

The Connected Business

Wednesday November 2 2016

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Central banks eye digital money

Bitcoin-like currencies could ease international finance but harm openness, says Jane Wild

‘If you can’t beat them, join them,’ could well be the mantra for the world’s central bankers. Having watched as bitcoin went from obscure experiment in digital money to a currency with a market value of almost \$10bn, they themselves are now experimenting with digital currencies rather than waiting idly to be swept away by the tide of technology.

Countries around the world – the UK, Russia, Canada, Australia, China and many more – are examining how they might mint their own digital currencies and put money on the blockchain. Efforts have intensified this year, although research is still at an early stage and many puzzles have yet to be worked out. But most agree on one thing: that the world is moving towards use of digital currencies.

Within the Bank of England, a team is already considering what a central bank-issued digital currency could mean. “The technology is moving quickly,” says Victoria Cleland, chief cashier, in her glassed-walled office inside the fortress-like Bank. “A lot of people think central banks are very risk averse, but we are thinking, ‘Are there opportunities to grasp innovation ourselves?’”

In assessing the risks and benefits, the central bank is canvassing the views of counterparts in other countries, academics and commercial banks to work out answers to the big questions. It



needs to know how turning its cash digital would affect the economy and financial stability, as well as determine whether the technology would be robust enough to stand up to hackers and serve

the UK’s 65m people. “This isn’t something we can squirrel away in the central bank because, if we were to do it, it would be completely transformative,” says Ms Cleland.

Central bankers began their homework by poring over bitcoin, the digital money launched online by an unknown computer scientist in 2009. Its breakthrough was that it was

secured not by any central overarching body, but by cryptography. Its operating system is a blockchain, and each transaction becomes a block that is linked – or “hashed” – by computers to the chain to form a permanent record of every transaction (a blockchain network) which is visible to all.

Bankers are drawn by the idea of fast, efficient, digital money that does not carry the cost of handling cash, and that can be tracked as it moves through the financial system. These advantages promise benefits in cutting risk, fraud and executing monetary policy. Central banks’ interest in deploying a blockchain to do this comes in step with moves by commercial banks and other financial institutions to use the technology to ease cross-border settlement transactions and overhaul antiquated back-office infrastructure.

They are less drawn, however, by the idea of digital money they cannot control and that can be used anonymously, the consequence of another aspect of bitcoin’s innovation: its decentralised, peer-to-peer network. Any central bank coin to emerge would have to find a different model.

There is an unresolved tension between blockchain libertarians who support open-source, decentralised networks, and those who seek closed, controllable databases.

“What is really exciting is cryptocurrency’s ability to have true peer-to-peer cash and transfer of assets. This is the real advance,” says Jerry Brito, executive director of Coin Center, a non-profit research organisation focused on the public policy issues around cryptocurrency technologies.

At the Bank of England, radical
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This cloud helps Temenos lower the cost of borrowing by 90%.

The Connected Business

Camera could spell the end of sniffing dodgy food

ON TECH

Maija Palmer



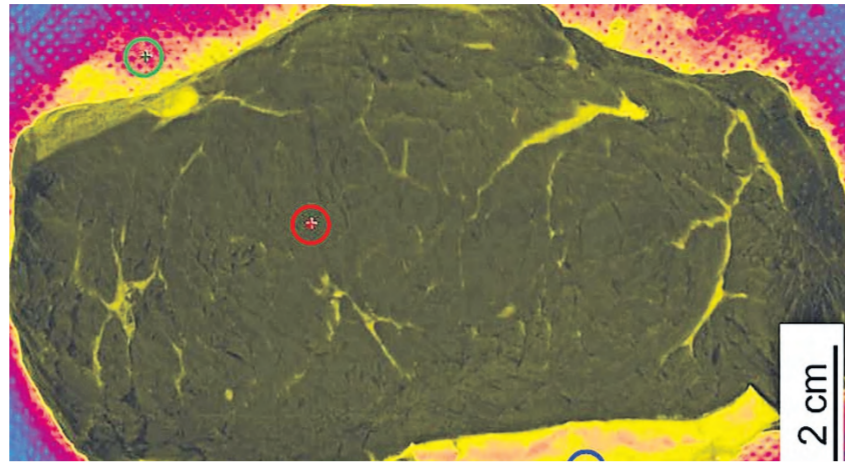
A friend taught me a trick to tell if pineapples are ready to be eaten. Tug gently at one of the spiky leaves on top and, if it comes away easily, the fruit has reached the right level of ripeness. I find this works pretty well, but for the most part, telling when food is at its peak is an inexact science of sniffing and prodding. A huge amount of food is wasted. Roughly a third of all the food produced globally – about 1.3bn tonnes – is lost each year, according to the UN Food and Agriculture Organisation. Waste happens at all levels of the process – from harvesting to transport to consumers throwing away perfectly good food because it has passed the use-by date.

