"Skinner's *ValueWeb* is a sweeping and well-researched analysis of the big technology trends that will shake the windows and rattle the walls of the industry."

— **Don Tapscott,** *Bestselling Author*

ValueWeb: How mobile and blockchain technologies are changing everything we value in trade, finance, life and relationships

The Internet of Things is all about machines trading with machines. Your fridge orders groceries; your car, fuel; your television, entertainment; and so on. However, machines cannot trade with machines if it's expensive and slow. Would you really want your TV to order the next season of *Game of Thrones*, if the payment took ten days and cost $25 or more to process? Unfortunately with the way the bank system works today, that is the problem we face. As a result, we need an Internet of Value to work with the Internet of Things. The Internet of Value, or ValueWeb for short, allows machines to trade with machines and people with people, anywhere on this planet in real-time and for free. Using a combination of technologies from mobile devices to bitcoin and the blockchain, FinTech firms are building the ValueWeb. The question then is what does this mean for financial institutions, governments and citizens?

"This book will be an invaluable read for all interested in the way business works."

— **Sir Roger Gifford,** *Former Lord Mayor of London*

"Chris Skinner argues, persuasively, that the combined technologies of mobile connectivity and distributed ledgers could deliver disruption, for the benefits of billions of citizens."

— **Andrew G Haldane,** *Chief Economist, Bank of England*

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CHRIS SKINNER

VALUE WEB

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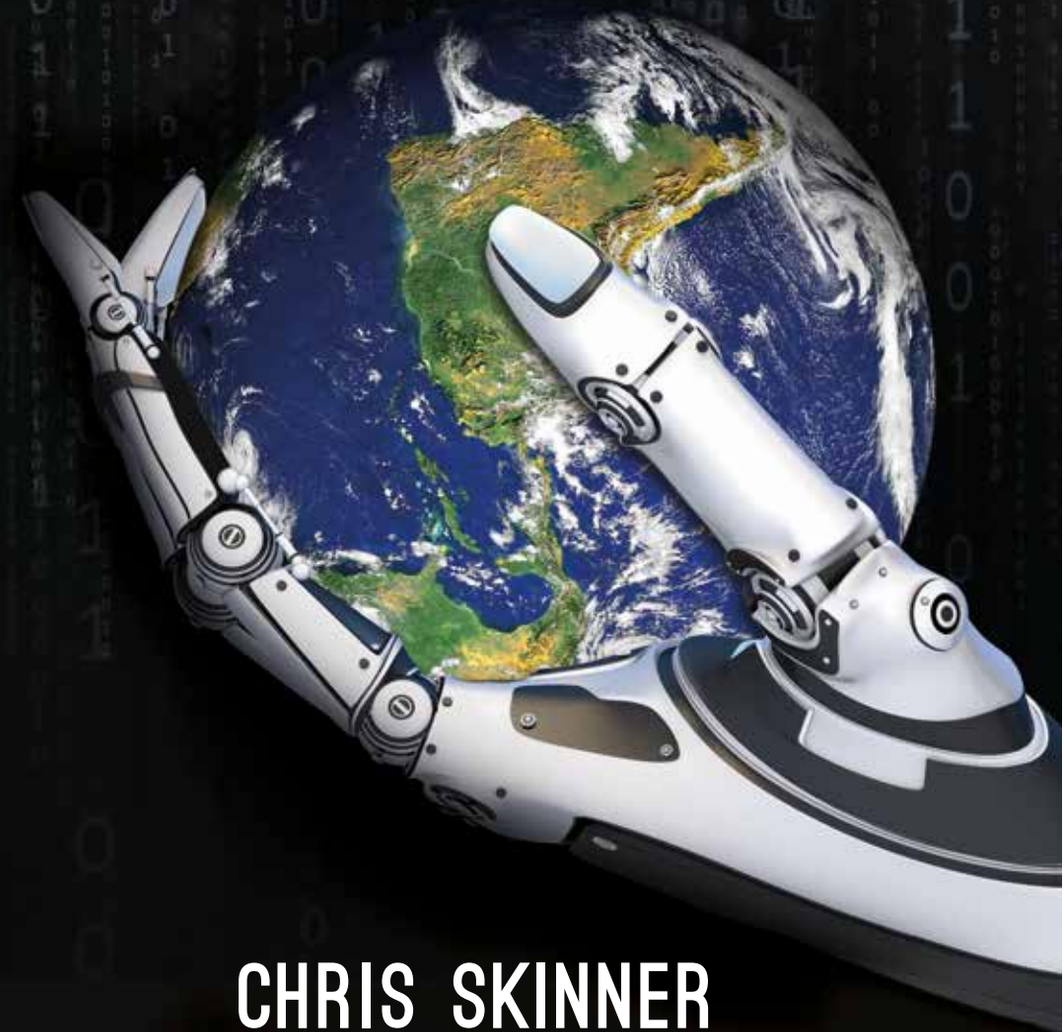
VALUE WEB

How FinTech firms are using mobile and blockchain technologies to create the Internet of Value



CHRIS SKINNER

Author of the bestselling DIGITAL BANK

"Chris Skinner: one of the most authoritative voices on FinTech anywhere"

— **Seth Wh eeler,** *Former Economics Advisor to the US President and The White House*

Praise for *ValueWeb*

"Chris Skinner—one of the most authoritative voices on FinTech anywhere—has provided us another timely and thoughtful look into the fascinating convergence of technology, e-commerce, and finance that is changing the world. Ignore these trends and the insights here at your peril."

—Seth Wheeler
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"Society is in the early stages of another financial revolution—one that is already changing the way we live and work. This book describes the fundamentals driving the processes at play, and will be an invaluable read for all interested in the way business works."

—Sir Roger Gifford
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"Global payments are ripe for disruptive innovation. Chris Skinner argues, persuasively, that the combined technologies of mobile connectivity and distributed ledgers could deliver just that disruption, for the benefits of billions of citizens."

—Andrew G Haldane
Chief Economist, Bank of England

"Financial services is up for huge disruption, most importantly from the blockchain revolution. Skinner's *ValueWeb* is a sweeping and well-researched analysis of the big technology trends that will shake the windows and rattle the walls of the industry."

