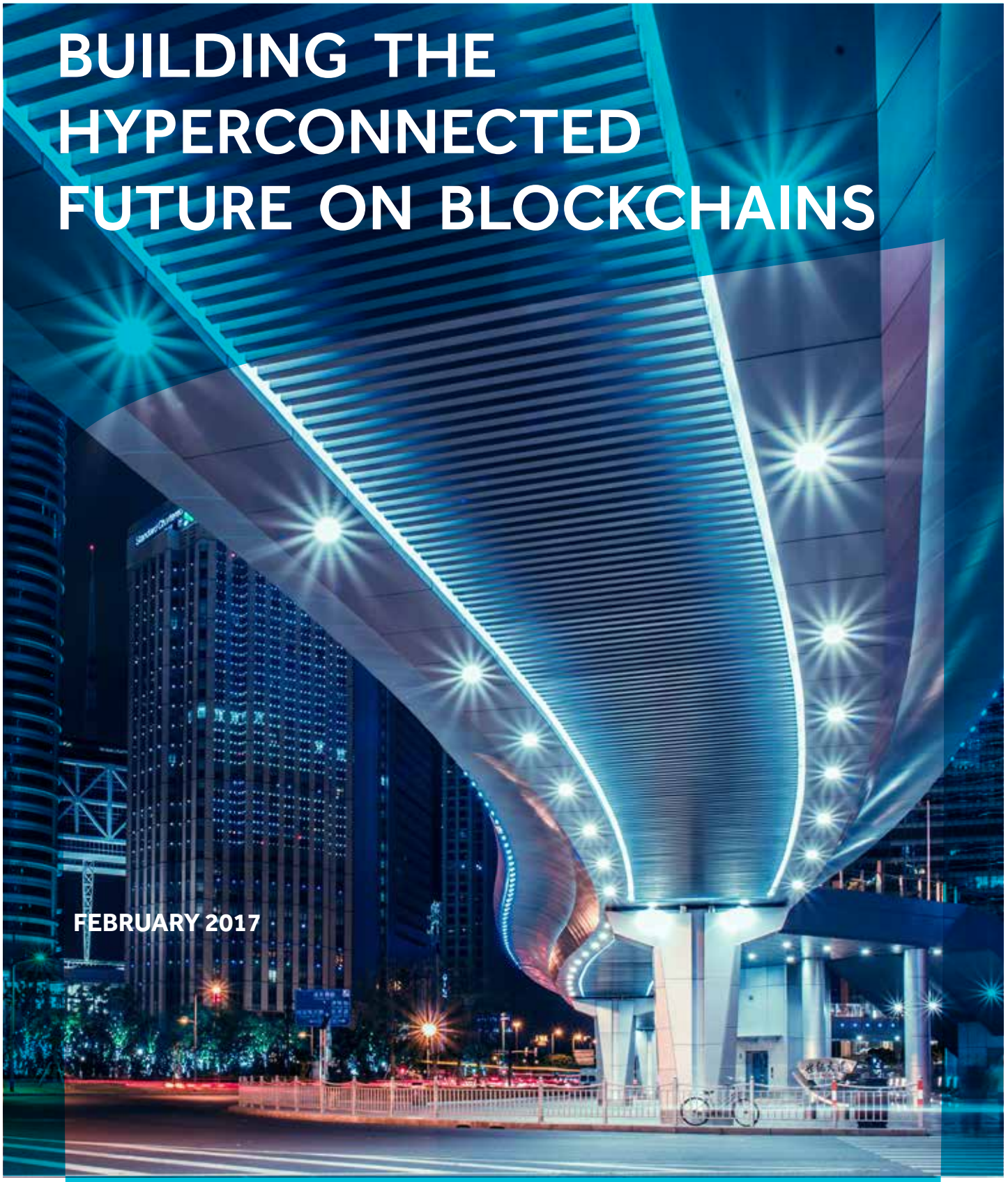
القمة العالمية للحكومات
WORLD GOVERNMENT SUMMIT

In Collaboration with

CONSENSYS

BUILDING THE HYPERCONNECTED FUTURE ON BLOCKCHAINS



FEBRUARY 2017

EXECUTIVE SUMMARY

This report hopes to bring the World Government Summit a fresh perspective on the current state of blockchain technology. The report explores how the blockchain will drive positive changes in nearly every area of civic life over the next ten years. Both national and municipal governments will realise these benefits as they adapt and adopt these technologies to meet diverse requirements, smoothly integrating into the technological fabric which supports and serves their citizens.

The global economy may also realise real benefits as the reduced transaction costs and increased security provided by the blockchain foster innovation in the global systems of trade which support us all. Security and reliability are core requirements of future computing systems. The blockchain is a bold new innovation that will bring this reliability and trust into every walk of life.

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THE INTERNET OF AGREEMENTS

BY HEXAYURT.CAPITAL

THE BLOCKCHAIN PRIMER

WHERE IS THE CENTRE OF THE WORLD?

Electronic communications have brought us closer together than ever before but we are still not quite in the same room.

In person-to-person communication, a tiny delay as our messages bounce around the world does not matter much. We may have to restart a few sentences on a video call, but we can overcome it. In computer systems a lot can happen in a few fractions of a second. At peak demand, VISA processes 24,000 credit card payments in one second. In the delay that a message takes to get to San Francisco and back, VISA has processed thousands of orders.

The New York Stock Exchange processes orders as they arrive. The closer you are to the exchange, the faster your orders clear. This has produced the high frequency trading phenomenon, as traders cram more and more computers as close as possible to exchanges around the world. Central clearing houses can never be fully fair if they operate at the speed of light: the closest player will always have an unfair advantage.

Who gets to be at the centre of our globalized world?

FAIR PLAY IN A DECENTRALIZED WORLD

The blockchain is a technology for fair play in a globalized world. It processes transactions and stores data much like any other computer system, but in a way which is incredibly useful for solving today's challenges.

It works by promoting 3 FAIRNESS ADVANTAGES:

1. EVERYWHERE IS THE SAME because a blockchain has no center. Blockchain aficionados call this "decentralization." There are no central clearing houses to move computers closer to. Transactions clear in the same amount of time regardless of where in the world they were issued. This means fair play for everybody regardless of their location. This is achieved by running transactions in small batches called "blocks."

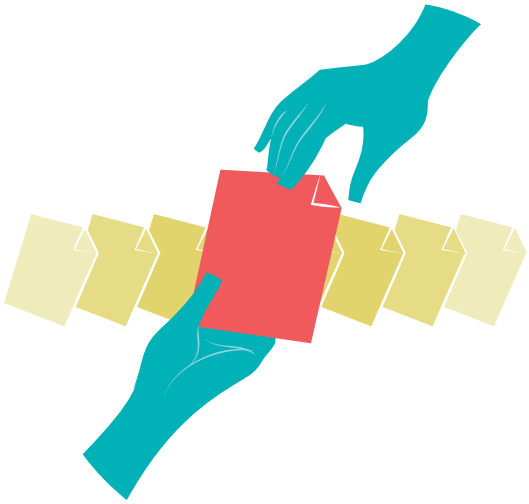
2. THE RECORD IS PERMANENT to protect transactions. A benefit of decentralization is extremely strong cybersecurity. The process which lets many computers all over the world process transactions together also means that if a machine is compromised, it does not affect the rest of the computers holding the blockchain. A blockchain is a secure sequence ("chain") of blocks.

