger of all transactions across a peer-to-peer network. Using this technology, participants can confirm transactions without the need for a central certifying authority. Potential applications include fund transfers, settling trades, voting, and many other uses.

How it works:



BENEFITS

- Increased transparency
- Accurate tracking
- Permanent ledger
- Cost reduction

UNKNOWN

- Complex technology
- Regulatory implications
- Implementation challenges
- Competing platforms

CRYPTOCURRENCY

Cryptocurrency is a medium of exchange, created and stored electronically in the blockchain, using encryption techniques to control the creation of monetary units and to verify the transfer of funds. Bitcoin is the best known example.

Has no intrinsic value in that it is not redeemable for another commodity, such as gold.

Has no physical form and exists only in the network.

Its supply is not determined by a central bank and the network is completely decentralized.

POTENTIAL APPLICATIONS



AUTOMOTIVE

Consumers could use the **blockchain** to manage fractional ownership in autonomous cars.



FINANCIAL SERVICES

Faster, cheaper settlements could shave billions of dollars from transaction costs while improving transparency.



VOTING

Using a blockchain code, constituents could cast votes via smartphone, tablet or computer, **resulting in immediately verifiable results.**



HEALTHCARE

Patients' encrypted health information could be shared with multiple providers without the risk of privacy breaches.

now? The controversial digital cash is certainly seeing some mainstream acceptance, with recent reports of Japanese companies paying employees in Bitcoin and house purchases in the USA being bought with Bitcoin. It could be a bubble or it could be the beginning of a new paradigm shift – the first stages of cashless societies around the globe.

Bitcoin is spent in much the same way as sending money digitally from your bank to pay for goods or services, except the necessity of a bank, acting as a third party, is removed. In the Netflix documentary *Banking on Bitcoin*, Gavin Andresen, Chief Scientist of the Bitcoin Foundation, explains, “Before, if you wanted to send something of value across the internet you had to get somebody else – a credit card company or PayPal or a bank – involved in the transaction. The promise of Bitcoin is that you’re directly sending this currency to another person and then the Bitcoin network performs the function a bank would perform. Bitcoin really puts the control back in the hands of everybody, everybody who is participating in the Bitcoin system is controlling how it works.”

In this sense, Bitcoin can be seen as an attempt to remove power from the astonishingly corruptible and corrupted financial banking sector and give it to the people. With no third “trusted” party, individuals have power over their own money and the control of personal information is returned to the individual, but as with most inventions, it’s impossible to predict how it will be adopted, adjusted and mutate.

One growing function is in international remittances. Often low-paid workers spread around the globe either don’t qualify for bank accounts or feel uncomfortable in the financial sphere, so they are forced to use wire services to send money back to their families. These remittance transactions are carried out by companies such as Western Union. The issue here is that they are very expensive and a significant amount of a person’s wage is lost in relatively high fees.

This is changing with Bitcoin. Andresen says, “Since Bitcoin doesn’t care about borders, I can just send Bitcoin to another country – and if my family in that other country has some way of spending that Bitcoin or exchanging it into local currency, then it’s just quicker and cheaper and more convenient. A lot of people think that remittances will be one of the really big first uses of Bitcoin.”

As Bitcoin is not controlled by a central company or person, it can’t be closed down. And if it can’t be closed then it simply requires more useful functions, >

such as remittances, to become widely adopted. This simple logic was at the heart of the digital currency drive back in the 90s when digital currencies were a niche subject for a small group of “Cypher Punks” (cypher denoting secret messages).

Working collaboratively and in competition, the leading figures in the Cypher Punk scene strove to launch a successful system. Nick Szabo had Bit Gold, Adam Back worked on Hash Cash, Wei Dai had B-Money and R-Pow was the brainchild of computer scientist Hal Finney.

When none of these attempts found wings, interest in digital currencies died off until roughly a decade later when Bitcoin was announced in the publication of a white paper in October 2008, by Satoshi Nakamoto.

The interest in digital currencies, which coincided with the global financial crisis, was reignited. This unknown figure, Satoshi Nakamoto, had seemingly cracked it with Bitcoin. The first Bitcoin was created on January 3, 2009 – just weeks after the collapse of the Lehman Brothers and the beginning stages of the





Above: Gavin Andresen is the Chief Scientist of the Bitcoin Foundation.

economic meltdown. Nakamoto sent that first Bitcoin to the aforementioned Hal Finney.

Although completely unheard of for most people, Bitcoin had arrived. It has stealthily outperformed all global currencies in eight out of the last nine years. As success mounted the spotlight naturally turned towards Nakamoto, yet the founder of Bitcoin remained in the shadows. Nakamoto's identity has long been a hotly contested blend of myth making and obfuscation and the ongoing lack of incontestable truth means it remains something of a holy grail for investigative minds.

In early 2016, the world thought Nakamoto had been unveiled by the publications *Wired* and *Gizmodo*, as Australian computer scientist and information security specialist, Craig Wright. An expert in cryptography, Wright had long been evangelical in his support for the digital currency. At a Bitcoin conference in Melbourne in 2014 he stated, "Bitcoin is basically the future of everything. I'm not talking money, I'm talking everything. It comes from the idea of merging a number of cryptographic protocols with a triple entry ledger. It's the way and means of creating not only smart currency but a means of tracking and registering anything that can exist. That's anything from IDs, reputations, people, ownership of

digital property rights and the micro payments associated with those, charging, assurance contracts – anything you can think of. Anything that we have now and more."

In May of 2016, Wright provided a demonstration to the BBC of the verification process used in the very first Bitcoin transaction. But the pressure of being the creator was too much for Wright and he later reneged on the claim. In a final posting on his personal blog Wright stated, "I'm sorry. I believed that I could do this. I believed that I could put the years of anonymity and hiding behind me. But, as the events of this week unfolded and I prepared to publish the proof of access to the earliest keys, I broke. I do not have the courage. I cannot."

As it stands, there is no Bitcoin creator claim from any party and the Bitcoin Core Project – an open source project which releases Bitcoin client software stated, "There is currently no publicly available cryptographic proof that anyone in particular is Bitcoin's creator."

What is not in dispute is the core reason behind the phenomenal success of Bitcoin – the blockchain. An encryption-based digital ledger, the blockchain effectively replaces the centralized third party. It is an open ledger, online for anyone to see, and by monitoring

HOW YOUR BITCOIN IS SECURED



and updating that ledger in a collective and consensus-based system, the third party, for example a bank acting as a repository of all the information, is dispensed with. That saves on the fees, inefficiencies and the potential for corruption and risk that comes from centralised banks are subject to.

Michael Casey, a columnist at the Wall Street Journal, says, "Bitcoin, in being the first to achieve this holy grail of decentralized value exchange, that transfers that process of trust to a collective agreement around a body of independent computers, who are compelled by an incentive system to maintain that consensus and confirm the information to be correct, is incredibly liberating because it means we can do it without all these intermediaries in all these different realms. The most important thing behind Bitcoin is not the currency, the key factor is the blockchain".

However, as the number of Bitcoins in circulation rises – there are approximately 15.5 million bitcoins currently in circulation, with an imposed cap of 21 million – the rigorous computation required to maintain the validation process and mine bitcoins via the blockchain, means colossal power consumption.

An article on grist.com, that was re-published by *Wired*, claims that each bitcoin transaction requires the same amount of energy used to power nine homes in the US for one day. The article also stated that the aggregate computing power of the bitcoin network is nearly 100,000 times larger than the world's 500 fastest supercomputers combined. The calculations meant that over 150 individual countries in the world

consume less energy annually, and that the Bitcoin power-hungry network is currently increasing its energy use every day by roughly the same amount of electricity that Haiti uses in a year.

The mathematics used to make these comparisons have since been denounced as heavily flawed, in particular by Andreas Antonopoulos, a California-based Bitcoin expert and author of several books on Bitcoin. Antonopoulos says, "If you look at the big picture, mining – for the value it delivers in terms of securing the transaction of this novel payment system – mining is probably creating the most efficient secure mechanism on a per transaction basis than any of the payment networks that have existed ever before". What is irrefutable is that Bitcoin transaction fees have gone from around \$2 a transaction in October 2017 to \$37 in late December.

Bitcoin may well level out with respect to its carbon footprint, or the bubble could burst any day, or it just might evolve into much more than a booming digital currency – the possibilities are left to be seen. According to Antonopoulos and legions of Bitcoin advocates – Bitcoin is here to stay. Antonopoulos advises, "Start thinking of Bitcoin not as a currency but as a trust platform. One that provides you with a scriptable environment where you can combine conditions that get evaluated neutrally by a network-centric system of trust. I mean, it's an enormously powerful idea and you can do all kinds of decentralized things with it that we haven't yet imagined beyond currency."

DRONES IN

Wildlife biologists and environmentalists are increasingly using drones to study wildlife and gather data.

The leading cause of death for wildlife biologists while they are working is small plane or helicopter crashes. In order to learn about wild animals, biologists have traditionally flown small planes or helicopters overhead, poured over satellite pictures, or approached on foot.

Between 1937 and 2000, 91 biologists and other scientists died in the field, according to a 2003 study in the *Wildlife Society Bulletin*, and 60 of them were killed in plane or helicopter crashes. What's more, the study says, most of those 60 appeared to have been flying at the low altitudes necessary for observing and tracking wildlife. Since then, another two have died in the same manner.

Drones (also known as unmanned flying vehicles or UAVs), on the other hand, are much safer than climbing into a helicopter to count reindeer, abseiling cliffs to study mountain goats, climbing trees to peer into raptor nests or getting close to dangerous animals such as lions. They are also much faster, cover more area and are inexpensive to operate.

Chris Johnson, an ocean sciences manager at WWF Australia, does whale research in the Great Australian Bight. In the past he relied on low altitude flying in an airplane, which roughly cost between \$2,298 to \$7,659 per day. In 2016 he used an off-the-shelf drone, priced at around \$4,289 in total, along with some additional lens, hard drive and battery costs. This approach proved just as effective.

No wonder that the use of drones in wildlife research, conservation and environmental monitoring is rising steadily. Drones have observed animals small and large, from pygmy rabbits to elephants. They have mapped out the habitats endangered species such as orangutans rely on, and been used to investigate how diseases might spread. In Australia, marine biologists have already had success using drones to identify which areas of the ocean would make the best marine mammal conservation zones. Drones have also been used to monitor illegal whale hunting and logging, rainforest restoration plans, and the tracking of melting glaciers in the Arctic.

Drone technology makes it easy to gather

highly accurate data and footage of a region over time to easily examine changes and track findings, to ultimately help researchers make more accurate observations. And because they carry digital cameras that produce geo-referenced photos, the data drones gather can be fed into image-recognition algorithms to vastly improve the accuracy of population counts.

David Johnston, a marine biologist at Duke University, says: "Traditionally we would have to rely on satellites or on aircraft to get the kind of information that we're getting, and even then it wouldn't be as high resolution. But with the drones, it allows us to be able to go and do this kind of research whenever we want. We don't have to wait until the satellite pass happens when it's not cloudy, we don't have to try to get an aircraft crew together."

"Drones can offer a very safe, green, and inexpensive alternative to manned aircraft," adds David Bird, an emeritus professor of wildlife biology at McGill University in Montreal who is a leading proponent of drone research.