—Don Tapscott
Best Selling Author, most recently with Alex Tapscott Blockchain Revolution

"Chris Skinner captures the maturing of FinTech in his book, *ValueWeb*. Not only does he define many of the FinTech buzz words from Blockchain to Value System Integrators, he gives real examples of practical application of the concepts. It's not surprising that he calls for innovation in traditional banking and points out the dead giveaway of anyone trying to fake it as a digital bank: First, you don't need a cross-channel organisation in a truly digital bank, and second, you never mention channel or omnichannel in a digital bank. He sums up what those enlightened in managing change have known all along, it all comes down to leadership. And that's my favourite part of this book, the leaders he profiles along the way."

—Deanna Oppenheimer
Former Vice Chair, Global Retail Banking, Barclays Bank

"Best insight into money in the 3rd industrial revolution, aka the digital revolution, you will read."

— Lawrence Wintermeyer
CEO, Innovate Finance

"In *ValueWeb*, Chris Skinner has brought to bear his long experience in financial services and technology to create a fascinating and comprehensive overview of the blurring of boundaries between them. The book describes how technology is disrupting traditional financial services by making transactions simpler and cheaper, and how banks must proactively leverage these trends to be future-ready."

— Chanda Kochhar
Managing Director and Chief Executive Officer, Icici Bank

"Chris has a great eye for the case studies and practical examples of innovation that help you to really reflect on where banking is going."

— David Birch
Director, Consult Hyperion

"A great follow-up to his best-seller *Digital Bank*, Chris Skinner provides an in-depth look at the exchange of value in an evolving digital universe. Through case studies, interviews and personal observations, Chris explains how the world is moving away from traditional currencies towards a ValueWeb. This is another must-read, not only for those interested in the world of FinTech, but anyone wanting to get a glimpse of a future where monetary and non-monetary transfers occur instantaneously across mobile and digital networks."

— Jim Marous
The Financial Brand/Digital Banking Report

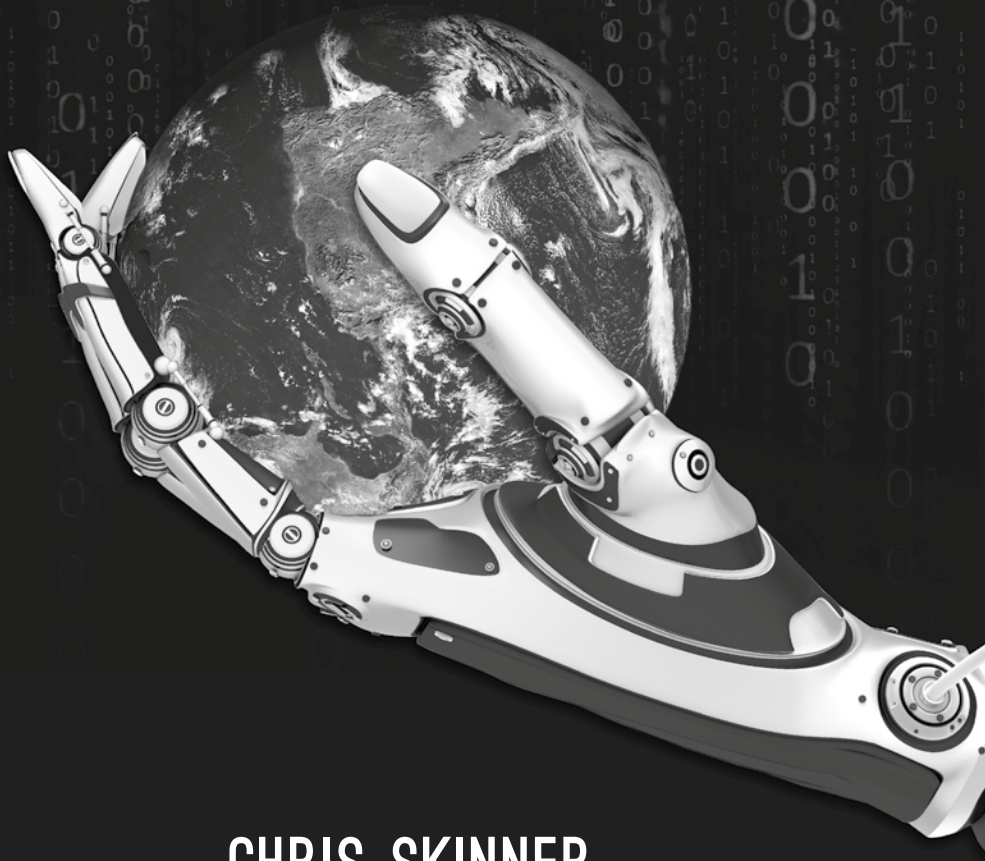
"If I could only call one person when the FinTech apocalypse happens, Chris Skinner would be the person I would call. His huge depth of knowledge, coupled with his ability to summarise complex subjects into memorable and simple to understand chapters for this book, make it a must read for any bank wanting to know which way to dig."

— David M. Brear
Chief Thinker, Think Different Group

VALUEWEB

VALUE WEB

How Fintech firms are using mobile and blockchain technologies to create the Internet of Value



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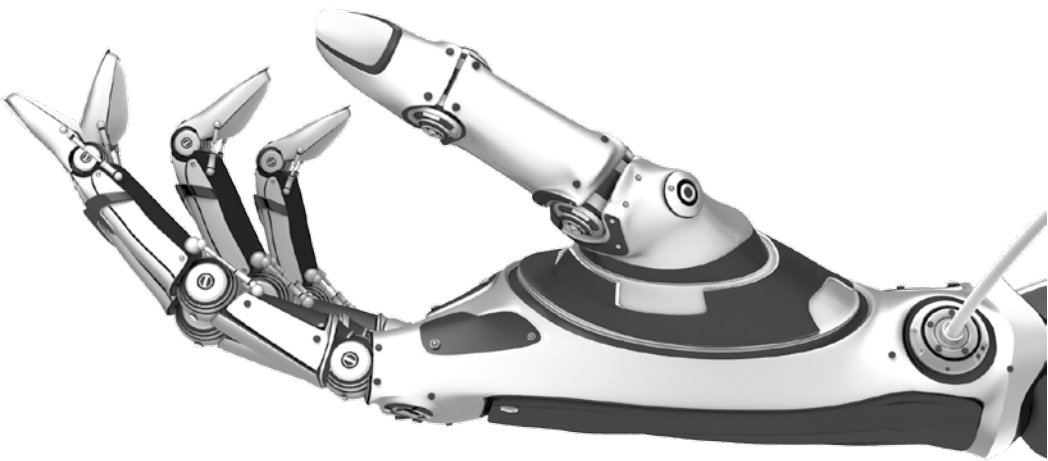
INTRODUCTION



After writing *Digital Bank* in 2013, I turned to other ideas, since that book was primarily about the challenge faced by banks to adapt to new technology. For those who are unaware, the key premise of *Digital Bank* is that a bank must be built for the internet age. That means transforming the structures built in the last century for the physical distribution of paper in a localised, physical network, and reconstructing operations for the digital distribution of data in a globalised network based upon the internet. A digital bank is an internet-based bank, in other words.