3. NOBODY IS IN CHARGE of the global blockchain as a whole. It is operated by a fair consensus which makes all participants equally responsible and equally capable. Local blockchains can be run by a sovereign entity or a company, and they can choose who can participate, similar to an existing corporate network but more secure. Global blockchains work more like the internet itself: anybody can participate, but without compromising the inherent security of the blockchain.

These attributes were first realized in a system called Bitcoin, which created a digital money used mainly by internet natives who dreamed it might some day become a rival to gold as a store of value. Bitcoin continues to compete for space as an international currency, but the main innovation has moved past it into a new domain: smart contracts.

SMART CONTRACTS

A smart contract is a way of making a deal, and locking in all the details, using the fairness and security of the blockchain. These agreements could be simple things like a bond or an option, or more complex instruments which look more like a small computer program than a financial instrument as it is commonly understood. The financial industry already uses a lot of software to represent financial instruments, so this is an extension of existing practices.



A smart contract can also interact with the real world. For example, imagine a self-driving car that needs to recharge. Both the charging station and the car can access the blockchain using wireless internet. The smart contract says it will pay for electricity at a pre-agreed price. The charging station checks if the car is the car listed on the contract, and the smart contract automatically pays as the electricity is delivered.

Other systems could provide this kind of functionality, but none with the elegance and simplicity of a smart contract. In a world with enormous numbers of smart devices cooperating to produce high quality services, this functionality may be a key security, reliability and service breakthrough.

REGISTERS

Another way to see the blockchain is as a register or ledger. The attributes of fairness, permanence and so on are a good fit for what we want from record keeping systems, including public records. A blockchain allows one to check if an item is provably unique: exactly one owner for a car, or building, or domain name. This attribute is useful and convenient within a nation, helping with routine processes like asset transfers. It is also potentially very useful internationally because it provides a single source of truth when doing transactions in an unfamiliar environment.

In the UK, for example, selling a house is a complex multi-stage process involving several intermediaries who execute an essentially medieval bureaucratic process to effect a property transfer. The UK Government Digital Service Registers Authority is examining how blockchains and similar systems could streamline processes as simple as registering a new company and as complex as proving identity to issue passports. The hope is that a standard technology for maintaining and publishing government statutory registers could make many operations both inside of government and in business easier, more convenient, and safer. The safety and integrity of public records, in an age of increasing cybersecurity concerns, is paramount.

When we created the initial ideas which grew into the Dubai Blockchain Strategy, our intention was to build on the pre-existing strengths of government. Secure record keeping is a core competence of the state. New technology allows government to extend its services in new ways. The original conception inside of Bitcoin and Ethereum (two leading blockchain projects) was that many goverment-type services could be provided without strong reliance on state support. However, as our understanding of the blockchain has matured, it becomes increasingly apparent that the blockchain is a natural fit for the needs of the state. As we move forwards, each new technology permits sovereign authority to provide services in new ways through a process of constant adaptation, innovation and improvement.

GLOBALIZATION 2.0

LIBERATING PRODUCTIVITY BY MAKING SIMPLE THINGS EASY

When simple things get easier, big systems can become more productive.

The containerization of shipping, and the quality revolution in manufacturing which made mobile phones possible both came from cost and reliability breakthroughs in fundamental processes. Blockchain technologies stand poised to repeat this revolution for the slowest and most difficult parts of the day to day process of running an organization: compliance, regulation and the paperwork. Business, government and society will all benefit.

Globalized trade and cheap microelectronics came from a series of refinements in very basic processes which, when it was all added together, produced a revolution.

Imagine a future in which many business deals have this property, allowing for a tightly meshed international business environment in which efficiently connecting resources from all over the world is a creative act. Computers to do most of the grinding administrative work of aligning all the details. People make the creative decisions. Although this may seem like a large step from where we are today, we firmly believe that such a world is possible, that it is coming towards us, and that it is a better world for all. Reducing transaction costs and risks can change the world.

DEEP DIGITIZATION: FINALLY FIXING PAPERWORK

Today international trade and other forms of international cooperation are profoundly difficult at a large scale because the individual links may be just a little bit unreliable. If a project requires assembling components from all around the world, even if they can be shipped very quickly using air freight services, the risk that a supplier will glitch, or something will get stuck in customs holding back the entire project is always very real. The least reliable part of the process is the part with the least computerization: customs, bills of lading, and so on. Robot ports hauling standardized steel sea containers still rely on paper bills of lading in most cases. This mismatch, between the world of near-instantaneous electronic communication and the hard realities of bureaucracy can be resolved with blockchain technology.

We can bring the world of paperwork up to the speed of the rest of the global economy.

Today machine-to-machine cooperation involving business and government are slow, costly and often require quite a bit of "manual labor" (programming) to create. The main problem is one of standards. Each organization has its own IT solutions and ideas about how to do things, and building the bridges between these organizations is often as much a manual process as hauling tons of coffee off a ship one bag at a time, as it was done before the advent of containerization.

MAKING DEALS BY HAND

If a local airport, local hotel and a local taxi service want to set up an automated system to pick up guests at the airport, the principle of the deal might take 20 minutes to agree. But making the computers link the booking system to the taxi allocation software might cost more than the deal is worth to any party. When organizations work together with machine-to-machine coordination as part of the framework of the deal, there is a good chance the computer part of the agreement will be the stalling point. The costs simply stop cooperation in all too many cases.

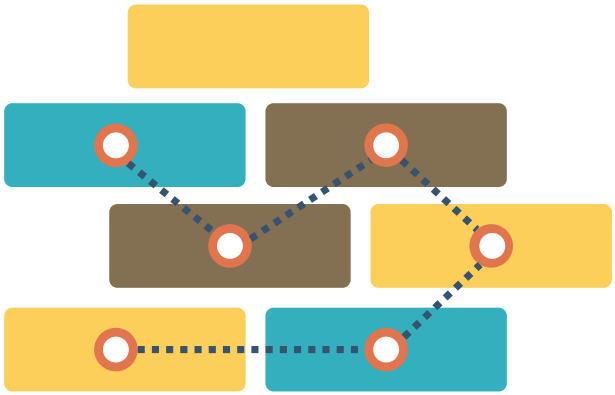
ANY PLACE WHERE COMPUTERS AND THE REAL WORLD INTERSECT CAN BE TRANSFORMED

We still coordinate with humans because it is often simply more economically efficient and more flexible here and now. But manual coordination does not scale and in the long run might be more expensive, and it will always be a little bit unreliable. This could be thought of as the "craft mode of production" for deals and coordination. It is as inefficient as hand-making furniture or clothes. Deals and coordination are still bespoke.

The problem this raises is that forming complex value networks is difficult when people are part of the process. Human processes are flexible, resilient, but also just a little bit fallible. If we imagine a large scale cooperation with hundreds or thousands of organizations collaborating, but each link is a little bit unreliable, it's obvious to see there will be a lot of difficulty. Errors made in one place get passed on to other places, and problems ripple out. In manufacturing, this is like buying unreliable components: they throw the rest of the precise production process into chaos.