THE MANY USES OF DRONES

The military uses drones largely on "3D missions", which stands for dull, dirty, and dangerous. The same might also apply to wildlife research and conservation.

The drones wildlife biologists typically use are small, portable and fairly affordable. However, they can capture detailed photos, or be fitted with thermal cameras or other sensors. In Antarctica they have been used to study and count penguin colonies and film the feeding behaviour of humpback whales. At the opposite Pole, drones equipped with thermal imaging equipment are being used to track polar bear communities in the Arctic. In Spain, drones are being used to chart the paths flown by a flock of kestrels in Seville. David Bird and his colleagues have used them to study seabirds that breed on cliffs, while drones are also being used to sample insects at heights of 200 metres.

In 2015, South Africa established some of the first formal drone legislation, and other countries have started making limited exceptions for their use in anti-poaching trials where



ENVIRONMENT

THE WILD





Clockwise from top: Wild birds of prey are known to attack drones, which is being used in the Middle East to train hunting falcons; In the Arctic drones are being used to track polar bears.

the drones are allowed to fly as far as 15 miles from the operator. So far, the effectiveness of drones is still being debated although South Africa's Council for Scientific and Industrial Research conducted a two-month trial and concluded that the technology is "a remarkable support tool" in anti-poaching activities, however officials have yet to release the data supporting those findings. However, one unexpected discovery was that some drones can steer elephants away from park boundaries – possibly because they sound a bit like bees, which the pachyderms detest.

In the future, drones could be used to collect microbes from the air to monitor how diseases spread. They could fire tranquilizers at animals that researchers want to put ID tags on, or collect samples of hair, blood, and scat. Bird and his colleagues have stuck radio trackers and antennae to drones to pin down signals from songbirds wearing transmitters. Drones could also be used to obtain identifying DNA from whales. When whales surface to breathe, they shoot a mist of saliva, mucus, and air from their blowholes, which is filled with DNA that could be sampled by a drone.

CHALLENGES AND ETHICS

Still, the field of drone-based wildlife research is still in its infancy and biologists are navigating the challenges and complexities of mixing wildlife and drones.

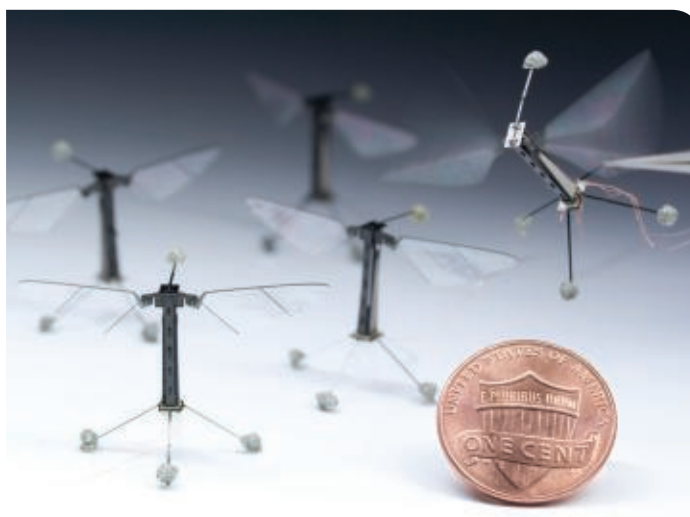
Drones have to suit a variety of tasks and, therefore, work continues to improve their maneuverability, autonomy, and endurance. For example, the drones used in South Africa, Malawi and Zimbabwe

for anti-poaching activities are fixed-wing, while bespoke BatHawk drones are outfitted with cameras, video transmitters and telemetry. On the other hand, most drones have a fleeting battery life and, though they are becoming hardier, cannot operate in wet or windy weather. In Antarctica, for example, the cold weather quickly drains batteries.

There are also legal aspects. Even experienced pilots crash drones, which is why their use is widely regulated. The US Federal Aviation Administration decrees that drones have to stay within line of sight, and that is true of many other countries. This means that, for now, research drone missions are limited in scope and cannot cover very large areas. Simply put, legislation and bureaucracy are still trying to catch up to the huge potential of drones, while at the same time preventing abuse.

Then there is the ethical question what effect drones have on wildlife. Biologists carrying out field studies are typically interested in animals' natural state, or how their behaviour changes when conditions are altered. As a result it is of paramount importance to know whether drones disturb the animals and, if so, exactly how.

Helicopters and planes are noisy, but they tend to keep their distance from their subjects. Drones, however, fly in far closer and have unintended consequences. David Bird and his team discovered that flying too close to birds called murres made them leave their nests, which allowed gulls to swoop in and eat the eggs or nestlings. They also lost a \$7,000 drone when a seagull attacked it. That was not an isolated



THE FUTURE IS CLOSE

While biologists and environmentalists are incorporating drones into their fieldwork, UAV researchers are designing newer models that are cheaper, more maneuverable and autonomous. The limitation of battery life still remains a challenge although researchers are building planes that glide like albatrosses by exploiting thermal updrafts, and developing solar-powered drones that never have to land and refuel.

The biggest factor that is inspiring the next generation of drones is nature. Prototype insect-like drones that are far less intrusive could soon take to the skies. Researchers from the University of Maryland have engineered sensors for their experimental drone based on insects' eyes. Such vision-based navigation will allow drones to automatically circumvent obstacles, which promises more precision than GPS-based systems. Going beyond eyes in the sky, researchers are attaching arms that can grab objects in midair like an eagle, and kestrel-like legs that allow drones to perch.

On the software front, drones are also getting smarter. Intel has begun pushing the boundaries of wildlife research by using artificial intelligence-based drones, with two successful studies already completed. Intel is also a leader in swarm technology. Its Shooting Star drones, which have already performed in a record-breaking 500-drone light show, showcase the integration of computing, communication, sensor and cloud technology. At Harvard's Wyss Institute, the RoboBee project is developing tiny drones smaller than a paper clip and weighing a tenth of a gram. Such swarms of drones could function as a team, with each drone collecting specific information to be integrated into a larger dataset.

It seems the sky really is the limit for the role of drones in wildlife and environmental research. ↑

Clockwise from top: Launching a drone to observe humpback whales; The RoboBee drones weigh a tenth of a gram; A drone's eye view of an osprey nest.

incident as ospreys, in particular, are known to down drones regularly. However, it happens far more often that recreational drones collide with birds.

In the first study to test wild animals' physiological reactions to drones, University of Minnesota researchers implanted sensors in American black bears' bodies. They then flew a platter-size quadcopter near wild bears 17 times to test their reaction. Most of the bears did not seem to react, yet the sensors showed that the bears' heart rates went up significantly. Whether the heart rates went up due to stress or curiosity has yet to be determined.

In a further study, a team of French and South African biologists observed the reaction of semi-captive and wild birds to drones. They found that the approach angle had a significant impact on the birds' reaction, but approach speed, UAV colour and flight repetition did not.

Drone proponents point out that many wild animals have habituated to human interference, ranging from radio collars through to helicopters and researchers walking among them. Overall, the consensus is that researchers need to keep studying both behavioural and physiological responses in wildlife to find out what is acceptable.

BIOELECTRONICS

Chronic conditions such as diabetes or hypertension may soon be treated by small implants that will change the messages your nerves send around your body so you feel better. This new field is known as bioelectronic medicine.

The novel *War of the Worlds* toys with the idea of what would happen if aliens were to come to conquer our planet. It's an idea that's done to death, but it's the end that really gets you. Unlike other sci-fi fantasies that end with warfare, the book ends with a whimper. You see, the Martians had complete control of their surroundings back on Mars. While they were far more advanced than humans in most spheres, their bodies had no exposure to pathogens. A lack of pathogens means they didn't have an immune system. Since the Martians never really needed one on Mars, their immune systems withered away thanks to evolution. The idea that they would have to deal with humans was no problem at all, but dealing with bacteria was an out of context problem for Earth's invaders. And thus, they all died through diseases they caught on Earth.

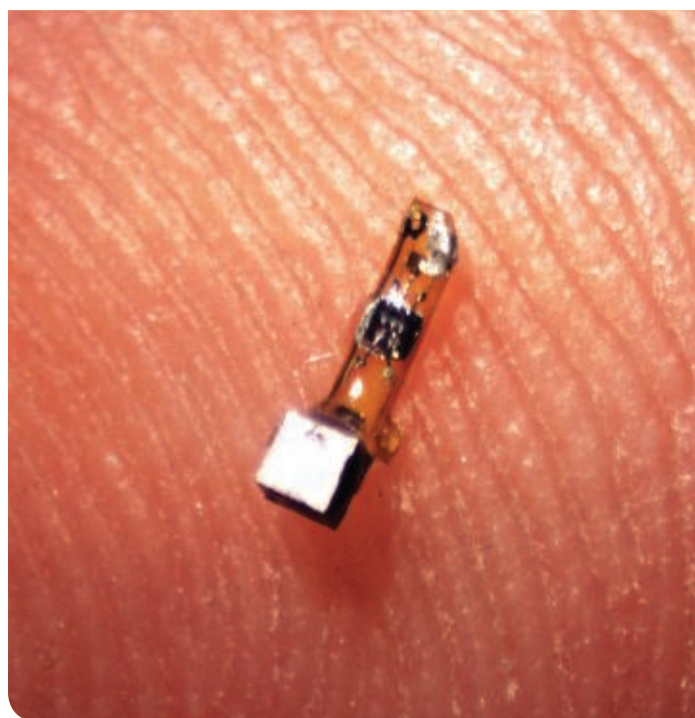
This book written by H. G. Wells in 1897 acts as a prophecy of sorts. Don't worry, aliens aren't coming to invade – that we know of. The hard facts are far less exciting. Many medical experts believe antibiotics, the miracle medicine that helps us fight diseases that killed the Martians in *War of the Worlds*, are killing us. While antibiotics are super effective against

bacterial infections, they do not work against all viruses such as those that cause colds and flu. Which is why you shouldn't pop those antibiotic pills at every sign of an infection.

When used properly, antibiotics can help destroy disease-causing bacteria. However, overdependence on and misuse of antibiotics actually helps to create drug-resistant bacteria and in some cases, could also kill some of the “good” bacteria that help you digest food, fight infection, and stay healthy. Over time, if more and more people take antibiotics when not necessary, drug-resistant bacteria continue to thrive and spread.

Experts have found that deaths attributable to antimicrobial resistance each year – that, in short, is the bugs developing a tolerance of the stuff designed to kill them – are now estimated to dwarf the numbers of people killed by road traffic accidents, diabetes, diarrhoeal disease and even cancer. Some estimates predict 10 million deaths, preventable were it not for antibiotic resistance, globally every year by 2050. Little wonder then that the General Assembly of the United Nations gathered to make a commitment to address the issue in September 2016. In the history of >





Top: Biomedicine is targeting different parts of the body.

Above: The latest pacemakers are minute in size.

the UN the General Assembly has only focused high-level meetings on health issues three times before, and they were for HIV, Ebola and obesity.

Plain and simple, we're killing ourselves with our medicines and we need to find a way to cure all our diseases with zero side-effects as the payoff right now is just not worth it. Lucky for us, scientists are working on just that. The day is not as far as you'd think where we'd be treating diseases such as cancer, diabetes and arthritis through implantable devices

that adjust the electrical signals in the nervous system instead of pills and chemotherapy. They're calling this bioelectronic medicine.