In that book I first mentioned bitcoin, the new digital currency. Over the years since, bitcoin as a currency has declined in volume, but the technology that currency was based upon, a shared ledger called the blockchain, has gone mainstream. Banks, payment processors, asset managers, governments, regulators and companies in general have all been experimenting with how to use the blockchain ledger to record the exchange of value.

This led to me thinking increasingly about the exchange of value and how we value things. More and more, I began to write about value stores, value tokens, value structures and value systems. I soon found that others were talking about the Internet of Value and therefore it soon became natural to talk about the ValueWeb. The ValueWeb is all about how the internet is changing the way we value things in trade and finance, but also in life and relationships.

Value is not only exchanging money and currencies, but also *likes* and *favourites*. Pageviews, Klout and followers are a major force of value today. Companies will pay to get attention, and attention translates into views. It is for this reason that individuals are becoming important as media channels. An individual with millions of followers is a big influencer in their communities, and that is bankable. It is why someone like Felix Arvid Ulf Kjellberg, a 25-year old Swede, is one of the most important voices on the planet. Who is Felix? He's better known as PewDiePie, a vlogger who has 40 million YouTube fans and banked over US$7 million in 2014 from advertising on his homepage. It is the reason why American Matt Stopera has become an internet sensation in China (all thanks to a lost iPhone). It is how Chen Kun, Yao Chen and Guo Degang have become bigger in China than Jackie Chan, thanks to Sina Weibo, a microblogging site.

This is the new world of global connectivity and it is driven by the mobile network integrated with the smart network of the internet. Instantaneous, non-stop, global, real-time connectivity is changing the way we think and relate to each other. However, this new connectivity would be nothing if we could not trade and exchange value cheaply and easily through it. This is the focus of the book: how we can trade easily and instantly on a globalised basis through the mobile internet.

In this context, we need a cheap, global, real-time value exchange structure, and this is being built in two forms. On the one hand, we have a new form of value exchange being constructed through the blockchain; on the other, we have the old form of value exchange being replaced by the blockchain.

This is the two-stream world explored in *ValueWeb.* The pages that follow provide you with an in-depth review of what is happening in building the new world of value exchange, and the likely developments over the years to come. Unlike *Digital Bank,* this book does not focus upon banks or banking per se, but on the wider question of how the Internet of Value is being built, how it will operate and what it means.

It is for these reasons that I have consciously sought to interview the key players in the emerging world of the ValueWeb, rather than focusing upon banks and payment processors. It is why the case studies and interviews contained in this book are with many new start-up companies and observers of this new world of the Internet of Value, rather than established companies and existing players.

The first half of the book therefore explains *ValueWeb,* and points to two specific trends that are shaping this new world.

First, the mobile connectivity that is allowing every single person on the planet to be able to use an electronic network connection. Seven billion people are now connected through a network when, just ten years ago, less than a billion people were on the network. That's a massive change, because everyone on the planet can now connect and exchange value in real-time, person-to-person—if you prefer, peer-to-peer or P2P. The key here is that mobile P2P connectivity enables everyone to be able to trade and exchange value one-to-one, globally and in real-time. Most

importantly, a mobile telephone not only allows you to trade, i.e., buy things, but also to create new entrepreneurial structures, i.e., sell things.

A mobile is both a payment device and a point-of-sale (POS). This is why mobile trade is rising fast and is allowing every single person on this planet to connect, trade and exchange in real-time. This is transformative, as people who could not access trade and finance ten years ago can do so today. This will lift many out of poverty and is a big focal point for investment in the mobile ValueWeb, as illustrated in an interview with Kosta Peric of the Bill & Melinda Gates Foundation.

As Kosta points out, you cannot build a mobile ValueWeb that includes everyone on the planet if you have expensive and slow-value exchange systems. The old exchange systems—the banking system—takes days to process payments and charges a high cost. The new exchange system has to be cheap—almost free—if poor farmers in emerging markets are to use it.

This, therefore, is the second big trend explored in the book: how to build an instantaneous and near free value exchange system. This second trend is clearly based upon the new technology spawned by the bitcoin currency, called the blockchain. That discussion is possibly best illustrated by my interview with Chris Larsen of Ripple Labs, a major player in the building of new structures for global value exchange between banks. However, there are many other views that are just as important, which is why half of this book is about cryptocurrencies, bitcoin and the blockchain.

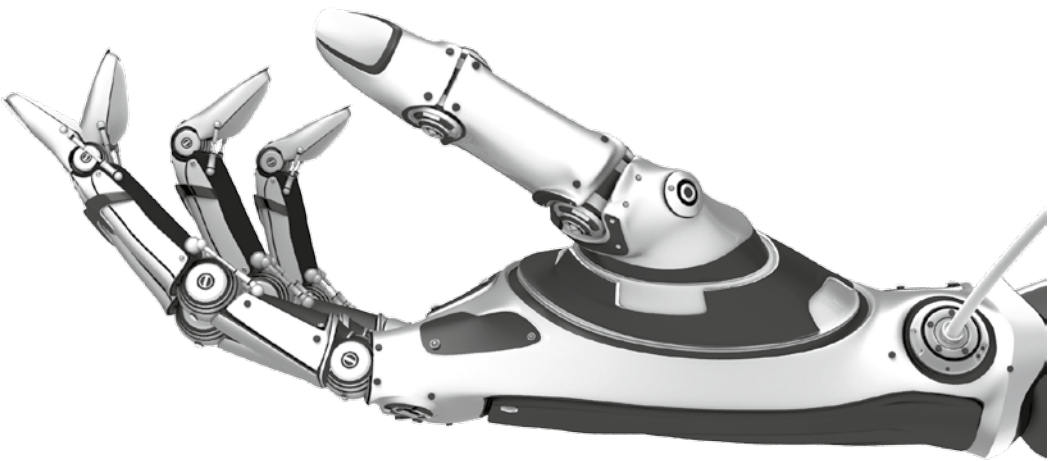
So these are the key issues explored in *ValueWeb:* how mobile and blockchain technologies are building a new internet, based upon the global exchange of value in real-time and almost free. These themes are explained in depth in the first half of the book, and then illustrated through the interviews with the people building this ValueWeb in the second half.

