TDL | Trust in Digital Life

Multiple Views on Blockchain Conference Report

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NEC Laboratories
Europe GmbH

Multiple Views on Blockchain

A One-Day TDL Conference

Opening Remarks

On Friday 17 June 2016, Trust in Digital Life (TDL) held a one-day conference, in partnership with The Hague Security Delta (HSD) and the Institute for Financial Crime (IFFC). The event was co-sponsored by Intel, NEC and miiCard.

The goal of the event was to examine the opportunities and challenges associated with blockchain from different perspectives in order to create a multi-faceted picture of the field. By taking multiple views on blockchain, the event aimed at providing a forum to discuss technology, use cases, economics and policies bringing together researchers, practitioners and regulators engaged in blockchain and crypto-currency activities. Hence, the longer term objective is to create a multi-disciplinary community focussed on blockchain.

Panel 1:
Research Foundations for Blockchain

Moderator:
Ghassan Karame,
Chief Researcher, NEC Laboratories Europe GmbH

On the security and performance of proof of work
Professor Dr Srdjan Capkun,
ETH Zürich

Proof of Work (PoW) powered blockchains currently account for more than 90% of the total market capitalization of existing digital currencies. Srdjan remarked that although the security provisions of Bitcoin have been thoroughly analysed, the security guarantees of variant (forked) PoW blockchains (which were instantiated with different parameters) have not received much attention in the literature. In his talk, Srdjan introduced a novel quantitative framework to analyse the security and performance implications of various consensus and network parameters of PoW blockchains. Based on this framework, one could capture existing PoW-based deployments as well as PoW blockchain variants that are instantiated with different parameters, and to objectively compare the trade-offs between their performance and security provisions. Finally, Srdjan reported that PoW blockchains can attain an effective throughput above 60 transactions per second (tps) (which implies that the current Bitcoin throughput of 7 tps can be substantially increased) without compromising the security of the system.

The promises and pitfalls of distributed consensus systems: from contract signing to crypto-currencies
Alexander Dmitrienko,
ETH Zürich

Alexandra asserted that the key to the success of blockchain is in its ability to achieve distributed consensus. However, the side effect of the highly distributed approach is the waste of energy, and significant processing resources are required. If not incentivized to be more efficient, would blockchain technology still be successful? In addition to distributed consensus, the benefits include privacy, with no need for trusted third parties and banks that complicate the picture and lead to additional security and privacy attacks.

The challenges are its scalability, throughput capacity, storage limits, integration with legacy systems and ever-increasing power consumption. If we want to use blockchain on a large scale, we have to solve these problems. Another challenge is that security and privacy problems in blockchain are well understood.

It remains to be seen whether the stakeholders (banks, governments, financial processing players) could accept blockchain-based solutions designed as they are today. Crypto-currencies do not need banks, but banks want to invest in disruptive technologies and to get involved. However, potential uses of blockchain technologies are not limited to finance. The approach can be used in voting, as shown in Estonia where a trial blockchain-based e-voting system for e-residents and citizens who are shareholders in companies listed on the Tallinn Stock Exchange will be launched in collaboration with Nasdaq. But is this a realistic model, considering technology and use case limitations? We have to find answers to all these questions.

Governance, consensus and blockchain as a service – the emergence of a science of distributed ledgers
Professor Michael Huth,
Computer Science, Imperial College London

The most important application of blockchain is a distributed ledger, with PoW as a key ingredient. Michael examined the security issues of PoW in a private blockchain. Is blockchain revolutionary or is it a new use of well-known technologies? The business requirement for blockchain has not yet been developed. In order to use blockchain as a service, requirements for various contexts and use cases need to be analyzed. And many security issues are still not understood, let alone resolved.