In case you're wondering how electrical signals will help, you should know that it's our nervous system that sends signals to our tissues and organs to suppress inflammation. Since the pills we consume are oral in nature, they travel through our bloodstream, interacting with other organs along the way thereby causing side effects. The bioelectronics type of medicine, also called electroceuticals, precisely target the medical condition by controlling the neural signals going to a specific organ.

We have Kevin Tracey to thank for all the progress. In 1998, the president and CEO of the Feinstein Institute for Medical Research in Manhasset, New York decided to convert a room in his lab at the institute into an improvised operation theatre. After spending years searching for a link between nerves and the immune system, he found that stimulating the vagus nerve – the captain of your nervous system that controls everything from blood pressure to breathing – with electricity would alleviate harmful inflammation. His work seemed to indicate that electricity delivered to the vagus nerve in just the right intensity and at precise intervals could reproduce a drug's therapeutic – in this case, anti-inflammatory – reaction. His subsequent research would also show that it could do so more effectively, at a lower cost and with minimal health risks.

Taking notes and leading the way in this new form of treatment is GlaxoSmithKline (GSK) – one of the world's largest pharmaceutical companies. The company partnered with Google's life sciences venture, Verily, in August 2017 to help advance the research.

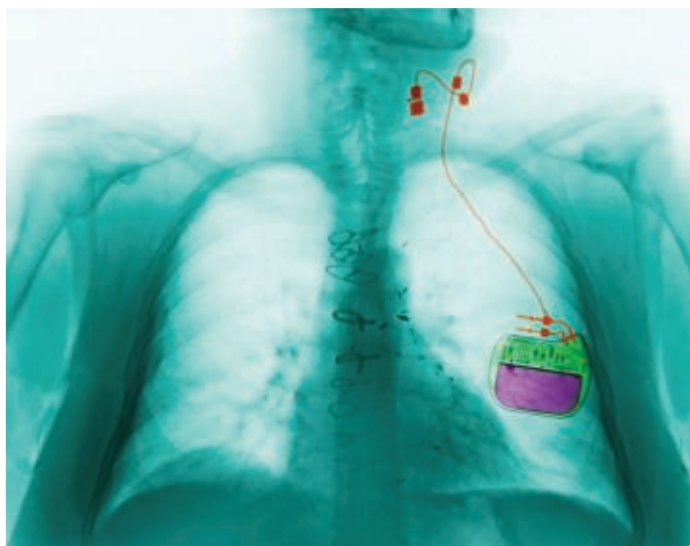
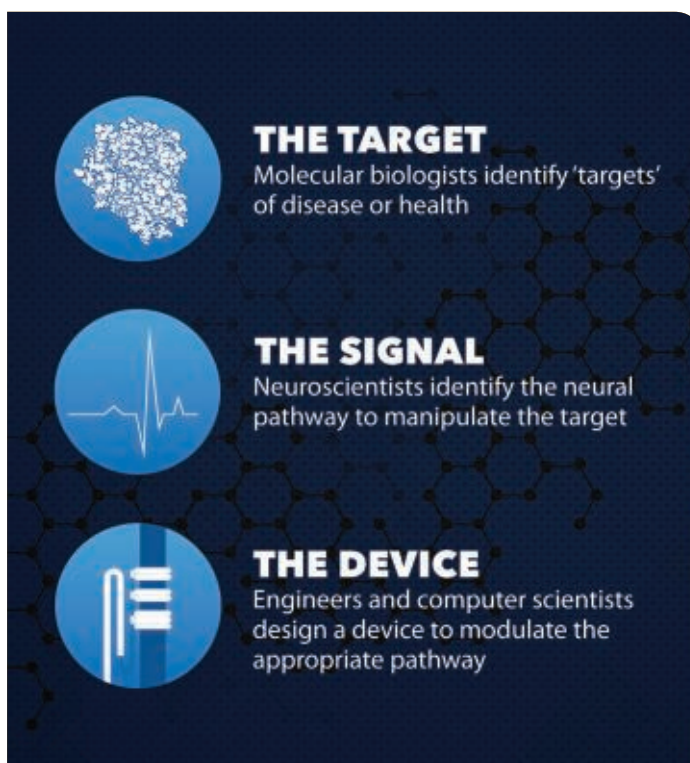


The two companies are investing a combined \$700 million over the next seven years to study the treatment, which won't be available to patients for 10 years. It's not all good news though.

While bioelectronic medicine presents an opportunity, it also offers significant obstacles. Despite all the optimism and progress from the healthcare community at large, researchers still don't fully understand the body's electrical pathways, or how to precisely manipulate the currents to treat medical conditions. Another obstacle is building small implants, some of them as tiny as a cubic millimetre – that's about as big as a grain of sand – robust enough to run powerful microprocessors. Should scientists succeed and bioelectronics become widely adopted, millions of people could one day be walking around with their nervous systems attached to mini-computers.

We do, of course, already use electricity to treat some conditions: Pacemakers have steadied abnormal heart rhythms for decades and more recently, doctors have used so-called deep brain stimulation probes – like Boston Scientific's Vercise system – to treat Parkinson's disease. However, both approaches involve major surgery.

Despite all the obstacles though, the medical fraternity agrees that this is too big an opportunity to pass up just because other precautions are not in place. After all, the discovery of this science was an



accident. Sensing the importance of bioelectronic medicine and its possible impact on the world, the US National Institutes of Health announced last year it will provide more than \$20 million for research into its Stimulating Peripheral Activity to Relieve Conditions (SPARC) programme. DARPA received \$80 million from the US government for its initiative, ElectRX, to develop bioelectronic treatments for chronic diseases and mental health conditions for active military and veterans. ⚡

Top left: Kevin Tracey is the father of biomedicine.

Above: A vagus nerve stimulator to treat epilepsy.

THE LEGAL ISSUES OF DRIVERLESS CARS

The UAE, especially Dubai, is working on a legal framework for driverless cars. The US is working on it at a federal level and the UK has laid out legislation before parliament. What exactly are the legal issues around driverless cars and how are governments addressing them?



It maybe a few more years before self-driving cars hit our roads but regulators around the world are already racing to put legislations in place for driverless cars. Amongst other things, self-driving cars are expected to cause significant disruption to the traditional automobile business and insurance models and reduce personal car ownership. Laws that protect users but are also conducive to the technology are key to the success of driverless car innovation.

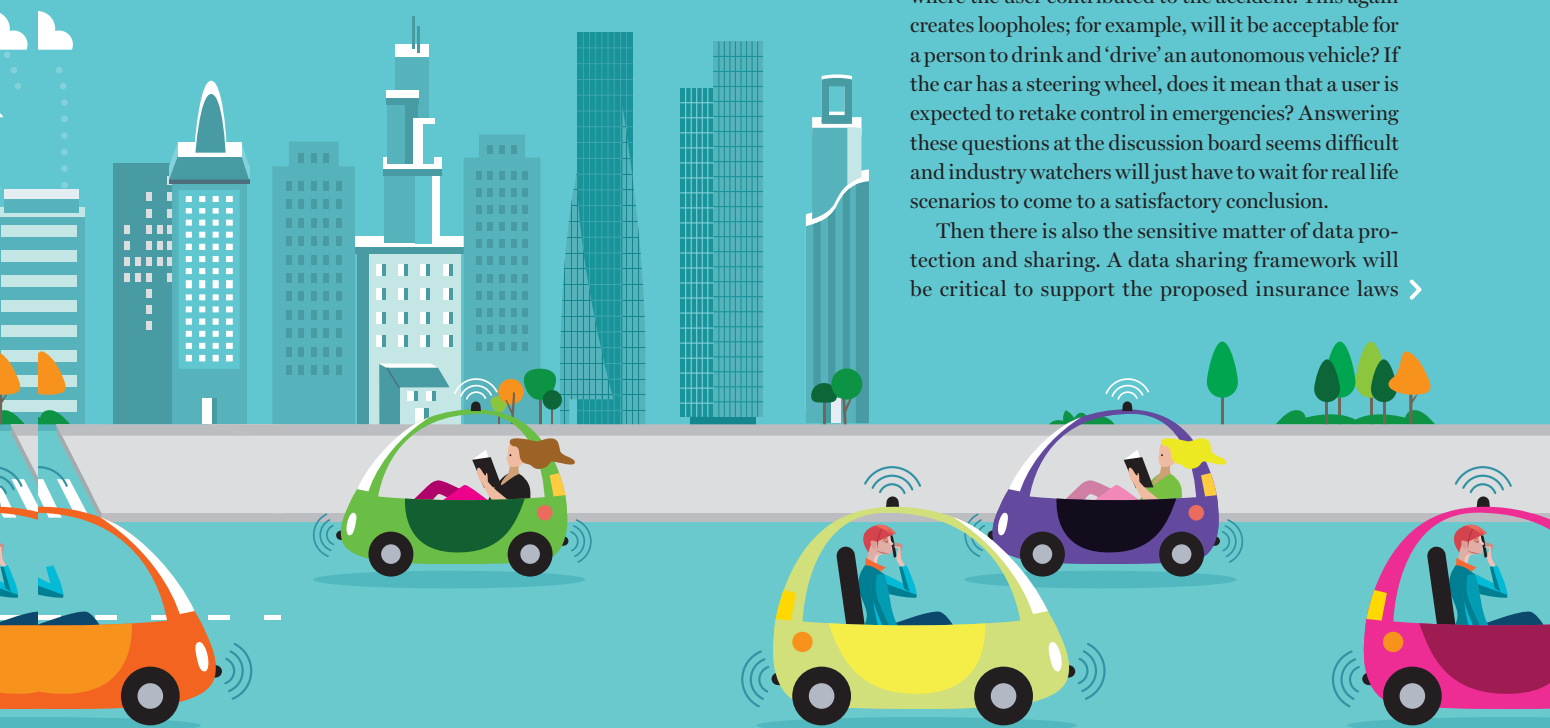
The United Kingdom is one of the countries actively working on developing autonomous car regulations. In an attempt to be at the forefront of the technology, proposals for autonomous car insurance laws have been created, codes of practice for the testing of self-driving vehicles have been introduced and numerous trials are taking place across the country. The UK has created six different categories for self-driving cars and the technologies within them based on their ability – ranging from no automation to fully automated. But some grey areas still remain.

The first issue at hand is that of product liability. With self-driving cars, the fault for accidents may shift from the driver to the manufacturer. The country's Consumer Protection Act 1987 imposes strict liability for injury or damage where a vehicle is found to be defective. The law defines a defective product as one where safety is not at the level such as people are generally entitled to expect. Known as the consumer

expectation test, this clause removes the need to prove the manufacturer's negligence. Instead, it is based on the consumer's expectations. Given that average consumers often have little product familiarity, it becomes critical for manufacturers to ensure that products are marketed responsibly. Thoroughly familiarising consumers with autonomous car technology will make it easier for manufacturers to comply with consumer expectations and reduce their liability risks.