So that's the new book. Half of the book explains the ValueWeb, and then the second half explores the people building it. I hope you like this book, and welcome feedback.

Chris Skinner, Autumn 2015

1.

WELCOME TO THE VALUEWEB



The first steam engine was patented in 1606 by Spanish inventor Jerónimo de Ayanz y Beaumont but it wasn't until 1829, some two centuries later, that George Stephenson sent *The Rocket* on its way, creating the first viable railway service. The railway created the tracks that built America and fuelled the process of getting goods from A to B fast—but it took two centuries to get there.

Rail was just one of several innovations during the 19th century that saw the Industrial Revolution transform life. Another key invention was electricity. Electricity is generally attributed as an invention to Michael Faraday in the 1820s, although again its roots go back two centuries previous, when the words *electric* and *electricity* made their first appearance in print in Thomas Browne's *Pseudodoxia Epidemica* in 1646.

In other words, the last great revolution in trade took 200 years to establish. This new one—the networked revolution of providing our planet with communication, P2P, for everyone—has taken about 70 so far. The roots of the network revolution start with the invention of the computer. Different folks have different views of which developed first but I believe it was ENIAC, the World War II weather forecasting system that was created in 1943 and was up and running in 1946.

70 years later, we have this machinery in our pockets and purses, with the average smartphone being more powerful in terms of computer processing power than NASA's Mars spacecraft of the last decade. But it takes a long time to digitise the entire planet; we began with the building blocks of networks, access, and infrastructure, and have gradually moved from information and commerce to caring and sharing, to what I see today as the most radical network transformation, focused upon value.

It is interesting, for example, that the most radical changes the internet has introduced so far has been the disintermediation of the travel and entertainment industries, with music and film revolutionised in its distribution and pricing. Yet, in banking and payments, the only real innovation until recently was PayPal. And PayPal is not really an innovation in banking and payments, but just an extra layer on top of existing banking and payments infrastructures.

But the network transformation of how we exchange value, which I call the ValueWeb, is transformational in all aspects of banking and payments.

That is why we are seeing so much investment in FinTech, with over a thousand new start-ups receiving over $12 billion in investment in just the last few years alone. According to the latest statistics, FinTech investments are doubling year-on-year, and 2015 looks set to be a new record year, as we see $20 billion being pumped into this market from venture capital funds, private equity and other sources.

This is why we are seeing so many new names becoming mainstream, and a third of all this investment is going into payments start-ups, because the time is finally ripe to reinvent banking and payments through technology. Currency Cloud, Transferwise, TraxPay, Square, iZettle, Stripe, Dwolla, Klarna and others are all changing the payments game.

The main theme of my previous book, *Digital Bank,* is that we built our financial systems in the last century for the physical distribution of paper in a localised network, and now have to rethink that system for the digital distribution of data in a globalised network. It is not just an evolution of the business model, but a fundamentally different business model.

The old structure has been cemented into place by old systems, and seeks the transfer of goods and services through a value exchange system that is hand-to-hand rather than peer-to-peer. If you take our old value exchange mechanisms, we had banks and counterparty banks and infrastructures like Visa and SWIFT that were all required for enabling monetary transactions.

We then added PayPal to overcome the challenges that created for us, as the network moved towards globalisation. As a result, we don't just have a four-pillar model in place—issuing bank, acquiring bank, card processor and merchant—but, in some cases, an eight-pillar model.

This costs, as every counterparty is taking a fee. That will not work in the age of the internet, and does not support a globalised value exchange system, which is why the open sourced network has created bitcoin.

Cryptocurrencies, of which bitcoin is one, are the manifestation of what is needed to support a ValueWeb. We cannot have global value exchange without some form of digital currency, a cryptocurrency, and the digital identity that goes alongside this. That is why cryptocurrencies are so fundamental to the transformation we are seeing today.

Now most people think when bitcoin is mentioned that we're going off on some flaky tangent. That's because bitcoin has been associated with cybercriminal activities and has had its name tarnished by suspicious exchanges like Mt. Gox and Bitstamp. These are just early day issues in an early day experiment, however, and thinking that bitcoin as a currency is suspect because of Mt. Gox and Bitstamp's issues is a bit like saying the UK Pound is flaky because of the collapse of Northern Rock and Bradford & Bingley.

However, where I do agree with many critics is that bitcoin will need some form of change as the idea of being a money without governance just doesn't wash. Money without governance is like having a society without police. It leads to terrorist funding, money laundering and drug running, as illustrated by the activities of the dark net marketplace Silk Road. However, just like the change in commerce on the internet that saw free downloads and copyright theft through Napster and Pirate Bay, you eventually see order from chaos.

Out of the anarchy of the music and entertainment revolution, we have seen iTunes, Netflix and more create a better value world that people feel, generally, is worth paying for. In a similar way, we will see the fledgling movements of the cryptocurrency world move towards mainstream adoption over time. In fact, we are already seeing it. USAA, the New York Stock Exchange and BBVA invest in firms like Coinbase; J.P. Morgan, Goldman Sachs, Barclays and others are seeing how they could use the blockchain for securities settlement (just use Colored Coins); and, in the meantime, several banks are actively working with Ripple to replace their counterparty transaction engines.

In other words, the use of cryptocurrencies and smart contracts through the blockchain is already happening. But there is more to the ValueWeb than buying and selling physical and digital goods and services. It's about creating and sharing ideas, thoughts, entertainment and more.

The ValueWeb is represented by *likes, shares, favourites* and *page views.* My blog gets around 2,000 page views per day, whilst my Twitter handle has over 11,000 followers. That means that I have a value and a presence that can influence. It is why firms want to advertise on the blog, pay me to mention them and ask for retweets. I ignore them all, as that's not my business model.

The ValueWeb allows guys like PewDiePie, the Slow Mo Guys and reformed porn stars to make millions from their cute, weird and funny YouTube sites. This is because anyone can be a voice today. Anyone can be a channel. Anyone can be a social media star.

Take a look at YY in China, where karaoke singers are making $15,000 a month from *likes* of their songs, and you'll see what I mean. In the ValueWeb, anyone can create value through digital goods and services but also from digital thoughts and ideas. That's the difference, and the currency is not just monetary but also influence and entertainment.