According to Michael:

The crypto-currency Bitcoin is an open, distributed system that solves a state replication problem through a form of eventual consensus, where we may think of a state as a complete history of financial transactions, bundled into blocks that are chained up. A key innovation in Bitcoin is its use of Proof of Work for cryptographic puzzles whose solutions generate trusted transaction blocks, where trust in a chain of blocks increases with the total work invested in its creation.

Let us call solutions of state replication "distributed ledgers", the blockchain of Bitcoin being an example. Is Proof of Work the right mechanism for building trust in distributed ledger technology? It is believed to cost too much in terms of energy and incentive mechanisms. But such beliefs should be backed up with proper scientific understanding: for example, how the answer may depend on whether a distributed ledger is an open or a closed system. In short, we need science and engineering for building consensus mechanisms that scale well, are cost-effective, yet also resilient to active attacks from the outside or within.

Hyperledger fabric: towards scalable blockchain for business
Marko Vukolic, Research Staff Member, IBM Research Labs, Zürich

Marko explained that the PoW-based blockchain is growing and it is extending the ledger with heavy and negative impacts on the system's scalability and overall throughput. He compared the PoW way with state machine replication (SMR) observing that there is a trade off between node scalability and performance. He proposed that the Hyperledger fabric is the most suitable and scalable blockchain technology. The existing blockchains unify many functionalities in one node which limits achievable performance, harms scalability and may be at odds with confidentiality. Practical design approaches are still a matter of debate.

Panel 1:
Discussion

The first question the panellists had to answer was what their top priority was in blockchain research. Performance, scalability, security and diversity in the applications were called as the fundamental issues in research. But what applications need scalability? There is a distinction in the scalability of the fabric and the scalability of the applications. ICT companies are the most active participants in development, but others need to be on board, especially insurance companies: anyone in fact who needs to build distributed trust. Governments are beginning to be active but they are interested in millions of participants and not in the technology behind the system.

Blockchain can help in a broad range of use cases, but with regard to fighting the risks associated with money laundering and financing terrorism, this technology cannot help much at present. In general, it is an issue of international policy and regulation. A global blockchain might help with the forensics, but people have to be willing to put their data in the blockchain. Multiple stakeholders have to trust each other in this scenario, which in itself will bring significant changes to existing systems.

Energy requirements for Bitcoin are a serious concern. Is Bitcoin still controllable if it keeps growing? It is possible to modify Bitcoin and prevent it from running beyond its capacity. Although it is not a centralized currency, there is a group of actors who control the ecosystem. There is a democratic issue, because we don't know the people who created the Bitcoin currency. The problem is that there could only be one PoW and centralised systems can perform much better than decentralized systems.
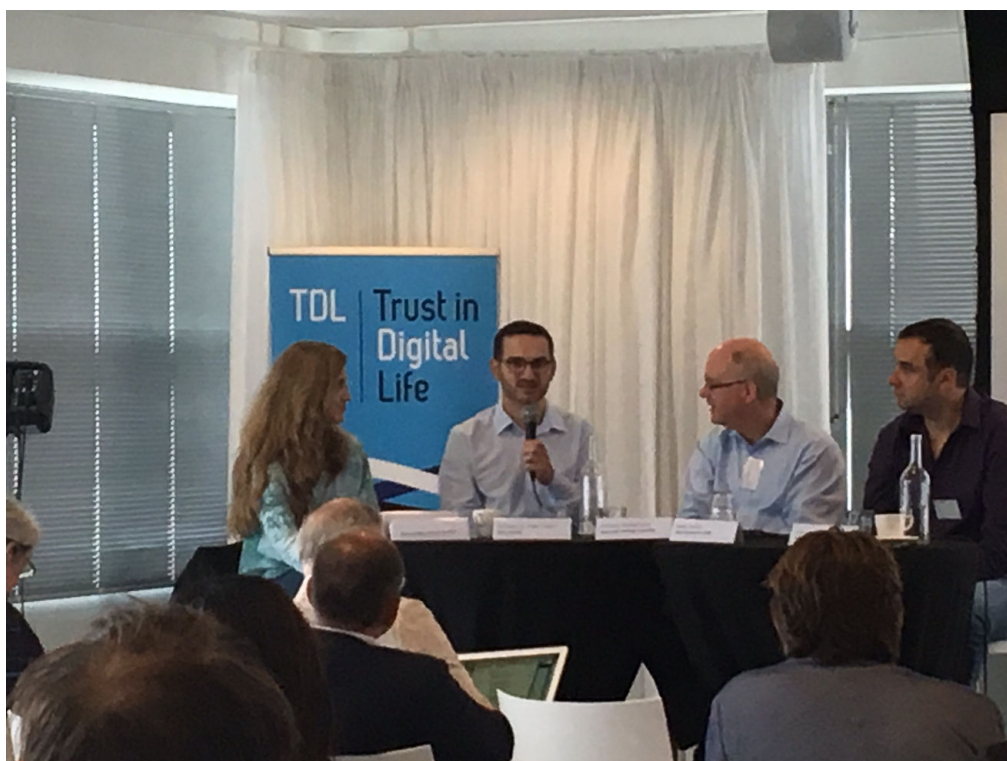
Panel 1:
Discussion
continued