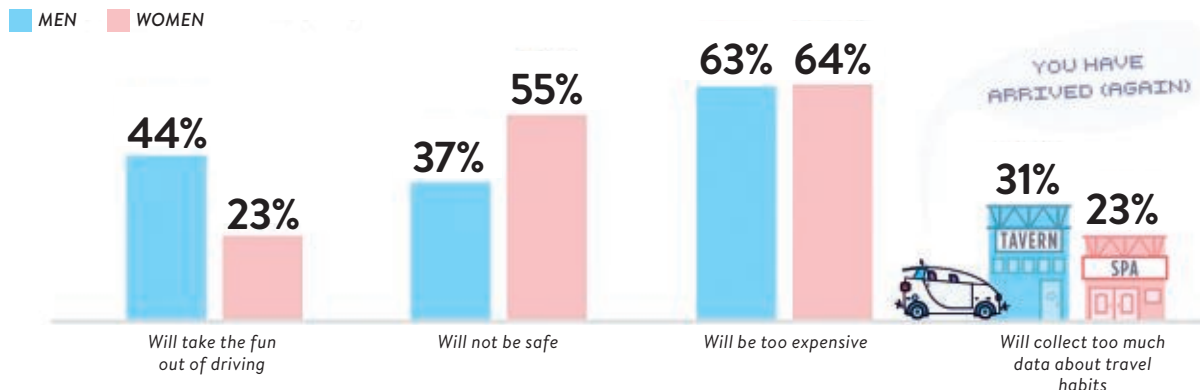
Another key issue is that of insurance. The UK government aims to develop a model whereby it is easy for drivers to claim and difficult for companies to avoid liability. Under the UK's Road Traffic Act 1988 ("RTA"), the "user" of a car is generally liable for the car's actions. With driverless vehicles on the roads, the law would need an update. In March 2017, the House of Commons passed the second reading of the Vehicle Technology and Aviation Bill which sets out practical proposals such as the establishment of a single insurer model to include use of automated vehicles, where the user will have a direct claim against the motor insurer who then recovers the cost of damages payments from the vehicle manufacturer. Notably, only automated vehicles, considered capable of self-driving and recorded on a list of automated vehicles kept by the UK Government would be subject to these new insurance and liability provisions. However, insurers are still free to curtail or even exclude liability in cases where the user contributed to the accident. This again creates loopholes; for example, will it be acceptable for a person to drink and 'drive' an autonomous vehicle? If the car has a steering wheel, does it mean that a user is expected to retake control in emergencies? Answering these questions at the discussion board seems difficult and industry watchers will just have to wait for real life scenarios to come to a satisfactory conclusion.

Then there is also the sensitive matter of data protection and sharing. A data sharing framework will be critical to support the proposed insurance laws >



WHAT PEOPLE DON'T LIKE ABOUT DRIVERLESS CARS

(Respondents could select more than one choice) Source: nerdwallet



Below: The question of liability in driverless cars is being addressed by new legislation.

– information will be required to determine who was in control of the vehicle at the time of an incident. For autonomous vehicles to work effectively in a fully functioning ‘internet of things’ world, data sharing will have to be made easier without compromising on security. Governments will have to put in further stricter regulations regarding cyber security.

In the United States of America, more than 50 bills have been introduced in 20 states over the last several

months providing some degree of regulation on self-driving cars. But each state has its own requirement, which may not be applicable in the other states. This patchwork of rules could play havoc, confusing owners of self-driving cars and potentially harming innovation.

“If you had 50 different requirements for 50 different states, each state (might do it) different,” said Chan Lieu, an adviser to the Self-Driving Coalition for Safer Streets, whose members include former Google driverless car project Waymo, automakers Ford and Volvo and ride-hailing firms Uber and Lyft. Under those conditions, “it’s going to be very, very difficult to build a vehicle to be effectively sold across the country.”

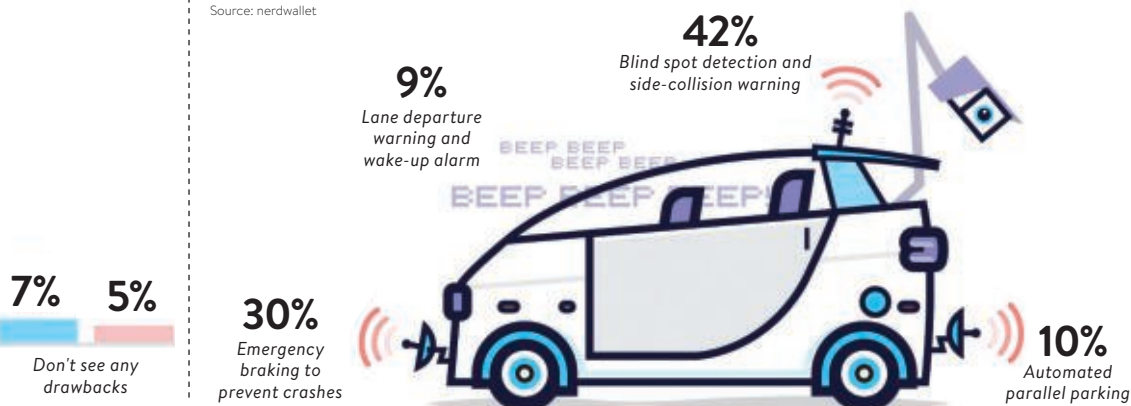
Further afield in China, there are several plans in the pipeline to develop self-driving rules, although these are seeing delays in implementation due to clashes between powerful local authorities and the central government. Japanese carmaker Toyota plans to get its self-driving car on the streets by the 2020 Tokyo Olympics pushing authorities to quicken regulatory frameworks.

In Dubai, the Roads and Transport Authority (RTA) plans for 25 per cent of all journeys in the emirate to become self-driving by 2030. A structure for e-security; a communication system enabling communication between vehicles and high definition e-maps are part of the plan. Across the UAE, it will be the Emirates Authority for Standardisation and Metrology (ESMA) that will be responsible for drafting regulations for self-driving vehicles. These will be applied at the Federal level. “These standards will meet the government’s plans within the national agenda and enhance the UAE’s competitiveness globally. Esma is focusing on providing the highest safety standards in modern transport vehicles that match the latest technologies and innovation in terms of self-driving vehicles and communication between them and the surrounding environment,” said



MOST DESIRED ADVANCED TECHNOLOGY FREATURES

Source: nerdwallet



Across the UAE, it will be the Emirates Authority for Standardisation and Metrology (ESMA) that will be responsible for drafting regulations for self-driving vehicles. These will be applied at the Federal level. A structure for e-security; a communication system enabling communication between vehicles and high definition e-maps are part of the plan.

Abdulla Almaeeni, Esma's director general. Esma has formed a team of partners, including the Federal Authority for Land and Maritime Transport, the Telecommunications Regulatory Authority, Dubai Police and Dubai's Roads and Transport Authority, among others, to participate in the draft.

Wherever in the world it may be, there are some basic regulations all driverless cars will have to meet with. For instance, pre-mapped roads must be made available to self-driving cars; manufacturers must fully train customers on the safe operation of these vehicles; software updates must be promptly available and it will be the customer's responsibility to ensure these are applied. Officials also want laws in place to ensure that manufacturers do not mislead consumers by exaggerating the car's self-driving capabilities. ♪

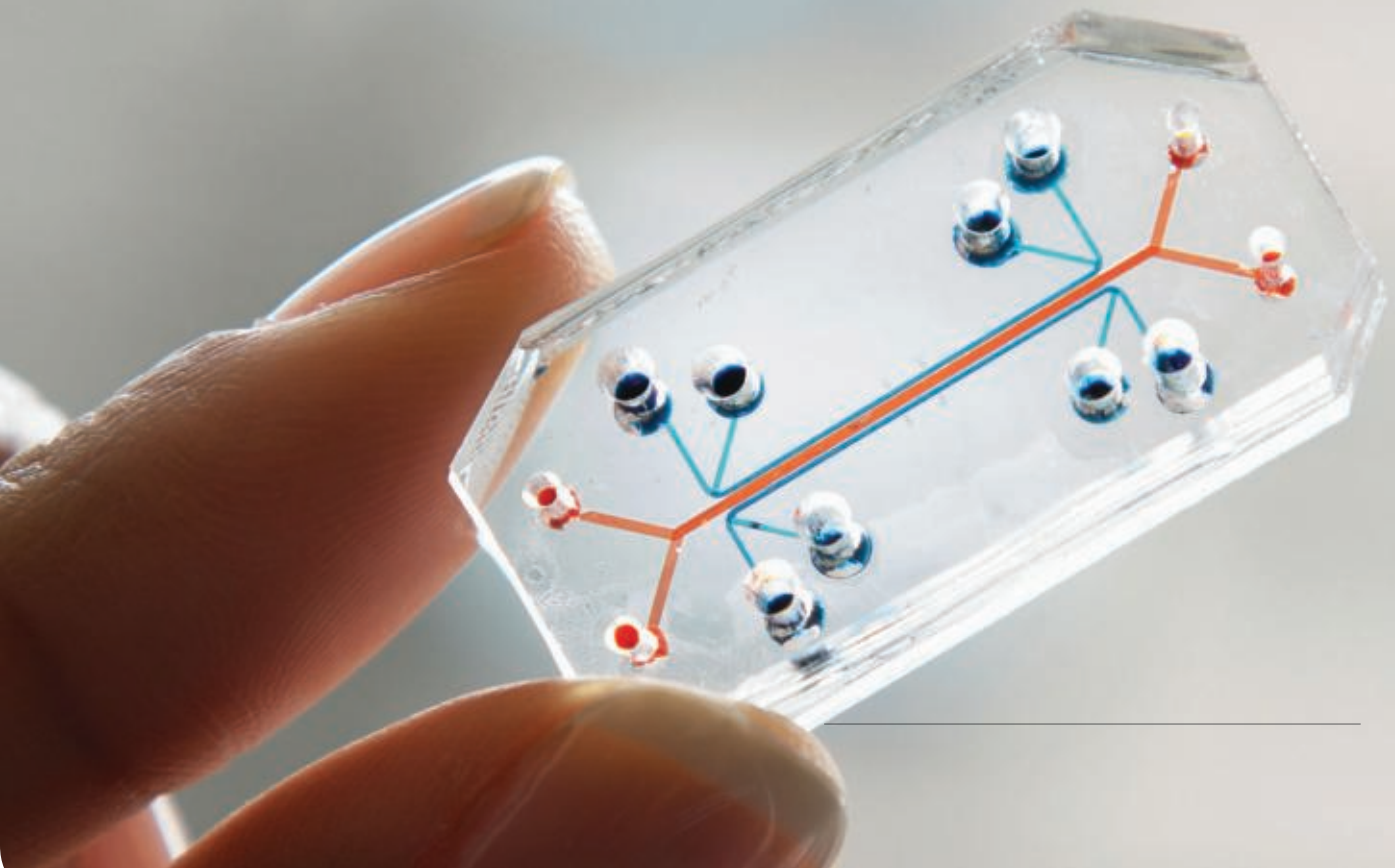
Left: Driverless cars are already being tested on the roads of Dubai.

EXPLORE

INNOVATIONS

CHANGING HEALTHCARE

As healthcare organizations face immense pressure and unprecedented challenges to improve quality, increase efficiency and lower costs, innovation is becoming the industry's need of the hour. We take a look at some of the most revolutionary innovations the healthcare industry has put forward.