But there's more to the ValueWeb than this, as it's not just about currencies for buying and selling goods or sharing ideas; it's about inclusion. Take a look at the Bill & Melinda Gates Foundation newsletter for 2015. In the newsletter, a specific section talks about wiping out poverty by creating financial inclusion through the mobile network:

> "In the next 15 years, digital banking will give the poor more control over their assets and help them transform their lives. The key to this will be mobile phones. Already, in the developing countries with the right regulatory framework, people are storing money digitally on their phones and using their phones to make purchases, as if they were debit cards. By 2030, two billion people who don't have a bank account today will be storing money and making payment with their phones. And by then, mobile money providers will be offering the full range of financial services, from interest-bearing savings accounts to credit to insurance."

The mobile phone is truly transformational for the poor and financially excluded. It has allowed fragmented groups of people who had no ability to communicate over distance to suddenly access digital reach. Goat herders, fishermen, sheep farmers and cattle ranchers across Africa are now becoming merchants and businesses through the reach of their mobile. A mobile text message can pay for wool, milk, meat and more, and they are able to advertise their goods through Instagram, Facebook and Twitter. This truly

is a revolution, as that means we now have seven billion people who are connected one-to-one, peer-to-peer, able to exchange digital and physical goods and services, ideas and thoughts through the ValueWeb. It is why Bill Gates goes on to say that cryptocurrencies like bitcoin will be fundamental to this shift in thinking:

> "Bitcoin is an exciting new technology. For our Foundation work we are doing digital currency to help the poor get banking services. We don't use bitcoin specifically for two reasons. One is that the poor shouldn't have a currency whose value goes up and down a lot compared to their local currency. Second is that if a mistake is made in who you pay then you need to be able to reverse it so anonymity wouldn't work. Overall financial transactions will get cheaper using the work we do and Bitcoin related approaches. Making sure that it doesn't help terrorists is a challenge for all new technology."

In summary, the ValueWeb is a new generation of the internet that is underway right now, illustrated by FinTech investments, and is geared to redesign the exchange value for the internet age. It is rethinking the structure of how we deal with buying and selling through the net, whilst digitising money and more. Through the ValueWeb and the deployment of cheap, mobile technologies, every single person on this planet can now be part of the value ecosystem. That is a fundamental shift for our planet as it means that anyone, anywhere can be a merchant; anyone, anywhere, can buy or sell anything, anytime; anyone, anywhere can be a voice, a media star, a channel; and anyone, anywhere can monetize the things they make and even the things they think, just by sharing and caring.

THE WAY VALUE IS SHARED ON THE VALUEWEB

Previously, we had a world of physical value exchange with physical tokens. The physical value tokens were cards and cash; the physical value exchanges were stores and garages and shops. The store of value was the bank. This last

element was importantly different to the others, as the physical value tokens could only be used at the physical value exchanges. When they weren't being used, some folks kept them under their bed, but that's not a safe value store. So we had governments create a system to regulate the value stores to ensure they were safe, secure and could guarantee that they would not lose the value tokens.

Then the internet came along and changed the game, since now our value tokens are digital. Value tokens are the units of value used to recognise worth. Units of value can be esoteric things, such as Facebook *likes*, Twitter *favourites* or LinkedIn *shares*; to virtual and digital currencies like World of Warcraft Gold or Candy Crush Points; to loyalty tokens from air miles to retail store cards; to prepaid stores such as airtime on the mobile network; to cryptocurrencies like bitcoin; to real world currencies in a physical or digital form, from cash and cheque to card and mobile wallet.

As can be seen, a vast array of value tokens exist, some of which are a closed loop, like air miles and loyalty cards, which are hard to cash-out; whilst some are transparent and easy to trade, like cryptocurrencies. The tokenisation of value is the digitisation of money. In fact, as the industry talks about tokenisation, we should just think of airtime and cryptocurrencies as part of that kaleidoscope of value tokens that now exist. After all, these are just digital tokens of value that represent something of worth that can be traded.

They can be used anywhere, anytime, globally, on digital value exchanges through websites and digital domains. The value exchanges operate 24–7–365, and there are no geographic boundaries to where I choose to invest or spend a value token. Equally, we have a wide range and variety of value tokens, not just money. Of course, money is now digital and we have digital dollars, euros and yen, but we also have cryptocurrencies. Cryptocurrencies change the game because they operate outside centralised control through the decentralised structure of the internet. That is a game-changer and is the reason why we are seeing banks and bankers investing in bitcoin. But the internet has gone much further and deeper in digitising value, as the value tokens we use are no longer necessarily of a monetary form.

For example, as mentioned, we have value tokens generated through loyalty schemes with retailers, airlines and others trying to lock in customers through reward points. In fact, one of the greatest value tokens is airtime on mobile networks. This is illustrated well in Zimbabwe, where the national currency imploded due to hyperinflation and so only South African Rand and US Dollars were accepted as payment. The problem here is that local retailers often do not have small change when you buy something. Give them $10 for a $2 item and you'll be lucky to get any change. This has been solved by offering airtime minutes on the mobile network as change.

Equally, we are creating our own value tokens in games with World of Warcraft Gold being one of the best examples. What do you do when you spend months or years playing a game and then get bored with it? How can you monetize your valuable points? Trade them with other players and start another game, of course.

More fundamentally is that we have value being generated by just being liked for your ideas. PewDiePie creating videos for YouTube, or even people like me writing blogs and tweeting, creates a value feed that generates revenue. PewDiePie generates revenues through adverts on his video feed. In fact, the most impressive social network is YY.com in China, which takes virtual currency and streaming video to heights not yet reached by Western social networks. On YY, users can play games, talk to their friends, or use virtual coins for social deals à la Groupon. But what really makes YY standout is the fact that it has a built-in system that enables site users to earn real profit. Top karaoke singers regularly make $20,000 per month from virtual gifts. YY allows users to spend virtual roses as tickets to access live content from their favourite artists and teachers.

Here's how it works. Say you have some type of talent; perhaps you're a tech-savvy musician or passable karaoke singer. To make money on YY, you create an artist account, put up some of your songs, and hopefully develop a following. After building up a respectable fan base, you could even schedule a live concert on the site, and for the price of one "virtual rose", your followers would be able to watch the performance and interact with others attending the concert via video and chat. After the concert, you would be able to exchange your hard-earned virtual roses for real money.

So we have many new forms of value tokens being used in many new forms of value exchange, and the question is: where's the value store and how can you trust in these new forms of value exchange?