AUTOMATED RELIABILITY FOR COMPLEX SYSTEMS

Cultures which master and deploy these kinds of highly reliable and efficient systems can do amazing things. Most of the organizations which have these skills are advanced manufacturing organizations. For example, an aircraft or a mobile phone contains thousands of parts, manufactured by hundreds of contractors. One substandard component can render a phone useless, and with planes the reliability issues are even more vital. These devices can only exist because each individual component has a defect rate so low that when the whole device is put together, with all those individual components adding their risk of failure to the whole, the device is still extremely reliable. This is only possible because of quality control regimes like Six Sigma which provide near-zero defect rate manufacturing.

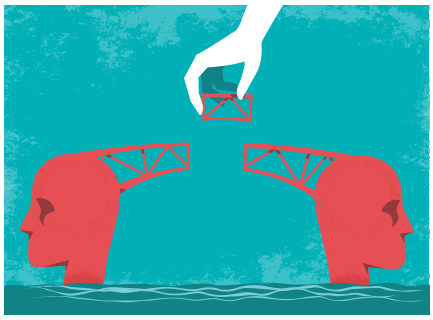


Systems can only get big and complicated because each individual component is incredibly reliable. If we try and build systems at this level without extremely reliable underlying systems, there will be lots of errors, contingency management, and redundancy, and heavy and expensive recovery plans. Such systems seldom fulfill their economic potential. Even when they work, people instinctively see the inefficiency and know that with the right changes, another, better world is possible.

What if we had near zero defect computerization of deals and administrative processes in business and government? How does the world change when business and government transactions are as flawlessly efficient as modern manufacturing?

TRANSPARENCY & INTERNATIONAL DEVELOPMENT

That same kind of complexity bedevils international development efforts. Instead of component vendors, we have field partners who actually dig wells or install solar panels. For the project as a whole to succeed, each has to do a good job, and this has to be demonstrated to funders without taking 20% of the project budget to do the auditing and proving. In more complex collaborations, each aid agency may wish to use its own tracking and monitoring systems, and interoperability between these systems is as hard as any other kind of computer-based cooperation. Projects get tangled because there are lots of details, and things always snag.



But if shared global registers—blockchains—could be used to track money and benefits generated from an international aid project, could better and more ambitious projects be coordinated? In business, what if blockchain style precision and transparency could be bought to building real estate portfolios or coordinating air travel arrangements and booking hotels? What if we could deploy reliable software agents ("smart contracts" by another name) to make our back-up arrangements if something goes wrong?

THE INTERNET OF AGREEMENTS

In the Internet of Agreements™, when technologists deliver machine-to-machine handling of agreements to a high enough standard, it will revolutionize business and international cooperation. The blockchain is the most likely platform to give rise to that world: it is the world that the smart contract ecosystem will create as it matures.

As we move forwards down this path, we will start to see the enormous potential for productivity improvements which the digital age has always promised. The parallels to container shipping, advanced manufacturing and logistics, and the internet itself are clear: if all the small steps are really reliable, the big things happen much, much more easily. Today contracts between organizations are hard to understand, difficult to read for both humans and computers, and are hard to combine together to create new services, or delegate to third parties to carry out on our behalf.

REDUCING TRANSACTION COSTS CAN CHANGE THE WORLD

Combining two contracts to create a third contract—"composability of contracts"—does not really work except in very specialized cases, and certainly not in a fluid and transferrable fashion. We have institutions like subletting of real estate, or service level agreements with associated compensation, but every single link in such chains is a paper contract with fallible humans on each end. It is very difficult to create new products and services by recombining elements in the marketplace when those components have independent legal and administrative complexity. This limits the effectiveness of many areas of the economy.

Just as manufacturing can only be as fast as the slowest process, networks of contracts are as reliable as the least reliable contract. The result is companies in the centre of these "networks of contracts." These large companies absorb slack and problems in the many contracts required to get the job done: prime contractors act something like insurers or market makers for the skills and talents of many smaller companies. They are there to absorb and manage unreliability. They charge hefty fees for taking this role in securing delivery.

Of course trucks will still break down, and apartments will still have plumbing problems. But the incidental complexity involved in business operations could go down by a very large factor, into a domain where a much more complex, contingent and interwoven business environment will emerge. Such an environment might be as different from today's business environment as container shipping is superior to packing boats by hand. It will be better for government, business and people.

THE SHARING ECONOMY

The sharing economy is currently structured in a model that Robin Chase, the founder of ZipCar (a very successful car sharing service) describes in her book "Peers, Inc." The Peers, Inc. model describes Peers who are a network of asset owners with a spare room, a car which isn't used while they are at work, or similar sleeping assets. The "Inc." is an incorporated company which joins these assets together into an accessible market. This central clearing house typically charges a substantial fee for this service. In return the company manages software creation costs, legal and regulatory interfaces with government, marketing and advertising for the brand and so on.

However, this model makes it quite hard for the Peers to get a square deal from the Inc in the centre. Because the Inc is a company with a few thousand staff, and the Peer is typically an individual with a little sliver of resources to share, in the event of a dispute they are not evenly matched. This pattern replicates between market makers and vendors at all scales. SWIFT and VISA are quite powerful compared to their member banks: being barred from either network would be catastrophic for many financial institutions. Dee Hock, the founder of VISA, tried and failed to build an interbank network before VISA was created because of these commercial dynamics.

To get the Peers a square deal in such an environment requires some kind of collective representation or altered ownership model, or regulation from the government. A future can be envisaged in which peers are formed into collective bargaining blocs a little like labor unions, or a future in which peers own the Inc structure which represents them, or a future in which the government regulates sharing economy companies quite strictly to ensure a fair deal for all. Government levels the playing field between powerful institutions and ordinary people in many areas. The sharing economy may continue to throw out the kind of problems which cause governments to pay attention and take action.

However, in a business environment in which a forest of small contracts, represented as blockchain smart contracts, is woven together into a reliable mesh of interlocking deals, with support from the government, perhaps the balance shifts towards the Peers. When the cost and complexity of running a sharing economy market for cars, housing or some other resource drops by 90% or 95% because of automated contracting infrastructure on blockchains perhaps the natural economic equilibrium will favor many small actors working together in networks rather than larger single corporate bodies. The implication here is that as the Nobel prize winning economist Ronald Coase predicted, as transaction costs drop, flexible markets replace natural monopolies at every scale with a corresponding increase in the baseline efficiency of the whole economy.

WHEN ORGANIZATIONS WORK TOGETHER WITH MACHINE-TO-MACHINE COORDINATION AS PART OF THE FRAMEWORK OF THE DEAL, THERE IS A GOOD CHANCE THE COMPUTER PART OF THE AGREEMENT WILL BE THE STALLING POINT

A sharing economy deal, organized one person at a time, might involve five or even eight participants: a buyer, a seller, a cleaner, an insurer, a dispute resolution service, an auditor and perhaps additional pre-paid services like tow truck cover for a car rental. Making these agreements at an individual level is simply too expensive, but in a smart contract environment it could be as simple as sending an email: software makes sure the deals are simple to set up and reliably executed.

BLOCKCHAINS FOR REGULATORS

What is the outlook for international cooperation in a world like this? Because we have no automated way of handling compliance with local regulations, most cross border deals have some degree of additional complexity simply because they are cross border. This complexity encourages people to trade mainly within their own countries, and this leaves economic opportunities unexplored. To smooth out these issues, it is often decided to flatten local regulatory frameworks on a large scale. For example, the Single Market in Europe is one attempt to make cross border trade easier. Much of the impact of the Single Market is driven by regulatory factors independent of the Eurozone: trade agreements are mainly an exercise in cutting red tape. WIPO, WTO and the international trade agreements extend this basic trend globally.