PACEMAKERS

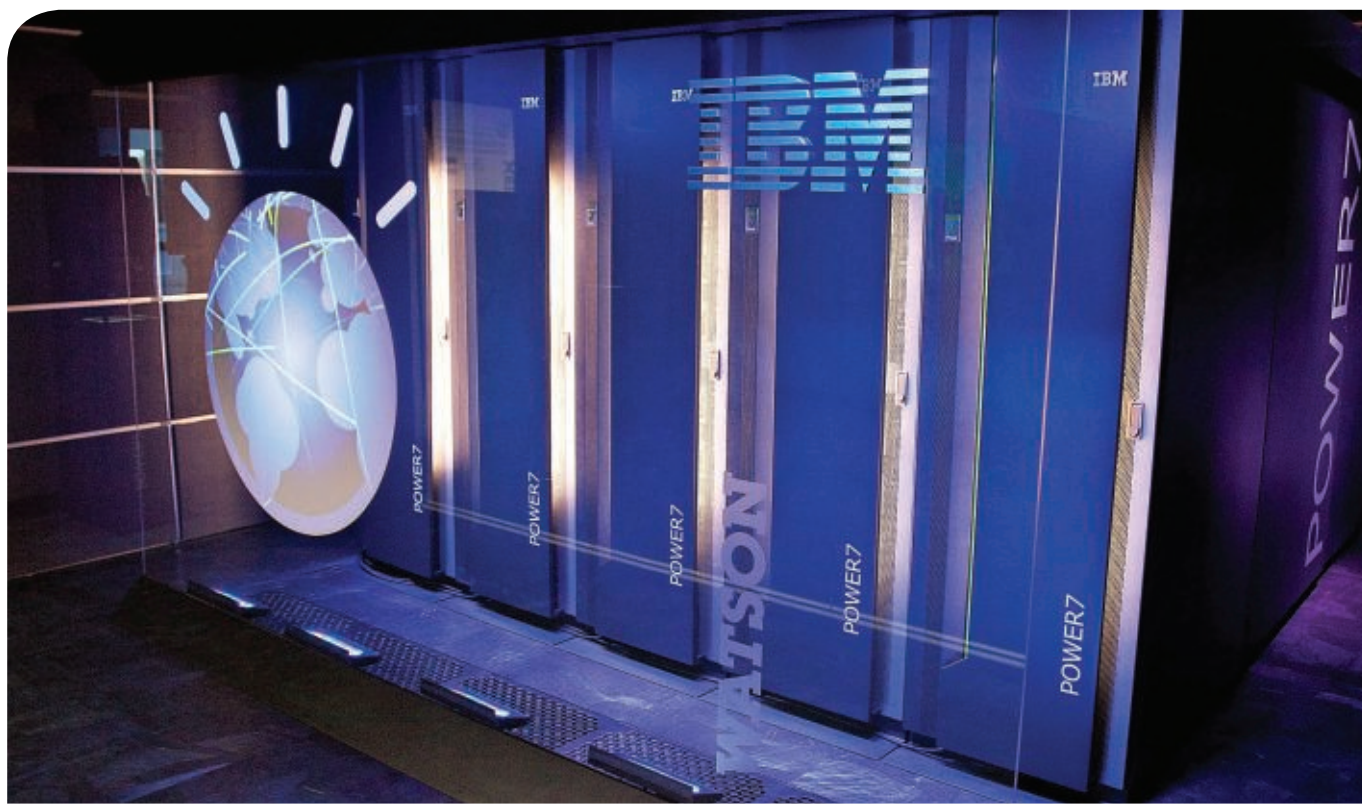
In February 2017, the world's smallest pacemaker was successfully implanted in a patient in the United States of America. The Micra® Transcatheter Pacing System (TPS) is one-tenth of the size of traditional pacemakers and is the only leadless pacemaker approved for use in the United States. The device is the size of a large vitamin pill and does not require any cardiac wires (leads) or even a surgical pocket under the skin to deliver pacing therapy. Since TPS is delivered through a catheter and implanted directly into the heart, it offers a safe alternative to conventional pacemakers. TPS also lets doctors automatically adjust pacing therapy based on a patient's activity levels. If a patient needs more than one heart device, the miniature TPS has a feature that enable it to be permanently turned off. A new device can then be implanted in the body without the risk of electrical interaction.

Scientists at the University of Buffalo are also working on a system that would eliminate the need for pacemaker batteries. The University's Department of Mechanical and Aerospace Engineering together with the Intelligent Dynamic Energy and Sensing Systems Lab (IDEAS Lab), is developing a piezoelectric system that converts the heart's vibrational energy into electricity to power pacemakers. If the innovation goes through, receiving a pacemaker would become a

one-time procedure without the need for patients to come back for battery replacements, saving the healthcare system vast amounts of money and limiting patient risk that occurs with these procedures. So far the IDEAS Lab has built a 1cm 'S' shaped device that produces sufficient power (at least 10 microwatts) for heart rates from 20 to 100 beats per minute. Now, they are working on a .5cm piezoelectric strip that absorbs vibrational energy from the heart generating enough energy to power a heart rate up to 150 beats per minute.

3D4MEDICAL

To revamp the healthcare industry, it is imperative to revamp its very foundation – healthcare education. 3D4Medical is one such company. Its robust 3D training tools teach medical students anatomy with unprecedented precision – without the need to cut open a cadaver. The company's award-winning Complete Anatomy digital educational platform facilitates the exploration of human anatomical characteristics that are difficult to visualize via traditional methods or without hands-on training. Students can explore anatomy by zooming to minutiae; rotating to every angle; cutting through structures and discovering what is behind every layer. The software also allows students to stimulate diseases by adding fractures, bone spurs and pain sites. The app's Lecture Builder feature allows educators ➤

**Above:**

Supercomputers such as IBM's Watson are turning vast amounts of raw healthcare data into accessible information.

Below:

Personalised drugs through 3D printing are already a reality.

to create custom lectures incorporating 3D4Medical lecture material and/or their own material. Audio, MRIs and X-rays can be integrated into the lectures too. Students can share their recordings or quizzes with others via a cloud-based platform.

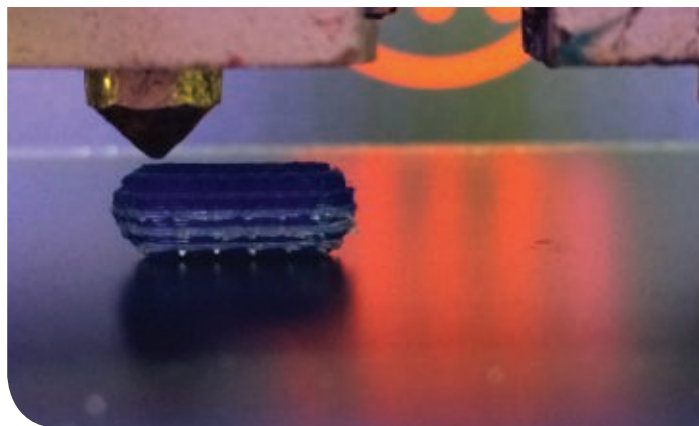
MICROCHIPS THAT REDUCE CLINICAL TRIAL TIME

Clinical trials ensure that the medicines that reach us from pharmacy labs are safe and effective. But this is a long and tedious process, which takes years to complete and costs billions of dollars. Researchers

are now toying with new technologies in the hope to reduce the time and cost of such trials. Take for instance the researchers at Wyss Institute who along with a multidisciplinary team of collaborators have engineered microchips that recapitulate the micro-architecture and functions of living human organs, such as the lung, intestine, kidney, skin, bone marrow and blood-brain barrier. The chip is the size of a computer memory stick and contains living human cells. Mechanical forces such as the breathing motion in lungs or deformations found in intestines can be applied to the chip. Since it's made of clear flexible polymer, researchers can easily observe the inner working of human organs. These 'organs-on-chips' could also be the potential alternative to traditional animal testing.

3D PRINTED DRUGS

Imagine having a tablet that suits your exact body type instead of a standard off-the-shelf pill. 3D printing could make this possibility a reality. Personalised, 3D-printed drugs are ideal for patients who respond to the same drugs in different ways say researchers. Medical practitioners will be able to use each patient's individual information (such as age, ethnicity and gender) to produce doses specific to them. A 3D printed tablet has the potential to be a 'one pill for



all ills' solution as doctors can print tablets with layers of different chemical combinations to treat multiple ailments at once.

SUPERCOMPUTERS TO STORE DATA

In recent years, data storage has emerged as the Achilles' heel for the medical industry. There is just too much data – in 2011, data in healthcare touched 150 exabytes and since then it has increased at a rate of 2.4 exabytes per year. Comprising patient records, research, clinical trials and medical journals, 80 per cent of this data is unused. At projected growth rates, the volume of healthcare data will soon be zettabyte and yottabyte scale. That's enough data to fill a stack of DVDs that would stretch from Earth to Mars.

The massive surge in data is pushing organisations to look for cheaper and efficient ways to manage it without compromising on security. Supercomputers such as the IBM Watson are the panacea data medics are looking for. With the ability to process 500 gigabytes per second, the Watson Health Cloud can bring together vast amounts of data into a centralized, cloud-based hub. Reading 200 million pages of text in three seconds, Watson's advanced analytics can turn raw data into useful information that can help patients. Watson has already proved its mettle in oncology where it is suggesting tailored treatment plans for individual patients based on their medical records and offering information of what clinical trials are available to them.

ARTIFICIAL INTELLIGENCE

As we saw in the previous section, there is no shortage of data. Using it is the problem. AI is starting to demonstrate the kind of impact it can have in medicine from accurately interpreting patient records including pathology slides, x-rays, skin lesions, and scientific literature. These highly advanced AI systems are capable of employing deep learning algorithms to sort through massive amounts of structured and unstructured data to automatically detect, diagnose, and suggest treatment regimes for medical conditions. There are numerous start-up companies working on AI applications in health care, with the engagement of the major technology companies who have all made major investments in this space.

Recently, the AI research branch of Google launched its Deepmind Health project, which is used to mine medical records in order to provide better and faster health services. These words are not just empty phrases; Google Deepmind is able to process hundreds of thousands of medical information within minutes. Although research into such data-harvesting and machine learning is in its early phase, at the moment Google is cooperating with the Moorfields Eye Hospital NHS



Foundation Trust to improve eye treatment.

Sentrian, a start-up, is taking a radical approach. It actually aims to bring the medical community closer to the future, where smart algorithms tell people they are going to be sick even before they experience symptoms. Sentrian, which was launched two years ago with \$12 million, focuses on chronic diseases. Its outspoken goal is to eliminate all preventable hospital admissions through remote patient monitoring. It does this in a two-step process. First of all, it harvests patients' data from the more and more widely available biosensors, and then to deal with this sea of data, it teaches machines to do the work of a dedicated clinical team, monitoring each patient's data continually to detect subtle signs that warn of an impending problem.