But what if there was a smartphone app that could tell you whether food was still safe to eat?

This is not completely in the realm of science fiction. Abi Ramanan, co-founder of ImpactVision, is developing hyperspectral imaging software that could tell you how fresh a piece of beef is, or how ripe an avocado, by analysing how they reflect light across the electromagnetic spectrum, beyond the range of visible light.

This is the kind of technology that Nasa uses to study planets and monitor the surface of the earth. Deeper spectroscopic analysis reveals the chemical make-up of the materials. The concept applies as much to what is on a plate as what is on a planet.

“Every object – an apple, bread, meat – absorbs and reflects light in a unique way,” says Ms Ramanan. Even different types of meat, from beef to horse meat, have different spectral fingerprints, so you would be able to verify the bovine origin – or otherwise – of your favoured supermarket meatball. At the moment,



What's the beef? A spectroscopic image of a piece of meat – ImpactVision

ImpactVision is working on how to apply hyperspectral imaging to meat production and plans to install cameras on conveyor belts in packing plants.

Ms Ramanan says that analysing the infrared spectrum will even indicate the beef's tenderness and what its acidity level is, an indicator of its eating quality. “Up to now the food industry has relied

on visual inspections, destructive tests and pulling random samples off for testing,” says Ms Ramanan. “It is inexact. Our technology can tell you the pH [acidity] of every piece of meat and its tenderness without it having to be touched.”

Anything that does not match the desired 5.5pH level required for steak,

for example, can be pulled off the production line before it is packed and shipped. Trials have shown that the technology could greatly decrease waste in the supply chain as it can help meat producers to detect problems earlier, so avoiding costly recalls of food that might spoil if shipped.

If meat can be classified more easily, it can be used more efficiently. Meat with a pH of above 5.5 can still be used for ground mince, for example, but should not be sold as steak.

Bananas, for which the exact state of ripeness is crucial when it comes to transporting them, could be another product that would benefit from the technology, Ms Ramanan says.

It could be used to detect contamination – such as in the case of melamine-laced baby-milk formula in China in 2008.

The technology offers many non-food uses. Optina Diagnostics, based in Quebec, Canada, is using similar technology to scan people's retinas to detect Alzheimer's disease, while Texas-

based Rebellion Photonics uses it to scan oil rigs for dangerous gasses.

One day, Ms Ramanan says, the sensors will be small and cheap enough to put in a smartphone. So far, hyperspectral imaging cameras are too big and expensive for this. BaySpec, based in San Jose, California, sells handheld hyperspectral cameras for several thousand dollars a piece.

But prices could fall as the market grows. Israel-based Unispectral has raised \$7.5m to develop a hyper-spectral digital camera that could eventually fit into a phone.

“People in Silicon Valley say this will happen in a year. Others say it will take 10 years, or never happen. I think it is somewhere in the middle,” says Ms Ramanan.

At that point my days of tugging pineapple leaves may be over. We might be able to say goodbye to those inexact and wasteful use-by dates on food labels. One thing is certain – it would make photographing and posting pictures of food online more interesting.

Artificial intelligence moves from sci-fi to daily life

Applications From beer to toys, smart technology is to be found everywhere, says *Jessica Twentyman*

Artificial intelligence is creeping into our daily lives in unexpected ways. It is not just transforming online services with innovations such as Apple's Siri voice recognition app, which will send emails when you instruct it to, or Microsoft's Skype translation services, which enable you to communicate online with people whose languages you do not speak.

Wider applications of artificial intelligence, such as image and pattern recognition (classifying data or objects based on common features), natural language processing (how computers understand and respond to human speech) and machine learning (when software learns something without being programmed to do so) will soon be featuring in many products and services.

The Connected Business examines some of the more unusual uses of artificial intelligence that may be coming to a home or office near you:

Pest control

In recent years, pest control company Rentokil Initial has been experimenting with rodent traps equipped with sensors

and WiFi. These send data to a command centre, which the company has built with partners Google and PA Consulting.