The first piece, the value store, is the bank—but banks are not stepping up to the mark. The majority of banks will only bank money, currency and related investments. You might be able to store gold and silver at the bank, but it's unlikely that you can bank World of Warcraft Gold (unless you're Fidor Bank, of course). As for banking YY *Roses*, QQ *shares,* Facebook *likes* or *favourite* Tweets, there's nothing out there right now. That's quite worrying as, in ten years' time, most of our existing memories may have become unreadable and lost. When Facebook becomes Sharedome and then Gameground, all your historical memories become incompatible with successive generations of systems.

And with the average person born today potentially living for over a century, what will today's millennials be looking at in 2115 to remember their lives? Will we be living in a digital dark age? Vint Cerf, a "father of the internet", thinks so. As Mr. Cerf puts it: "The key here is when you move those bits from one place to another, that you still know how to unpack them to correctly interpret the different parts."

This is the key reason why you need a value store—a bank—that guarantees readability, rather than compatibility, generation through generation. Equally, it needs companies that can guarantee to be around for over a century, and there are few that can offer that, other than banks. After all, most banks have been around for over three centuries, because they are licenced, and therefore this is one of the few industries that could provide a guaranteed value store for digitised memories and value tokens.

In summary, we therefore have taken physical value tokens, exchanges and stores and digitised them.

- Physical cash and cards become digitised cryptocurrencies and value tokens
- Physical shops and retailers become digital domains and websites
- Physical bank branch structures become digitised value stores

The next question is: how do you generate trust in this digitised world?

This requires digital identities to be associated with these digital value tokens, exchanges and stores.

THE VALUEWEB AND BIOMETRIC BLOCKCHAIN AUTHENTICATION

Now we need to focus on digital identities, as you cannot have digital value tokens, exchanges and stores without secure digital identities. And there are two forms of identity: you and your devices.

Your identity is embodied in a secure authentication of you, which is increasingly moving to biometric authentication. In fact, we now have multi-authentication capabilities of you: your voice, your fingerprint, your eyeball, your heartbeat and more. These are all capabilities for authentication through your devices. Your mobile can provide the biometric authentication of you. Soon, other devices will authenticate you. For example, the Royal Bank of Canada is trialling the use of Nymi, a wristband that authenticates heartbeats, as is the UK's Halifax bank.

The Nymi band records a customer's heartbeat, which is then synced with a smartphone or other device. A Bluetooth connection to the band is then all that's needed to login to the banking app, because sensors detect that the authenticated person is still wearing the band.

Other methods are improving the use of biometrics for authentication, too. Facebook has been developing DeepFace, a facial recognition system, to look at two photos and, irrespective of lighting or angle, identify who is in the picture. In 2014, they could do this with 97.25 percent accuracy compared with the human brain, which can achieve this with 97.53 percent accuracy. By now, they may have even surpassed this.

Therefore, we are adding more and more devices with more and more biometric technologies to ensure that humans can easily interact with devices without the need for PINs, passwords or tokens. In fact, by 2020 every smartphone, tablet, and wearable device will have an embedded biometric sensor, according to Acuity Market Intelligence; and half of mobile commerce and one in ten in-store payments will be authenticated with biometrics, says market researcher Goode Intelligence.

But this raises the question: who authenticates that it is your device being used for authentication? Even more importantly: who authenticates your devices when they start doing business with each other? When your fridge orders groceries; your TV orders entertainment; your car orders fuel; who authenticates it is your fridge, TV and car that are ordering, and what role do you play in the process?

These are all key questions and the answer is: the blockchain.

We've talked about the blockchain as a technology for transactions but, more importantly, it is becoming a technology for authentication, thanks to its smart contracts capability.

For those unsure of the blockchain's full potential, a simple explanation is that the blockchain is the ledger system created by the Bitcoin protocol. This is a ledger where everyone can see in a public forum the exchange of transactions, because every exchange of bitcoins is recorded on the blockchain in a public domain. Not the details of that transaction, but that a transaction took place. You can never revoke or eradicate that the exchange took place, and its time and place. In other words, you have an irrevocable record of a transaction occuring.

That irrevocable record of the transaction could be buying or selling something, or it could be transfers of ownership or recording of contracts. It is this area that is of most interest in the context of authentication, as device purchases will be recorded on the blockchain in the future, as will any other purchase of goods or services.

This means the blockchain potentially becomes a global recording mechanism of transfers of ownership; a global invoice system, if you like. The key for me is that the blockchain may, over time, become our global system for recording everything of value being exchanged.

Now, let's say that happens, from a machine-to-machine commerce internet viewpoint, the blockchain becomes our fundamental method of authenticating machine-to-machine transactions. When my fridge, TV or car orders stuff, there is no biometric so my blockchain registration of these devices becomes the authentication.

In other words, the bank sees a request of payment to Tesco of £35.12 for groceries, requested by *Chris Skinner's refrigerator.* How do they know

it is *Chris Skinner's refrigerator?* There's just an automated check of the last transfer of serial number XY12-FFDC-90LT-DPP1 (my fridge's serial number) on the blockchain. Yes, according to that record, the last transfer of XY12-FFDC-90LT-DPP1 was a purchase made by Chris Skinner, who owns this bank account, on 1st December 2014 and there has been no transfer since, so the bank authorises the payment.

So I now have no role in this process, except to authorise transactions. Then, when I do, the bank checks I'm breathing, using my heartbeat for authentication.

This is a world away from where we are today, but a world that will be with us within a few years—so we'd better get ready.

THE ORIGINS OF MONEY IS PART OF OUR DNA

In most science fiction movies, there is no money. Hollywood's vision of the future has removed the need for cash, and I've blogged before about Gene Roddenberry's views on money in "Star Trek: Money is a terrible thing". His idea is that money will disappear as we explore space and, as we send rockets out to Pluto, his vision is getting nearer. Money hasn't disappeared from society yet, however. It has just changed from a physical form and moved to a digital structure. The new digital structure of money is not just a cryptocurrency, however.

The cryptocurrencies may be the value exchange mechanisms between machines, but it's the chips inside machines that are our new wallets. As we move into Web 3.0, we move into machine-to-machine commerce—and this can only be transacted in a neatly organised value system.

My vision for this new value system is that every machine, or commercially enabled thing if you prefer, will have intelligence inside. A chip. That chip inside will be designated an owner. The owner in most cases will be you and me, and these things we own are part of our recognised digital identity structure.