The level of maturity of blockchain technology is mixed at this point, and could be rated as two-three out of ten. There are a lot of challenges and misunderstandings, but also solutions. Bitcoin is a solution for services that do not require considerable scalability, and Hyperledger is very promising. System performance is clearly the most serious issue. But nonetheless it is clear that blockchain has a future.

According to Ghassan:

The first panel was animated by various discussions addressing the security, privacy, scalability, and premises of existing blockchain technologies. The moderator and panelists effectively shed light on the differences between existing open blockchain consensus protocols, such as proof of stake and proof of work, and Byzantine Fault Tolerant consensus protocols, such as the one used in Hyperledger. There was a general consensus that there is quite a big gap between what the technology can currently offer, and between the various use-cases which are currently being envisioned by the industry. That said, it was argued that existing technology can still cater for a limited number of possible use-cases, especially if performance or scalability is not a major requirement.

Panel 2:
Applications of Blockchain for Enterprise

Moderator: *Claire Vishik, Trust & Security Technology & Policy Director, Intel Corporation*

Blockchain came to prominence two years ago. An open source environment was created and now the potential scope is enormous. As a new approach to data application, it is probably better than many of the tools we are using today and provides a lot of opportunity. This panel discussed how industry is looking at the opportunities beyond financial applications.

Making blockchain real for business

Matthew Golby-Kirk,
Global Blockchain Labs Enablement,
CTO Europe Office, IBM

Matthew set out his take on what blockchain technologies are, why it is important for his business and how IBM can help to apply blockchain. Blockchain is a shared, replicated, permissioned ledger technology allowing participating parties to become members of multiple ledgers. The shared version of blockchain has consensus (achieving agreement between parties), provenance (history of an asset in a chain), immutability (the fact that you cannot change the information which is added in the chain), and finality. Blockchain can open up business networks by taking out cost, improving efficiencies and increasing accessibility. IBM supports the Linux Foundation Hyperledger open standard, open source and open governance blockchain.

Blockchain in the enterprise

Raimund Gross, Innovation Manager and Futurist, SAP

Raimund gave a perspective on blockchain from someone in an enterprise context looking beyond its applicability in financial services. Using healthcare as an exemplar, the drivers for the use of blockchain are: multi-party, information imbalance (everyone shares the same information), trust, security, digital asset focus (thinking of the supply chain as a whole) and transparency. The difficulties are: show me the money (not why should we use blockchain, but how?), the ease of technology and tools, and production cases (today the closest is payment). A good start is being able to understand PoW, consensus and putting it in place. We should discuss and engage but come to our own conclusions if blockchain is the right technology for a particular situation or application.