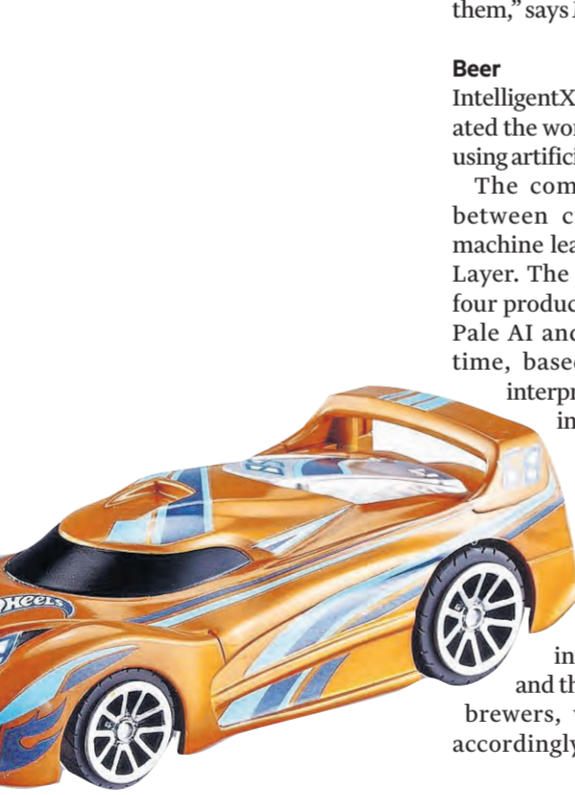
A member of staff is only sent to a trap once the machine has told the command centre it has caught a rat or a mouse. This is more efficient than routine patrols, which would often find empty traps.

Rentokil Initial now has more than 20,000 such devices in 12 countries. It has collected more than 3m pieces of data with these so far. These could be used to finesse the company's digital pest control services with a dose of artificial intelligence, says Tim Shooter, an independent technology consultant who worked with Rentokil Initial on the pilot project.

By blending information from the traps with weather and mapping data, it might be possible to better identify rodent breeding or migration patterns and identify infestation-risk hotspots before they develop, he says.

“That would mean a

Intelligent things: algorithms help improve recipes for Intelligent X's beverages (above); a Hot Wheels AI race car (below)



significant shift away from reactive pest control services... in favour of proactive services that tackle problems before a customer's even aware of them,” says Mr Shooter.

Beer

IntelligentX Brewing claims to have created the world's first beer to be brewed using artificial intelligence.

The company is a joint venture between creative agency 10x and machine learning specialist Intelligent Layer. The recipes for the company's four products – Golden AI, Amber AI, Pale AI and Black AI – change over time, based on customer feedback interpreted using a machine learning algorithm.

Codes printed on the bottles direct customers to a Facebook Messenger bot, which asks questions such as: “How would you rate the hoppiness out of 10?” The responses are then interpreted by the algorithm and the findings are passed to the brewers, who tweak their recipes accordingly. The questions change

based on the responses the algorithm finds most useful. IntelligentX's beers can currently be purchased from UBrew in Bermondsey, London, but will soon be available to order online.

Home security

While security company Cocoon's devices use the motion sensors and cameras one might expect, they also detect sounds and vibrations – including low-frequency signals inaudible to humans – and use machine learning to understand the noises that are usual and those that may signify a break-in.

Every home has a unique sound fingerprint, says Cocoon co-founder and head of software John Berthels: this may include lorries rumbling by, the central heating switching itself on and off or a pet moving around. The devices gradually build up a picture of what is “normal” for each house.

If noises deviate from the established patterns – a back door being forced open or a window breaking – the device will send an alert to the users' smartphone, prompting them to check their home on a live video link, set off a high-pitched alarm or call the police. About

850 people took part in Cocoon's Indiegogo crowdfunding exercise, raising almost \$250,000, and the devices are now on sale online for £299 (\$399).

Toy cars

In September 2016, US toymaker Mattel unveiled Hot Wheels AI Intelligent Race System, a twist on its much-loved line of toy racing cars which dates back to 1968.

Unlike slot-car systems like Scalextric, which keep cars on track by means of a pin, Hot Wheels AI has sensors on the underside of each car that interpret a gradient pattern printed on the track.

The AI behind this is no more complex than the technology that guides a robot vacuum cleaner, but it means players can race against self-driving, computer-controlled cars and those controlled by other humans.

The cars are larger than their predecessors and require a games controller. Players can also launch virtual hazards such as oil slicks and tyre blowouts to sabotage their competitors.

The toys are now available on retail sites and Mattel will be hoping for a Christmas hit.

Innovation found 20,000 leagues under the sea

Deep sea cables

An invention that captured Jules Verne's imagination is more relevant than ever, reports *Geoff Wheelwright*

It was in the mid-1800s that communications pioneers first laid cables on the seabed to create the world's telegraph – and later telephonic – infrastructure.