So I have a number of things designated as mine on a shared, internet ledger. My car, fridge, television, front door, heating system, several watches, shoes and jackets are all registered as mine. All of these things have chips inside, and these chips give them intelligence. My heating can be controlled

from my watch; my television orders my entertainment; my fridge orders a regular grocery shop; and my car drives itself to gas stations and refuels as often as needed.

In order to do this, all of these devices have been recorded as mine. They are attached to me through my digital identity and my digital identity is recorded on a trusted, shared ledger for the internet of things. If my car refuels too often or my fridge makes an exceptional order for over $1000 of groceries, I get alerts that require my biometric approval.

All of these things are transacted through the air, via a shared ledger of trusted exchange. In my case, they are recorded on some form of poundchain; Americans operate on a dollarchain; and the Chinese on a renminbichain.

These digital currency chains not only transact value exchange, but also manage identities and ownership. This is how you can achieve the science fiction vision of value exchange immediately and invisibly through the ether.

The reason why this is a likely outcome of the Internet of Value and Web 3.0, the Internet of Things, is that we are moving towards a revolution in trade, as well as a revolution of financial value exchange.

This can be seen from the earliest forms of homo sapiens and how we adapted through every generation of trade. In his brilliant book *Sapiens,* Professor Yuval Noah Harari provides a brief history of humankind. He explains how we have created a world of fiction in order to allow humankind to ascend to the top of the food chain.

Companies, money, governments, religions, law and all the things that structure our world are all fictional creations of humankind that allowed us to conquer the world. It's a complicated idea to explain here, but the gist is that no animals have companies, money, governments or legal systems. Most animals function as part of a hierarchy lead by an alpha male or queen matriarch. Man has created social structures and relationships of trade and communication that allow hundreds, thousands and millions of people to live together. By contrast, most animals have tribes of no more than a couple of dozen creatures. We have tribes of hundreds of thousands, organised in cities and all working alongside each other, thanks to our formalised structures of trade.

In the book, Harari traces homo sapiens back over 200,000 years and notes that 70,000 years ago we began to migrate from Africa across

Asia and then, 45,000 years ago, to Australia and more recently (16,000 years ago) to the Americas. The key to our expansionism was language and shared myths that enabled us to believe in gods, demons and priests, and allowed us to move from being nomads to fishermen to farmers, exchanging trade and value along the way.

> "While we can't get inside a Neanderthal mind to understand how they thought, we have indirect evidence of the limits to their cognition compared with their Sapiens rivals. Archaeologists excavating 30,000-year-old Sapiens sites in the European heartland occasionally find seashells from the Mediterranean and Atlantic coasts. In all likelihood, these shells got to the continental interior through long-distance trade between different Sapiens bands. Neanderthal sites lack any evidence of such trade. Each group manufactured its own tools from local materials …
>
> "The fact is that no animal other than Sapiens engages in trade, and all the Sapiens trade networks about which we have detailed evidence were based on fictions. Trade cannot exist without trust, and it is very difficult to trust strangers. The global trade network of today is based on our trust in such fiction entities as the dollar, the Federal Reserve Bank and the totemic trademarks of corporations. When two strangers in a tribal society want to trade, they will often establish trust by appealing to a common god, mythical ancestor or totem animal. If archaic Sapiens believing in such fictions traded shells, it stands to reason that they could also have traded information, thus creating a much denser and wider knowledge network than the one that served Neanderthals and other archaic humans."

Harari's book is fascinating, and this extract is partly an explanation as to why homo sapiens are the only hominid's left on this planet. 200,000

years ago, there were many other hominid species including Homo Erectus, Homo Neanderthalensis, Homo Rhodesiensis, Homo Tsaichangensis, Homo Sapiens and Homo Floresiensis. According to analysis by Harari and others, it is the very fact that we could create trade systems based upon shared fictions that exchanged forms of value through language, information and things that were useful or beautiful—shells, obsidian, stones, flint—that we ascended to become the most intelligent of species and, consequently, dominated the planet.

By contrast, most became sentient or, as Harari refers to it, underwent a Cognitive Revolution, we began to search, explore and then, some years later, farm and settle. Until just over 10,000 years ago, most humans were hunter-gatherer nomads. We would move from area to area through the seasons, exploring and gathering food. Sometimes we would starve, since we had no means of developing crops. That changed after the last Ice Age, which some scientists believe created annual plant growth. As a result, we could seed fields of grain and grow food stocks.

Farming worked well to allow humans to produce food to last throughout the year, and hence we could create settlements. Then we had too much food and produce. As a result, we had to create another form of value exchange and, being homo sapiens, we invented this new shared fiction of money.

Various stories appear about money but the first mentions date back over 12,000 years ago, when ancient tribesmen in Antonia swapped Obsidian stones to store value. What this represented is a move from basic production of goods to the trading of goods and services, and we have seen the progression of the use of currency and value stores through the ages as civilisations and societies have developed. However, our progression of these stores of value are changing and moving faster and faster, as our technologies develop.

For example, the Antonians not only traded in stones but other forms of value, from cattle to sheep. In other words, it was more of a form of bartering than currency itself. Seven thousand years of development led to a revolution in trade and commerce, however. In fact, every time we progress in technology, trade and commerce, we have a revolution in finance.

In 3,000 B.C. priests in ancient Sumer revolutionized trade and exchange when they invented money. This first form of money was a coin, a shekel, which priests offered to farmers in exchange for their excess produce. This happened because the Ancient Sumerians were one of the first civilisations to farm, and create an orderly system of food production. Mankind went through a revolution of trade and commerce as farming became commonplace in civilised communities.

Farming created money—coins that were made from precious metals, such as gold. This worked for an eon but proved difficult when distances were involved. Carrying a heavy bag of gold coinage was not ideal when you might encounter bandits or thieves, or had a horse that could only carry so much weight. Hence, the Chinese invented paper money 2,300 years later, in 740 B.C. This was predictable in value—unlike gold coinage, which had to be weighed and measured. The paper money was issued and underwritten by a government—the Tang Dynasty—and proved to be a far more reliable mechanism for trade.

So we moved from barter, then farming, to coins for a trusted value store, to cash for trade across distances.

This system worked well until the next big change in trade and commerce: the Industrial Revolution. As businesses were created that sourced goods from overseas and traded across national boundaries and over great distances, a new form of currency was needed. Hence, traditional coinage was too heavy to carry across such distances, bearing in mind that they were made from gold, and governments started to licence institutions, banks, to enable trade on their behalf. The new government-licenced institutions could therefore issue paper money—a cheque or bank note—that could be as trusted as a gold coin. This was a key move—from coins to paper—and enabled the rapid expansion of trade and commerce globally, as the industrialisation of economies developed fast in the 18th and 19th centuries.