THE SAFETY AND INTEGRITY OF PUBLIC RECORDS, IN AN AGE OF INCREASING CYBERSECURITY CONCERNS, IS PARAMOUNT

If there were reasonably competent computer representations of that red tape so it could be managed by automated systems, might it be possible to create streamlined commercial zones based on software mapping out regulatory requirements, rather than having to simplify the regulatory situation to the point where a human can navigate? Nations and regions could keep their local regulatory frameworks, if they were presented in a framework which would allow companies from the rest of the world to use software to understand and adapt their offerings to the local environment. We may not need the blunt instrument of regulatory standardization to enable global trade in only a few years.

Making regulations legible to computers is a long journey. However, the wave of digitization which is being triggered by the adoption of blockchain technologies across the landscape shows the global direction of travel. Every industry and most large economies have several areas of innovation and disruption as blockchains are adopted, and there is little doubt in the minds of most practitioners that these trends can only grow and converge. The problems that the blockchain solves are long standing, expensive and profitable to resolve, and so progress will be at least stable, and possibly extremely rapid.

UNDERSTANDING GLOBALIZATION 2.0

Computers have come a very long way since the golden age of facilitating international trade by flattening local regulation. That paradigm is old and has not been challenged in many decades. But now the technology has caught up with the challenges of representing the real world. If we correctly deploy technology to facilitate international trade, we can get a much better new equilibrium: on one hand, local flexibility and the ability of local governments to regulate in the interests of their people. On the other hand, the ability to cheaply and effectively form international complex value networks to liberate the productivity which is still locked up behind transaction costs and regulatory diversity.

You could think of this model as "Globalization 2.0" The first globalization was an industrial model of globalization, where everything has to be made with the same standards before people can work together. In Globalization 2.0 computers take the strain of handling local differences in standards, regulation and consumer preference, and advanced manufacturing meets these requirements because it can run small batches tailored to local needs efficiently.

Computers handle the red tape, and the blockchain is the next step.

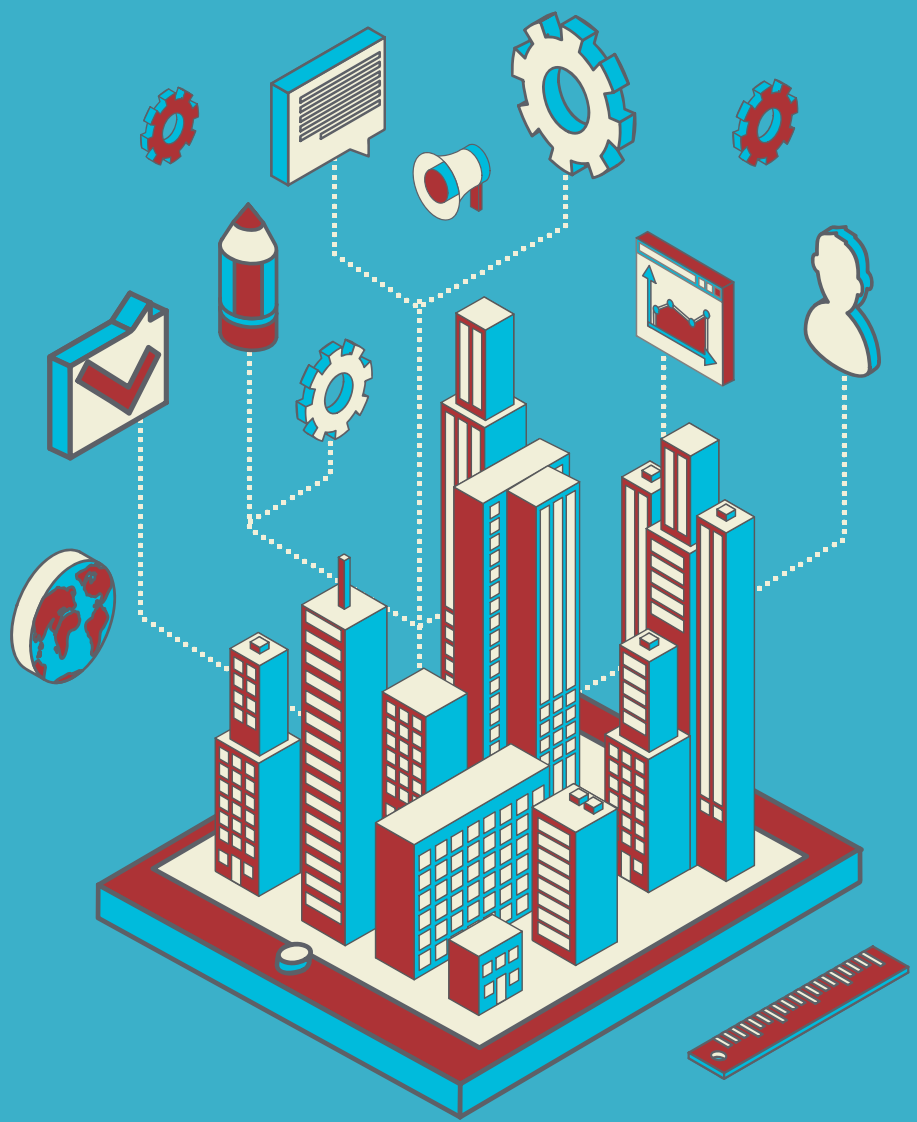
BLOCKCHAINS OPEN DOORS TO THIS NEW WORLD

Computers are capable of doing far more than they currently do for us. Because they are a relatively recent technology, society, business and government are only slowly adapting to the new capabilities which are at our fingertips. But in an ever more crowded and resource-constrained world, it is very helpful if we can rapidly adapt to new conditions and get the benefits from every opportunity. Constrained budgets go much further if we do not leave useful doors closed.

Simply getting a much higher quality representation of the physical and legal world loaded into computers is an enormous step forwards. In the same way that digital mapping gave us a whole range of new services and occasionally goods, getting existing property rights databases (land ownership, company directorships and similar structures) into a form where computers can easily get at them will allow for all kinds of optimizations. The same may be true for other diverse areas like identity systems (to fight credit card fraud and streamline relationships with public service providers), medical, energy systems, self-driving cars and other automated transport systems, and more. Any place where computers and the real world intersect can be transformed.

Laying strong, solid foundations for the 21st century means having a bold, coherent vision for the future. We believe there is a broad, open opportunity to begin the economic transformation of the global economy to take full advantage of the reduction in transaction costs and increase in security which blockchain technology offers. We expect the field to mature rapidly beyond the pilot stage and to deliver clear economic and security benefits very quickly. Before meaningful work can begin on internationalization and trade using blockchains, individual governments must get at least some part of their internal systems up to speed on this new technology platform.

THERE IS A BROAD, OPEN OPPORTUNITY TO BEGIN THE ECONOMIC TRANSFORMATION TO TAKE FULL ADVANTAGE OF THE REDUCTION IN TRANSACTION COSTS AND INCREASE IN SECURITY WHICH BLOCKCHAIN OFFERS



HYPERCONNECTIVITY

by ConsenSys

The ubiquity of connection to the Internet among an increasing number of devices and individuals is only increasing. As the world becomes "hyper–connected" blockchain technology provides an opportunity to maximize the capabilities of these interconnected computers. This can be seen in a plethora of different fields, ranging from identity, to transportation, to energy.