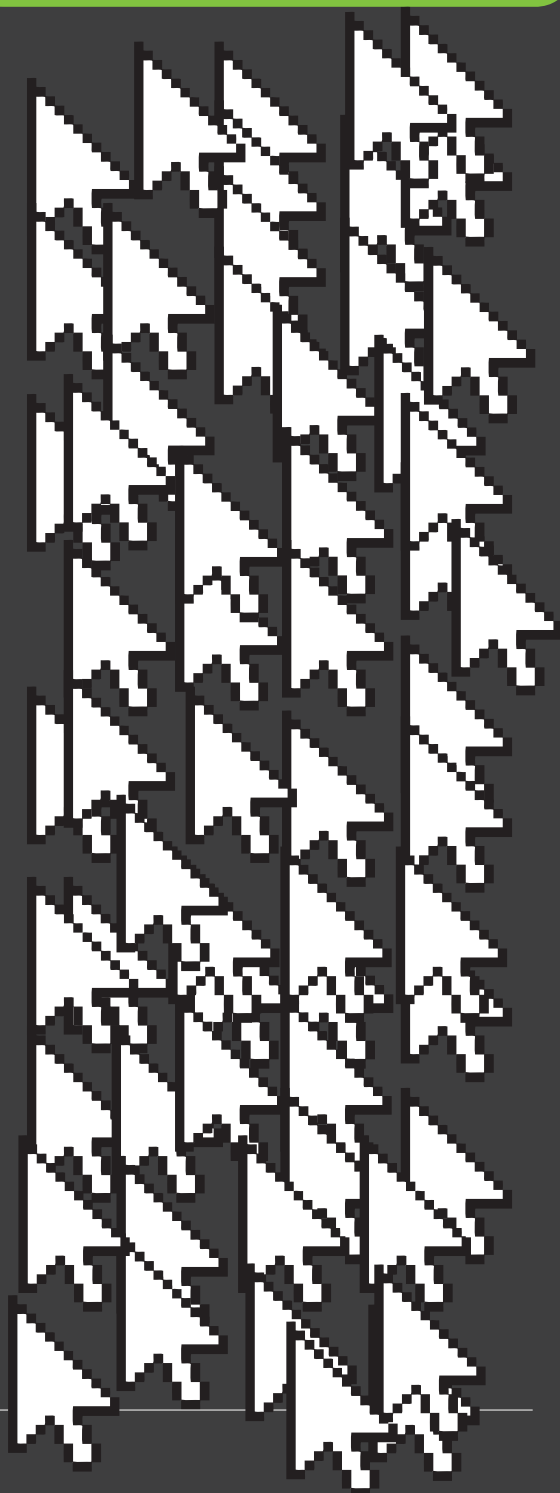
Enlitic uses the power of deep learning technologies, specifically its prowess at certain forms of image recognition to harvest the data stemming from radiology images and applying it in unique medical cases. Deep learning refers to the process by which a computer takes in data and then, based on its extensive knowledge drawn from analyzing other data, interprets that information. The start-up's technology can interpret a medical image in milliseconds – up to 10,000 times faster than the average radiologist.

In a test against three expert human radiologists working together, Enlitic's system was 50 per cent better at classifying malignant tumors and had a false-negative rate (where a cancer is missed) of zero, compared with 7% for the humans. Impressive, isn't it? †

Above: Artificial Intelligence can automatically detect, diagnose and suggest treatment regimes.

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THE END OF NET NEUTRALITY

A historic vote by the US Federal Communications Commission in December 2017 ended net neutrality as we know it

The month of December was certainly one defined by big headlines and controversy.

It was the month when US President Donald Trump chose to recognise Jerusalem as the capital of Israel, and where French President Emmanuel Macron declared that the world was losing its battle against climate change.

But arguably one of the most contentious issues of all caught little attention in the Gulf Cooperation Council.

A vote held by the US Federal Communications Commission (FCC), according to its critics, changed the face of the internet as we know it with repercussions to be felt the world over.

For those on both sides of the argument, the debate surrounding net neutrality has been heated.

In the week of the FCC vote on the decision companies including Reddit, Etsy and Kickstarter warned that any attempt to alter net neutrality rules would change the global internet experience.

The issue is complicated but can be boiled down to a few key issues.

The previous status quo meant all websites were treated equally by internet services providers in the United States – home to companies and sites loved by users the world over including Google, Facebook, YouTube, Instagram, Snapchat, Amazon and many more. This meant companies like US telecoms and media behemoths AT&T, Verizon and Comcast are prevented from blocking or slowing sites, and perhaps most importantly charging companies so their websites are accessed faster.

Critics say changing these rules would mean telecoms providers could essentially offer the fastest access to companies that pay them the most money, in turn meaning large companies with deep pockets will have a significant advantage over smaller sites with limited funds – creating a more





Above: On December 14 last year the FCC made the contentious decision to end net neutrality.

difficult playing field for those looking to follow in the footsteps of the internet giants.

In contrast, the providers have long been concerned of becoming ‘dumb pipes’ after having seen companies like Google and Facebook become success stories with huge stock market valuations on the back of networks and capacity they have provided and must continue to invest in. They argued current rules discouraged investment in networks, meaning worse quality internet access for the public.

The most recent debate surrounds rule changes in 2015 that allowed the FCC to prevent providers from blocking access to apps and websites, throttling internet traffic speeds and selling fast lanes. This followed the overturning of a 2010 open internet regulation in 2014 when the FCC was sued by Verizon, which argued the rules on providers were too stringent.

That same year it was revealed that video streaming service Netflix, which generates large amounts of traffic, had paid for more direct access to Comcast customers after the company refused to address network congestion that was slowing streaming services in 2013. Following the deal Netflix streaming quality was said to have transitioned from VHS level to HD for Comcast customers. Netflix later reached similar deals with Time Warner Cable, AT&T and Verizon.

The reason Netflix paid for this access is simple. In the age of modern broadband services speed is everything and users grow frustrated if a site does not load quickly. Indeed, speed is a commonly cited factor when it comes to website traffic with search engine Google now using load speed to determine its rankings. Those on the side of the providers say companies like Netflix that generate large amounts of traffic should pay more, just as larger vehicles pay higher fees to access toll roads. Those opposed suggest such arrangements

are anti-consumer and block or deter access to some services.

On November 22 last year, FCC chairman Ajit Pai published a draft order dubbed ‘Restoring Internet Freedom’ which would roll back the previous ‘Open Internet Order’ issued in 2015 and downgrade broadband from a telecommunications service protected under the US Communications Act to an information service.

The FCC voted to repeal the 2015 rules in a three to two vote on December 14 in a day of particular contention for the commission. As US media noted, the vote lasted for more than an hour, with speeches from all five commissioners and even a brief evacuation following a bomb threat. Members of security told everyone to exit the room as footage of dogs sweeping an empty room of seats and tables was live streamed on the internet.

The outcome of the vote was expected given the majority held by Republican members of the FCC intent on rolling back rules created during the years of the Obama administration but less expected was the relative silence publicly from companies that would be most affected.

Facebook CEO Mark Zuckerberg pledged his support for net neutrality in July stating: “Net neutrality is the idea that the internet should be free and open for everyone. If a service provider can block you from seeing certain content or can make you pay extra for it, that hurts all of us and we should have rules against it.”

But he made little direct comment following the rule change. Others including Microsoft backed net neutrality in July with the tech firm posting a 23-page letter to the commission outlining its argument.

“As users of the internet and builders of the internet age, we believe that our success and consumers’ enjoyment of the internet has grown out of one fundamental feature – the ability of consumers to use their internet connections without interference from network providers.

“Freedom from interference from network operators has fostered tremendous gains in productivity and economic activity over the past decade. As this Committee and the FCC develop

PERCENTAGE OF PEOPLE IN SUPPORT OF NET NEUTRALITY

Source: mozilla

76%

AMERICANS

81%

DEMOCRATS

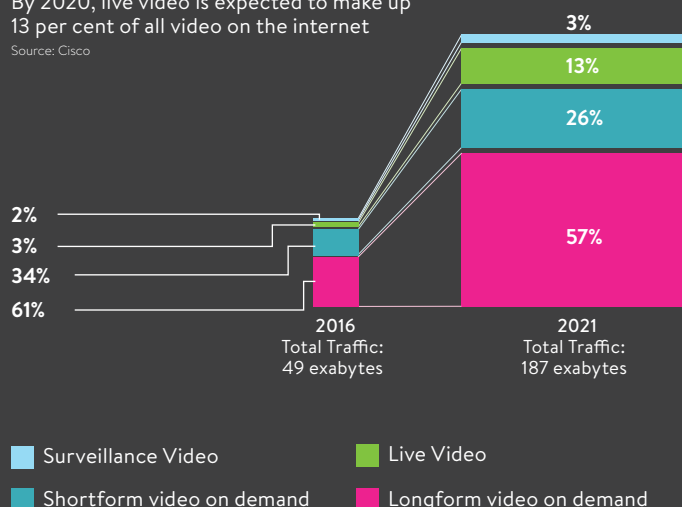
73%

REPUBLICANS

GLOBAL INTERNET VIDEO TRAFFIC

By 2020, live video is expected to make up 13 per cent of all video on the internet

Source: Cisco



policies for next generation networks, now is not the time to abandon this fundamental feature.”

However, they were among the large companies that were less active in the week building up to the vote.

On the face of it, critics argue the December repeal means a situation faced by Netflix is more likely to reoccur, with internet providers only required to publicly state they are blocking, throttling or prioritising certain content.

“The impact of this vote is clear. It is now legal for your broadband provider to block a legal website or service without consumer consent. It is now legal for broadband providers to set up their business to discriminate against some content and favour their own,” said Chris Lewis, vice president at non-profit Public Knowledge in a warning that broadband providers could start charging more for services.

“By entirely eliminating its rules and oversight role, the FCC has effectively given broadband providers the green light to press forward with anticompetitive and anti-consumer business models.”

In contrast, supporters point out that the repeal it is just restoring the status quo prior to 2015 when the internet had already been around for decades.

“The internet wasn’t broken in 2015. We were not living in some digital dystopia,” FCC chairman Pai stated after the vote, arguing the decision still allowed the Federal Trade Commission to take the FCC’s place as an internet watchdog.

“The main problem consumers have with

the internet is not and has never been that their internet provider is blocking access to content. It’s been that they don’t have access at all.”

But it is clear the fight over net neutrality is far from over. Opponents of the repeal, which must be approved by the Office of Management and Budget before it can go into effect, are positioning to sue the FCC.

Democrat members of the US Senate and House of Representatives are hoping to use their authority under the Congressional Review Act (CRA) to stop the repeal; US senate minority leader Charles Schumer said the day after the decision.

His opposite number on the Republican side, Senate majority leader Mitch McConnell, said he would oppose Schumer’s effort after supporting the FCC repeal.

As this political sword fight continues, the issue of net neutrality is sure to be a talking point in the build-up to midterm elections in the US in November 2018, amid calls from organisations like Public Knowledge for Americans to contact their representatives in Congress.

And it is clear that internet service providers will not escape scrutiny in the months ahead either, with warnings that they may not benefit from the change in regulation – at least initially.

While stating that the FCC vote was “credit positive” for internet services providers that could have faced regulation of their rates under the 2015 rules, ratings agency Moody’s suggested in a note the day after the vote that companies would want to “tread lightly” when it came to engaging in acts of paid prioritisation of traffic or throttling.

“There could be significant negative public reaction to these acts,” it warned, further adding: “at least in the near term, the cost of negative publicity on their existing businesses far outweighs the benefit of additional revenue streams these companies can generate”.

Below:
Supporters of net neutrality fear that broadband providers will now press forward with anticompetitive and anti-consumer business models.



INTERVIEW



MEDIA SPOKESPERSON

Her Excellency Noura Al Kaabi has an encompassing vision of the digital revolution and the opportunities and challenges it offers.

As the UAE's Minister of Culture and Knowledge Development (MCKD), a board member of the UAE's National Media Council, and Chairwoman of the Media Zone Authority-Abu Dhabi and twofour54 Her Excellency Noura Al Kaabi is well-versed in all issues relating to media. These include the positive and negative impacts of media, its role in education and society, women's rights, youth development and the projection of political power.