However, it didn't work quite so well when workers moved from factories to offices. During the 1950s, the United States led the revolution in office work and professional entertainment became *en vogue.* The trouble is, when you're entertaining a client, it proves to be a real pain if you end

the lunch or dinner and have to write a cheque. Writing a cheque interferes with the client engagement—you have to take your eyes off the focus of conversation—and so Frank McNamara invented the credit card.

Frank was an executive at the Hamilton Credit Corporation and had a problem. His finance company was struggling with uncollected debt, whilst Frank needed a way to make more money. McNamara came up with taking the idea of a charge card, back then being used mainly just in department stores, to the restaurant business. His innovation was to use the charge card in restaurants and then add interest to the monthly payments. That way the finance company was able to make a profit from every card that was issued.

He managed to convince many restaurants in lower Manhattan to sign up for the card, by offering customers a 10 percent discount for every purchase. Many restaurants and stores signed up, because there was no fee or charge and it made it easier to purchase meals without worrying about cash. This led to the launch of the Diner's Club in 1950, and so was born the new industry of the credit card.

This brings us nearly up-to-date. As we have seen, in 12,000 years we moved through the following progression:

- barter for nomadic societies
- cash for farming societies
- cheques for industrial societies
- cards for office-based societies

But now we live in a networked society, a globally connected world. That demands a new form of currency and some would immediately point to bitcoin or the blockchain. That's relevant, but it's only part of the answer. Just as cards needed Visa and MasterCard to succeed globally, and just as cheques and cash need to be backed by a trusted mechanism of government licencing and banks, we need an internet-age value exchange mechanism that is trusted, immediate and works through time and space, to support the chip-based economy.

In the chip-based economy, anything can exchange value with anything, anywhere, anytime. All objects will soon have intelligence inside, a chip inside, and will need a method of transmitting value and exchanging and

trading. This internet-age system will therefore be based upon chips. The chip-based economy means that the Internet of Things can work.

The internet of things creates a grand vision of the not too distant future where everything communicates with everything else. We would have chips as tiny as nanodots inside every brick, pavement slab, tyre, wall, ceiling … you name it. We have more intelligent chips inside car engines, visual entertainment systems, wearable devices, from rings to necklaces to bags to shoes. Everything is communicating with everything else and our devices are all attached to us through the blockchain.

The result is that my futuristic vision of no one paying for anything becomes a reality. I drive to the big city and park. My car tells the metering system it's my car and it's parked here until I come back. When I come back it asks the system how much it owes and pays. I do nothing.

My car then drives me to the gas station—I don't drive anymore as it's self-driving—and it asks the station robot for $30 of LPG. The robot pump system delivers and I just sit, working and enjoying the entertainment and world around me. The car drives off and all of the transaction is seamlessly in the background.

I've asked my Tesla to take me downtown to a decent bar—I haven't been in this town before—and it delivers me to Joes 99er. Joe—or the guy behind the bar—gives me a large whisky and Bud. It's my usual tipple and my shoe just told his stock management system that's what I'd want. I felt a little vibration from my shoe that confirmed this would be ordered and just let it go. It was too much trouble to shake my left foot for a gin and tonic.

After three Buds and whisky combos, I jump back in the car and I'm ready to hit the casino. The car asks me three times if I really want to do this—it knows what happened last time—and I just say, "Yea". I'm cool and mellow and a little bit drunk, something I'm ultra-aware of as I'm supposed to be sober in charge of a self-driving car. (Why that law still exists, I have no idea.)

So the car drops me at Caesar's Shed, it's five steps down from the Palace, and I start shooting some blackjack. My shoe vibrates again, as I've just lost $2,000 in the first five minutes and my budgeting balance for the month for gambling has been reached. But it's only 2nd June for heaven's sake. I stamp

my foot and the balance is lifted, along with a healthy top-up of $10,000 moved from my savings account in real-time.

By the end of the evening, my savings are gone and the bank's given me a loan of $15,000. I hate it when I click my shoes together and say, "There's no place like home". After all, that's the trigger for my biometric check to ensure it really is me saying that I want an extra line of credit. No one notices the heartbeat check and the touch of my finger to the side of my glasses.

Ah well, a good night was had and not a payment or authentication was visible. Just wireless credits and debits from the stamp of a shoe to the touch of an eyebrow.

The world has changed a lot in the last ten years. I remember in 2010, I used to keep lots of pocket change in my car to pay parking metres, and got frustrated with the endless stops at tollbooths to swipe my credit card. By 2015, things had improved immensely. Now I just have NFC payments, prepaid apps and one-time passwords. No longer would I jiggle around trying to find the right change.

You buy a fridge, a car, a house, a smartphone, a wearable, a whatever. All the things you buy have clear serial number identifications as well as chips inside to enable them to transact wirelessly over the web. Upon purchase, your device is recorded as being yours using your digital identity token (probably a biometric or something similar). The recording of that transaction takes place on the blockchain.

Now, you have multiple devices transacting upon your behalf. Your fridge is ordering groceries from the supermarket; your car auto refuels as it self-drives the highways; your house reorders all the things needed for the robot vacuum and other cleansing devices it uses; and so on. Each transaction is a micro-purchase around your wallet, but involving no authentication of you. The authentication is of your devices. Should a large transaction occur, or maybe just to check-in as contactless payments do with every twenty or more transactions, you are requested to agree that this is your device ordering on your behalf by providing a Touch ID or similar. And all of this is being transacted and recorded on the open blockchain ledger of your bank cheaply, easily and in real-time.

What this provides is the scenario I keep referring to, invented years ago by Gene Rodenberry, when he came up with the idea for Star Trek. Now Star Trek has lots of things that were forecasts about the future that came true, from communicators that were the predecessors of Motorola flip phones to body scanners that could be hand-held. One of the other predictions was that we wouldn't need money.

Have you ever seen anyone pay for anything on Star Trek?

The reason you don't need money in the future is that all the transactions you make take place wirelessly around you, through your internet of things. You walk into a store or mall, and all of your devices and identity are communicating your location and intention. As a result, you never pay for anything. You just authorise with the blink of an eye or the wave of a watch.

So we have now moved through the following progression:

- barter for nomadic societies
- cash for farming societies
- cheques for industrial societies
- cards for office societies
- chips for networked societies