The following case studies are some examples of first steps to take today—actions within government that can begin to create a supportive environment for blockchain innovation and lay groundwork for the intergovernmental efficiencies to come.

PATH TO ADOPTION

HOW GOVERNMENTS CAN ADOPT BLOCKCHAIN

Governments, like any potential blockchain user, should look at the pain points in their business processes and try to re-envision them as processes taking advantage of smart contracts and the blockchain. Education should be geared towards executives as well as IT staff. Collaboration needs to be focussed on what blockchains are best used for—and what they are not well suited for. Most importantly, there should be a place where IT professionals can experiment with the technology, "get their hands dirty", and learn fast. Microsoft has implemented this type of sandbox environment on Microsoft Azure cloud,[1] where developers can spin up an Ethereum "blockchain sandbox" in 10 minutes and get to work, and the ecosystem is full of developer tools, platforms and templates to get started with blockchains and smart contracts.

MOST IMPORTANTLY, THERE SHOULD BE A PLACE WHERE IT PROFESSIONALS CAN EXPERIMENT WITH THE TECHNOLOGY, "GET THEIR HANDS DIRTY", AND LEARN FAST.

Hong Kong had a three-tiered approach where they educated their IT departments, their regulatory leadership and then built a "blockchain sandbox" environment where they experimented with blockchains, which resulted in a whitepaper[2] and 3 proof-of-concepts projects which revolved around specific pain points afflicting Hong Kong: mortgage applications, trade finance, and digital identity. Singapore similarly created a "blockchain sandbox" with fintech startup R3 and the Monetary Authority of Singapore to test financial instruments and the

tokenization of fiat currency.[3]

Individual states within the U.S. are starting to explore use cases for blockchains and distributed ledgers and regulatory environments supportive of blockchain companies. For example, the Illinois Blockchain Initiative sent out a Request For Information[4] to learn about blockchain applications in the public sector.

RESEARCH CHALLENGES & COST-EFFECTIVE R&D

In addition to requests for information, hackathons, research challenges and labs are good ways to investigate blockchain technology. In August 2016 the U.S. Department of Health and Human Services had a Use of Blockchain in Health IT and Health-related Research Challenge which received more than 70 submissions.[5] The United Arab Emirates government recently sponsored a online global hackathon in January 2017 focusing on blockchain for governance with over 130 projects submitted from 41 countries. The United Nations Development Programme has an Alternative Financing Lab exploring blockchain applications[6] and UNICEF has recently invested in a blockchain startup designing a blockchain system for identity in early childhood development.[7]

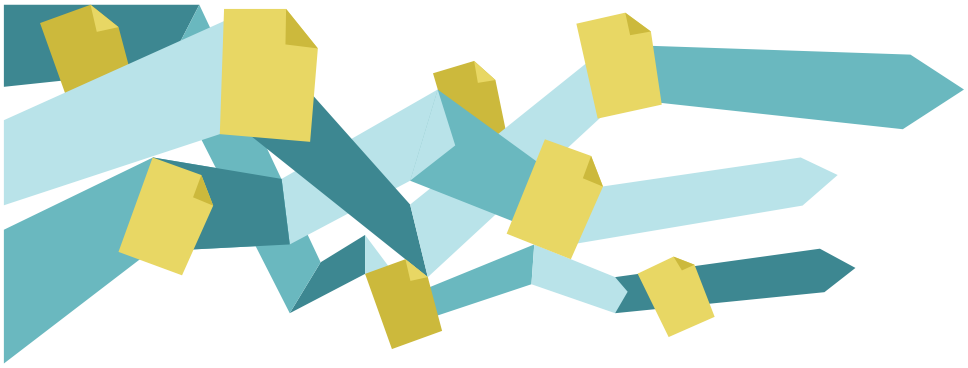
BLOCKCHAIN CASE STUDY

HOW TO PUT A GOVERNMENT ON A BLOCKCHAIN

INITIATIVES & SERVICES	ECOSYSTEM DEVELOPMENT	POLICY
Ask agencies to create **Requests for Proposals** explaining pain points they believe could be solved by blockchain	Host **educational workshops** and **conferences**, inviting experts and experienced practitioners	Create **working groups** to formulate and advocate for **supportive regulatory environments**
Start with **proof-of-concept projects** that demonstrate cross-organizational capabilities and help stakeholders understand benefits	Foster grassroots innovation through **hackathons, national challenges, bootcamps and accelerators**	Facilitate **standards and interoperability** to harness network effects and minimize duplication
Build smaller functional components with **testing & integration** phases following a longer-term **roadmap for integrating existing services**	Build relationships with **IT leaders**, foster a supportive environment for **startups and investment**, and grow **regional technical knowledge**	Create workflows for using blockchain's tamper-proof auditability to **improve compliance and regulation**

REGULATORY FRAMEWORKS

If governments start to move their paper records to blockchain-based systems, the legal status of smart contracts and digital signatures, KYC syndication, workflows for auditing and compliance, and standards for interoperability will need regulatory support. Some legal experts suggest that in the future the legal system must develop the capacity to understand the intent behind code such as smart contracts. Several working groups are currently exploring these types of issues including COALA,[8] designated as the Internet Governance Forum's Dynamic Coalition on Blockchain Technologies and the Smart Contracts Alliance of the Chamber of Digital Commerce.[9] Moreover standards bodies are beginning to explore blockchain use cases, such as one for Extensible Business Reporting Language (XBRL), an accounting language mandated by the U.S. Internal Revenue Service.



PRIVACY, PERFORMANCE, CUSTOMIZATION

A blockchain can be public, such as the Bitcoin and Ethereum global blockchains, or private, such as blockchains on a consortium's shared infrastructure. On a public blockchain sensitive data needs to be encrypted to ensure privacy, but encrypted data cannot be used by smart contracts. Private blockchains allow for organizations or consortia to build systems that take advantage of a blockchain's integrity properties without exposing data outside the organization.

The purpose of a private blockchain deployment is usually to share it with at least one other party across some departmental or organizational boundary that would be impractical to do with traditional database. With a private blockchain shared data can be verified by both parties trustlessly. But use of a public or private blockchain is not mutually exclusive. Data from a private blockchain can be periodically fingerprinted and sent to a public blockchain, which can provide additional auditability.

The blockchain ecosystem at present is brimming with new innovations. Some companies are building customized blockchains for enterprise use cases ranging from finance to asset tracking. As custom private implementations may hinder future interoperability, consortiums such as Enterprise Ethereum are being formed to discuss this. Most blockchain implementations are open source, so this will provide governance for enterprise requirements while maintaning public blockchain compatability.

CITY AND NATIONAL INITIATIVES

DUBAI'S MAJOR INITIATIVES SUPPORTING BLOCKCHAIN TECHNOLOGY GROWTH:

- The **Dubai Future Foundation** showcases futuristic technologies and research via the Office of the Future, Museum of the Future and Mostaqbal Portal, the largest-read Arabic language science publication online: http://mostaqbal.ae
- The **Dubai Future Accelerator** enables startups to work with government entities. Currently in a 2nd round, over 2,200 companies from 73 countries applied to the 1st.
- The **Dubai Future Academy** introduces 3 courses: the Executive Education Programme, Future Design Diploma, and masters in Applied Future Sciences.