According to Raimund:

As blockchain is sometimes already positioned as the foundation for a new generation of transactional applications, it pays off to identify the value drivers of that new architecture. With the promise of establishing trust and transparency while streamlining business processes, blockchain is attributed significant future potential that makes it worthwhile for enterprises to understand it in more detail.

Enterprises are specifically looking at opportunities to reduce third party requirements while in parallel increasing the speed and reducing the costs of business processes. The potential is specifically seen in areas where multiple parties need to access the same set of information to ensure transaction consistency across organizational entities. By ensuring transparency and non-modifiability, blockchain offers an environment of trust to support business execution.

Broad scale adoption of blockchain in enterprises is still to be achieved. Currently it faces some of the classical struggles that innovation is prone to experience. As the overall understanding in the market is still limited – at least compared to other topics – there is not yet a large number of incumbents working on it. Therefore the usability and accessibility of blockchain technology is still in its infancy and requires substantial expertise. With first successes and once production cases appear, blockchain will gather momentum and become more and more established.

Th way forward for enterprises is clearly to be knowledgeable and understand the market development. By participating in the eco-system and elaborating blockchain in their area of expertise, overall topic maturity will be reached. Only by active engagement will enterprises be able to identify the relevant change indicators and signals to constantly monitor. With that they will be well positioned to benefit from future blockchain applications and business models.

Blockchain in healthcare

Arno Laeven, Head of Blockchain Lab, Phillips

Philips is interested in blockchain in healthcare, because it earns most of its money from monitors in hospitals. To use blockchain, Arno asserted that we need a regulatory framework: you do not want your healthcare record to be open and accessible to anyone. We should not underestimate the need for trust. By using blockchain to verify that you are the person that you say you are, your personal data is used for your own benefit by allowing you to manage your own personal data store, with the underlying blockchain not reliant on third parties. Arno demonstrated how this works in three use cases: a data marketplace, an adherence program and a vaccination program.

Blockchain: disrupting trust services

Jacob Boersma, Managing Consultant, Digital Identity and Blockchain, Deloitte

Jacob also stressed the importance of trust in blockchain systems. Although today the only real production technology in use is Bitcoin, blockchain is more important than the underlying technology of Bitcoin, because it can cut out the middle men such as banks, governments, notaries *et al*. Blockchain still has some major challenges to overcome: no clear regulation, the lack of well-founded reputation, and perceived issues with anonymity, scalability (not designed for high speed or large storage) and the permanent storage of data. The bottom line is that at the moment the technology is not trusted enough for big players and the user experience must be improved. But the greatest challenge is the hype itself: right now overheated expectations could be blockchain's greatest threat. How current trust service providers incorporate future developments of blockchain will determine their future role.

Panel 2:
Discussion

If you can think of one application that would be the key to success of blockchain, what would it be? The panelists all agreed that identity would be the key to success as it would build the foundation for many other applications. Blockchain can distribute identity information to the person who owns it, rather than to an authority. Although an identity profile consists of many elements, the core needs to be the responsibility of the user to use as actually required.

Panel 2:
Discussion
continued

For example, if you go to a liquor store, the cashier only needs to know if you are over 18 years old. Proferring a traditional ID card gives the cashier more information than is necessary for the transaction and potentially violates your privacy. Today, a lot of companies use Facebook to establish identity but there is a big opportunity for blockchain to change this.

Another question for the panel was: why do I need blockchain? The regulator of a specific market decides if you have to use blockchain. A private or permissioned blockchain expects that not all suppliers want to work with just a database – so it has to be technology neutral.

The panelists also discussed the need for regulation. Individual companies can change the market, but regulators will help to get us there faster. There is a sweet spot for regulation. It is hard to get something new adopted, if the regulator does not completely understand it. Regulation is principal based and, in general, governments are the ultimate regulators. The more one government adopts, the more pressure there is on other countries to do likewise, notwithstanding the problem of transparency, and the reality that not every government is trustworthy. The discussion finished with the conclusion that we should neither start with super complex environments nor search for problems to solve. Do not chase the hype!