At the Knowledge Summit 2017, which was organised by the Mohammed Bin Rashid Al Maktoum Knowledge Foundation, Her Excellency shared her considerable insights in a session entitled 'The Digital Revolution and its Role in Traditional and Social Media'.

Characteristically, HE Al Kaabi outlined an in-depth strategic vision for the future and how the UAE has managed to deal in a sound and strategic way with all forms of challenges.

"We want to be able to celebrate exporting the last barrel of oil," HE told delegates to the Knowledge Summit. In order to achieve that aim the UAE has laid foundations to match the

trending technological development. "These structures and measures are reflected in what we call a [ministerial] cabinet for the future; initiatives such as a Day and a Year of Innovation; consideration of innovation at workplaces, as well as individuals representing the country in technological and AI spheres."

By capitalising on the Fourth Industrial Revolution and becoming a digital hub for the region the UAE hoped to equip the country's youth to utilise the digital revolution while improving livelihoods.

"We're in a place where we see hope, we dream and we want the majority of our population, which is the youth, to live in a better place than today," she said. "We want ... to live a very sustainable life so our investment has to go to entities that are not driving their own agenda – (an agenda of) hate speech, extremism or sectarianism. It's about exploring and empowering the youth... and embedding that future agenda in everything we do."

"The past period has witnessed the emergence of certain groups and entities that have >



wielded technologies to benefit their own agenda, thereby posing new forms of threats that we have not witnessed before,” HE elaborated.

As a result, the wielding of ‘soft’ power is of prime importance. “The UAE has always been an advocate of peace, security and social welfare and is sparing no effort to inculcate concepts of moderation and tolerance,” she said on the side lines of the Knowledge Summit. HE Al Kaabi pointed to the fact that more than 200 nationalities live in peaceful co-existence in the country, a fact that, she says, testifies to the principle of cultural pluralism and tolerance the UAE is championing at all fronts.

According to HE Al Kaabi the main elements of soft power in the UAE are represented by education and knowledge management, media which succeeds in reaching the audience in the 21st century, in addition to the third element which was continuous training to spread skills and develop them.

These elements are of critical importance in the modern era where technology can be both a tool

of enlightenment and a dispenser of new threats.

“In this age of communication that we are witnessing now, wars are always present in people’s mind,” HE said, adding “the kind of war created by means of communications at present is much more dangerous than the traditional form of war, especially in light of the presence of a large number of technology users who easily get influenced by such digital types of war.”

Above: HE Al Kaabi at the Knowledge Summit 2017.

Her Excellency Noura Al Kaabi was the first UAE national to be ranked in Foreign Policy magazine’s ‘Top 100 Global Thinkers List’. In 2014, she was named as one of Forbes Middle East’s 30 Most Influential Women in Government; and was awarded ‘Business Woman of the Year’ at the Gulf Business Industry Awards. Her role in growing the UAE’s media industry was recognised by America Abroad Media in 2015; and she was named as one of the 20 most powerful women in global television by The Hollywood Reporter in 2016. She has been a WEF young global leader since 2014.

“Digital platforms nowadays take three principal forms. The first is widely-used social media sites and accounts which are easily accessible to large numbers of people who are almost impossible to trace as they usually don’t reveal their real identity. The second is the advanced technological applications used by some groups, like Daesh, whose elements manage to woo and radicalise large numbers of certain categories of people. The third form is that used by state departments, as some governments have realised that web portals are the most effective way of communicating their messages, including their political agenda, and interacting with their people, going all the way down to disseminating false reports about other countries, examples of which we have witnessed recently.

“The present age we are living in necessitates the use of unconventional means to face the non-traditional forms of wars, including digital diplomacy,” she added.

Due to the prevalence of fake news, it is of prime importance to nurture a generation of youth who can distinguish between rumours, deceptive content and authentic news. As a result, media and national companies must think of developing political, music, sports and drama critics who can deliver ethical content to the UAE audiences.

“Such young influencers and stars represent the UAE media, and even if they have audiences on their own away from the agencies they’re working for, let them. At the end of the day, content is what we should worry about,” said HE Al Kaabi.

“People are now obsessed about content, so media agencies must ask themselves, ‘what are they presenting to their audience?’ They must keep in mind that the UAE audience is made up of diverse nationalities who are looking for a meaningful message.”

As such, culture is of critical importance. “I want people to believe in being part of building their culture through what they write, act or the music they compose,” she said. “They should feel responsible for being part of their culture.”

That is why initiatives such as the Louvre Abu Dhabi, which bring together cultures and civilisations bridging East and West are of prime importance.

It is clear that Her Excellency Noura Al Kaabi embraces the digital revolution, but she is also aware of the challenges that lie ahead. Fortunately, the UAE is well positioned to take full advantage of the opportunities it offers. †



“I WAS ONE OF THOSE NERDS BEFORE THE NAME WAS POPULAR,”

SEYMOUR CRAY, A LEGENDARY FIGURE IN THE WORLD OF COMPUTERS, TOLD DAVID ALLISON IN AN INTERVIEW WITH THE SMITHSONIAN INSTITUTION IN MAY 1995. IT WAS A TYPICALLY LIGHTEARTED REMARK FROM A MAN WHO WAS KNOWN FOR HIS STREAMLINED LIFE.

Cray, a mythic figure in the world of computing even whilst alive, is widely regarded as the father of supercomputing. He and the companies he either founded or co-founded created and led the high performance computing industry for three decades, with his primary focus being the design of faster and faster scientific computers.

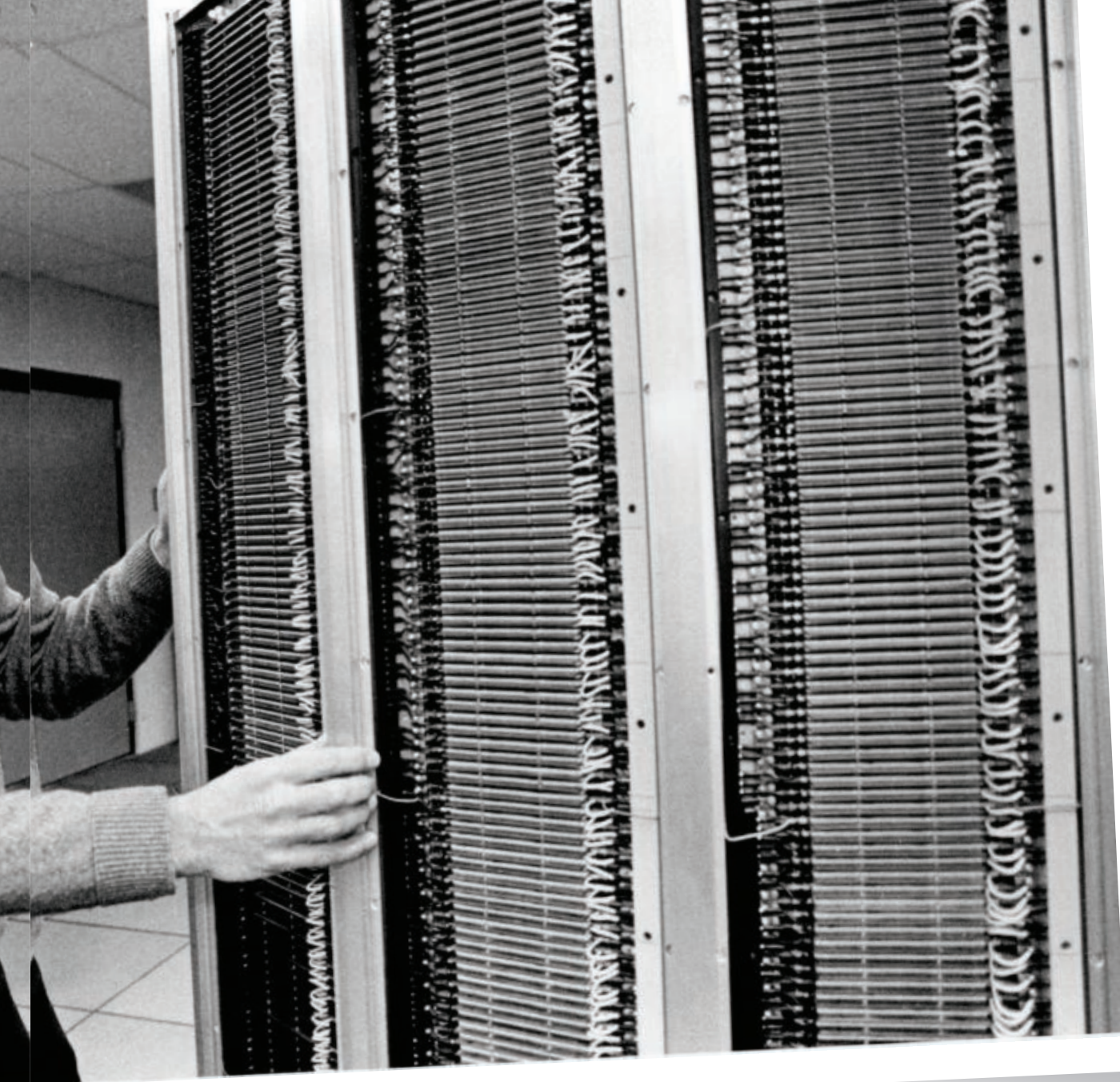
“I was driven by the fascination with making improvements in the tools that were available,” he told Allison. “I enjoyed doing the work. The work was a goal in itself for me. The fact that I saw benefit to society and I got positive feedback from the rest of the people that I worked with all encouraged

that. But basically I enjoyed doing the work. The fact that this could be done repetitively generation after generation and still be a productive kind of activity I found very satisfying.”

During a keynote session at the Supercomputing '96 conference, held a little over a month after Cray's death following an automobile accident near Colorado Springs, Charles Breckenridge, co-founder of SRC Computers, said that “no one in the history of Seymour's field has accomplished the consistent successes that he recorded during his lifetime”.

“He dedicated his entire career to the design and development of large-scale, high performance systems





for science and engineering,” said Breckenridge. “He often said that he felt he was put on earth to do that job.”

It had all begun with the CDC 6600, which was built in 1964 by the Control Data Corporation (CDC), a company Cray had helped co-found in 1957. It was the fastest machine in the world until the arrival of the CDC 7600 in 1969.

The CDC 6600 outperformed all other contemporary computers by a sizeable margin, earning it the tag of ‘supercomputer’ and effectively kickstarting a race for supercomputer supremacy. Cray and his companies would lead that race until his final design, the Cray-4, which he had designed and had operating on his manufacturing floor at the time of his death in 1996.

The CDC 6600 was a masterpiece of design and performance. It had 400,000 transistors, more than 100 miles of wiring, a built-in Freon refrigeration system, 64K 60-bit words of memory, and a central scientific processor supported by 10 very fast peripheral processors. Output was by line printer, punched card, or magnetic tape. It also had an interactive video display (probably the first computer to have one) that allowed users to view graphical results as data was being processed. In total, more than 100 were sold at a cost of between \$7 and \$10 million each, primarily to national laboratories and universities in the US that undertook computationally intense work. A trend that continues to this day.

Above: Seymour Cray with The Cray 1A vector processor supercomputer





Above: China is currently the world leader in the supercomputing stakes with the Tianhe-2 running at 33.86 petaflops.