Visionary French writer Jules Verne was so enraptured by the idea of undersea telegraph cables that one features in his 1870 novel *20,000 Leagues Under the Sea*, when Captain Nemo's crew find the remains of the world's first transatlantic cable, laid in 1855, off the shores of Newfoundland.

Now, 146 years after Verne's book, undersea cables are thriving, according to Alan Mauldin, research director at the Washington DC offices of TeleGeography, an international telecommunications market research company.

Citing data published by the US Federal Communications Commission, he says the technology is the dominant

method of international telecommunications, and about 99 per cent of all intercontinental telecoms traffic – data, phone calls, texts, emails – is transmitted via submarine cables.

There is big growth in the sector now because of the fast-rising requirements of cloud-based technology businesses and their customers, as well as the demand for greater capacity from financial services companies seeking the smallest possible delays in transaction times (known as latency).

Mr Mauldin says that demand for global bandwidth is growing at up to 40 per cent year.

There was a time when cables were laid and controlled by large consortiums of national telecommunication carriers, but this is changing. Microsoft and Facebook announced this year they are jointly building Marea (Spanish for “tide”), a 6,600km scheme billed as the “highest-capacity subsea cable to ever cross the Atlantic”.

This cable is faster per second by 16m-20m times than a home internet connection and is due to be completed by October 2017. It will be operated by Telxius, the infrastructure unit of Spain's Telefonía, and run from Virginia in the

US to Bilbao, Spain, and then to network hubs in Europe, Africa, the Middle East and Asia.

The companies have not provided costings for the project.

Meanwhile, Google was part of a \$300m consortium that backed the 9,000km Faster cable project linking the US West Coast to Chiba and Mie prefectures in Japan, completed in June. Three months later, Google extended the cable to Taiwan to increase the speed and reliability of its services.

Peter Jamieson, chairman of the European Subsea Cables Association, an industry group, welcomes the investment of large technology companies.

He says many systems are still run by older companies such as BT, AT&T, Telefonía, Vodafone and large communications providers like Level 3, Hibernia Networks and Global Cloud Xchange.

After a long period in which the incumbents have been adding little capacity, established companies are starting to do more, Mr Jamieson says. Vodafone this year went live with a cable from Bengal to Southeast Asia, South Asia and the Middle East.

In September 2015, US-owned Hibernia Networks rolled out Hibernia

Express, an “ultra low latency service” aimed at the financial services industry. It boasted of being able to provide the lowest latency between New York and London, and said it was a 5 millisecond improvement compared to existing high-speed networks which now link businesses in the two global financial centres.

Meanwhile, Aqua Comms, based in Dublin, announced in January that its America Europe Connect subsea fibre-optic cable network from County Mayo to Long Island was live.

The company says this too offers reduced latency.

Mr Jamieson adds that Google, Facebook, Amazon and Microsoft are not content with leasing capacity on services managed by others.

“They want to control their own traffic and therefore they are co-financing the new round of submarine cables.”

He rejects the idea that satellite

technology is a competitor to undersea cables for carrying digital communications. “Satellites cannot compete with the capacity required, the speed or the latency,” he says.

But investment in the cable industry is not for those seeking a quick return. Backers need patience and deep pockets to undertake the time-consuming process of building new cables, according to Paul McCann, who runs an undersea cable consultancy in Sydney, Australia.

“It is a long-term investment, not a ‘get rich quick’ opportunity,” says Mr McCann.

Mr Mauldin agrees, and says investors who are likely to get frustrated with the process should best avoid it.

“From having the idea, to finding a route, to doing a survey of the marine area, to getting the environmental permits, building the cable and then laying the cable – usually it takes at least two years depending on where you are laying it,” he says.

Additionally, working out when a completed project will actually be delivered is not an exact science, he adds. “Usually people announce one date and then add at least six months to it.”

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Visionary: author Jules Verne wrote about the first undersea cable in *20,000 Leagues Under the Sea*



The Connected Business

Central banks eye move to digital currencies

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options are being discussed. One scenario even involves the blockchain being used to bypass high-street banks, with individuals holding accounts directly with the central bank, cutting out the commercial banks' role as middleman in the circulation of money. One person familiar with the process says that high street banks have been privately pushing against this model.

But the days when bankers worried that bitcoin might be a threat to national currency are fading.

"We don't see private currencies having an edge over fiat currencies [those declared by central banks to be legal tender]," says Dong He, who has led research by the International Monetary Fund into digital currencies.

"There have been episodes of private currencies competing with government-issued coins and notes but ultimately they were replaced by fiat currency."

A bigger issue is regulation of digital currencies. This is a looming challenge that will require cross-border co-operation. Monetary authorities must come together, Mr He says, to start thinking about the necessary regulation of digital money that will be flowing around the world. He says the IMF should provide a platform for discussions to happen.