Panel 3:
Regulatory and Societal Issues in Blockchain

Moderator:
Riccardo Masucci, Senior Privacy and Security Policy Manager, Intel Corporation

Nowadays the pace of technological advances is much faster than the pace of law-making. To address societal concerns associated with new technologies, policymakers and regulators need to be aware of the benefits and the potential of technology in order to develop informed policy and legal views around disruptive environments such as the blockchain and its numerous applications in different fields. Some sectors are already regulated (e.g. the financial sector) so they may not need additional provisions. A sound understanding of technology can help scaling and supporting blockchain, without impinging on innovation.

Blockchain: An initial approach to regulation
Jason Albert, Assistant General Counsel, Regulatory Affairs Corporate, External & Legal Affairs, Microsoft

A smart approach to future policies and regulations should look at uses of blockchain rather than at the technology itself, to make sure that it doesn't harm consumers or is used for nefarious purposes. The financial volatility of crypto-currencies (e.g. the value of Ethereum is dropping) associated with current capital requirements are an indicator that the legal framework is definitely outdated. New provisions could include blockchain-specific regulation, sector-specific regulation and generally applicable regulation such as data protection. We should regulate use cases and be very careful as to how we regulate. The image of blockchain/bitcoin is sometimes linked to illegal transactions like selling drugs. We have to take people aware that there is no complete anonymity and what the consequences of this are for privacy. Who is the data controller in the blockchain? Privacy is a fundamental human right but how can we secure privacy when the system is designed to be open? On the other hand, identity management is an interesting application of the blockchain which could help law enforcement authorities too.

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Harnessing blockchains to decentralise data governance
Fabrizio Sestini,
Senior Expert in Digital Society
Innovation, DG CONNECT,
European Commission

The European Commission acknowledges the potential of blockchain and looks at its innovative applications to fix asymmetries in data governance. Fabrizio explained the vision of a distributed architecture where each piece of user-generated information remains under the full control of the user who generated it. The goal would be to create a decentralised innovation eco-system, open to new entrants and innovation (access to big data and privacy by design) and new services (collaborative economy, participatory consumption, open democracy). For example, the Collective Awareness Platforms for Sustainability and Social Innovation (CAPSSI)[1] is an initiative promoted by the European Commission comprising a number of distinct pilot projects, demonstrating new forms of bottom-up innovation and social collaboration based on open data, open knowledge, open source software and open hardware. Today, it is already building on 36 running projects.

Data protection implications of blockchain technology
Fidel Santiago, Technology and Security Officer, EDPS

Protecting personal data in a new technological environment such as the one blockchain will enable, poses new challenges for data protection authorities around the world. Personal data is contained in the blockchain but "traditional categories" may need to be reinterpreted to effectively protect individuals. Fidel took stock of the existing EU privacy legal framework and explored some of the key issues in closed and open blockchain scenarios.

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[1] https://capssi.eu

According to Fidel:
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The application of data protection law to blockchain technology and its most popular implementation, Bitcoin, requires solving some complex issues, e.g. due to the distributed nature of public blockchain implementations like Bitcoin. The information in that blockchain is public and unalterable by design; and the processing of the data is shared among all the members of the blockchain network. The basic principles of data protection – lawfulness, purpose limitation, data subject rights, etc – are very difficult to analyse in these cases. A thorough discussion between the data protection and the blockchain communities is needed. One objective, applying privacy by design, should be to be able to provide a privacy-friendly technology.

Self-regulation for virtual currencies companies
Mieke de Haas, Compliance Officer, Biccur

The Associated Bitcoin Companies of the Netherlands (VBNL), of which Mieke is a board member, addresses regulatory issues concerning virtual currencies. Their primary goal is to combat and prevent fraud through exchanging a *modus operandi* on fraud cases. They also inform members of the European Parliament about the risks and counter-measures associated with virtual currencies, which will probably be included in the AML4 guidelines.