Cray's background was in mathematics and electrical engineering. He had worked at a company called Engineering Research Associates after graduating from the University of Minnesota in 1951 with a master's degree in applied mathematics, and was as interested in the aesthetics of design as much as he was in computing.

"To Seymour, elegance of physical design was as important as reaching the performance goals," said Breckenridge. "In this area also he was also unmatched by anyone. [He] regarded every system he worked on as a stepping stone to the next. And most of them were foundations for other systems built by others using his basic designs. It is ironic that most of the competition for Seymour's machines came from companies that he had been instrumental in making successful."

Supercomputers emerged from a desire to learn; to further human knowledge and understanding, as Dag Spicer, senior curator at the Computer History Museum in California, explains.

"A supercomputer is, by one definition, the fastest computer of its time," says Spicer. "So, from that definition, the idea of a supercomputer really arose from trying to solve the challenging mathematical problems of the time in which computers first appear (late 1940s to 1950s). These problems were nuclear weapon design, artillery firing tables, and weather prediction."

"Also, until the 1980s, the US government was the single largest buyer of Cray computers. The applications being worked on in this period (1950 to 1980)

TOP 10 SUPERCOMPUTERS

Petaflop/s on the Linpack benchmark

Source: top500.org

33.86

Tianhe-2



CHINA

17.59

Titan



USA

17.17

Sequoia



USA

10.51

K Computer



JAPAN

8.59

Mira



USA

6.27

Piz Daint



SWITZERLAND

5.54

Shaheen II



KSA

5.17

Stampede



USA

5.01

Juqueen



Germany

4.29

Vulcan



USA

were typically of three types: cryptography, weather prediction, and nuclear weapons design. In the 1980s, 'vertical' solutions to a broader scope of problems emerged and supercomputers began to be used in virtual wind tunnel testing, car simulation, molecular biology, chemical engineering, astrophysics, and so on. In short, it began part of a model of scientific discovery based on theory, experiment, and simulation."

In 1995, Allison had asked Cray how he characterised the world of computers in the mid to late 60s, and also the customers he was trying to attract.

"As I perceived it the scientific community was just discovering that they could really solve partial differential equations on computers in an iterative process, finite element analysis was just really being appreciated," replied Cray. "Suddenly there was almost an infinite requirement for computing because it became so clear that the more steps you could do in your iterative solution, the better the answer would be, therefore in modelling something like weather or in the military applications modelling a nuclear reaction, all these things required the solution of differential equations where you could divide it into as many small units as you could imagine and you were limited by the

computing power to do it at that level of sophistication."

In many ways Cray's career followed the political developments of the Cold War, with his customers representing the top echelon of the US weapons and intelligence services, customers for whom funding was rarely an issue.

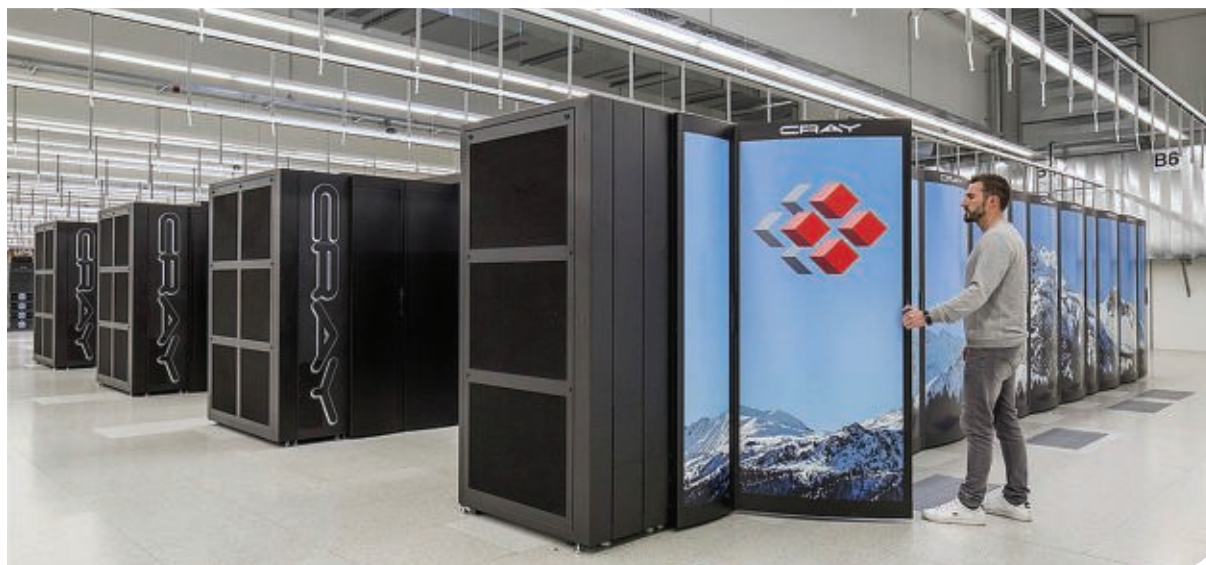
Although the CDC 6600 is recognised as the first supercomputer, the IBM 7030 (Stretch), built in 1961, and the Atlas, a British computer developed by the University of Manchester, Ferranti and Plessey, were forerunners. Only one Atlas was ever made, but it was the fastest computer in the world at the time of its release. The Stretch, meanwhile, was IBM's most complex computer design ever, with custom designs created for the Atomic Energy Commission and the National Security Agency (NSA) in the US. Only 19 were sold.

In the mid-70s the Cray-1, built after Cray had left CDC to set up Cray Research in 1972, saw integrated circuits replace transistors, delivering 170 megaflops (million floating-point operations per second) of processing speed. The CDC 6600 had been capable of only nine megaflops of processing power.

"There was a major event in terms of electrical ➤

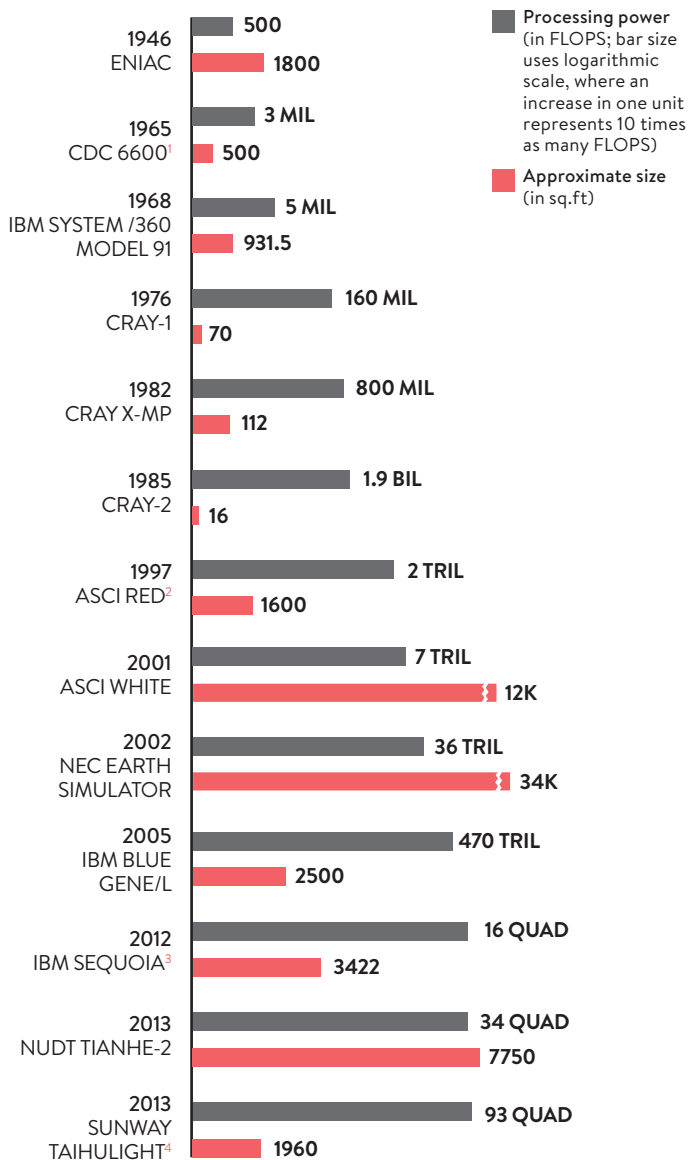
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Below:
Switzerland's
Piz Daint
supercomputer
was recently
upgraded to work
at 19.6 petaflops.



EVOLUTION OF SUPERCOMPUTERS' POWERS, FROM 1946 TO TODAY

Source: Popular Science



1. CDC 6600: Rapidly sifted through 3 million of CERN's experimental research images per year. 2. ASCI Red: Modeled the U.S.'s nuclear weapons' capabilities, avoiding underground testing. 3. IBM Sequoia: Used more than 1 million cores to help Stanford engineers study jet engines. 4. Sunway TaihuLight: Reached a record 93 petaFLOPS by trading slower memory for high energy efficiency.

integrated circuit, which was a collection of devices all on one chip. There was another basic threshold here. The first Cray Research machine designed from '72 to '75, I would guess, used an integrated circuit for the first time in my design career and this turned out to be very much more cost effective than putting so many little discrete components together. It was another major plateau."

From then on the history of supercomputing is a race towards increased processing power. The ASCI Red, built in 1996 under the US government's Accelerated Strategic Computing Initiative, was the first system to break the teraflop (trillion floating-point operations per second) barrier, followed by the IBM Roadrunner in 2008, which was the first to break the petaflop (thousand trillion floating-point operations per second) barrier. The current fastest computer in the world is the Sunway TaihuLight in China, which operates at 100 petaflops.

Although Cray remains the dominant mass producer of supercomputers, China is currently producing the fastest machines. This fact is a "source of considerable anxiety in the US defense establishment as well as commercial interests" says Spicer.

"Supercomputing has moved into what is called a 'fourth paradigm', which basically means supercomputer users are now trying to make new scientific discoveries via analysis of immense amounts of data (which a supercomputer can plow through very quickly)," says Spicer. "Supercomputers are also used massively in the physical sciences and engineering as well, where real-world physical systems are simulated on the computer with ever increasing fidelity to the natural phenomena being modelled.

"On the national security front, which is always a heavy user of supercomputing, the NSA continues to be a massive user of the technology as do the national energy laboratories who, instead of designing new nuclear weapons are now being used to certify the safety of existing weapons in a programme that is called 'stockpile stewardship'."

The race to achieve the next level of processing power is well underway, with the potential benefits of hitting that milestone manifold, including the ability to answer questions relating to climate change and the growth of food resistant crops in droughts.

"The next goal for supercomputers is to hit exascale performance – a billion billion calculations per second," says Spicer. "The US goal is for 2021; China's is 2020. Currently the Department of Energy has allocated \$258 million to various US manufacturers (HPE, Cray, IBM, Intel, Nvidia, AMD) to advance the technology towards that milestone."

All of which is far removed from the CDC 6600's humble nine megaflops of processing power.†

components at that point in time," Cray told Allison. "All of the machines that I designed at Control Data were based on discrete components and in 1972 there was an opportunity to use something called an



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يركز المتحف على الإنجازات التي تحققت على أيدي الفائزين بجائزة نوبل في الكيمياء، كما يسلط الضوء على أهم الكيميائيين العرب وإنجازاتهم في هذا المجال وأثرهم في تطور علم الكيمياء