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هاكاثون الحكومات الافتراضي للتعاملات الرقمية
BLOCKCHAIN VIRTUAL GOVHACK

The UAE government hosted the largest **virtual blockchain hackathon** with $140,000 USD in prizes Dec–Jan 2016/17. Over 1,000 participants from 41 countries were represented by 131 unique blockchain solutions to global government challenges in these areas:

1	Global Identity	20	%
2	Reducing Footprint	13	%
3	Crime & Fraud	11	%
4	Health	14	%
5	Smart Cities	10	%
6	Other	32	%

BLOCKCHAIN ACADEMY

EDUCATION	RESOURCE PIPELINE	REGIONAL TALENT
• 3 Month academy offered quarterly • Basic blockchain knowledge to advanced topics • Smart contract development • Decentralized application architectures • Infrastructure and tools • Case studies of adoption	• Online application portal to build contact database • Prepare and administer an online test, coding challenges or short hackathons to screen applicants • Screen top 100 applicants, interview top 50, accept 20 out of 500–1000 applicants	• Create a network of hiring partners at regional IT companies and startups • Pro-rated tuition payback period within 1–2 years of employment • Facilitate job placement • Foster an alumni community of continuous learning for long-term success

Above is an overview of a proposal for a Blockchain Academy whose goals are to create a pipeline of technical and skilled resources for projects in the region, attract talent, develop a regional ecosystem and establish a region as a skills leader in blockchain technology.

IDENTITY

IDENTITY IS EVERYBODY'S BUSINESS

Figuring out who a person is begins nearly every interaction in business or government. Homeowners need to identify people to know that they are legitimate authorized representatives of a service company. Doctors need to tie a patient's records to a patient in an emergency room. Banks need to understand a person, and their context, to satisfy Know Your Customer requirements.

Most identity systems in the world today case specific. Government-issued identity credentials, like passports and ID cards, are often used to anchor an identity in reality, and bridge these disconnected systems. However, this solution is still imperfect as dual citizenship introduces complexity and confusion. The rest of our identity information that we have established over time resides in silos owned and is controlled by corporations like Amazon, Facebook, or eBay and are very hard to access by the people whose information in held inside these systems. It is nearly impossible to truly know someone today.

WHAT DOES THE BLOCKCHAIN OFFER TO IDENTITY?

Decentralized identity changes all of this. To illustrate, let's examine uPort, the identity management platform being built at ConsenSys. The goal of uPort is to allow people to build a complete picture of their identity that is in their control with a simple, intuitive mobile app backed by the power of the Ethereum smart contract blockchain. This technological breakthrough improves on previous implementations of identity because it allows the individual to establish a complete, portable picture of their identity, while maintaining the security that allows this identity credential to be trusted by governments.

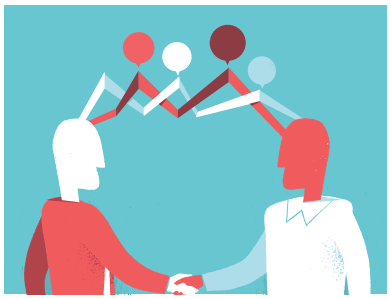
Perhaps most importantly, uPort allows digital identities to become a universal API that connects the identity silos mentioned above. uPort's system allows people to *decentrally store* and manage their identifying information—held in the form of credentials issued by various governments and other identities—and *centrally control themselves* the flow of this information between service providers, ranging from governments to banks to hospitals. uPort identities can securely authenticate themselves by simply selecting which credentials they want to share and providing their fingerprint.

The uPort app is the main way that people interact with their digital identity. It functions as a secure digital identity wallet which allows people to manage credentials issued by authorities or other identities. It also allows people to provide digital signatures for secure digital transactions of all types. When considered collectively, these credentials represent a complete picture of the individual. It wouldn't be a stretch to assume that a single identity could hold credentials issued by hundreds of providers. This is much more information than can fit on a single passport or ID card.

The uPort digital identity app unlocks a smarter world for the people and organizations using it: usernames, passwords, forms, impersonal services, and siloed information will all become a thing of the past. uPort is decentralized identity for the new economy—managed by the user.

BANKS CAN SHARE KNOW YOUR CUSTOMER DATA

Currently there is no standardization in the identifying information customers must submit to financial institution and these institutions often duplicate effort in performing Know Your Customer (KYC) checks. This imposes very high transaction costs on both banks and customers without actually adding much security to the global financial system: if fraud is taking place, each institution will be shown the same fraudulent documents and submit them to very similar testing. It would be better to do extremely rigorous professional validation once, and then use this very well checked identity document for all subsequent transactions. These credentials need to be made visible to other organizations who wish to use them with very high security and a minimal risk of error: an idea use case for blockchains, and therefore uPort.



Digitally signing claims about others, known as attestations, allows for other identities or institutions to verify and attest to the validity of an identity's profile data. This can be useful for Know Your Customer where a bank can attest to customer data it has verified such as age, address or other attributes. On a blockchain that identity can develop over time as a person accrues attestations, property and other types of licenses and authoritative powers.

Regulatory frameworks, standards and processes are required that support sharing of KYC verifications between institutions are needed. Although some banks are beginning to use third-party KYC providers,[1] this adds additional risk as banks are legally liable for KYC due diligence.

A product for identity and attestations such as uPort can mitigate this risk, because blockchain-based attestations would require digital signatures by validating financial institutions which can be publicly verified. As the US Financial Crimes Enforcement Network regulations and European Anti Money Laundering directives move towards stricter customer due diligence and data collection[2], blockchain-based KYC systems are likely to help government and financial institutions simplify KYC syndication.

The uPort system is ideal for managing the process of KYC sharing between institutions in a way which will create enormous value and improve competition and financial system usability for all parties.

PROPOSED USE CASES

A blockchain identity system will allow end-users to:

- Own and control their personal identity, reputation, data, and digital assets;
- Securely and selectively disclose their data to counterparties;
- Login and access digital services without using passwords;
- Digitally sign claims, transactions, and documents;
- Control and send value on a blockchain;
- Interact with decentralized applications and smart contracts; and
- Encrypt messages and data.

An identity system will also allow enterprises to:

- Establish a corporate identity;
- Easily onboard new customers and employees;
- Establish an improved and transitive Know-Your-Customer process;
- Build secure access-controlled environments with less friction for employees;
- Reduce liability by not holding sensitive customer information;
- Increase compliance;
- Maintain a network of vendors; and
- Establish role-specific, actor-agnostic identities (i.e. CTO) with specific permissions.

AUTONOMOUS TRANSPORTATION

BLOCKCHAIN CASE STUDY

Autonomous vehicles have a number of characteristics that make them suitable for management via blockchains. We need to track the location, use and performance of the vehicle; manage complex ownership and rental agreements, and account for the fuel or energy costs incurred by the use of the vehicle. With these capabilities, we can increase efficiency, improve utility for passengers and citizens, and create new markets and financial instruments to finance the rollout of automated transport systems.