Keynote:
Marietje Schaake, Member of the European Parliament

Marietje looked more at the opportunities associated with blockchain rather than the threats. Everyone has so many expectations that blockchain will boost economic growth and eliminate government processes and red tape due to its decentralized nature. With this enormous promise come enormous expectations, but Marietje remains realistic. She thinks that blockchain will not eliminate government, but will be used to create synergies among governments, businesses and individuals. She was enthusiastic that the European Parliament has suggested a light touch approach to regulating blockchain developments. She also pointed out that a new currency brings many sensitivities, added to which, today a lot of people have no clue what blockchain is, a situation which suggests there should be an advisory committee or council. On June 21 the European Parliament will focus on blockchain. The intention is to use technology for public goods and not-for-profit models.

Panel 3:
Discussion

Blockchain is extremely difficult to regulate, because the technology is very disruptive. How can we bridge the gap between regulation, high level principles (e.g. privacy) and new technology? One way to bridge the gap is privacy by design. If we regulate all aspects of blockchain deployment, there will be no room for innovation, so there should be a balance between regulation and innovation. Regulation must be to a minimum to ensure openness. From the technology point of view, how can we comply with existing regulations? This question at least suggests that there should be political debate to investigate and analyse what (if anything) needs to change. Today there is self-regulation: Bitcoin companies can do anything they want, not least because most governments do not yet fully accept their role. Another interesting perspective is the possibility to add regulations into the blockchain itself.

Why are virtual currencies on tax forms, but it is not possible to pay your taxes with these currencies? Governments tend to see virtual currencies as a risk instead of an opportunity. For now, they only want to ensure protection for consumer using virtual currencies and to combat fraud and financial crime.

In the future it might be possible to transcend geographical borders. In some regions Bitcoin could be much stronger than an existing currency, but it is unlikely that it will replace a major currency such as the euro or US dollar. Besides financial applications, we could use blockchain for democratic mechanisms but that would depend on the scalability, trust and willingness of the authorities.

The audience asked Marietje Schaake to clarify the European Parliament's light approach to regulation. Her answer was that they do not want to exert full regulatory force, because there should be room for research. The European Parliament would like to actively engage with the horizontal Task Force DLT (on distributed ledger technology), led by the European Commission, consisting of technical and regulatory experts, in order to provide expertise and assess benefits and risks. We face a major challenge in innovation to which decision-making is reacting and it is vital to look at the full spectrum of opportunities.

Panel 3
Discussion
continued

Another question for the panel was about the opportunity to use blockchain for voting. Electronic voting is not happening yet, because of technical scalability and privacy concerns. The panelists seemed open to this solution but suggested to evaluate also the impacts if the system was abused. For example, the Estonian government is already using an e-residency platform, where Estonian citizens have an e-identity linked to their private identity, which (positively) influences their approach to data protection. The same e-residency platform was used for a pilot project with Nasdaq to allow Estonian shareholders to use a voting system based on blockchain.

Do existing laws provide enough tools that can be applied in the context of new technologies? If not, is there a need for change? It could be really dangerous if the exchange between virtual currency and real money is not regulated.

It seems a logical step to create a US dollar blockchain, because people trust that the US government will still exist in the future. The panelists indicated that one needs a virtual currency that is backed by a central bank – which can be done, but, for various reasons, may take a very long time. Despite this, there are banks already working to do this, such as the Dutch National Bank's current experiments with blockchain.

Panel 4:
Innovation, New Markets and New Ideas

Moderator:
David Goodman,
Principal Consulting Analyst,
TechVision Research

Today the IT market for good, new ideas, technologies and applications is very healthy and growing. What differentiates blockchain? The single unifying theme transcending all of the previous discussions has been trust: a lot of the hype and enthusiasm is ultimately linked with trust.