When a move to official digital currencies might occur is hard to estimate, he says, but a switch could happen within the next five to 10 years. For him, it is a question of moving with the times. When large parts of the financial system are using blockchain for financial transaction, so will central banks.

Of course, money is already electronically held and processed, but blockchain technology could offer a far more sophisticated operating system, with the prospect of "smart" money.

Charles Hoskinson, head of IOHK, a company that makes cryptocurrencies, says being able to "programme" cash held in accounts will benefit ordinary people, corporations and governments.



Brother, can you spare an online dime? Bitcoin was created in 2009, since when it has been joined by a host of competing digital cryptocurrencies — Chris Ratcliffe/Bloomberg

Ones to watch The rise of online-only money

There are hundreds, if not thousands, of digital currencies but only a few have significant support. Most so-called alt coins are likely to remain niche instruments. Many who put cash into them are speculators who hope wider take-up will send their investments soaring. But digital currencies have now caught the attention of financial institutions and central bankers. Here are some of the popular digital coins that are currently available.

Bitcoin The first digital currency to gain widespread adoption has the highest market value at about \$11bn. Since its creation in 2009, bitcoin has demonstrated that the algorithms driving it are robust. However, it will be forever tainted in the eyes of many because of its use by criminals on dark-net sites and its association with scandals in which customers' bitcoin were stolen from hacked exchanges. It runs on an open-source protocol that operates across a network of users' computers. But

its flaws are preventing it from being more widely adopted so it can become a means of payment as big as MasterCard or Visa.
Market value: \$11bn. Price per coin: \$687.41

Ethereum The second-biggest digital currency is ether, an open-source, decentralised currency running on the Ethereum blockchain. The Ethereum project takes virtual currencies further than bitcoin, by developing new applications on the underlying technology. One innovation is exchanging ether using legally binding contracts stored on its blockchain, the distributed ledger infrastructure on which it operates. Companies such as IBM, Microsoft and Samsung have experimented with Ethereum's protocol.
Market value: \$1bn. Price per coin: \$11.26

Ethereum Classic This cryptocurrency came into being in 2016, when the creators of Ethereum

decided to split Ethereum's blockchain after a hacker stole millions of dollars in customers' deposits. But this move outraged many who believed a core principle of blockchain — that it was tamper-proof — had been violated by its founders in an effort to protect depositors' funds. They stuck with the original chain, however, so although Ethereum and Ethereum Classic were once in fact the same algorithm, the two have since become separate currencies despite sharing a similar name.
Market value: \$84m. Price per coin: \$0.98

Ripple Ripple is working with banks including Santander and UBS to develop the infrastructure to allow financial companies to make payments to each other across borders, a core aim of the sector. It aims to be faster and cost less than the infrastructure banks use. It would offer services in competition with existing providers such as Swift,

which provides secure financial messaging products.
Market value: \$298m. Price per coin: \$0.008376

Dash Originally named Darkcoin, this currency began to gain popularity in 2015 by vaunting its privacy benefits. Dash's network operates in much the same way as bitcoin does, but it is designed to add an extra layer to transactions, mixing them up so it is difficult to link the buyer and seller.
Market value: \$65m. Price per coin: \$9.49

Litecoin If bitcoin is gold, Litecoin is silver. That was the principle stated by its founder, a former software engineer at Google. Although it was inspired by bitcoin, it was designed to offer an edge over its rival in that its network can handle more transactions more quickly.
Market value: \$193m. Price per coin \$4.01
Figures correct at time of publication

"You can put all kinds of extremely advanced terms and conditions on a digital account for money: where, when and who can spend it, and how much I can spend. That can happen with a bank account on a digital ledger."

Digital currencies will eventually benefit the developing world too, says Tilman Ehrbeck, a partner at the

philanthropic investment firm Omidyar Network, set up by eBay founder Pierre Omidyar.

Mr Ehrbeck argues that because they are low-cost and easy to use on electronic devices, digital currencies will enable greater access to financial services for the billions of the world's unbanked. But for now, the research is

most concentrated within the financial sector.

"It's inevitable there will be a government digital currency, eventually," says Kenneth Rogoff, a professor at Harvard who studies the concept of a "less-cash" society. He believes that cash will never disappear, and that there will always be a role for small notes.

Kenneth Rogoff warns that central bank-operated digital currencies could be 'decades away'

"Eventually, there will be government digital currencies that ordinary people have access to at very low cost."

But he warns: "A government digital currency could be many decades away, and there are all sorts of security and regulatory issues that have to be navigated first. That said, many central banks are already thinking about it."

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