BLOCKCHAIN AND SMART CITIES

Automation of transport is a critical task for smart cities, and businesses and governments have recognized blockchain as a vital part of the solution. Chinese automaking giant Wanxiang recently invested $30 billion USD in a new smart cities initiative that includes using blockchain technology to essentially securitize the batteries that are used in electric cars.[1]

By leasing rather than selling batteries to vehicle owners, Wanxiang can reduce up-front purchase costs. However, the benefits go far beyond an initial cost reduction: by monitoring battery usage and performance, batteries can be recalled for maintenance or replaced when needed. Comprehensive data on battery performance and deployment also allows the batteries to be treated as an asset to be sold to investors, smoothing the financing of new technology for consumers and manufacturer alike.

In the model suggested by Wanxiang, a car could have any number of owners, including the direct holders of the car and owners and investors in the securitized battery of the car. Today when a person goes to fill their car with gas, that person simply pays with their credit card, an exchange between two counterparties. But in Wanxiang's blockchain-enabled vision of autonomous electric vehicles, the exchange could involve three or more parties entering into a complex financial interaction.[2]

This interaction is too complicated for counterparties to conduct using paper, physical credit cards, or different accounting systems. Using the blockchain allows smoother payment flows between devices, people and businesses. Smart contracts allow us to specify the logic of payment flows between the parties to the transaction that occurs every time an electric car, for instance, goes to a battery charging station.

THE DEVICE ECONOMY

There is no reason to imagine that the autonomous vehicle itself could not be similarly securitized on a blockchain. An autonomous car could drive around a city, pick up passengers, be routed by a hailing application or network of routing applications, all coordinated using a blockchain. Such a car could be owned by a small or large group of individuals in any bundle of securitized products.

The sharing economy has allowed many people around the world to access shared resources rather than pay for expensive assets outright. Blockchain technology enables the next phase of this: the easy creation of complex value networks around access to physical objects and infrastructure. By separating ownership, access, maintenance and financing, we can enable each area to be handled by the most appropriate people.

BLOCKCHAIN TECHNOLOGY ENABLES THE NEXT PHASE OF THIS: THE EASY CREATION OF COMPLEX VALUE NETWORKS AROUND ACCESS TO PHYSICAL OBJECTS AND INFRASTRUCTURE.

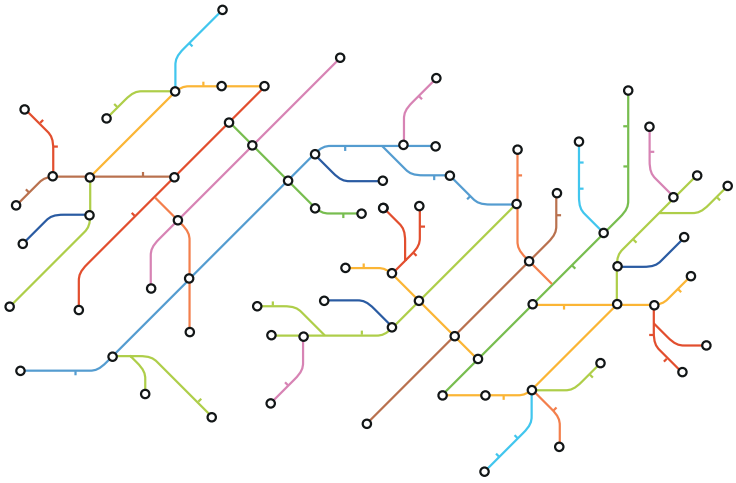
Blockchain technology can also enable automated interactions between devices. For instance, each autonomous vehicle would need to have a blockchain-based identity, and that identity would need to hold or use money required for paying tolls or battery charging costs.

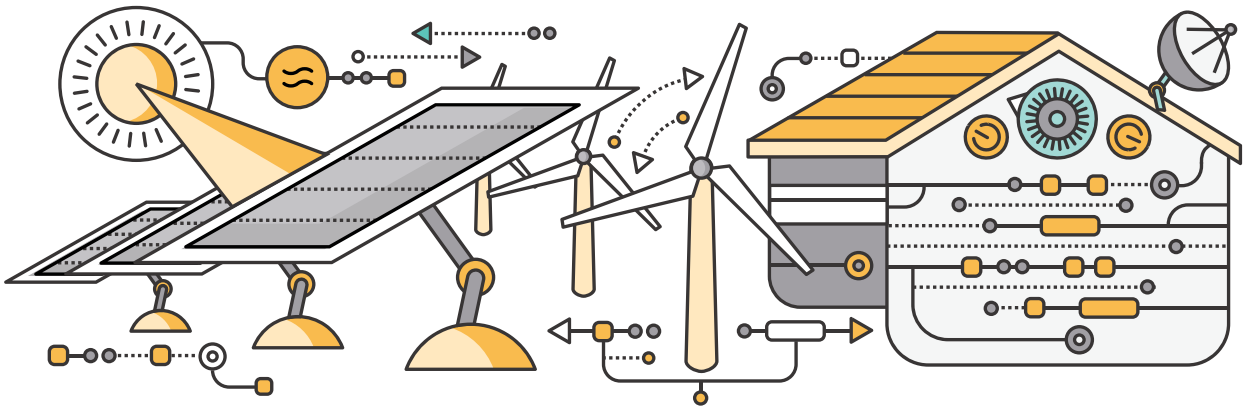
Automatic negotiation between devices is already happening. Some governments have determined that it is more efficient to install toll booths on highways that only accept automatic E-ZPass payments.[3]

NEW HYPER-CONNECTED MARKETS

Routing vehicles once required paper maps and experiential knowledge of traffic patterns. Now, companies like Uber and Waze have made routing vehicles into a well-controlled and scientific activity. If a car is autonomous, even without the blockchain, it can probably avoid traffic jams better than a human driver. But in a future scenario enabled by blockchain technology, routing vehicles could emerge as an economic activity in itself.

In a crowded city, traffic routing can reduce congestion for everyone, but not all journeys have the same economic value. With blockchain-enabled autonomous vehicles, if a car or taxi wanted to go faster than the cars around it, it could pay more and get a faster route, automatically negotiating the economic interaction with the other vehicles around it. For governments, the ability to charge flexibly for road use at certain times or in certain places can reduce congestion or pollution, and encourage optimal use of the available roads.





ENERGY

BLOCKCHAIN CASE STUDY

REPLACING RECS WITH PEER-TO-PEER INCENTIVES

Renewable Energy Certificates (RECs) are used to bring green energy resources to the electricity market. A REC is a proof that 1 megawatt-hour of electricity came from a renewable energy resource. In the U.S. all renewable-based electricity generators tied to the grid produce two distinct products:

1. Physical electricity
2. RECs.

DOUBLE COUNTING 'GREEN' ELECTRICITY

Developers are encouraged to build renewable energy projects like wind and solar farms in order to claim RECs which are sold to wholesalers and ultimately consumers at a retail profit. It is important to understand that the actual energy associated with a REC is sold separately and is used by another party. These "green" credits are basically a label that other utilities buy with the power to verify it meets "renewable" standards set by a state.[1] They have any relation to actual energy prices. Consumers of 'green energy' from RECs are probably paying a premium for this label rather than buying electricity from a renewable source.

RECs have been controversial because of the double counting problem wherein utilities receive RECs verifying that a local source of power is renewable and then sell these RECs to other utilities. When a renewable electricity generator sells electricity, it sells the juice — then sells the the credits separately.