Blockchain for enterprises
Wilfried Hoffman, Co-founder, Tymlez

Wilfried engaged the audience with his energetic enthusiasm on the theme that blockchain is not just hype with new gadgets and applications but a key part of the total enterprise infrastructure, and for several years to come will demand a balance between managing the old and the new. As we cannot predict how blockchain will be used in the future, Wilfried emphasized the need to be realistic and to start small. He was confident that there is no shortage of possibilities in existing circumstances. His company is working with its clients on use cases like a shareholder register, digital asset management, loyalty system and airplane maintenance.

According to Wilfried:

Blockchain technology confronts organizations with the challenge how to **combine the new with the old**. Blockchain applications have by their nature an impact on the existing IT landscape. The concept of a decentralized computerized network, combined with a distributed database, ledger of transactions, interferes with the more traditional ways of digitization and computing. To make the most effective use of blockchain technology, companies need to define an innovation strategy that takes into account their legacy.

According to Wilfried:
continued

The characteristics of blockchain technology makes it a good foundation for the **compliance** systems of tomorrow, by capturing quality and transaction data in a transparent, real-time, immutable and tamper-proof manner. Blockchain-based systems can register the identity of individuals, devices, documents (digital assets) and the transactions in which they are involved. The transactions can trigger, via smart contracts, notifications, alarms or other actions and so it becomes an automated way to measure and manage the quality of processes. Blockchain technology can provide greater transparency, safety and trust. When organizations that cooperate in a value chain share their outcome in blockchain-based systems, the overall costs for compliance will decrease for the involved companies but also for the regulatory institutions.

The **Internet of Things** is a clear example of the trend for more decentralized, even distributed systems. It is here that blockchain technology comes into play. Is there a better way to automate a distributed group of IoT devices than via a distributed automation technology, like blockchain? The blockchain could be used to issue and authenticate device identities, to make them interact and transact autonomously. Smart contracts in the blockchain could be used to give each device an operational framework. Companies like Samsung and IBM are already experimenting with household appliances that interact via a distributed blockchain; for instance, to optimize the energy costs and to order maintenance autonomously (if it is within the guarantee). Other companies like Tymlez have demonstrated the logging of quality data into a blockchain. The temperature of sensitive goods like food products or pharmaceuticals could in this way be tamper-proof recorded during transport (to ensure compliance). There are plenty of opportunities to leverage the synergy between the distributed IoT and blockchain technologies.

Second generation blockchains are capable of storing and analyzing data more efficiently. Where Bitcoin uses a flat file to store data, new blockchain implementations, like BigChainDB and Tymlez, use a database structure and allow for queries. This enables analysis for different purposes, from **business intelligence** for companies to research for universities and governments. Analysis could be performed by any data analysis tool on a computer or cloud or could be performed by using smart contracts to analyze in a distributed fashion.

According to Wilfried:
continued

Another promise of blockchain is that individuals might own and manage their own data again (from a privacy or earnings perspective). Such systems could be setup by using cryptographic storage of data in the blockchain. Advertising companies could for instance ask an individual's smart contract a certain question/query ("are you older than 18 years?") and get only that answer ("yes"). Individuals could in this way protect their own **big data**, instead of allowing access to all their data at once. Individuals could also monetize these requests (earnings per request). So new business models for advertising, insurance and research are coming up!

Reinventing real estate using blockchain technology
Robert Reinder Nederhoed,
CEO, Bitmymoney

After Wilfried's promising and pragmatic ideas, Robert continued with an assessment of reinventing real estate using blockchain technology. He spoke of three generations: value (first generation), assets (second generation) and contracts (third generation), of which contracts (autonomous decision making) is the most complex but also the most promising.
How can we combine the logistics of finance with trade? The answer is by being radical, but keeping your feet on the ground. One of his ideas was that you can invest a small amount of money in real estate on Blandlord.com, which is based on blockchain. The message so far is anchor with the real world and start small.