ENTER MICROGRIDS & SMART METERS

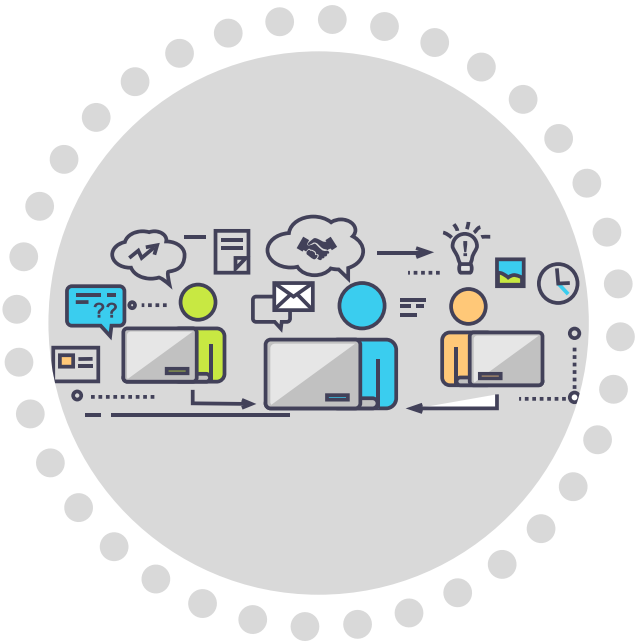
Microgrids are defined as a group of distributed energy resources (DER) with clearly defined boundaries that can connect and disconnect from the grid.[2] Here's why Microgrids are important: when Hurricane Sandy hit NYC, one neighborhood, Battery Park, had distributed energy assets in place while the rest of the lower Manhattan around it went dark. Microgrids add resilience in the face of natural disasters and peak grid loads such as summer heat waves.

As solar panel prices fall and become more popular, smart meter installations are also on the rise. They are

widely available in U.S. states like Texas and the EU mandates that 80% of consumers have smart meters by 2020. Smart meters enable the near real-time collection of data on decentralized energy production as well as consumption.

COMMUNITY ENERGY MARKET SHARING ECONOMY

A blockchain platform can enable peer-to-peer transactions between prosumers (i.e., producer-consumers) of household energy such as solar panel owners and other consumers. Their energy surplus can be converted to digital tokens using data provided by smart meters every 15 minutes. While the physical energy itself is fed back to the grid, the blockchain enables a virtual accounting layer whereby prosumers can convert their surplus to energy tokens and then sell those in an online energy market. Distributed ledgers simplify and secure the auto-reconciliation and accounting.



The consumer would now have a choice: buy 'green' energy from REC retailers which may not actually represent renewable energy or buy from a peer-to-peer energy market of prosumers. They can also chose to buy these tokens locally: prosumers can transact and price energy with neighbors directly, leading to a community pricing structure that reflects the value of local green energy and near real-time supply and demand. By adding a household battery and smart appliances prosumers can take further advantage of dynamic pricing with more efficient household energy scheduling.

UTILITIES & DECENTRALIZED ENERGY INCENTIVES

Utilities supporting community blockchain energy markets can earn transaction and infrastructure fees. Demand-response can be more efficiently managed by prosumers themselves at the household and neighborhood level as well as by regional utility operators who need to guarantee uninterrupted power supply and flexibility services to household and commercial customers.

In countries such as Germany, Japan and the UK, energy markets are already decentralized and these peer-to-peer incentivization mechanisms more easily implemented with the blockchain can further catalyze the growth of household prosumer energy investment.

Blockchain-based energy markets and incentive models are currently being explored by a number of companies. Some startups in frontier markets are also exploring solar panel payment plans, crowdfunding and pay-as-you-go smart meters using blockchain-based systems. Blockchain technology can provide prosumers the opportunity sell their energy to whom they choose more quickly and at better prices, receive faster ROI on their home renewable energy investments and contribute to more resilient and green national energy infrastructures.

HEALTHCARE

REVOLUTIONIZING HEALTH RECORDS

Many countries suffer from a fractured landscape of Electronic Medical or Health Record (EMR or EHR) systems. The average U.S. patient has approximately 19 distinct medical records and in a 2010 survey reported seeing 18.7 different doctors during their lives.[1] Patient privacy and ownership are important user concerns, while data collection, interoperability and exchange, claims processing and measuring research outcomes remain challenges for healthcare providers. The blockchain's unifying features can help improve these systems.

PATIENT-AUTHORIZED DATA EXCHANGE

Using a blockchain, patients can have their medical information follow them wherever they go rather than being scattered amongst disparate providers and health systems. Authorized medical professionals can retrieve a patient's relevant medical history at point of first contact rather than relying on telephone calls and paper files. Improved patient records would allow providers to communicate better care and monitor treatment progress more accurately.

The blockchain can be a repository of access-controlled information securely shared across organizations. As a new archetype for Health Information Exchange, all of this data can be made portable for patients in a cryptographically secure way. Health records with selective disclosure ultimately controlled by the patient can be securely implemented using smart contracts and attestations digitally signed by authorized providers. Designated friends and family, physicians and other providers can also be given access to the record in a confidential web of trust, with access authenticated and accounted for on a blockchain.

PRIVACY-PRESERVING PATIENT OUTCOMES

Anonymization is made more secure using the key systems blockchains rely on. Using this patients could elect to disclose their anonymized information verified by healthcare providers to medical researchers. This would create a global research registry of medical interventions and patient outcomes. An anonymous global registry like this could bring insight into the cost and effectiveness of available treatment options. Blockchain-based asset tracking systems that trace prescriptions from pharmaceutical suppliers to

anonymized patient use can also allow for more accurate feedback, recall and follow-up.

Health readings taken from personal devices like Fitbit and Apple Watch are stored "in the cloud," but the data is replicated and frequently transferred, making it vulnerable to theft and corruption. Patient-generated health data (PGHD) can be more securely anonymized, stored and efficiently gathered on a shared blockchain to supplement research data in a privacy-preserving way. This reduces the data collection overhead and enables a global bank for Precision Medicine research initiatives that aim to take into account differences in genes, environment and lifestyle.[2]

EVIDENCE-BASED MEDICINE

Blockchains can be used to ensure the integrity of clinical trial protocols in Evidence-Based Medicine. Trial protocols can be published and timestamped on a distributed ledger to prevent manipulation of data after the fact. Samples and specimens can be fingerprinted and asset tracked as they are sent to other labs for analysis and experiment verification. A single sample can then be used for multiple trials. Blockchains can thus serve as a way to create an audit trail to ensure that proper methods were followed, increasing trust in reported scientific outcomes, while creating a unified global datastore to search for that information.[3]

HEALTHCARE VALUE CHAIN: VERIFIED CLAIMS

Blockchain distributed ledgers can greatly simplify claims processing overhead across providers and insurers. Initiatives to aggregate medical claims such as All-Payer Claim Databases (APCDs) about health care use and cost could also be made easier to collect using blockchains, contributing to more effective policy decisions. Blockchain-based identity systems can be used to prevent fraudulent and duplicate claims, and a distributed ledger could be used to simplify claims settlement and accounting.

The paperwork necessary to qualify and re-qualify for healthcare benefits many patients are not able to complete without assistance. A blockchain-aware medical record could link an individual's health and KYC-verified information transparently while providing greater privacy. Individuals would not need to re-qualify should they fall below particular financial thresholds or have repeated attestations of chronic illness from registered physicians.

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