Is blockchain tech too disruptive to solve the identity problem?
Dug Campbell, Product Manager,
miiCard Organiser, Scottish
Blockchain Meetup

The last speaker of the day asserted that there is a general assumption that digital identity will do good, but the system is inefficient. The fear that social media companies control identities is real: nobody wants to sign into their medical record with Facebook. Blockchain has the potential to decentralize identity which can be many things (e.g. physical body, cryptographic keypair). One reason to solve the identity problem using blockchain technology is because new distributed platforms will rewire our digital economy. Today, we search public databases for information whereas in the future we will check blockchains in order to confirm whether such information is true. However, by moving to a system where individuals are in control in this way, serious questions will also need to be asked about individuals' willingness and ability to manage their own keys. We will need to build systems and technologies to make it simple to revoke and replace keys, and also hardware solutions to keep them safe.

Panel 4:
Discussion

The discussion started with the question as to who is going to drive the new markets – start-ups, governments or enthusiastic consultants. And how is this going to evolve over the next few years? The grass roots are based in the private sector, because generally speaking governments do not have the means or wherewithal to effectively drive new initiatives. Nevertheless, to get the best outcome for all parties, it is important that the public and private sectors work together.

Issues with defining globally useful identity has been ongoing for more than twenty years with many false starts and promises. Is there a role for blockchain to play and what would it be? A scalable universal identity solution is a hard nut to crack and not without significant risks, but ultimately it is not a technology issue. Nevertheless, the 'right technology' has the potential to help overcome the social, legal and political roadblocks. Blockchain?

What is the incentive for people to run with a specific blockchain technology? The one big difference is that it integrates the financial system with logistics – not as a token but as real value. We are building on an existing blockchain, we don't build a new one. Plus, it gives a lot more efficiency if you get rid of the middleman.

Some ideas are great in theory, but they are not really implementable. So what are the parameters for a good use case? The framework is in the balance between the number of participants and the quality of management. For example, a single company may find that blockchain is insufficient for its database needs.

Blockchain could provide a solution for the friction in transferring money between countries today. For example, it takes a long time to distribute the royalty money associated with music. However, even though this can be made more efficient, it will not change the economics. For example, it would be possible to build Spotify on a blockchain so that you can see who is listening to what music but that wouldn't necessarily ensure that the monies eventually reach the 'right' bank accounts.

Panel 4:
Discussion
continued

The panelists loved the notion of open non-permissioned blockchains, but they were realistic that closed permissioned blockchains are more likely to thrive in large organizations. The various use cases that were discussed work in more private surroundings where it's the technology rather than the concept that is being used. There is a huge multiplier effect in open public blockchains, because people interact and engage – hence the challenge is much greater.

In conclusion, innovation is alive and well and there was confidence that both the public and private sectors will come up with new markets and ideas. There is so much enthusiasm about blockchain that the future looks bright which was abundantly clear during the course of the day, not least with the attendance of a member of the European Parliament. There's no doubt that the power of this new technology will continue to inspire us. It was a fascinating day full of contrasts in which some important themes, like identity and trust, were recurrent in all the sessions.

TDL's vision is that trust must become an intrinsic property of any online transaction involving personal information, incorporating legal, business, and technical advances, supporting cyber security policies, and integrating societal considerations so that citizens and end users will recognize trustworthy services, transactions, and data, and be prepared to pay for them. Trustworthy ICT will increase confidence and trust in modern society, bring new and attractive ways of living and working, and further strengthen Europe's democratic and social values.

The association's mission is to provide its members with a European business development platform in order to stimulate development and user acceptance of innovative but practical trustworthy ICT. Guided by its strategic research agenda, TDL acts as an incubator for a portfolio of sprint projects intended to validate new and innovative technology concepts, promotes cross-sector collaboration, and aggregates the results into industry recommendations for policy makers and the European Commission.

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